Post-Evaluation Report (2011-2)

Tuvalu Funafuti Household Solid Waste Reduction Technical Assistance Project

Prepared by

Dr. Lee Pai-po (Deputy Secretary General, TaiwanICDF)

Chen Shu-ping (Project Manager, Auditing Office, TaiwanICDF)

International Cooperation and Development Fund

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CONTENTS

EXECUTIVE SUMMARY

Disposal of solid waste is a major problem in Tuvalu, where there is insufficient land area or infrastructure to allow for conventional means of disposal, and recycling may not be economically feasible. The deterioration of the environment is increasingly affecting the health of local residents and unsightly rubbish and poor sanitation is harming tourism and limiting its associated economic benefits.

In May 2008, the TaiwanICDF dispatched two staff members and a specialist to perform a project feasibility study. In July 2008, following the submission of a report for the study, the TaiwanICDF authorized JSDAN Environmental Engineering Co., Ltd. to implement the project as Executing Agency.

The goal of the project was to reduce the volume of garbage on Funafuti initially by 75 percent, with the ultimate goal being to reduce the daily volume of waste produced by each household on Funafuti by 85 percent. To address these goals, the TaiwanICDF dispatched experts to Tuvalu on short-term assignments to assist in the drafting of a regulatory framework for environmental protection, and to aid in establishing a refuse sorting system. The project also provided assistance to establish a recycling system for metals, plastics and paper. Small-scale incineration equipment was used to handle waste items that cannot be separated or recycled, which will extend the life of landfill sites. Volunteers were also dispatched to Tuvalu to work on the project.

Of the projected project outcomes, an operation to shred and deliver garden waste to the Taiwan Technical Mission (TTM) and then produce compost for extension work in household vegetable gardens was successful. However, the period over which the in-country feasibility study was conducted was too short and, accordingly, an inadequate study resulted in a project design whose content and goals were not fit for purpose. In particular, this gave rise to misunderstandings with the government of Tuvalu (GOT), and with European Union (EU) agencies whose work overlapped with elements of the project.

The recommendations of post-evaluation are as follows:

(a) The feasibility study should have been clearer and more comprehensive;

(b) Project documents should be drafted in the local official language and

accompanied by an appropriate Memorandum of Understanding;

(c) Projects should be sufficiently monitored during implementation;

(d) Projects should be followed up by an objective Final Report.

I. BASIC DATA

1. Project Objective

Reduce solid household waste generated in Funafuti by 85 percent by the end of 2009.

2. Project Methodologies and Strategy

(1) Reduce unnecessary disposal of garden waste by collecting and using such waste for the production of compost;

(2) Strengthen sorting mechanisms for solid household waste in order to reduce unnecessary disposal of waste and increase recycling; and

(3) Prolong the lifespan of landfill sites in Tuvalu.

3. Project Content

(1) Reduce garden waste

(i) Procure and install wood chipping machines and set up a compost production field at the TTM; coordinate with relevant local agencies or government departments to collect garden waste from individual households for delivery to the TTM. The TTM will integrate a range of operations to produce compost and then distribute the finished product to the GOT for onward sale to citizens.

(ii) Once garden waste has been converted to compost and derivative products, responsibility for sales and associated commercial activities will rest entirely with the GOT.

(2) Strengthen sorting mechanisms for household solid waste

(i) Provide categorized recycling bins

Provide recycling bins to households, schools, hospitals, government agencies, shops, hotels and similar, publicly accessible sites in Funafuti; make recycling a convenient option and improve the motivation of citizens by providing clear, color-coded labeling for the bins and categorizing them into easily understood groups (e.g. metals, plastics, paper, glass).

(ii) Tuvalu currently has no mechanisms or facilities for sorting waste. The project will require significant input from experienced

Taiwanese stakeholders, particularly toward the purchase of mechanized equipment and materials such as wood chippers, plastic bottle breakers, and composting and polythene sacks. The GOT will be responsible for managing and maintaining equipment, and securing facilities and sites. Since the majority of waste generated in Tuvalu is garden and organic waste, compost production and associated efforts should take priority.

(3) Education and training

(i) Short-term experts or volunteers dispatched by the TaiwanICDF to Tuvalu will conduct workshops or campaign activities and promote environmental concerns, in coordination with relevant school programs and community activities. Given that education is a long-term endeavor, medium- or long-term volunteers and experts will also be required.

Initially, operations on Funafuti island will be the primary concern. Authorities will cooperate with the public in each administrative area and provide education and training activity. Long-term volunteers will be hard to recruit; therefore, volunteers could be sourced each administrative area and dispatched to perform various environmental campaigns in each of the zones. A curriculum for educational activities will be required in order to ensure that outcomes are consistent across administrative boundaries.

(ii) Use local broadcasting channels and media to publicize the importance of recycling and sorting waste resources.

(iii) Work with the GOT to establish a National Sanitary Day; encourage public clean-up drives, remove waste that has accumulated in back yards and plastic from the marshlands.

(4) Prolong the lifespan of landfill sites

(i) An operational, dedicated landfill site already exists in Tuvalu, but its efficiency is limited by the fact that waste is not sufficiently categorized or sorted. In order to strengthen planning at the site, waste will be placed in different sections by category and measures

will taken to promote better efficiency in a limited space, including:

(a) Measurement of the area and capacity of the site, in coordination with the relevant authorities; and

(b) Estimation of the lifespan of the site.

(ii) The project will reduce the volume of waste at the landfill site and improve the efficiency with which the site is used by providing an anti-corrosive incinerator with a capacity to incinerate 300 kg of non-recyclable waste per hour.

(iii) The GOT will be responsible for constructing a basic, waterproof shed to house the incinerator and for employing personnel to operate it.

(5) Provide legal and regulatory advice and consultation

(i) Tuvalu's existing waste management operations involve the Department of the Interior, the Department of Natural Resources and Environment, and the Funafuti kaupule (island council). Governance of waste management issues is therefore not sufficiently focused and lacks coordination. Improving the efficiency of waste management systems will require Tuvaluan stakeholders to unify their endeavors.

(ii) The project will help to set penalties and rewards for recycling and waste management operations.

(iii) The project will establish pickup routes and timetables for waste collection services.

4. Implementation Start Date
   January 2008.
5. Implementation End Date
   December 2009.
6. Approval Amount
   NT$11,295,000.
7. Source of Funding
   TaiwanICDF

8. Anticipated Benefits

	Reduce garden waste	**Promote sorting of solid household waste**	**Prolong the life span of landfill sites**
Implementation methods	1. Produce compost. 2. Establish a compost production site at the TTM; deliver compost and derivative products to the GOT.	1. Increase number of recycling bins. 2. Publicize recycling.	1. Establish an incinerator. 2. Reorganize the existing landfill site.
Responsibilities of Taiwanese stakeholders	1. Provide mechanized facilities for producing compost, including a wood chipper of 30 hp or above. 2. The TTM will produce and pack the compost.	1. Procure color-coded recycling bins and divide into appropriate categories of material. 2. Purchase plastic bottle breakers and polythene sacks. 3. Volunteer personnel to publicize and promote environmental issues and education.	1. Procure an incinerator with a capacity to incinerate 300kg of non-recyclable waste per hour. 2. Volunteer personnel to provide assistance and instruction on operation and repair of the incinerator.
Responsibilities of Tuvaluan stakeholders	1. Coordinate and centralize the collection of organic waste, for onward delivery to the TTM's compost production site. 2. Oversee the collection of garden waste by governing institutions (Funafuti kaupule, Department of the Interior, etc.). 3. Schedule waste	1. Sort metal waste for processing at the iron-aluminum can recycling site. 2. Sort plastics into sacks for use by AusAid. 3. Organize discrete landfill sites in northern Funafuti including sites for glass, oversized boxes and paper and oversized metal waste.	1. Provide a dedicated site for the incinerator. 2. Construct a basic waterproof shed and employ staff. 3. Oversee operations at the incinerator so that only non-recyclable waste is incinerated. 4. Dispatch staff to maintain the incineration

	Reduce garden waste	Promote sorting of solid household waste	Prolong the life span of landfill sites
	collection timetable according to various categories of waste.	4. Make inquires regarding the overseas disposal and/ or sale of recycled waste. 5. Strengthen the positive effective of waste management and recycling by drafting plans for an "Environmental Protection Police System."	facilities at scheduled intervals.
Anticipated Benefits	1. Immediate reduction of waste to 75 percent of pre-project levels. 2. Increased government income from sale of compost and derivative products. 3. Beautification of Funafuti.	1. Recycled waste could be sold to augment government income. Alternatively, the GOT may negotiate a deal in which waste is reduced by shipping recycled materials overseas free of charge. 2. Recyclable waste that cannot or has not been disposed of could be used, for example, to reclaim marshland (plastic bottles) or as cats-eyes (glass bottles).	1. The life span of existing landfill sites will be extended. 2. Non-recyclable waste will be reduced by incineration. 3. Reduction in pollution caused by wastes that would otherwise affect shorelines and groundwater resources. 4. Ash created as a byproduct of incineration can be used to reclaim marshland.
Project output/ Measured target	Reduce solid household waste generated in Funafuti by 85 percent by the end of 2009.		

II. PURPOSE OF EVALUATION

Post-evaluation is performed within a few years of the completion of a project or program and represents an important phase of the project cycle. The process refers to the objective assessment of the efficiency and effectiveness of the implementation of a development program, along with its logic and socio-economic impact among intended beneficiaries. The purpose of such evaluation is to obtain a comprehensive and independent appraisal of the extent to which the objectives of a project or program have been achieved or are likely to be achieved, and learn from that experience.

