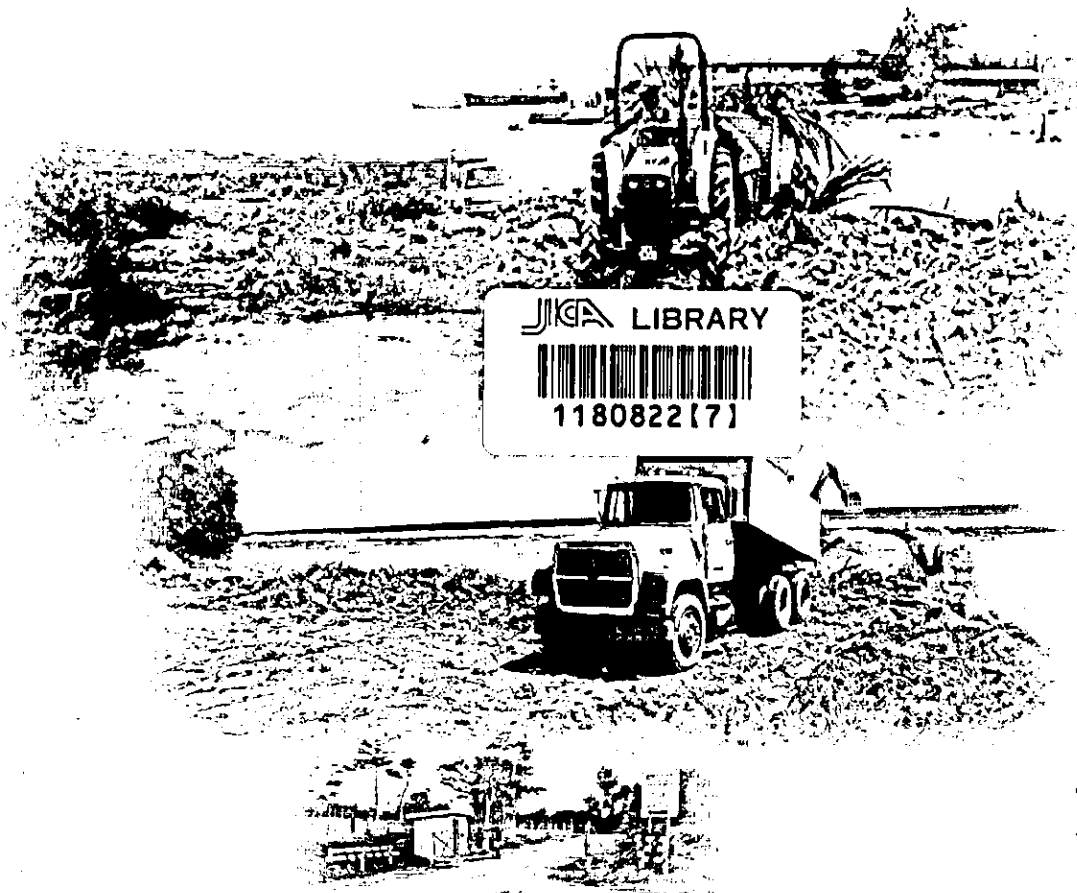




JAPAN INTERNATIONAL COOPERATION AGENCY

Guidelines for Solid Waste Disposal Site Management in Pacific Island Countries

Background Report



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**GUIDELINES FOR SOLID WASTE DISPOSAL SITE MANAGEMENT
IN PACIFIC ISLAND COUNTRIES**

BACKGROUND REPORT

March 2001

Prepared for

Japan International Cooperation Agency (JICA)

Prepared by:

**Egis Consulting Australia
Level 1
67 Albert Avenue
Chatswood NSW 2067 Australia
Tel: (02) 9412 9999
Fax: (02) 9412 9686**



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EXECUTIVE SUMMARY

Introduction

The management of waste materials is a world wide problem. The small island developing states of the Pacific increasingly share this problem. While Pacific Island Countries (PICs) may differ in terms of topography, climate, population density, economic development, land use, and geology they share the following features:

- Limited land availability and high population density in urban areas;
- Limited institutional capacity and financial resources;
- Poor waste disposal practices and storage of waste generated;
- Limited scope for recycling and recovery and limited collection and transport services;
- Lack of treatment and disposal facilities for special wastes, and stockpiling of special wastes.

In most PICs waste disposal commonly involves the dumping of rubbish at official and unofficial open dumping sites. These sites have a low initial capital investment and operating costs. However, the environmental and health impacts of such operations are potentially significant, and the lack of monitoring of the dumps and impacts on the surrounding community, land and water is a matter of major concern. It is often argued that existing open dump sites should be closed and controlled landfills constructed in their place. However, in view of the severe technical and financial constraints many PICs face, practical reality is likely to necessitate that attempts must first be made to place a measure of control over open dumping practices and gradually upgrade the sites.

In response to the poor condition of solid waste disposal sites in Pacific Islands Countries and the challenges to improve the situation, the Government of Japan through the Japan International Cooperation Agency (JICA) engaged Egis Consulting Australia to develop regional guidelines for improving the management of solid waste disposal sites in urban areas in PICs. The guidelines will be used by JICA in Oceania to help select, design and implement more sustainable activities in solid waste disposal site management in PICs.

Existing Solid Waste Disposal Situation

The management of solid waste disposal sites in PICs is, in the whole, generally quite poor. There are a number of reasons for this including inadequate / ineffective waste management planning, inadequate data to effectively plan waste management activities, inadequate legislation or inefficient enforcement / application of existing legislation, and a lack of awareness in some countries of the seriousness of the resulting problems. In most PICs the inadequacies are often caused by a lack of funds for waste collection and waste disposal operations and / or ineffective institutional arrangements. While most governments, for example, do pay reasonable attention to the provision and protection of drinking water and electric power supplies, few resources and funds are expended on waste management activities.