The Tuvalu Funafuti Household Solid Waste Reduction Technical Assistance Project represents the first occasion on which the TaiwanICDF dispatched a team to perform post-evaluation. Since the process should be conducted by an independent department or outside specialists, the team was led by Dr. Lee Pai-po, Deputy Secretary General of the TaiwanICDF, accompanied by Chen Shu-ping, a Project Manager in the TaiwanICDF's Auditing Office. The mission conducted its evaluation in Tuvalu over a period covering February 17-22, 2011.

During the evaluation, the team called on the EU Country Representative for Tuvalu and relevant government departments – such as the Ministry of Natural Resources and Environment; the Ministry of Home Affairs; the Funafuti Kaupule; and the Solid Waste Agency – to solicit opinions on the project.

The team also visited Taiwanese embassies and the Taiwan Technical Mission to understand the point of view of Taiwanese stakeholders, judge whether the project had achieved its intended objectives and outcomes, hear observations on the local environment and take suggestions on the implementation of future projects.

III. BACKGROUND

Disposal of solid waste is a major problem in Tuvalu, where there is insufficient land area or infrastructure to allow for conventional means of disposal, and recycling may not be economically feasible. The growing population in Funafuti has placed increasing pressure on the local environment and created the potential for public health problems. At present, there is no formal waste disposal system and no regulation of what materials are dumped into borrow pits, which creates the potential for harmful substances to seep into the environment and affect marine ecosystems. The deterioration of the environment is increasingly affecting the health of local residents and unsightly rubbish and poor sanitation is harming tourism and limiting its associated economic benefits.

Sustainable development must be adaptable to the local conditions of every country. This so-called "localized" form of sustainability starts with the use of sustainable materials and ends by recycling or disposing of them in a proper manner. As small-island nations have pursued economic growth, the issue of resource sustainability has become ever more urgent because of the limited amount of space that can be given over to landfill. However, the proper processing of refuse can provide developing countries with an opportunity to enhance the nutrient cycle of their ecosystems and reduce environmental pressures. The Funafuti Household Solid Waste Reduction Technical Assistance Project carried out in Tuvalu was initiated to reflect principles that emphasize this approach toward sustainable development.

In May 2008, the TaiwanICDF dispatched two staff members and a specialist to perform a project feasibility study. In July 2008, following the completion of the study, the TaiwanICDF authorized JSDAN Environmental Engineering Co., Ltd. to implement the project as Executing Agency.

The project focused on reducing the volume of solid waste from households in Funafuti. Over the years, Tuvalu has faced a number of problems regarding waste processing, and experts were dispatched to Tuvalu to carry out field evaluations. One key issue was a lack of clear lines of authority among government agencies involved in tackling the issue, so that despite considerable efforts, few positive effects were being seen. Tuvalu lacked a system for sorting waste into categories, making it

difficult to achieve the goal of reducing the amount of garbage, and the country did not have any means to recycle, which was putting too high a burden onto landfills. The landfills themselves were poorly planned, which was reducing the effective lifespan of each landfill site. Tuvalu also suffered from a lack of education, and public awareness on waste management issues was low, which had limited the benefits of assistance previously provided by other countries.

In response to this host of problems, the TaiwanICDF dispatched experts to Tuvalu on short-term assignments to assist in the drafting of a regulatory framework for environmental protection, and to aid in establishing a refuse sorting system. In addition to setting reasonable targets over the reduction of the volume of garbage, strategies focused on sorting garden refuse into categories. This created an opportunity to produce compost, which would be re-used in home gardens across the island. The project also provided assistance to establish a recycling system for metals, plastics and paper. Small-scale incineration equipment was used to handle waste items that cannot be separated or recycled, which will extend the life of landfill sites. Volunteers were also dispatched to instruct citizens on refuse sorting techniques, and provide legal consultation services to strengthen the capacity of government agencies that deal with waste processing.

The goal of this project was to reduce the volume of garbage on Funafuti initially by 75 percent, with the ultimate goal being to reduce the daily volume of waste produced by each household on Funafuti by 85 percent. In beautifying the island, the project was designed to help Tuvalu attract more tourists; moreover, recycling various goods would result in extra income and extend the life of landfill sites. The TaiwanICDF would also benefit from this pilot project, by accumulating valuable experience on how to promote environmental protection in small-island nations.

The project cost was NT$11,295,000 (US$376,500). JSDAN Environmental Engineering Co. executed the project in August 2008 in Funafuti, of which 2.5 days were allocated to training; and submitted a Final Report in September 2008.

IV. EVALUATION OF PROJECT DESIGN AND IMPLEMENTATION

A. Relevance of Design and Formulation

The period over which the in-country feasibility study was conducted was too short, so that insufficient attention was given to understanding local environmental conditions. Furthermore, EU agencies had already been implementing a similar program since 2000 and, due to an overlap of resources between two similar programs, the TaiwanICDF project was not especially welcomed by EU agencies. Finally, elements of the project design led both the GOT and EU agencies to misread the intentions of the TaiwanICDF. Overall, project design as based on the feasibility study was judged to be *minimally relevant*.

B. Project Outputs

By the end of 2010, the per-day production of domestic waste in Funafuti had been reduced by less than 10 percent. In practice, among all solid waste, only garden waste had been managed sufficiently, with procedures having been put in place to collect, shred and deliver such waste to the TTM for compost production.

C. Implementation Arrangements

The project tender process and authorization of the Executing Agency were carried out in an appropriate fashion and in accordance with relevant laws. The Executing Agency followed the final project design but was not familiar with local social and economic conditions. The TaiwanICDF did not dispatch any personnel to evaluate the project while implementation was underway.

D. Conditions and Covenants

During the feasibility study and the implementation of the project, Taiwanese stakeholders did not draft formal agreements with relevant Tuvaluan authorities. With no relevant agreements or procedures in place, information exchange between the GOT, EU agencies and Taiwanese stakeholders was uneven. The three groups were

not easily able to reach a common consensus and cooperation proved difficult at certain times.

E. Related Technical Assistance

The Executing Agency organized a 2.5-day training session on the operation and maintenance of waste management equipment (Appendix 1) and the TaiwanICDF dispatched an environmental protection volunteer to join the project once the workshop was completed. The project was partly designed to integrate with other TTM projects.

F. Performance of Executing Agency

The Executing Agency implemented the project in accordance with the conditions of its contract. The agency performed its tasks well but was not familiar with local social and economic conditions.

No implementation agreements were signed between the TaiwanICDF and local government stakeholders, meaning that the TaiwanICDF had no right to oversee the operations of locally hired subcontractors. Subcontractors did not offer any reports or documentation relating to the project.

V. EVALUATION OF PERFORMANCE

A. Relevance

The project design was considered to be *highly relevant* to the TaiwanICDF's development strategy. However, the feasibility study was not sufficiently comprehensive and project outcomes show an insignificant and insufficient reduction in the production of solid waste in Funafuti. Project design, therefore, was only *moderately relevant* to the TaiwanICDF's development goals.

B. Effectiveness and Efficiency in Achieving Project Outputs

Project operations were *moderately relevant* to the project goals (Appendix 3). Of the three initially identified project components – (i) reduce garden waste; (ii)

promote sorting of solid household waste; and (iii) prolong the lifespan of landfill sites – only efforts to reduce garden waste yielded any substantial outcomes. This project component saw the TTM cooperate with local government and EU agencies to collect organic waste and produce compost (Appendix 2).

Equipment donated to Tuvalu as part of the project has not been utilized at a sufficiently high rate. At the Solid Waste Agency, two machines designed to manage plastics and branches have been broken down for some time. An incinerator remains in good condition, but is not in active use. According to the director of the Solid Waste Agency, this machine will be utilized during a separate project that was discussed (Appendix 3). Of the 1,400 recycling bins initially donated for the sortation of household garbage, less than half have been distributed to outlying islands, while the others remain stored at the central depot. A garbage truck donated to the Ministry of Home Affairs remains in good condition, having undergone regular maintenance.

An itemized list of waste management equipment donated is listed below:

Table 1: List of equipment in Tuvalu

Item	Quantity	Department	Condition
Plastic chipping machine	1	Solid Waste Agency	Awaiting repair
Shredder	1	Solid Waste Agency	Awaiting repair
Incinerator	1	Solid Waste Agency	Good, but not in use
Recycling bins	1,400	Solid Waste Agency	According the Director of the Waste Management Center, roughly 700 bins had been distributed to outlying islands and 700 bins remain stored at the center.
Garbage truck	1	Funafuti Kaupule	Good

Commentary on the project given by the Taiwanese embassy and the TTM is summarized as follows:

(a) Taiwanese Embassy

1. Project outcomes: The GOT initially expressed its appreciation for

Taiwanese assistance. However, the project was not implemented as per the original project design and project goals. The performance of the project therefore fell short of the embassy's expectations.

2. Project problems: Since Tuvaluan government agencies with interests in waste management do not have sufficient numbers of programming and field personnel, they are unable to coordinate their work. For this reason, donated equipment has not been utilized to a worthwhile extent.

3. Feasibility of integration with other programs: Further cooperation could be sought between Taiwan, the GOT and EU agencies on the composting component of the project.

(b) Taiwan Technical Mission

1. Project outcomes: The project did not match the requirements and conditions of the GOT and its citizens.

2. Project problems: Since donated equipment was unsuitable and spare parts and components are difficult to come by, much of this equipment was only used in the short-term and is now awaiting repair.

3. Feasibility of integration with other programs: Relevant Tuvaluan government agencies should receive assistance to contact suppliers and procure spare parts and components. Furthermore, Taiwan should continue to promote cooperation through the composting component of the project.

C. Preliminary Assessment of Sustainability

The feasibility study did not sufficiently understand or account for local environmental conditions and, due to unclear communication, the project initially failed to win the support of the GOT and EU agencies. The endeavors of the TTM, the Taiwanese embassy and volunteer personnel gradually became restricted to focusing on the collection of organic waste and compost production. The project was judged to be *moderately sustainable*.

D. Impact

The original project target was to reduce the per-day production of solid household waste in Funafuti by 85 percent by the end of 2009. However, actual reduction by the end of 2010 was less than 10 percent. During the project, only an operation to shred and deliver garden waste to the TTM and then produce compost for extension work in household vegetable gardens was successful. With this exception, the project cannot be said to have achieved its stated goals.

VI. OVERALL ASSESSMENT AND RECOMMENDATIONS

A. Overall Assessment

The project as it was implemented was only *moderately relevant* to the TaiwanICDF's development strategies and goals, and only *moderately sustainable*. Similarly, project operations only had a *moderately relevant* impact on the project goals.

B. Lessons Learned

(A) Flexibility in design:

1. The period over which the in-country feasibility study was conducted was too short and the study did not sufficiently understand or account for local environmental conditions. Similarly, project design did not evaluate environmental, marketing and organizational concerns. Furthermore:

    i. Tuvalu has an limited number of skilled and experienced officials who find themselves assigned to manage a wide range of assistance programs and projects. If a key official is unavailable, follow-up activities and administration often falter. Without comprehensive national waste legislation, including enforceable regulations, the sector has no clear institutional framework in which to operate. In order for Tuvaluan stakeholders to be able to manage their resources more effectively, project design should have been flexible, sustainable and less complex than it has been in the past.

ii. Since local people are not in the habit of sorting garbage and do not possess sufficient knowledge of the process, waste management issues should be promoted through primary-level and community education. Awareness must be focused and sustained over a long period.

2. The project could have involved greater cooperation with civil society and would likely have been more effective if there had been greater interaction with non-governmental organizations and local organizations. This would also have helped to avoid overlapping of resources and assistance.

For these reasons, local citizens did not become sufficiently motivated or engaged enough to sort their waste and the implementation of the project did not initially enjoy the approval of local organizations.

(B) Project implementation: The project remained under implementation after the Executing Agency had completed the training workshops. Since implementation agreements or contracts were not signed with local government stakeholders, implementation did not receive the explicit approval of relevant local agencies, and locally hired subcontractors were not obliged to prepare any project reports. Moreover, the TaiwanICDF did not dispatch personnel to evaluate the project during or immediately after implementation, leaving few or no opportunities to adjust or strengthen project activities at crucial junctures.

(C) Technical assistance and resource allocation: Project work involved a combination of technical assistance from a Taiwanese volunteer and from the TTM. Cooperation strengthened the project and won the project the gradual approval of relevant local agencies.

C. Recommendations—Project Related

(A) Comprehensive, clear feasibility study: The period over which the in-country feasibility study was conducted was too short and accordingly, the study did not adequately evaluate environmental, marketing and organizational concerns. This inadequate study resulted in a project design whose content and goals were not fit for purpose and gave rise to misunderstandings with the GOT and EU agencies.

(B) Project documents in local official language; Memorandum of Understanding: With the exception of the initial feasibility study and project design, project documents were not produced in the local official language, English. This hindered communication between the Taiwanese and Tuvaluan governments, denied the GOT an opportunity to adequately express its own comments at the right time, and created problems for local stakeholders wishing to understand how they could or should allocate resources.

(C) Ongoing monitoring of project implementation: The TaiwanICDF did not dispatch personnel to evaluate the project during and immediately after the Executing Agency had implemented the project, leaving few or no opportunities to adjust or strengthen project activities at crucial junctures. During this project evaluation, members of the evaluation team prompted relevant personnel from the Taiwanese embassy, the TTM and EU agencies to discuss and make adjustments to the project.

(D) Objective Final Report: Following the completion of the project, the Final Report submitted by the Executing Agency was not fully reviewed by TaiwanICDF staff or any independent consultant. By failing to utilize this document, the TaiwanICDF passed over an opportunity to gain experience during the implementation of the project, and failed to gain knowledge that could have been used to improve the project.

APPENDIXES 1. Activities of executing agency in Tuvalu

<table>
<tr><th>Date</th><th>Activities</th></tr>
<tr><td>August 13 (Thursday)</td><td>Introduce this project and team members.</td></tr>
<tr><td>August 14 (Friday)</td><td>Environmental education. Teaching how to build a water rocket.
<table>
<tr><td colspan="2">Visit school (150 minutes)
We invite teachers and students to joint us. We need a classroom for environmental education and a field for launching water rocket. A loud speaker is needed.</td></tr>
<tr><td>10 minutes</td><td>Introduction this project and team members</td></tr>
<tr><td>40 minutes</td><td>Environmental education: How to do waste reduction?</td></tr>
<tr><td>10 minutes</td><td>Your password.
Say something which is recyclable.</td></tr>
<tr><td>60 minutes</td><td>Create water rocket(at most three students to form a team)
Participants should prepare their own PET bottle, adhesive tap, and knife.</td></tr>
<tr><td>30 minutes</td><td>Launch water rocket</td></tr>
<tr><td colspan="2">Finally we will invite teachers and students to joint the competition of waste-to-art and waste-to-toy.</td></tr>
</table></td></tr>
<tr><td>August 15 (Saturday)</td><td>1. Send out Zero Waste Cooperation brochure.
2. Interact with residents.
3. Propagate knowledge of waste resorting, re-use, recycling and reduction.
<table>
<tr><td colspan="2">Visit communities (60 minutes)
We need local officer or the volunteer of ICDF to accompany us. A loud speaker is needed.</td></tr>
<tr><td>30 minutes</td><td>Send out Zero Waste Cooperation brochure</td></tr>
<tr><td>20 minutes</td><td>Interact with residents</td></tr>
<tr><td>10 minutes</td><td>Propagate knowledge of waste resorting, re-use, recycling and reduction.</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Date</th><th>Activities</th></tr>
<tr><td>August 16
(Sunday)</td><td>Short lecture about waste recycling and waste reduction.

<table><tr><td colspan="2">Visit church (30 minutes)
We need the volunteer of ICDF to accompany us.</td></tr><tr><td>20 minutes</td><td>20 minutes</td></tr><tr><td>10 minutes</td><td>10 minutes</td></tr></table></td></tr>
<tr><td>August 17
(Monday)</td><td>Environmental education. Teaching how to build a water rocket.

<table><tr><td colspan="2">Visit school (150 minutes)
We invite teachers and students to joint us. We need a classroom for environmental education and a field for launching water rocket. A loud speaker is needed.</td></tr><tr><td>10 minutes</td><td>Introduction this project and team members</td></tr><tr><td>40 minutes</td><td>Environmental education: How to do waste reduction?</td></tr><tr><td>10 minutes</td><td>Your password
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<tr><td>August 18
(Tuesday)</td><td>1. Send out Zero Waste Cooperation brochure.
2. Interact with residents.
3. Propagate knowledge of waste resorting, re-use, recycling and reduction.

<table><tr><td colspan="2">Visit communities (60 minutes)
We need local officer or the volunteer of ICDF to accompany us. A loud speaker is needed.</td></tr><tr><td>30 minutes</td><td>30 minutes</td></tr></table></td></tr>
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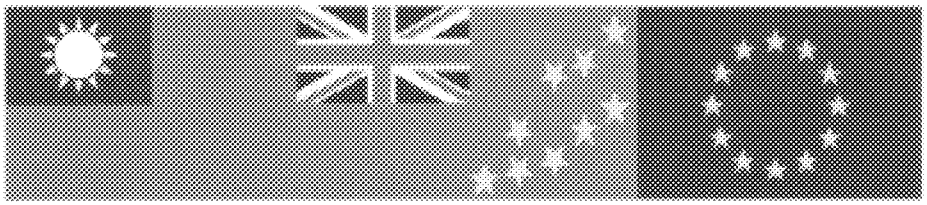
<table>
<tr><th>Date</th><th>Activities</th></tr>
<tr><td></td><td>
<table>
<tr><td>20 minutes</td><td>20 minutes</td></tr>
<tr><td>10 minutes</td><td>10 minutes</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">August 19
(Wednesday)</td><td>Invite Tuvalu’s environmental authorities, environmental groups, teachers and experts to attend the round table meeting of environmental affairs.
Share Taiwan’s experiences with Tuvalu.</td></tr>
<tr><td>
<table>
<tr><td colspan="2">Round table meeting (120 minutes)
We invite Tuvalu’s environmental authorities,environmental groups, teachers and experts to attend this meeting for discussing environmental affairs.
This meeting needs a big room and a projector. We need the volunteer of ICDF and the staff of embassy to assist us.</td></tr>
<tr><td>10 minutes</td><td>Registration and know each other</td></tr>
<tr><td>20 minutes</td><td>Introduce Taiwan’s experiences in waste management</td></tr>
<tr><td>20 minutes</td><td>Propose the discussing issues about environmental affairs</td></tr>
<tr><td>60 minutes</td><td>Discuss issue by issue.</td></tr>
<tr><td>10 minutes</td><td>Conclusion and thanks for participation.</td></tr>
</table>
</td></tr>
<tr><td>August 20
(Thursday)</td><td>Equipments install and practice.</td></tr>
<tr><td>August 21
(Friday)</td><td>1. Invite students to join in the competition to make a collage of branches or to make a water rocket.
2. Invite officers and local teachers to judge the competition.
3. The competitions should be finished within 3 hours.
4. Award prize for the highest flight rocket and most creative collage of branches.</td></tr>
<tr><td>August 22
(Saturday)</td><td>1. Remind the residents to fill out the questionnaire and hand it over to the “Zero Waste” consulting team.
2. Invite officers to draw out five winners of Questionnaire Lottery. The winners should be on site. The absent will lose their opportunity. The winners will get a special prize.</td></tr>
<tr><td>August 24
(Monday)</td><td>Equipments operation and maintenance training.</td></tr>
</table>

APPENDIXES 2. Memorandum of Understanding



MEMORANDUM OF UNDERSTANDING

Between the Parties participating in the EU-funded
10th EDF Tuvalu Water Waste and Sanitation Project

Represented by:

Ministry of Home Affairs

Ministry of Natural Resources and Environment

Embassy of the Republic of China (Taiwan)

Solid Waste Agency of Tuvalu

Funafuti Kaupule

and

EDF National Authorising Officer

On behalf of:

Ministry of Finance and Economic Planning

September 2010

FOREWORD

The European Commission approved the Tuvalu-EU 10th European Development Fund (EDF) *Tuvalu Water Waste and Sanitation Project* (TWWS) in late 2009. Tuvalu co-signed the 10th EDF TWWS Financing Agreement between Tuvalu and the European Commission on 19 February 2010. The Financing Agreement includes the Technical and Administrative Provisions (TAP, Annex 2) of the TWWS, which presents the broad outline of activities and partnerships contained in this Memorandum of Understanding.