In summary, the common causes of the current poor management of solid waste disposal sites include:

1. Ineffective and / or inappropriate institutional arrangements and limited institutional capacity. Specific problems include:
 - Lack of, or inadequate legislation and regulations;
 - Lack of enforcement of existing legislation, particularly in regard to the prevention of littering and indiscriminate dumping of waste;
 - Wrong (inappropriate / ineffective) Government Departments are managing the waste disposal site – not a primary / core function;
 - Conflict of interest - often the health or environmental departments, who are meant to be regulators, are undertaking the waste management activities eg. Tonga, Samoa;
 - Lack of communication and support between relevant Government agencies eg. those with the equipment do not cooperate with those responsible for operating the waste disposal site or those with an understanding of the environmental issues are not involved;
 - Lack of suitable resources for undertaking the landfilling operation, environmental monitoring or regulation of the activities.
 - Lack of knowledge and (hands on) experience in sanitary landfilling operations. This includes all level of personnel: managers, supervisors and equipment operators; and
 - Lack of equipment (to compact and cover waste materials) and support systems eg. for maintenance.
2. Limited financial resources and the lack of a sustainable funding mechanism for operating the solid waste disposal site. This includes a lack of funds for capital works, equipment, the ongoing operation and maintenance of the site and equipment including costs of cover soil, other operating costs, site rehabilitation costs, and post closure management and monitoring costs. This particularly includes funding for management and supervision of the site and funding for equipment to undertake compaction and covering of the deposited waste. Often this lack of funding is associated with the institutional arrangements ie. waste management is not a core function of the Government agency responsible for such eg. Department of Health, and as a result waste management is not a priority issue and does not receive the necessary funding.
3. Inappropriately located landfill waste disposal sites eg. located immediately adjacent to residential areas, located in unsuitable hydrological / geological setting (permeable soils, high groundwater table, no cover material available on site), or located in an environmentally sensitive area (mangroves, reef flats, adjacent creeks or rivers).
4. Difficulties in siting and establishing a new, sanitary landfill waste disposal sites due to:
 - Lack of land for landfill waste disposal activities (particularly small atoll islands);

- Land ownership arrangements, which make resumption or purchase difficult or impossible; and
- NIMBY. No body wants a dump, as they know it, next door.

This results in limited availability of land for waste disposal activities. Generally, waste disposal activities are restricted to Government owned land, which is often limited and commonly below the high tide mark.

5. Lack of planning of the landfill waste disposal site operation, including a lack of data to undertake such;
6. Lack of management and supervision of the landfill waste disposal operations, which is often due to the institutional problems and / or lack of funding;
7. Lack of health and environmental management measures, including:
 - Lack of stormwater and leachate management control measures - resulting in contamination of surface waters and groundwater
 - Lack of soil to cover deposited waste (and maintain sanitary conditions). This is a particular problem for small atoll islands;
 - Lack of covering and compaction of the deposited waste.
 - Lack of vector control measures / programs;

These problems are also usually a function of the lack of funding.

8. Unsafe / poor management of special wastes eg. medical waste, septage / sludges, highly degradable and odorous waste eg. offal, food processing wastes
9. Increasing quantities of waste materials requiring local management / disposal, particularly imported packaging materials and vehicles, which are consuming scarce landfill waste disposal space.

Particular problems commonly encountered with waste disposal sites on populated, atoll islands include:

- The lack of land for undertaking landfill waste disposal activities. This is particularly the case in highly populated, and growing, atolls such as South Tarawa (Kiribati) and Majuro (Marshall Islands). Landfill waste disposal on these islands occurs on both ocean side and lagoon side reef flats, with minimal environmental controls, which is having an adverse impact on the reef.
- The geological / hydrogeological setting – permeable soils and bedrock, high groundwater table, which is used as a source for potable water. Landfilling activities present a groundwater contamination risk, dependent on the level of environmental management and monitoring measures implemented.
- The limited availability of soil for covering the deposited waste, to maintain sanitary conditions.

Relevant Activities of Donors, Regional and International Organisations

There are many organisations providing assistance to PICs operating throughout the Pacific Region. These organisations undertake a wide range of activities with a number of the organisations having an active interest in the improvement of solid waste management sites (either directly or as part of a focus on urban sanitation services). Some of the more recent or current activities relating to solid waste disposal operations include:

- 2 large landfill design and construction projects – Tonga (AusAID) and Suva, Fiji (EU)
- Several smaller projects in Niue, Christmas Island (Kiribati), Nauru and Tuvalu. Typically (but not always) these projects have been part of a larger project focusing on water supply and sanitation with the focus not necessarily being the solid waste disposal side. The adequacy of these operations / landfills has not been assessed as development has only just been completed or nearing completion and there is insufficient data available for the assessment.
- Other waste disposal projects (waste to energy), under a PPP arrangement are being considered in Samoa and Cook Islands (NZODA). It is noted that a landfill project is also being considered by the ADB in the Cook Islands.

Sustainability of Aid Projects

A number of issues were identified by donors, local, regional and international organisations in the provision of aid / assistance. These were experienced not just in relation to solid waste sites but in other areas as well. The identified issues related to:

- Recurrent financing;
- Asset maintenance;
- Environmental and safety standards; and
- Training and human resources.

These issues are summarised in the following sections.

Recurrent Financing

Most organisations identified recurrent financing as an issue in providing aid / assistance in PICs. Establishing a method for recurrent financing after delivery of a facility / equipment is imperative to ensure the ongoing operation of that facility / equipment and ensure that maximum benefit is therefore achieved from aid provided resources. This issue is addressed by aid organisations in a number of ways including:

- Execution of an MOU with the recipient country to ensure ongoing finance to operate and maintain the facility / equipment provided;
- Requiring funding and resources input by the recipient country during project start up (to encourage ownership of the project / facility).
- Assisting the recipient country to establish a funding mechanism to generate revenue for ongoing operation and maintenance of the facility / equipment (eg. through taxes, charges, fees, government allocation).

It is considered that all of these activities will assist in addressing the issue of recurrent financing although the issue may be best addressed through a combination of all the above or application of a single option after a full assessment of the existing situation.

Asset Maintenance

Most organisations also identified the lack of asset maintenance as an issue in providing aid in PICs. The lack of asset maintenance by recipient countries is due to a number of factors such as lack of ongoing funding (primary reason), a lack of training in the operation and maintenance of the facility / equipment, provided, a lack of equipment and / or spare parts to undertake the required maintenance. All organisations have generally recognised this and now ensure that training accompanies the provision of new facility or equipment.

Alternatively inappropriate equipment which is unsuitable for PICs may have been provided making maintenance difficult due to frequent breakdowns resulting from climatic impacts on equipment or lack of access to spare parts.

The issue of asset maintenance can be addressed by ensuring that prior to the provision of any assets / equipment that the aid organisations assesses the suitability of the asset / equipment being provided by assessing the following:

- Suitability of the asset / equipment for the intended application in the proposed environment;
- Ability of the recipient Government to fund the ongoing operation and maintenance of the asset / equipment;
- Ability of the recipient Government to operate and maintain the asset / equipment, and the need for training and supply of maintenance equipment;
- The availability / supply of spare parts to repair the asset / equipment in the event of breakdown, and the need to provide a range of selected spare parts as part of the aid project.

In addition, the provision of assets should always be accompanied by appropriate training, access to maintenance equipment and an MOU to ensure the asset is maintained in an appropriate manner.

Environmental and Safety Standards

In the absence of environmental and safety standards in the developing country, organisations providing assistance / aid are left to determine what standards should be applied to a project. By applying the environmental standards of the donor / organisation's home country or internationally recognised standards can mean that the cost of a project becomes prohibitively expensive and is not sustainable (the recipient country cannot afford to operate and maintain the facility / equipment).