Within the waste component of the 10th EDF TWWS is the household separation, municipal collection, shredding, and processing of green/garden waste[1] into compost and (or) other soil conditioning products.

Green waste comprises more than 70% of the waste stream in Funafuti. Its diversion from landfill for processing to provide compost and other soil conditioning products not only removes a significant volume of waste from the waste stream, it has the potential to create large volumes of rich, high-quality compost for use by both by the Taiwan Technical Mission's Agricultural Farm and by people in the wider Funafuti community interested in household gardening.

In recent years, the Republic of China has funded a range of development projects in Tuvalu. One of the biggest and most successful of these has been its agricultural farm on Funafuti that grows fruits and vegetables for sale to the general public, private businesses (e.g., restaurants), and other consumers. It is hard to over emphasize the success of the Taiwan farm. It provides local employment, and on a weekly schedule it supplies farm produce on a relatively large commercial-scale. This is made possible because the farm produces its own high-quality soil compost from shredded green waste supplied by waste operations funded by the Tuvalu Government, as collected by the Funafuti Kaupule.

Previous government efforts, however, to collect residential and municipal green waste, and the processing of such waste into high-quality compost has been, at best, a partial success. Only large volume green waste shredding is done, with little actual soil composting for food production. Such composting only occurs at the Taiwan farm.

The purpose of this MOU is to build on past donor-funded green waste management and composting efforts. Specifically, these are:

- AusAID-funded Waste Management Project (1999-02), which established the systematic collection of household green waste;
- EU-funded 8th and 9th EDF budget support for waste management operations and service provision (2003-07); and
- The ROC-funded Taiwan Technical Mission (2002 to-date).

(By way of background, the ADB conducted a comprehensive technical waste study in 2005 that fed directly into the planning/programming exercise that led to the green waste component of the TWWS.)

During the 10th EDF planning/programming exercise conducted by Tuvalu and the European Commission (2006-09), the Taiwan Technical Mission was identified as the agency best suited to reposition the government-funded collection of green waste and process it into compost and other soil conditioning products on a much larger and more efficient scale than has been done in the past. As the largest consumer of green waste, the Taiwan farm also possesses the resources and expertise required to receive large volumes of green waste and undertake large-scale green waste composting.

[1] Hereinafter the terms vegetation, green waste, organic waste, garden waste, and yard waste are interchangeable.

Discussions with ROC officials on the proposal for the Taiwanese Technical Mission to administer and operate the green waste composting component under the 10th EDF TWWS began in 2008. ROC officials subsequently expressed their willingness to support the TWWS green waste initiatives by hosting the TWWS green waste component, with funding for plant, material and equipment funded by the EU, and with recurrent costs, including that for plant and equipment maintenance, funded through the recently enlarged national budget for waste operations and service provision.

This Memorandum of Understanding has been developed in consultation with Tuvalu Government authorities, ROC authorities, officials of the Taiwan Technical Mission, and Funafuti Kaupule staff, with support from the European Commission and the AusAID-funded Waste and Sanitation Advisor, to formalise the arrangements between the Parties to this MOU to implement the green waste collection, disposal and composting component of the 10th EDF TWWS project.

Section 1
GOT, ROC, LOCAL AGENCIES

The Ministry of Home Affairs, Ministry of Natural Resources and Environment, Ministry of Finance and Economic Planning, Solid Waste Agency of Tuvalu (SWAT)[2], Embassy of the Republic of China (Taiwan), and Funafuti Kaupule wish to enter into this MOU to record their joint understanding and expectations of how they intend to exercise and perform their respective functions, powers, duties and responsibilities in relation to the collection, delivery, and composting of green waste, obtained from residential, commercial and municipal sources in Funafuti.

This MOU complements the *Agricultural Technical Cooperation Agreement* (2003) between the Republic of China and Tuvalu for the development, among other things, of Tuvalu's agricultural sector, including, but not limited to, conducting extension projects aimed at increasing agricultural production in Tuvalu by providing information and advice on improved agricultural techniques to the management staff of the Department of Agriculture, within the Ministry of Natural Resources and Environment.

Section 2
DIVISION OF KEY ROLES AND RESPONSIBILITIES BETWEEN THE PARTIES

A. 10th EDF TWWS: Waste Management / Green Waste

In order for the Taiwan Technical Mission (i.e., the Taiwan Agricultural Farm) and the Funafuti Kaupule to assume their functions, duties, roles and responsibilities under the 10th EDF TWWS Project, the TWWS shall provide the following EU-funded equipment, plant and material, respectively, for (1) green waste composting operations, including funding for the construction of new and (or) expanded composting facilities and infrastructure, and (2) waste collection equipment for the systematic collection and delivery of residential, commercial and municipal green waste to the Taiwan Agricultural Farm.[3]

Taiwan Agricultural Farm:

1. Two branch-breaking chipping/green waste shredding machines;
2. One compact mechanical front-end loader with detachable loader bucket and dozer blade;
3. One pre-fabricated multi-purpose tool and equipment shed;
4. A purpose-built timber-frame and corrugated tin-roof sheltered area suitable for rainwater catchment with concrete foundation and flooring, for green waste composting and processing operations – AND (OR) – an extension to the existing ROC-built composting facilities;
5. Two 10,000 litre rainwater tanks and associated guttering, piping and plumbing fixtures; and
6. Other miscellaneous items as agreed by the Parties, in support of the Taiwan's TWWS-related green waste composting operations.

The above equipment, plant and material shall be delivered to Taiwan's existing composting operations area, at the Agricultural Farm, or shifted to a new composting area sited elsewhere, as determined jointly by the Ministry of Home Affairs, SWAT, and the ROC.

Following delivery of the above equipment, plant and material to the Agricultural Farm, it shall remain the property of SWAT, with funding for plant and equipment maintenance provided by and paid for under SWAT's annual budget (see Sections 2.B.3 and 2.C.8 below).

Funafuti Kaupule:

1. Two waste collection tractors;
2. Two waste collection trailers; and

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[2] Created under the *Waste Operations and Services Act 2009* (funded by the 10th EDF).

[3] Equipment also to be used for the Kaupule's other Funafuti-based waste operations and services.

3. Two waste collection cages (for trailers).

Following delivery of the above equipment to the Funafuti Kaupule, it shall remain the property of the Kaupule, with funding for equipment maintenance provided by and paid for under SWAT's annual budget (see Section 2.B.2 next).

B. Tuvalu Government

The Tuvalu Government, through its annual national budget, has allocated SWAT recurrent funding in the following amounts (as of fiscal 2010):

1. The total annual SWAT operating budget is nearly $400,000 per year.[4]
2. The new annual Funafuti Kaupule operating budget, funded by SWAT through the national budget for all waste collection, delivery and disposal operations, including that for green waste, is as follows (budgets are indicative):

   Staff: 2 plant operators + 4 labourers = A$47,900
   Operations: running cost + plant maintenance = A$29,800
   Overheads = A$7,500
   TOTAL = $$83,200

3. Of SWAT's annual operating budget, the following components will be funded in support of the Taiwan Agricultural Farm's composting operations (budgets are indicative):

   Staff: Supervisor + 2 labourers = A$19,423
   Operations: running cost + plant maintenance = A$14,675
   Overheads = A$3,858
   TOTAL = A$37,956

In addition, SWAT shall be responsible for:

4. Coordinating the transfer of the existing government-run composting operations, including all previously provided plant and equipment funded by the ROC, as well all green waste stockpiled at the existing hanger site, to the Taiwan Agricultural Farm, or a new composting site to be identified.
5. Supervising the delivery of collected green waste to the Taiwan Agricultural Farm's composting facility.
6. Composting operations liaison and support, as the agency responsible for oversight of all waste management services and operations in Tuvalu.

In addition, the Ministry of Home Affairs, in conjunction with SWAT and the Department of Lands and Survey, shall be responsible for:

7. Securing new or additional land space for ROC composting operations – if required.

C. Taiwan Technical Mission / ICDF[5]

The Taiwan Technical Mission shall be responsible for:

1. The receipt of garden waste at its Agricultural Farm composting facility.

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[4] This is a roughly A$260,000 annual increase from average annual funding levels appropriated in national waste management budgets dating back to 2000. This funding increase is a direct result of one of three governance commitments Tuvalu adopted when it co-signed the 10th EDF Country Strategy Paper and National Indicative Programme (CSP/NIP) with the EU: 1) the enactment of comprehensive waste management legislation (see EU-funded *Waste Operations and Service Act* 2009 [WOSA]); that led to 2) significantly increased funding for waste operations and service provision; and 3) increasing the percentage of organic waste separated from the waste stream to over 50%, for green waste composting (the SWAT target is 90%).

[5] ROC International Cooperation Development Fund.

2. The processing of the garden waste by chipping/shredding and further processing to produce compost or soil conditioners.
3. Recordkeeping in relation to the volume of garden waste received at the Agricultural Farm, including the volume processed, utilised by the farm, sold and (or) otherwise disposed, with the data conveyed to SWAT on a regular basis.
4. Use of compost or other products by the agricultural farm as needed without the application of any cost or payment.
5. Supply of compost or other soil conditioning-related products to the Funafuti community, sold by volume at a fair cost to be determined by the ROC. The sale price of compost, etc. shall be regulated by SWAT to ensure that consumers are being offered a fair price.
6. Produce suitable quantities of shredded vegetation for use by the Funafuti community as an 'additive/bulking agent' for composting toilets and make this material available for collection by the community free of charge.
7. Proper accounts and records of money received (if charges are applied) from the sale of compost or other related products produced, with the information/data conveyed to SWAT on a regular basis.
8. In coordination with PWD or privately contracted mechanical workshop, maintain and repair all plant, machinery and equipment supplied under the TWWS, with maintenance funding provided by SWAT (see Section 2.B.3 above).
9. Provide liaison support and cooperation with SWAT in all matters pertaining to the delivery, composting, use, distribution, and sale of green waste.

D. Funafuti Kaupule

The duties and responsibilities of the Funafuti Kaupule shall be:

1. Waste collection and disposal services on Funafuti, including green waste collection, delivery and disposal of such waste for composting at the Taiwan Agricultural Farm. This Kaupule green waste service provision shall be funded by SWAT, with funding contained in the Tuvalu Government's annual national budget (see Section 2.B.2 and 2.B.3 above).
2. All residential and commercial green waste collection shall be undertaken island-wide, providing waste collection and disposal services to every Funafuti household, commercial business, or other green waste producers.
3. All collected residential and commercial green waste collected shall be delivered to the Taiwan Agricultural Farm, unless otherwise directed by the (a) ROC composting supervisor, (b) the SWAT Director, or (c) the SWAT Operations Officer, the three of whom shall work together in joint consultation before advising the Funafuti Kaupule.

Section 3
DATE THE MOU ENTERS INTO FORCE

This Memorandum of Understanding is effective from the 10th day of September 2010.

Section 4
LEGAL STATUS OF THIS MEMORANDUM OF UNDERSTANDING

1. The Parties to this MOU acknowledge that it is not their intention for this Memorandum to have a binding legal effect. It is a statement of their shared intention to work together in a spirit of national government, local government, and inter-donor co-operation to achieve the objectives and purpose of the green waste component of the 10th EDF TWWS.

2. In the event of any inconsistency between a provision in this Memorandum, and any provision in any statute, the laws of Tuvalu in general, and specifically the *Waste Operations and Services Act 2009* and *Environment Protection Act 2007*, that provision prevails over the procedures outlined in this Memorandum.

Section 5
DURATION OF THIS MOU

1. The agreements reached between the Parties pursuant to this Memorandum shall continue for the duration of 10th EDF (TWWS) through at least 2012-13.
2. Agreements between the Parties under this MOU shall extend indefinitely beyond that period as may be in the best interests of Parties in relation to all green waste-related operations and services.
3. In the event the ROC withdraws its technical cooperation from Tuvalu, the Department of Agriculture will assume all the duties and responsibilities of the Taiwan Agricultural Farm as they pertain to the agreements between the Parties under this MOU.

Section 6
REVIEW AND AMENDMENT

1. The provisions contained in this MOU shall be reviewed from time-to-time by the Parties.
2. This MOU may also be amended by mutual agreement between the Parties, as may be required.

Section 7
MONITORING

The terms of this MOU shall be monitored on a regular basis by the Parties, and by independent authorities as may be appointed by the EDF National Authorising Officer (Secretary of Finance and Economic Planning), or his appointed deputy, or the Director of SWAT.

Section 8
MISCELLANEOUS

Parties to this MOU agree to promptly prepare and deliver all such documents and do all such things as may, from time-to-time, be reasonably required for the purpose of giving full effect to the objectives and purpose of the green waste collection, delivery, disposal and composting provisions of this Memorandum, which are underpinned and specified in the 10th EDF TWWS Financing Agreement, Annex 2: Technical and Administrative Provisions.

Section 9
REFERENCE DOCUMENTS TO THIS MEMORANDUM

Below are the key documents relevant to this Memorandum:

Tuvalu Government. *Environment Protection Act 2007* – including Regulations.

European Commission and Tuvalu. *Financing Agreement: Tuvalu Water Waste and Sanitation Project* (Identification No. TV/001/09). February 2010.

Tuvalu and European Community. *Tuvalu-EC Country Strategy Paper and National Indicative Programme 2008 – 2013.* October 2007.

Tuvalu Government. *Waste Operations and Services Act 2009* – including Regulations.

Done at Funafuti

FOR THE MINISTRY OF HOME AFFAIRS

Kakee P. KAITU
Secretary of Home Affairs
Date: 10 Sept 2010

FOR THE REPUBLIC OF CHINA (TAIWAN)

H.E. James TIEN
Ambassador to Tuvalu
Date: 10th Sept. 2010

FOR THE MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT

for Seve LAUSEVEVE
Secretary of Natural Resources and Environment
Date: 10/09/10

FOR THE SOLID WASTE AGENCY OF TUVALU

Susan TUPULAGA
Director
Date: 10 Sept 2010

FOR THE FUNAFUTI KAUPULE

Andrew IONATANA
Kaupule President
Date: 10th Sept 2010

ON BEHALF OF THE MINISTRY OF FINANCE AND ECONOMIC PLANNING

Limasene TEATU
Sr. Assistant Secretary of Finance and Economic Planning
Deputy EDF National Authorising Officer
Date: 10th Sept 2010

APPENDIXES 3. Environmental Impact Assessments of the Northern Funafuti Dumpsite

Environmental Impact Assessments of the Northern Funafuti Dumpsite (Borrow Pit No. 1): Review of Technical Studies Conducted Between 1995 and 2010

Prepared for:
European Union
Delegation for the Pacific

Prepared by:
J.M. Conway
TA to NAO
Ministry of Finance and Economic Planning

December 2010

1. Introduction

The EU Pacific Delegation has expressed concern about the environmental integrity of Funafuti's main landfill, the Northern Funafuti Dumpsite (NFD). The issue arose during the 9-11 November 2010 visit of the EU ambassador, expressed in relation to the rehabilitation of the NFD under the waste component of the 10th EDF *Tuvalu Water, Waste and Sanitation Project* (10th EDF Identification No. TV/001/09).

To shed more light on the issue, this paper revisits the technical findings of six donor-funded environment studies or specific environmental impact assessments (EIAs) of the NFD, also known as Borrow Pit No. 1 (in the donor literature cited here sometimes inter-changeably referred to as Borrow Pit No. 2).[1] This paper summarizes the key findings of each study, conducted by outside and independent environment, ecology, marine biology and solid/liquid waste experts. From 1995 to 2010, two studies were funded by the Asian Development Bank (1995, 2004); four were funded by Australia (AusAID, 1998, 2000[2], 2002), and one by Japan (Japan International Cooperation Agency [JICA] 2010).

In places throughout this report, the environmental impacts of the NFD and other ecological analysis refers to the AusAID dumpsite (AAD, Borrow Pit No. 3, in some documents cited here as No. 4), about 4.5 km south of Borrow Pit No. 1 – the NFD. For the purpose of comparative study, the characteristics of the AAD, its site topography, geology and soils, hydrology (groundwater and surface), and nearby marine ecology is, for all practical purposes, identical to that at the NFD – though the AAD is much smaller in extent.

This review investigates the findings of earlier donor-funded technical and environmental assessments of the conditions and possible environmental impacts resulting from the initial siting of the NFD and AAD, and their continuous operation over the last ten years (it is intended under the 10th EDF waste component to permanently close and reclaim the AAD for site redevelopment). The analysis cited here is the most rigorous and authoritative to-date, including the recent Japan-funded study in 2010.

2. 1995 ADB Study: Planning and Environment Management

The 1995 ADB study identified Borrow Pit No. 1, the location of the NFD, as the ideal location for siting a large municipal dumpsite. It met two specific site conditions, the same then as now: 1) It was furthest away from the general Funafuti population; and 2) It sought to minimize public health and other dumpsite-related impacts. The study did, however, recommend a landfill design that should be

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[1] Funafuti has ten so-called "borrow pits" located on Fogafale and Tegako islets. The pits were excavated by U.S. military forces in 1942 and 1943. The excavated and crushed raw material (coral aggregate) was used as re-fill to construct the Funafuti airstrip and surrounding airbase facilities during World War II. The largest pit is no. 1, location of the NFD on Tegako islet, north of the Fogafale-Tegako causeway. Pit no. 1 is approximately 1,200m long, with a dumpsite volume estimated at 128,709m^3, but perhaps larger.

"...above normal high groundwater to minimize the potential impact of saturating fill material and drawing leachate into the lagoon or near-shore waters [**p. 8-28**]".

Comment: This ADB infill recommendation, though ideal, was an unrealistic design solution. A landfill design that's above high (tidal) groundwater would have required large volumes of raw material in-fill – imported from offshore – to raise the internal borrow pit floor and reinforce the internal lagoon and oceanside embankments; in other words, reinforcement of the opposing berms. A more complete design using infill or a membrane liner would have been (and is) prohibitively expensive – explored in more detail throughout this paper.

Fill material to underlie dumpsites is usually clay, a material that doesn't exist in Tuvalu. The volume of imported fill required would have been on the order of 30-40,000m^3, at a tremendously high cost. The other option, installing some type of impermeable membrane liner, while technically difficult, would have been possible but only at perhaps an equally high cost. The Tuvalu Government could not afford either option – then or now; nor was funding from Australia or other donors forthcoming to fund this type of landfill design.

"[In Tuvalu] there is limited availability of [domestically produced or imported] exotic materials that end up as waste material; there are also no industries that produce harmful industrial waste. Primary waste constituents are: green waste (leaves, plant material), metal [ferrous and non-ferrous], paper products and plastic. Other materials such as medical waste, batteries, used chemicals [primarily paints, waste oil, etc.] make up a much smaller part of the waste stream [**p. B-61**]."