Generally most organisations appear to take a pragmatic approach to this issue, as the likely benefits of any project will typically have a net beneficial environmental impact even if international standards are not achieved. A small improvement is considered better than no improvement. Projects are seen as a stage in an overall aim of achieving best practice for that country - while international environmental standards can not be met in the short term, it is the long term aim that such standards would be met in all developing countries.

There is noted to be some support for the development of environmental standards for the Pacific region. It is however, recognised that given the diversity of the countries it would be difficult to gain agreement on such a set of standards.

Training / Human Resources

Training is an important component of work undertaken by various organisations throughout PICs. A common problem encountered is that following completion of the training the staff (typically from the recipient government) move on to another government department or potentially even leave the country and do not therefore fully utilise the training they have received.

Training which is done in groups to ensure "technical backstopping" and in-country to ensure it best meets the needs of the relevant people is considered to be the best approach to this issue. It is further suggested that following up on the adequacy and implementation of the training will help ensure that the best use of training budgets is achieved.

It is noted that given the low populations of the Pacific Island countries, the issue of retaining staff is always likely to be an issue.

It is considered that there is a need for training in PICs in the following aspects of waste disposal site management:

- Landfill planning and design;
- Landfill management and operation, including leachate management and effective operation and maintenance of landfilling equipment;
- Costs and funding of waste disposal operations;
- Environmental management and monitoring of waste disposal sites;
- Contract preparation and management – for waste collection operations and operation of waste disposal sites;

The training should focus on local / regional issues and include practical hands-on training. This is considered to be one of the most critical aspects to ensure the highest benefit is achieved by providing the training. Where possible the training should be done in country / in the region and use local examples / case studies.

Recommended Approach to Improving Solid Waste Disposal Sites

Waste management is a significant environmental problem in PICs. It is not just a matter of solving the problems of litter and indiscriminate dumping of solid waste - a full solution has public health, environmental, social, economic, commercial and sometimes international relations implications (ie. hazardous wastes).

Many problems associated with the existing poor waste management situation in PICs stem from a lack of funding and effective institutional arrangements to change the situation. These two problems need to be addressed and overcome (ideally before taking further steps) if there is to be a long term and sustainable improvement to the landfill waste disposal situation.

There is a wide range of options for addressing the many problems with landfill waste disposal sites in PICs. The situation at each landfill site in each PIC is invariably different and requires the development of a specific strategy / plan (solution) to improve the situation at that landfill waste disposal site.

The recommended process for developing and implementing a specific plan to improve a solid waste disposal site in a PIC encompasses 2 stages. These can essentially be classified as a planning/development stage and an implementation stage. See Figure ES.1.

Measures for Improving Solid Waste Landfill Waste Disposal Sites

There is a wide range of measures that can be implemented to improve solid waste landfill disposal sites in PICs. These generally include:

- Undertaking an investigation and assessment of the existing waste management system and landfill waste disposal activities – to obtain a complete understanding of the current situation and determine existing problems, issues and possible barriers to improving landfill waste disposal;
- Undertaking an investigation and assessment of existing landfill waste disposal site, including institutional arrangements and funding as well as site location(s), management and operations;
- Improving institutional arrangements / overcoming institutional problems, where required;
- Improving funding for landfill waste disposal activities;
- Upgrading the management and operation of existing landfill waste disposal site(s); and / or
- Establishment of a new, modern waste management facility that incorporates a sanitary landfilling operation (and rehabilitation of the existing dump site).
- Improving the management of special wastes;
- Implementing waste minimisation and recycling measures; and
- Conducting relevant and appropriate education and training programs

The Guidelines provide further details of how to undertake the above in PICs.

Social and Cultural Issues

Particular social and cultural issues that will need to be addressed in improving solid waste disposal site management include the following:

- Overcoming the obstacles associated with existing land tenure arrangements and acquiring land for landfill waste disposal;
- Changing community behaviour / waste management practices ie. no littering and indiscriminate dumping of waste;

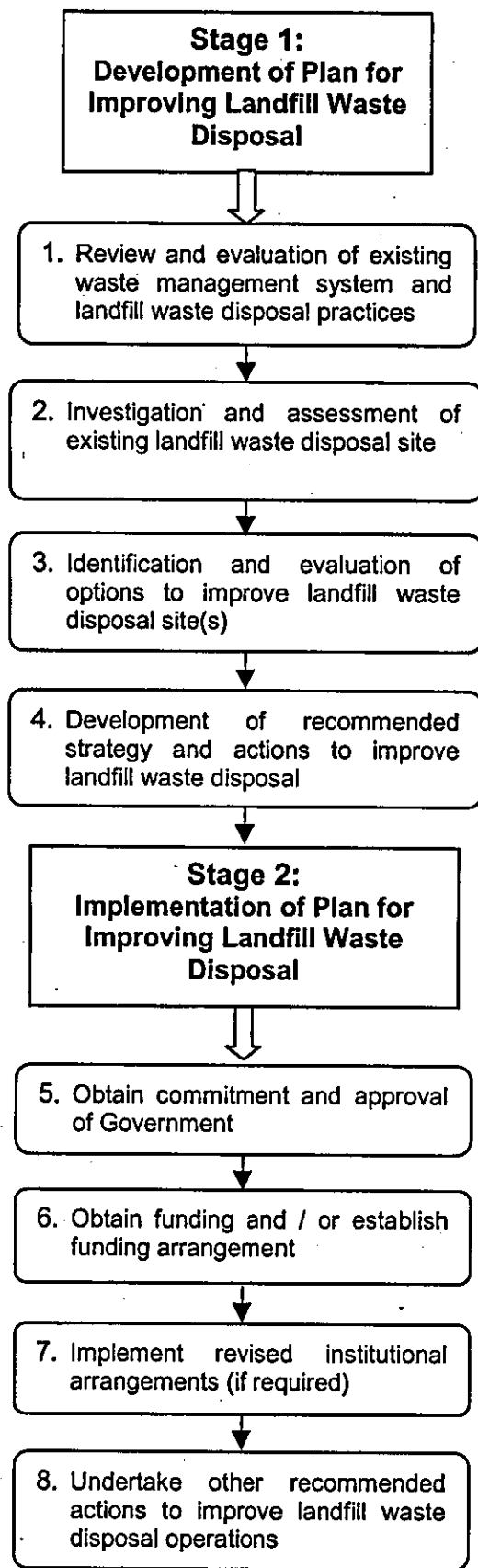


Figure ES.1 :
Recommended Approach to Improving Landfill Waste Disposal in Pacific Island Countries

- The impact of fees for waste management services; and
- Composting – particularly of human waste products.