Urban Planning and Environmental Management Study: Tuvalu Final Report (1995)
ADB TA No. 2319-TUV
Townland Consultants (Int'l) Limited (Hong Kong)
In association with Barrett Consulting Group and EDU International

3. 1998 AusAID Study: Waste Project Design Document

"The proposed landfill site [NFD is] away from human occupation and the freshwater lens system.[2] By placing the landfill at the end of the island where no water lens occurs, contamination of the freshwater source is avoided [there is no freshwater lens under the Fogafale and Tegako Islets]. Another advantage is that disease vectors which inhabit dumps will be removed from residential areas [**p. 4-4**]."

"Landfill areas should ideally have the following characteristics:

- Located away from where leachate from the landfill could contaminate groundwater or where the leachate could migrate to marine habitats;
- Not be placed in an area where they are likely to gross damage from cyclones;
- Drained to prevent surface run-off entering the landfill;
- Away from urban areas;
- In areas that are likely to be developed as future urban areas; and
- Fenced to control the movement of windblown rubbish, e.g., paper, light plastics, etc [**p. L-7**]."

"Borrow Pit No. 1 [NFD] located at the northern end of Fogafale [*sic*] fulfills most of these criteria. There are a number of problems that will need to be addressed when developing the site. These include: leachate control and the provision of suitable day cover material [**p. L-7**]." (*Note:* The report does not indicate where this "day cover material" might be sourced from, but presumably imported since it is not available locally in the volumes required.)

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[2] This lingering notion, that there's a lens of underground freshwater on Fogafale or Tegako islets, repeated often in the donor literature cited here, is both misleading and wrong. The water lens throughout these two islets is universally brackish – not potable.

"Lagoons, where tidal exchange is small, are particularly vulnerable to damage from leachate and run-off from a landfill.[3] It is possible to line a landfill with an impermeable liner, either using clay or a membrane-type liner. The cost of lining a landfill not only includes the cost of materials [and construction/installation], but also includes increased operational costs that occur because of the need to [protect] the integrity of the liner. *If the lining material [is] damaged, especially if the damaged area is near a natural seepage pathway, the impact to the environment may be more severe than if no liner had been used. Without a liner the leachate will be spread over a large area, and therefore the leachate concentration will be lower than if it seeps from a single location* [emphasis added; p. L-7]."

"An assessment of the geology [at the proposed site, NFD] indicates that the porosity of the coral [hardpan] in the area may in fact be quite low and percolation rates may be very low…The area does not have a fresh groundwater lens because of the narrowness of the islet, the low porosity of the islet material [again, mostly hardpan] would also limit the possibility of developing a freshwater lens[4] [p. L-7]."

Comment: Clearly, the project design team struggled with each tradeoff that arose from:

- Funafuti's limited land area, specifically the inhabited areas of Fogafale Islet, and mostly uninhabited Tegako Islet;
- A natural land constraint that makes it extremely difficult to locate a site for waste disposal, though a landfill had to be sited somewhere; and
- The cost of lining a landfill with clay, a source material not available locally (repeated in other donor-funded reports cited here), or the cost and technical difficulty of installing an impermeable membrane liner, which, if not properly maintained, may in fact exacerbate the leachate problem.

The AusAID-funded design team estimated that a proposed 40,000m^2 membrane liner would cost about A$600,000. The AusAID consultants did not explain how this estimate was derived, but it's likely the cost to establish this relatively high-tech solution could have been as high as A$1.0m, based on the cost of other domestic- and donor-funded civil infrastructure projects of broadly similar type and scale. The proposed 40m x 1,000m deep NFD area to be lined would have required significant physical reworking and grading of the northern Tegako landform, including blasting to flatten solid coral outcrops, ridges and other hard features of the site, to form a smooth evenly contoured surface ready for liner installment. It's highly likely that even then the liner would have required some type of clay-like sub-base to act as a liner cushion for a synthetic membrane on top, with the added cost of leachate drainage infrastructure to direct leachate to (possibly) a sump, where it could be pumped to the ocean-side of the borrow pit.

In the end, the AusAID-funded project did not install nor did it recommend any type of membrane liner at the NFD, or at the AAD. Not doing so was determined to be the safest and most cost-effective solution. Nor did the AusAID project budget allocate funds for any type of dumpsite liner. This would suggest that AusAID, and the project's consulting team, presumably with good reason, deemed the potential leachate problem manageable.

Tuvalu Waste Management Project: Final Project Design Document (November 1998)
Australian Agency for International Development (AusAID)

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[3] This implies that the tidal exchange within the Funafuti lagoon is weak. In fact, it is generally understood that the tidal exchange between the open ocean and the Funafuti lagoon is robust. The flushing of Funafuti's relatively shallow lagoon occurs at the surrounding atoll rim through several deep passages (ship channels) on its western side and a single deep passage to the southeast. The lagoon also fills and drains across reef flat, which accounts for 92% of the entire land area of the reef platform surrounding the rim, and through subterranean passages within the reef platform.

[4] Technically, it is not possible to "develop" a freshwater lens where one does not presently exist because of the unique characteristics of atoll geology and hydrology.

4. 2000 AusAID Study: EIA of Funafuti Landfill

This EIA cites Kaly and O'Brien, 2000 [**p. 13**] who state that the two landfills then under discussion (Borrow Pit No. 1 and 3) selected as proposed landfills are suitable. Generally, both are of "…low ecological diversity…low abundance of reef-associated organisms, and show existing damage due to other human activities". Though not elaborated on, the implication is that such activities were basically harmless in terms of danger to the marine environment (see *Ecological Audit of Funafuti Landfill: Marine Baseline Surveys and Assessment of Site Suitability*).

This EIA poses three potentially adverse impacts associated with the AAD, or any landfill on Funafuti, including the Northern Funafuti Dumpsite), excerpted and reviewed here, with comments in *italics*:

- Limited vegetation clearance [**p. 21**]: *No major vegetation clearance to-date but the area has been degraded*;
- The threat to flora and fauna was deemed *low* [**p. 17**]: Though vegetation has been disturbed from its natural state but is considered of low environment value, with perimeter vegetation retained. Where possible.
- The risk to geology and soils was deemed *low* [**p. 17**]: "Soils present at the site are essentially surface expressions of course textured, calcareous biominerals and therefore, there is minimal risk of erosion. Soils are well drained and localized flooding will generally be dependent on the tide."
- The hydrology risk was deemed *medium* [**p. 17**]: "There appears to be little preferential flow direction of groundwater to and from the site[s]…There is potential for contamination of both the lagoon and ocean from leachate migration. However, chemical conditions present within the landfill are expected to restrict the leachability and migration of metals and other chemicals…especially of potentially hazardous or problematic wastes are removed from the waste stream."
- The risk to marine ecology was deemed *high* [**p. 18**]: As briefly noted above, the area "…is considered to be of generally low ecological diversity, has low abundance of reef-associated organisms and shows existing damage due to other human activity. Chemical conditions present within the landfill are expected to restrict the leachability and migration of metals and other chemicals."
- Potential for contamination of groundwater[**p. 18**]: *Again, there is no potable groundwater at the NFD or AAD sites, or anywhere on Fogafale or Tegako Islets.*
- Contamination of the surrounding marine ecosystem [**p. 18**]: *Limited based on the core findings of this particular report, with qualifications discussed elsewhere in this paper.*

The EIA, of course, was most concerned with the generation of landfill leachate into the two surrounding marine ecosystems – the lagoon and ocean. Assuming, as the report does, in its Conclusions and Recommendations [**p. 21**] the removal of "putrescibles and hazardous wastes prior to disposal", of which there are few in the gross mass of waste deposited at the NFD or AAD, the EIA assumes this: "The saline water within the borrow pit and the alkaline nature of the coral base and walls is expected to restrict the leachability migration of [harmful] metals and other chemicals".

Among other landfill issues, the EIA recommended the following relevant issues/activities (again, comments in *italics* [**p. 21-22**]):

- Retain perimeter vegetation: *Some has been lost at the NFD between 2000 and now but it can be easily replaced/replanted to reinforce lagoon and foreshore protection.*
- Install drainage control devices to reduce [leachate] infiltration and surface runoff: 1) *No drainage control devices were installed*; 2) *nor were any subsequently proposed of funded in future aid-funded projects; nor did the study point out that this type of solution is beyond the technical expertise and financial means of the government.*
- Erect perimeter fence for security and screen purposes: *Planned under the TWWS Project.*
- Implement restricted hours of operation: *Planned under the TWWS Project.*

- Continue community education and awareness activities: *Planned under the TWWS Project.*
- Limit hazardous waste disposal: *Planned under the TWWS Project.*

The intent of bullet point 2 above, to install drainage devices to reduce "surface runoff", is misleading and unnecessary since neither the NFD or AAD experience surface run-off from rainfall. The nearby surrounding elevation at each site is flat, and the borrow pits themselves, by definition, are concave in shape. Nor can rainfall run over the top of lagoon- and ocean-side berms. It drains mainly through the porous atoll formation at the floor of the borrow pit.

Environmental Impact Assessment: Solid Waste Landfill, Funafuti, Tuvalu (September 2000)
AusAID Report No. 5.2.2/MSW7a
Golder Associates Pty Ltd (Milton, QLD)

5. 2002 AusAID Study: Landfill Management System

"There is no suitable source of clay lining material on Fogafale. Importation of clay materials is considered to be uneconomic and unsustainable in the long term…Use of [a] synthetic liner could be considered…[but preparing a] suitable surface would be difficult given the uneven rocky [terrain] and the lack of material resources [**p. 7**]."

Comment: The study assumed that most potentially hazardous or problematical wastes were or would be removed from the waste stream, and further assumed that the items directed at the landfill would be mainly comprised of tin cans and other metal objects, plastics and other films, cloth and leather.[5] At the time both were largely valid assumptions, though even in 2002 there was wider variety of waste material deposited at NFD than that cited, including a relatively large volume of green waste. In any event even today the volume of problematic waste, excluding green waste, is a tiny fraction of the total volume of waste material deposited at the NFD.

The study indicated that in a near best-case scenario "…the types of wastes [to be deposited at the site] are relatively inert when conditions are not chemically aggressive or reducing. The saline water within the borrow pit and the alkaline nature of the coral base and walls should restrict the leachability and migration of metals. *On this basis, use of a liner is not proposed* [emphasis added; **p. 8**]."

Comment: This study did suggest regular monitoring of water quality within the borrow pit and surrounding marine area to determine if marine water quality might degrade, and if such was the case a leachate pumping system should be installed for leachate disposal via ocean outfall. Neither regular water quality monitoring has been undertaken, nor has it been determined that a leachate and pumping system is required, nor, as other studies determined, is it economical or practical.

"Analysis of field data collected suggests that there is not a preferential flow direction and groundwater may flow either towards the lagoon or ocean as the tidal cycle waxes and wanes. This indicates that leachate generated by the landfill [will] migrate toward the ocean or lagoon [in equal parts, **p. 15**]."

"If the waste stream entering the landfill is appropriately managed, the quality of the leachate generated is expected to present a minimal risk to human health [and] the marine environment [**p. 16**]."

Comment: It is generally believed that the volume of potentially hazardous waste, little of which is generated locally, probably represents less than 0.5% of the waste stream. Studies have found that even poisons such as lead and mercury (probably zero percent in Funafuti) in sufficiently small quantities stay trapped inside the mass of garbage even in old, unlined dumps that were built before more stringent modern regulations were enacted in developed countries. Today, in modern municipal dumps, hazardous waste volumes of less than 1% are considered safe.

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[5] It must be said, cow-hide or other mammal-derived leather is not a common waste material found in Tuvalu, and would represent a tiny fraction of the waste stream from a few imported products such as leather shoes.

Tuvalu Waste Management Project: Landfill Management System (June 2002)
AusAID Report No. MSW8
Golder Associates Pty Ltd (Milton, QLD)

6. 2004 ADB Study: Waste Management and Recycling

The main landfill assessments of the Tonkin & Taylor study described the NFD as "…sufficiently remote as to not cause a direct nuisance (in fact it probably has less direct impact than the AAD). However, it is unsustainable, unsightly, unmanned, usually on fire [not true], and ecologically threatening due to its physical proximity to the sea and exposure to wind and waves in severe storms. Mobile wastes such as card board and scrap roofing iron are readily visible in the lagoon and on the ocean foreshore around the NFD area. Unfortunately, while it remains a "free" and uncontrolled [landfill] option, it will continue to be used extensively **[Section B-7, p. 3]**."

Note: The waste component of the 10th EDF TWWS acknowledges that the NFD is unsightly, unmanned, ecologically threatening, there exits the presence of mobile litter and other wastes, and it is a "free" and uncontrolled landfill. It is the intention of the 10th EDF TWWS to remedy each of these shortcomings through complete landfill rehabilitation, including making the NFD a fenced and controlled landfill.

Comment: However blunt (and largely accurate) the assessment by Tonkin & Taylor (2004), it does not present evidence nor does it describe hazardous leachate damaging or degrading the surrounding marine environment. Had this been occurring it's presumed this would have been emphasized, which is different than stating the NFD is "…ecologically threatening due to its physical proximity to the sea and exposure to wind and waves in severe storms". Tonkin & Taylor did note the practicality of the AAD (to be closed under the 10th EDF TWWS) and NFD as sites with relatively high tidal flushing and hence leachate dilution, the ecological suitability of the sites, and lack of other landfill siting options **[Section C.4.7]**.

Technical Assistance for Effective Waste Management and Recycling in Tuvalu (July 2004)
ADB TA No. 4214-TUV
Tonkin & Taylor International Ltd

7. 2010 JICA Study: Coastal Protection and Ecosystem Assessment

The key *concerns* and *findings* of the JICA-funded study are summarized and edited for clarity below.

Concerns **[p. 3-91]**: 1) Damage to NFD storm ridge (oceanside) caused by the construction of an access road; 2) Environmental impact on water quality and coral ecosystems caused by leachate from the NFD via the borrow pit; and 3) Impact on the coastal environment caused by the influx of waste attendant on the breakdown of the storm ridge.

Findings (in relation to 1-3 above **[pp. 3-91, 3-92]**):

1) There is concern that the existing access road on the ocean side will threaten the storm ridge, which provides valuable coastal protection. Because of the importance of the storm ridge for coastal management, the access road should be shifted to the lagoon side of the dump site inside the borrow pit reclaimed by waste.

2) [The TWWS project] will not take any preventative measures against leachate such as a covering liner inside the surface of the NFD before waste dumping. Measures to collect and treat leachate at the NFD or elsewhere is not a realistic option in terms of the topographical characteristics of an atoll environment, limited capacity of government authorities to undertake such work, and a high-cost to benefit ratio. Instead of investing huge capital in a final disposal system, waste minimization practice should take priority, such as avoid dumping organic waste **(10th EDF planned)**, increase green waste separation and composting **(10th EDF planned)**. Community understanding and involvement are indispensible for the implementation of the above activities, so that relevant organizations need to conduct continuous awareness raising activities **(10th EDF planned)**.

3) The storm ridge located about 400m north of the present NFD has been damaged, and some NFD waste has floated there. There is a growing apprehension that the storm ridge will be further damaged caused by an extraordinary event such as a storm surge, which could bring dumped waste into the lagoon-side area that effects the coastal environment. Countermeasures to repair the storm ridge should be undertaken as part of any dumpsite habilitation.

Comments on the JICA findings 1 and 3:

1) No new access road is underway nor is one planned under the 10th EDF TWWS project. The storm ridge on which the existing access road is located has retained its original elevation and basic topography with little visible stress on its coastal protection properties. Shifting the road to the lagoon side of the borrow pit on reclaimed land is not recommended since the lagoon side of the borrow pit is lower in elevation, far less physically robust than the storm ridge, and much more susceptible to coastal erosion.

3) There is as yet no plan to repair the storm ridge 400m north of the NFD, damaged by natural processes. This area does not form part of the NFD complex. Though it may pose some broader environmental concerns, the cost of such physical repair work is outside the scope of the planned TWWS-funded NFD site rehabilitation works, and it is not clear how one would access that particular area of the storm ridge since there is no access to it, except on foot. Better NFD management would likely alleviate any concern posed by this area, which is a significant distance from the NFD.

7.1 The results of JICA's water quality survey

"A coral ecosystem commonly distributed in an oligotrophic area is said to be seriously influenced by the eutrophication of the sea area due to the inflow of inland water that contains a large amount of phosphorous, nitrogen, etc. For the conservation of coral reef, Japan has the following environmental water quality criteria (Type 1: National Environment Conservation) {where T-N = total nitrogen; T-P = total phosphorous; mg = milligrams; and l = litre}:

T-N: 0.2 mg/l or less (1)
T-P: 0.02 mg/l or less (2)

"When the measurements of coastal seawater in the [18] study areas (seawater on the ocean and lagoon sides) are compared {against} the Japanese environmental criteria, all the T-N values meet the…criterion but some of the T-P values on the lagoon side near the coast [test sites LW3 and LW9] exceed the criterion.{**p. 5.25**}"

Comment: Neither site (LW3 or LW9) are near the NFD. The closest to the NFD, LW3, is approximately 6 km south, and is not influenced by the NFD (LW9 is approx 8-9 km south on the lagoon side off the main residential area of Fogafale). Testing site LW5 on Tegako Islet, the closest site to the NFD, is within safe bounds for both T-N and T-P.

"The comparison of these threshold values and the water quality analysis results in this study revealed that both the concentrations of inorganic nitrogen (NH_4) and inorganic phosphorous (PO_4) exceed the threshold values at LW3 and LW9 [well away from the NFD]…and exceed the threshold values for eutrophication, leading to fears about possible influence of eutrophication on the coral. On the other hand, the chlorophyll-a concentration in the seawater is 0.05μg/l or less or about 0.1 to 0.2μg/l in the overall study area, suggesting that eutrophication has not reached a level where it influences the growth of coral [**p. 5.26**]."

Comment: Again, the affected areas in question (LW3 and LW9) are not the result of leachate contamination emanating from the NFD, but from other sources significantly distant from the NFD.

The Study for Assessment of Ecosystem, Coastal Erosion and Protection/Rehabilitation of Damaged Areas in Tuvalu: Progress Report (March 2010)
Japan International Cooperation Agency (JICA)

8. Findings and Conclusions

The NFD is filled mostly with innocuous materials like paper, green waste, construction debris, aluminum and tin cans, plastic bags and packaging, cardboard, general household waste, and scrap metal (ferrous and non-ferrous). Bulky items such as scrapped cars, trucks, heavy equipment, and shipping containers, have been deliberately accumulated at the NFD for eventual export recycling (a component of the 10th EDF TWWS). To some observers, plastic bags and packaging accumulated at the NFD poses some concern because it doesn't decay in landfills, but neither does most other packaging. Paper, cardboard and other organic material – while technically biodegradable – tend to remain intact in the airless confines of a landfill if properly compacted (not strictly the case at the NFD, as past dump management practice has shown, but the broader point remains true). Studies have shown these latter mummified materials (paper, cardboard, etc.) actually use much more landfill space than plastic packaging. For example, juice or milk cartons take up half the landfill space occupied by the glass bottles they replaced; 12 plastic grocery bags fit in the space occupied by one paper bag. And, plastic bags made of corn starch, a natural biodegradable material, disintegrate within months.