Finally, in any consideration of the social aspects of waste management, it is important to remember the cross-sectoral nature of the issue. Consideration should be given to all the cultural and social aspects that may be associated with projects prior to their implementation.

In undertaking projects, JICA should incorporate a community survey as part of the project, where appropriate. This will ensure that public reaction (including social and cultural aspects) to a project is given consideration.

Opportunities for JICA to Assist PICs

There are a number of aid projects being undertaken in PICs that are focused on improving solid waste disposal operations. This includes:

- 2 large landfill design and construction projects – Tonga (AusAID) and Suva, Fiji (EU)
- Several smaller projects in Niue, Christmas Island (Kiribati), Vava'u (Tonga), Nauru and Tuvalu. Typically (but not always) these projects have been part of a larger project focusing on water supply and sanitation with the focus not necessarily being the solid waste disposal side. The adequacy of these operations / landfills has not been assessed as development has only just been completed or nearing completion and there is insufficient data available for the assessment.
- Other waste disposal projects (waste to energy), under a PPP arrangement are being considered in Samoa and Cook Islands (NZODA). It is noted that a landfill project is also being considered by the ADB in the Cook Islands.

Countries that are in most need of assistance in regard to solid waste disposal include:

- South Tarawa, Kiribati;
- Chuuk and Kosrae, FSM;
- Majuro, RMI;
- Apia, Samoa;
- Honiara, Solomon Islands;
- Nadi / Lautoka, Fiji.

Areas where JICA could contribute to improving the management of solid waste disposal sites in PICs include:

- Provision of technical assistance / funding to undertake detailed review of existing waste management situation;
- Provision of technical assistance / funding to assist with development and implementation of effective institutional arrangements and a sustainable funding mechanism;

- Provision of technical assistance / funding to prepare a plan for improving an existing landfill waste disposal site or development of a new waste management facility;
- Provision of funding and / or technical assistance to implement plans for upgrading an existing landfill waste disposal site or development of a new landfill waste disposal site including:
 - Investigation and assessment of existing landfilling operations
 - Engineering design and documentation of upgrading / remedial works
 - Undertaking site selection studies for a new landfill site
 - Engineering design and documentation of the new waste management facility
 - Undertaking an environmental impact assessment for the new waste management facility
 - Funding for capital works
 - Construction management / supervision
 - Provision of equipment for effective landfilling and hands on training for operators
 - Training for management, supervisors and operational staff, of the landfill waste disposal site based on competency based training needs analysis;

Note, programs should focus on working with the relevant Government agencies to improve the situation / develop a solution (thus providing on site training in the processes) – not simply providing them with a solution.

In addition, JICA could further assist PICs to improve management of waste disposal sites by:

- Providing training in management of special wastes at landfill waste disposal sites;
- Providing funding, facilities / equipment, and training for alternatively managing special wastes eg. incinerators or other treatment facilities for medical / clinical waste;
- Investigating and developing innovative, effective and sustainable waste minimisation programs for PICs eg. for separate organic waste management (composting), export recycling program, local reuse of glass in concrete, especially in low atoll countries lacking gravel sources, or the managed use of animals such as pigs and then crabs in composting/waste reduction cycles
- Undertaking a feasibility assessment of the use of incinerators on atolls, where landfill sites are effectively unavailable;
- Examining waste oil management opportunities – used automotive oil and cooking oil;
- Ensuring that projects to improve the operation of government departments, such as Finance, Customs, include activities to encourage waste minimisation and to assist in the development of sustainable financing for waste management operations (eg., tariff selections, subsidies for recycling activities);

- Providing funding for public education for waste avoidance and facilitate possible tax on imported goods;
- Provide funds for recycling research and efficiently run recycling operations. Most favourable and economic recyclables are non-ferrous metals and waste oil;
- Provide funds to facilitate wider practices of composting and education regarding value of composting;
- Providing technical assistance and funding to help initial management of special wastes by providing suitable long term storage while disposal mechanisms are being determined. Such site must have good site design, leak proof, cyclone proof, and secure against disturbance and theft.
- Provide funding and technical assistance to assist PICs to establish a waste tracking system, to identify waste types, quantities, origin of generation, transport methods and disposal method and facility.
- Provide funding and assistance to SPREP to establish a comprehensive and easily accessible database for waste management data, information, and issues in PICs. This will allow easy access to valuable information.

1. INTRODUCTION

1.1 BACKGROUND

The management of waste materials is a world wide problem. The small island developing states of the Pacific increasingly share this problem. While Pacific Island Countries (PICs) may differ in terms of topography, climate, population density, economic development, land use, and geology they share the following features:

- Limited land availability and high population density in urban areas;
- Limited institutional capacity and financial resources;
- Poor waste disposal practices and storage of waste generated;
- Limited scope for recycling and recovery and limited collection and transport services;
- Lack of treatment and disposal facilities for special wastes, and stockpiling of special wastes.

In most PICs waste disposal commonly involves the dumping of rubbish at official and unofficial open dumping sites. These sites have a low initial capital investment and operating costs. However, the environmental and health impacts of such operations are potentially significant, and the lack of monitoring of the dumps and impacts on the surrounding community, land and water is a matter of major concern. It is often argued that existing open dump sites should be closed and controlled landfills constructed in their place. However, in view of the severe technical and financial constraints many PICs face, practical reality is likely to necessitate that attempts must first be made to place a measure of control over open dumping practices and gradually upgrade the sites.

1.2 OBJECTIVE / PURPOSE OF THE GUIDELINES

In response to the poor condition of solid waste disposal sites in Pacific Islands Countries and the challenges to improve the situation, the Government of Japan through the Japan International Cooperation Agency (JICA) engaged Egis Consulting Australia to develop regional guidelines for improving the management of solid waste disposal sites in urban areas in PICs. The guidelines will be used by JICA in Oceania to help select, design and implement more sustainable activities in solid waste disposal site management in PICs.

Specific activities requested by JICA, as part of preparation of the guidelines, included:

- Review of existing documentation on solid waste disposal site management in PICs;
- Provision of an overview of the prevailing situation in solid waste disposal site management in PICs;
- Review and report on the activities of other donors and regional and international organisations in solid waste disposal site management in PICs;
- Preparation of a landfill management plan addressing operational and health and environmental management measures; and

- Provision of recommendations on realistic ways to provide effective and sustainable assistance for solid waste disposal site management in PICs.

A copy of the Terms of Reference for the Project is provided in Appendix A.