Based on this review of independent donor-funded environment and ecological assessments of the NFD (and AAD, to be closed in any event), the NFD has not nor does it pose an immediate threat to Funafuti's terrestrial environment, coastal ecology or marine ecosystems, nor has there been any damage caused to marine ecosystems resulting from NFD-generated leachate. Further, the assessments undertaken to-date, including the latest 2010 study by JICA, indicate that there is no leachate problem emanating from the NFD (or AAD).

The above donor-funded assessments repeatedly concluded that while clay or synthetic membrane liners were desirable if not ideal, including leachate drainage and disposal infrastructure, neither was necessary, practical, or cost effective. Furthermore, this conclusion is supported by the robust scientific findings released in the 2010 JICA report. Most modern landfills, which by regulation must be lined with clay, plastic, or both, equipped with expensive drainage and gas-collection systems, and covered daily with soil and monitored regularly for underground leaks are extremely costly to operate and not a viable option in Tuvalu. In the U.S. and Europe, for example, small-time operators who ran old municipal town dumps analogous to the NFD, could not afford to provide these safeguards when there was a shift in regulations imposed in the 1970s, 80s and into the 90s, which is why corporations moved in to manage dumps at new facilities that often service millions of people over a wide geographic area. Corporate ownership of the NFD is not possible due to its extremely small size, service area, and a long list of other factors.

Finally, an informal survey of local fisherman[6] suggests that lagoon waters near the NFD – a marine area broadly estimated at 250-300,000m^2 – have become favoured fishing grounds over the last 5-7 years due to an abundance of reef fish compared to other areas of the Funafuti lagoon. Though clearly an unintended consequence, a by-product of the NFD might well be more nutrient rich seawater stimulating the growth of fish populations. At least anecdotally, this suggests the following findings:

1) However unsightly the NFD appears at present, it may in fact produce a net public benefit in terms of indirect, increased fisheries production;
2) It validates the 2010 JICA finding that the volume of leachate the NFD generates is not hazardous; and
3) The small volume of generally problematic waste deposited at the NFD is not harmful to the environment.

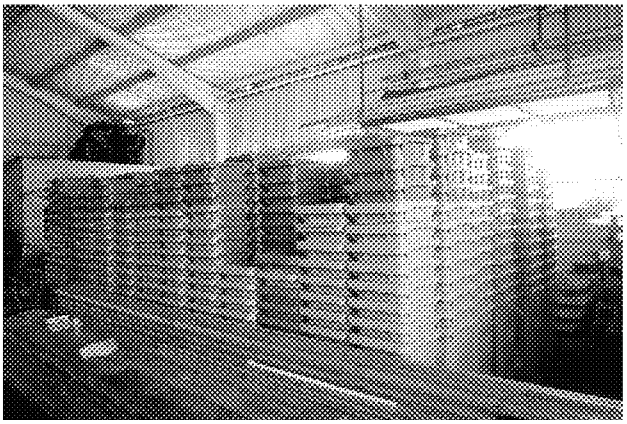
[6] Conducted by the author of this report.

SEA
SLUM
STEEL STORAGE
INCINERATOR SHEDS
WATER TANK
LAGOON

APPENDIXES 4. Pictures of donated equipments

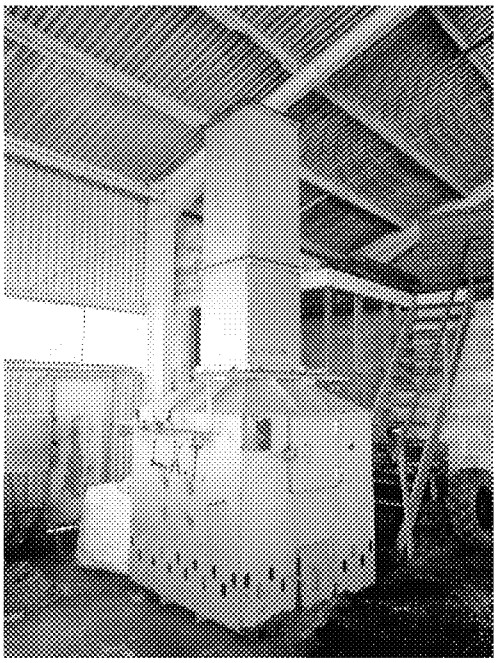
Garbage truck

Garbage truck



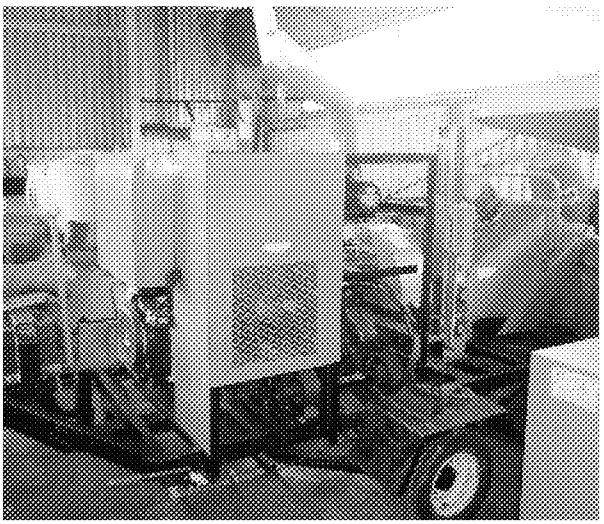
Parts of recycle dust bins still didn't distribute.

Dr. Lee communicated to the director of SWAT.

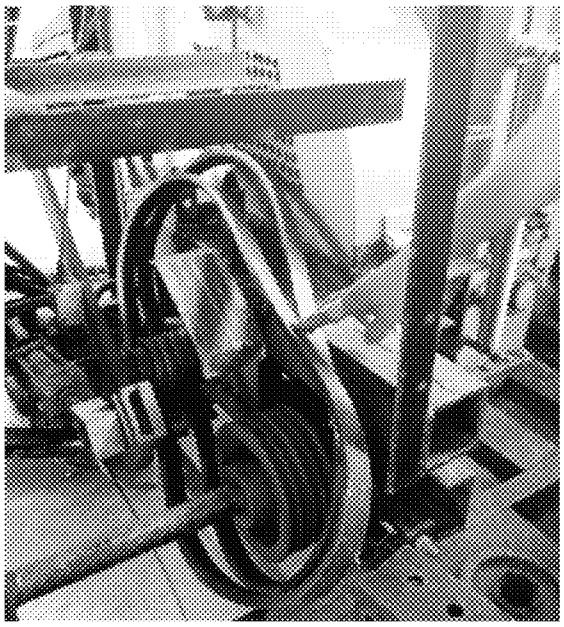


Incinerator

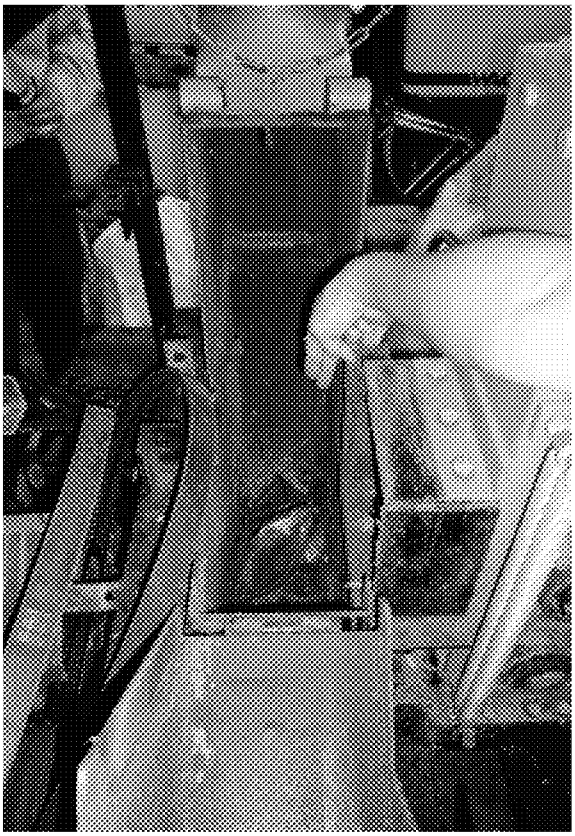
Plastic chipping machine



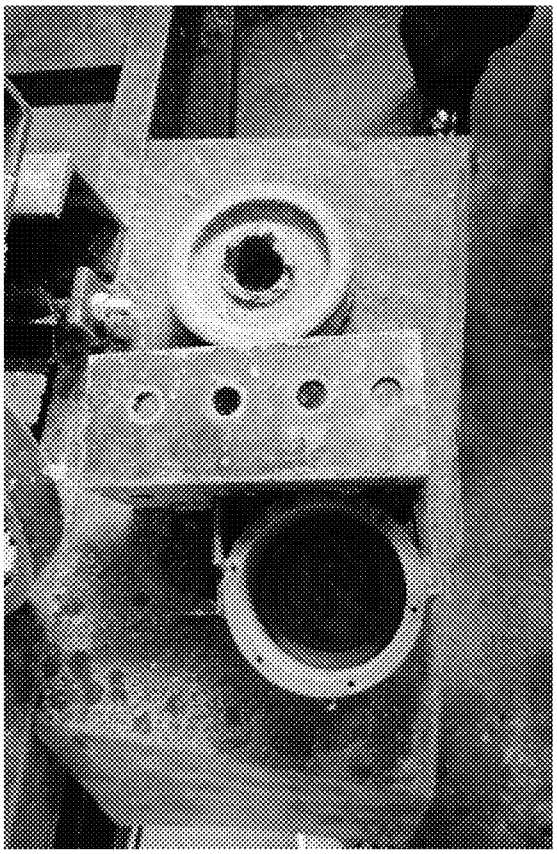
Shredder



Shredder



Shredder



Shredder

APPENDIXES 5. Scrap heap in the northmost part of Funafuti.