13 SCOPE OF WORK TO PREPARE THE GUIDELINES

To achieve the project objectives and produce the required Guidelines Egis undertook the following:

1. Project initiation meeting with JICA;
2. Review of existing documentation on solid waste disposal site management in PICs;
3. Review of the existing waste management situation in PICs by undertaking the following:
 - Meetings with JICA, SPREP, relevant Samoan Government agencies, and relevant donor organisations in Apia, Samoa (volcanic island). Egis would also inspect the existing waste disposal site in Apia.
 - Meetings with relevant Fijian Government agencies and relevant donor organisations in Suva, Fiji.
 - Provision of an overview of the current situation in Kiribati;
 - Provision of an overview of the existing waste disposal situation in Tonga (Tongatapu - raised atoll) and plans for establishing a new waste management facility.
 - Identifying, obtaining and reviewing relevant documents and reports on waste management prepared by others eg SKM (SPREP) – 8 APC countries including Vanuatu and the Cook Islands, Golders (AusAID) – Tuvalu.
 - Updating the information obtained in the 1997 AusAID review of waste management in the South Pacific by following up contacts in other Pacific Island countries not addressed above ie. Marshall Islands, Federated States of Micronesia.
4. Review and reporting on the activities of other Donors and regional and international organisations. This was undertaken via a letter / survey questionnaire plus follow up contact by phone and meetings in country (Fiji, Samoa), where able. This included the following organisations:

• SPREP	• JICA	• UNEP
• AusAID	• FAO	• WHO
• NZ ODA	• SPC	• European Union (EU)
• Canadian Aid	• Forum Secretariat	• ADB
• UNDP	• SOPAC	• World Bank

Egis provided a written description of the outcomes of the review.

5. Preparation of the Guidelines for improving the management of solid waste disposal sites in PICs. The Guidelines were prepared based on the collected information and

the experience of the project team, obtained on many other projects undertaken in the Pacific region. The guidelines do not try to provide specific solutions for individual landfill sites but provide a practical and realistic approach and methodology for progressively improving solid waste disposal sites in PICs.

6. Preparation of this Project Report.

A copy of the Workplan for the Project is provided in **Appendix B**, which provides a more detailed outline of the scope of work undertaken. A list of the persons and organisation met as part of this project is provided in **Appendix C** and a list of contacts with their details is provided in **Appendix D**.

1.4 SCOPE OF THE GUIDELINES

The Guidelines for improving solid waste disposal site management in PICs have been prepared and are presented in a separate document titled "Guidelines for Solid Waste Disposal Site Management in Pacific Island Countries".

The Guidelines provide a recommended methodology for improving landfill waste disposal sites in PICs. Where common issues for solid waste disposal sites in PICs have been identified, a solution or solutions have been suggested to address the problem. Where appropriate, the solutions have also been assessed to determine which are the most appropriate solution / option. The most appropriate option has then generally been incorporated into the Guidelines, however, it should be noted that other options might be more appropriate in particular circumstances.

Specifically, the Guidelines contain the following:

- A description of the recommended approach to improving solid waste disposal sites in PICs;
- A description of the possible measures to improve solid waste disposal sites, including:
 - Investigation and assessment of the existing waste management system, and particularly the landfill waste disposal site;
 - Improving institutional arrangements
 - Improving funding for waste disposal activities
 - Improving the management and operation of a landfill waste disposal site
- An outline of options for improving the management of special wastes at landfill waste disposal sites;
- A discussion on the development of new landfill waste disposal sites and the issues associated with such;
- A brief discussion of options for minimising waste generation and disposal, and the benefits of such for the waste disposal site; and
- An outline of the possible education and training needs in waste disposal site management and operation; and

1.5 SCOPE OF REPORT

This document provides a report on the preparation of the Guidelines and includes the following:

- An overview of the existing waste management situation in PICs, including the condition of existing waste disposal sites and the problems and issues associated with the existing operations. More detailed reports for individual countries are provided in the Appendices;
- An overview of the activities of other donors and regional and international organisations in solid waste management in PICs. Separate reports on each organisation are provided in the Appendices;
- A description of the recommended approach to improving landfill waste disposal operations in PICs;
- An outline of measures for improving solid waste landfill disposal sites in PICs. Further detail is provided in the Guidelines;
- A discussion on waste minimisation, and the potential benefits for landfill waste disposal operations;
- A discussion of the social and cultural issues associated with the existing landfill waste disposal sites and the recommended measures for improving such;
- A discussion of the education and training needs that will arise from the recommended measures to improve landfill waste disposal sites;
- The conclusions and recommendations of the Project, including an outline of opportunities for JICA to provide assistance to PICs to improve solid waste disposal operations;

2. EXISTING SITUATION

2.1 GENERAL

The Pacific region has an attractive image internationally that is widely used to encourage travellers from all over the world to visit. Due to increased environmental pressures, it is recognised that if care is not taken, the natural resources that form the basis of this substantial foreign exchange earning capacity may cease to be attractive. Once the image is damaged it may be impossible to repair. Over the last 15-20 years a number of reviews of environmental problems in the South Pacific has been produced (eg. Dahl and Baumgart, 1983; Dahl, 1984; Brodie et al., 1990; ADB, 1992). From the extensive documentation available, it is clear that many environmental problems are important either because of their region-wide impact, or because they are common to many countries in the region.

While a number of causes of the environmental problems have been identified, the inappropriate disposal of waste is seen as one of the primary causes. Secondary causes of environmental problems include inadequate waste management programs, inadequate legislation or inefficient enforcement/application of existing legislation, inadequate data for preparation of appropriate legislation and other mitigating actions, and a lack of awareness in some countries of the seriousness of the problems. In many countries the inadequacies are often caused by financial difficulties. While most governments, for example, do pay reasonable attention to the provision and protection of drinking water and electric power supplies, few resources are expended on waste management activities.

This section provides a summary of the existing waste management situation in PICs. This summary has been compiled from knowledge gained by the authors through working on numerous projects throughout the Pacific region, and from a review of waste management activities undertaken as part of this project. The summary addresses the following:

- The Pacific Island setting;
- Waste generation;
- Waste minimisation;
- Waste storage and handling;
- Waste collection;
- Waste treatment and disposal;
- Management of special wastes;
- Legal and institutional framework;
- Management and planning;
- Training;
- Public awareness and education;
- Funding of waste management activities;
- Information sources on waste management issues;
- Environmental impacts;

- Social and cultural impacts.

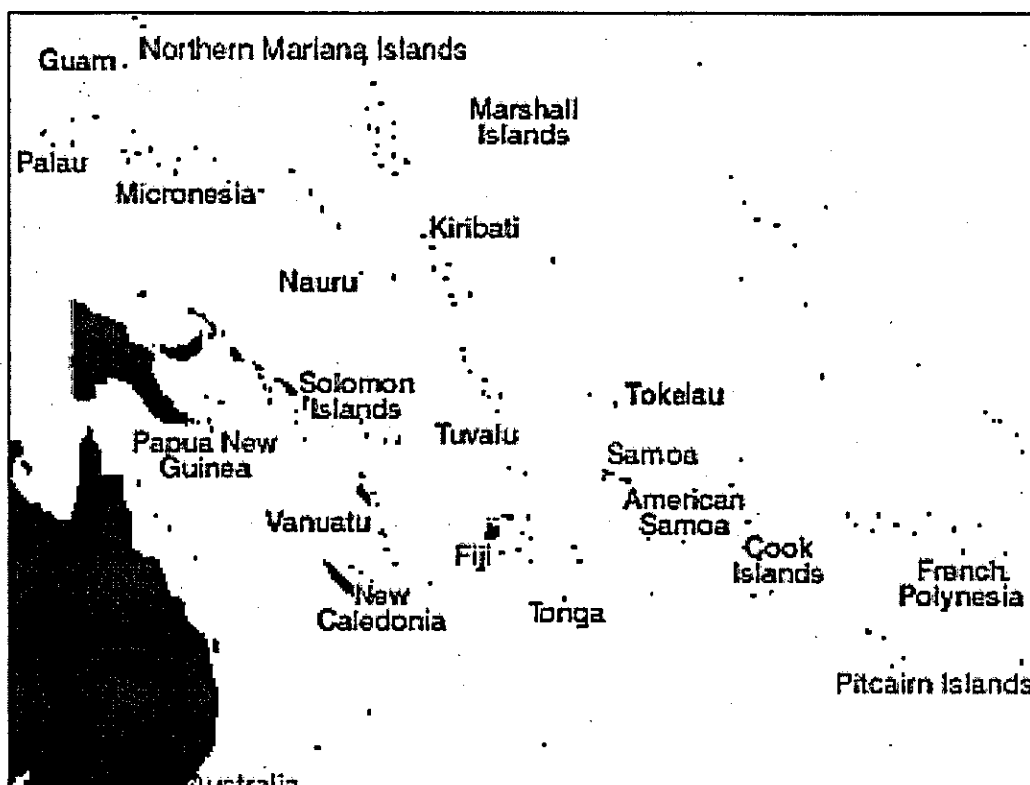
Detailed reports on the current waste management situation in various PICs are contained in Appendix E.

2.2 THE PACIFIC ISLAND SETTING

2.2.1 General

The South Pacific Region represents a substantial area of the world's major ocean, covering an area of almost 30 million km². As the land area is only about 550,000 km², the Region consists basically of a large number of small countries or territories separated by substantial stretches of ocean. See Figure 2.1. This "isolation" of islands/countries has both advantages and disadvantages. The disadvantages include problems of transport and communications. However, the lack of major industrial centres and the associated infrastructure of ports, shipping traffic, factory complexes and waste disposal sites is viewed by many concerned with the environment as a significant advantage. The small size of many of the islands is an environmental hazard, however, as it means that mistakes in management may be extremely difficult to rectify (at least in the short term). Furthermore the relative costs (per head or per unit area) are greater than in more developed countries.

Figure 2.1 – Pacific Island geography



Source: www.lonelyplanet.com.au

2.2.2 Land Area and Population

Data on land area, exclusive economic zone and population for PICs is provided in Table 2.1.

Table 2.1: Some Geographic Data on Pacific Island Countries

Country	Exclusive Economic Zone (km ²)	Land Area (km ²)	Population ¹		
			Estimated Size	Growth Rate %	Density Persons/km ²
American Samoa		197	54000	3.7	274
Cook Islands	1,830,000	240	19600	1.1	82
Federated States of Micronesia	2,978,000	710	134000	2.6	189
Fiji	1,290,000	18272	825000	2.0	45
French Polynesia		3265	230000	2.5	70
Guam		541	150000	2.3	277
Kiribati	3,550,000	690	76000	2.3	110
Marshall Islands	2,131,000	180	51000	4.2	283
Nauru	320,000	21	10000	2.9	476
New Caledonia		19103	175000	2.0	9
Niue	390,000	259	2000	-2.4	8
N. Marianas		471	59000	9.5 ²	125
Palau	629,000	460	16000	2.1	34
Papua New Guinea		462243	4400000	2.3	9
Pitcairn		5	50	-9.1	10
Samoa	120,000	2935	170000	0.5	58
Solomon Islands	1,340,000	27556	385000	3.4	14
Tokelau	290,000	10	1600	-1.3	160
Tonga	700,000	699	97000	0.5	138
Tuvalu	900,000	26	10000	1.7	384
Vanuatu	680,000	11880	175000	2.8	15
Wallis & Futuna		255	19000	1.3	74

Notes: 1. Data from Kesaia Seniloli, Population Studies Program, University of the South Pacific, Suva, Fiji
 2. Probably the result of in-migration

The population of many of the small island territories is increasing at a rate above the world average (see Table 2.1) and this represents a major problem in terms of environmental management. The expanding populations also want increased standards of living including piped water and sewerage facilities, better housing, a wider range of foodstuffs and consumer goods. All of these generally create additional stress on the environment as they lead to increased construction, increased waste disposal problems, deforestation and subsequent erosion and siltation.

2.2.3 Topography and Geology

General

The South Pacific islands can be categorised, geomorphologically, into a number of groups. They can be 'large' continental islands, eg. La Grande Terre, New Caledonia, or oceanic high islands (volcanic peaks rising as great domes of basalt, extending from the seabed) such as Savai'i in Samoa, or coral islands (raised coral platforms) such as Niue, or atolls, such as Funafuti in Tuvalu. A number of islands lie in between some of these categories, eg. Aitutaki in the Cook Islands or Chuuk in the Federated States of Micronesia, that are both 'almost-atolls', having a volcanic section and a substantial atoll-like reef area. The continental and larger oceanic highlands are dominated by very rugged landscapes, with the extent of flat or gently rolling land being small (<10%). The coral islands and atolls have an almost flat topography.

Large Islands

Large islands in the Pacific have variable lithology, but none will be dominated by limestone or reef materials. The underlying bedrock is usually weathered volcanics or sedimentary rocks derived from volcanics or mixed volcanic/reef materials.

The topography of the islands is often rugged, but many are large enough to have rivers that produce alluvial plains and deltas. The islands have variable coastal plain areas and occasional upland flat areas occur, many of which have been developed for more temperate crop growth. Most of the large islands have fringing or barrier reefs around at least part of the coast.

Large islands usually have adequate water supplies except where rain-shadow effects occur in dry seasons. Some of the large islands have significant surface water bodies, eg. rivers, streams and lakes.

Examples of large islands include:

- New Guinea, New Britain, New Ireland, Bougainville (Papua New Guinea);
- Guadalcanal, Malaita, Choiseul, Santa Isabel, San Cristobal (Solomon Islands);
- Viti Levu and Vanua Levu (Fiji);
- Espiritu Santo and Malakula and possibly Efate (Vanuatu);
- La Grande Terre (New Caledonia).

Suitable land is available for possible landfill sites, but land ownership is often a major problem in that most land is under communal ownership, and therefore not available to governments to utilise for such purposes. Similarly, soil and other cover material is usually available.

Volcanic Islands

Volcanic islands are those where the land has been derived predominantly from the subareal deposition of materials from volcanic activity. Some, eg. Koa in Tonga, Kolombangara in the Solomon Islands, have a typical volcano shape, while others show evidence of numerous craters, eg., Taveuni in Fiji, Upolo and Savai'i in Samoa. The

volcanic materials are predominantly basalts and andesites with basalts being more common in Eastern parts of the region. Many of the volcanic islands have adjacent fringing or barrier reefs.

Islands that belong in this category include:

- American Samoa group;
- Samoa group (Upolu, Savai'i);
- Niue, Vava'u and Eua (Tonga);
- Taveuni, Kadavu, Koro and Ovalau (Fiji);
- Rarotonga, Mauka, (Cook Islands);
- Pohnpei and Kosrae (Federated States of Micronesia);
- Kolombangara, Vangunu and Santa Cruz group (Solomon Islands);
- Numerous islands in Vanuatu;
- Numerous islands in PNG, especially in the Eastern groups;
- Wallis, Futuna and Alofi.

As noted above these islands tend to have very rugged topography, usually with a narrow coastal plain. The water situation is quite variable, with some islands (Upolu, Pohnpei, Taveuni) having rivers, streams and lakes, while others have very porous soils and underlying rock materials that do not support surface water bodies of any size. On the latter islands, groundwater is an important resource and should be protected from contamination by water disposal activities.

Soils vary considerable depending on the age of the island and the nature of the volcanic materials (ash and scoria versus flows, andesite versus basalt). Most islands have relatively young soils showing limited profile development, partly the result of age and partly the result of slope instability. Limited areas of land would be suitable for solid waste disposal, if not restricted by communal land ownership issues. In some areas, the use of heavy machinery will be a problem due to thixotropy (found in young volcanic ash soils, eg. Taveuni, Pentecost, Savai'i).

Atoll Islands

Atolls are essentially reefs of variable thickness built up by corals (and other organisms) resting on a volcanic base; they are unique to tropical and certain subtropical oceans since the reef-building organisms require water temperatures in excess of 22°C. Atolls are widespread in the South Pacific occurring from Oeno and Ducie east of French Polynesia to Papua New Guinea in the west, and from the Northern Marshall Islands in the north to New Caledonia in the south. Some countries consist entirely of atolls, eg. Kiribati, Marshall Islands, Tuvalu, Tokelau, others contain atoll groups, eg., the Tuamotu Archipelago in French Polynesia, the northern Cook Islands; and some countries consist of mainly volcanic islands with a few isolated atolls, eg. Ontong Java in the Solomon Islands.

The classical form of an atoll is a more or less continuous emerged or slightly emerged calcareous reef surrounding a lagoon but Cumberland (1956) has identified six types of islands in the Pacific partly or wholly associated with coral reefs. In this section atolls are considered as 'low' islands, where the maximum height of the emerged portion (usually less than 5 m) is made up of accumulations of broken reef material deposited by storms. The land area of atolls is usually small (< 100 km²), with the largest land area of any atoll being in Kiritimati (Kiribati, 365 km²). The deposition and accumulation of volcanic ash and/or pumice has occurred on many atolls, but the extent of this occurrence decreases on moving from the tectonically active zone of recent volcanism (10-25oS) in the south-west Pacific towards the equator.

The widely varied nature of atolls makes it difficult to generalise about them although many do have some common features. They usually have limited land area and few natural resources. Low atolls, particularly in the eastern Pacific, have limited supplies of fresh water and many are subject to prolonged droughts. The groundwater is often brackish (slightly salty). This peculiar environment has resulted in the development of a specialised flora - a plant community adapted to saline, alkaline soils, subject to water stress and salt spray. The natural vegetation is mostly strand species recruited from the Indo-Pacific strand flora of the shores of islands of all kinds in the region. The agriculture is also rather specialised, often being restricted to coconuts, pandanus, breadfruit and such root crops as *Colocasia* and *Cyrtosperma* grown in pits dug down to the groundwater table.

The groundwater table is always within 2-3 m of the land surface and as most atolls have unconfined aquifers that are used as a source of water for drinking, protection of the groundwater lens is of critical importance for human and animal health. This severely limits the opportunities for disposal of wastes of all kinds, and on atolls with significant populations, great attention must be paid to the location of waste disposal sites in relation of water storage and extraction zones.

Soil properties are to a large extent dominated by the calcareous nature of the parent material, whether or not this is mixed with guano, scoria or other materials. The soils tend to be shallow, alkaline, coarse-textured, carbonate dominated, having generally very low silica content. The fertility is highly dependent on the organic matter content. Organic matter can be high in undisturbed soils under natural vegetation, but can decrease dramatically as a result of inappropriate cultivation techniques, eg. land clearance and weed control by fire. As for all tropical soils, organic matter in atoll soils performs an important role in the concentration and cycling of plant nutrients. In atoll soils, however, a second role - that of moisture retention - is equally important. Since atoll soils are frequently sandy and excessively well drained, the moisture retention in the absence of organic matter is very low. Therefore the total amount of water retained often remains low and plants are subject to water stress unless the rainfall is high and relatively constant or they can tap the freshwater lens.

The shallowness of the soils limits the availability of soil for use as cover material at landfill sites. On some atolls, there are major sand deposits, both onshore and offshore. These could be used as cover materials, but the extraction of sand on atolls can create a number of other environmental problems, eg. coastal erosion, and needs to be carefully assessed before action is taken.

Other

A number of islands in the Pacific do not fit into the three categories above. These include the 'raised' atolls where the whole island has been tectonically uplifted and the

atoll morphology largely fossilised (new fringing reefs may have developed around them), eg. Lifou in the Loyalty Islands (New Caledonia), Makatea in French Polynesia, Vatu Vara in Fiji, Rennel in the Solomon Islands, Tongatapu in Tonga, Nauru, Niue. This group is also often referred to geologically as raised coral platforms. The raised atolls frequently have significantly greater land areas and usually have received additions of volcanic or other non-calcareous materials. The greater land area usually has a larger associated groundwater lens that can be exploited for human consumption or irrigation but the rainfall is still generally related to location and in the central and eastern Pacific prolonged droughts are common. On the raised atolls the soils are usually older and better developed as is the native vegetation. Substantial forests of *Calophyllum* and related species have developed on many of these raised islands.

A second group is islands that are partly volcanic, partly reef. These include the 'almost atolls' of Cumberland (1956), eg. Chuuk in Federated State of Micronesia, Aitutaki in the Cook Islands, where there is an atoll-like reef system, but with a small volcanic component forming part of the island. The other mixed islands are those where there is a distinct volcanic part and an adjacent reef platform (usually raised). Islands of this type include Guam, Saipan in the Commonwealth of the Northern Marianas, Babelthuap in Palau.

These other islands vary in size from 100 km^2 (eg. Nauru), to over $500 \text{ km}^2</math> (eg., Guam), maximum elevation and topography, and it is thus much more difficult to generalise about them. They do, however, have some land areas that could be used for landfill sites, and the soils are generally better developed, deeper and more abundant than on low atolls. The availability of soil for cover materials is still limited as on many of these islands, the available soils are used for crop production, mainly for local consumption. Traditional land ownership issues are frequently encountered on most of these islands.$

2.2.4 Economic Development

The Pacific region has experienced significant economic changes over the past 100 years as they have tried to achieve an improved standard of living. This has also been compounded by the rates of Westernisation, urbanisation and increase in population (Refer to Section 2.2.2, Table 2.1). In PICs, much of the population is employed in the subsistence sector while a less tradition commercial economy is rapidly growing. The subsistence sector is generally expected to be a primary source of employment and income for many years with agriculture remaining the principal source of employment. Agriculture usually represents the major source of income and of earnings from exports. Many different crop types are grown including sugar and coffee.

Much developmental attention has been focused on newer activities with the PICs becoming increasingly industrialised. PNG, New Caledonia and Fiji have a medium capacity in the industries of mining, forestry and fishing related industries and some manufacturing industries. Further details on imports and exports are shown in Table 2.2. Tourism is one of the fastest growing sectors of the economy in the Pacific, particularly for Fiji and Vanuatu. The countries of Tokelau, Wallis and Futuna essentially have no industry at all. (Pacific Islands Environmental Outlook, UNEP, 1999).

The economic performance of Pacific countries is mixed. "Their aid to GDP ratios are among the highest in the world and their growth has been modest: 2-3 percent on average over the last 20 – 30 years" (Financial Review Magazine, May 2001, "Our Man in the Pacific"). The GNPs of a number of Pacific Island countries are shown in Table 2.2.

Table 2.2 Economic indicators for some Pacific Island Countries

Country	Total GNP ¹ (US\$m)	GNP ¹ per person (US\$)	Annual Growth Rate ¹ (%) (1999)	Main Exports ²	Main Imports ²
Cook Islands	Na	Na	2.8	Copra, fresh and canned fruit, vegetables, clothing, black pearls	Food, manufactured goods, textiles, fuels, timber
Fiji	1527	2110	7.8	Sugar (40%), clothing, fish, gold, lumber	Machinery and transport equipment, petroleum, food, consumer goods, chemicals
Federated States of Micronesia	214	1800	0.3	Fish, copra, bananas, black pepper	Food, manufactured goods, machinery and equipment, beverages
Kiribati	93	1180	1.5	Copra (50%), seaweed, fish	Foodstuffs, machinery and equipment, manufactured goods, fuel
Marshall Islands	102	1540	0.5	Coconut oil, fish, live animals, trochus shells	Foodstuffs, machinery and equipment, beverages and tobacco, fuel
Nauru	Na	Na	Na	Phosphates	Food, fuel, manufacturers, building materials, machinery
Palau	Na	Na	Na	Trochus, tuna, copra, handicrafts	-
Samoa	177	1020	4.0	Coconut oil and cream, copra, taro, cocoa	Intermediate goods, food, capital goods
Solomon Islands	295	750	1.0	Fish, timber, palm oil, cocoa, copra	Plant and machinery, manufactured goods, food and live animals, fuel
Tonga	160	1690	2.2	Vanilla, fish, root crops, coconut oil, squash	Food products, manufactures, machinery and equipment, fuels, chemicals
Tuvalu	Na	Na	3.0	Copra	Food, animals, mineral fuels, machinery, manufactured goods
Vanuatu	224	1270	-2.0	Copra, beef, cocoa, timber, coffee	Machines and vehicles, food and beverages, basic manufactures, fuels, chemicals

Source:

- (1) AusAID, Pacific, Program profiles, 2000-01, sub reference Asian Development Bank, Asian Development Outlook 2000.
- (2) Sustainable Development Department (SD), Food and Agriculture Organisation of the United Nations (FAO), 1996 (www.fao.org)

Poverty is an emerging issue in a number of PICs. Urbanisation, a shift to a monetary economy, and rapid depletion of natural resources through over-exploitation are seen as some of the causes of this (particularly in the resource poor countries). The lack of human, technical and financial resources is a major hurdle to implementing environmental considerations in decision making in most PICs (UNEP, 1999).

The poor economic state of many of PICs has direct implications on waste management. Where economic development and hence government revenue is limited, priority areas such as health services, education, water and electricity supply generally receive funding in preference to waste management. The lack of sufficient funding will result in the continued poor management and disposal of waste in PICs, and consequent detrimental impacts on the environment, public health and the economy eg tourism. More specifically, insufficient funding of waste management will result in poor operation and maintenance of landfill waste disposal sites, little or no environmental management or monitoring; and no rehabilitation of the sites. Therefore, any projects relating to solid waste disposal site management should address this by ensuring a sustainable funding mechanism is established (fee collection, waste disposal charges etc.). This will ensure the long term operation and sustainability of the project by providing funds for equipment purchase, site employees and environmental monitoring.

Implementing the charging of fees may require legislation in many PICs. The attitude towards paying fees for waste collection in some countries will be very negative. PICs have a poor history of collecting fees for services and both politicians and the community in general are not committed to the fee for service model. Consequently education programs for both members of parliament and the community could be required and links need to be established between neglect of waste management, health problems and the cost of these problems. The passage of such legislation is the right and responsibility of Pacific Island countries.

Any projects relating to solid waste disposal site management however will not be sustainable unless they address this funding issue. Ongoing adequate funding needs to be available for equipment purchase operation and maintenance, site employees' salaries and environmental planning and monitoring.

Consideration of funding for a new landfill and engineered remediation should also be a part of establishing a funding mechanism. The actual funding of these activities is discussed further in **Section 2.12**.

2.3 WASTE GENERATION

Understanding waste generation and disposal is a key aspect to successfully managing waste, since 'one cannot manage what one does not understand'. Numerous documents describe and report on attempts to assess waste generation and disposal, but they have often been of short duration (1-3 weeks) and conducted irregularly, and consequently do not provide data on seasonal variations or changes in public behaviour. As a result, there has been no comprehensive collection of data on amounts, types and disposal of wastes in the Pacific Region, although an attempt is being made to address this through a European Union- funded SPREP initiative, the Pacific Regional Waste Awareness and Education Programme, which began in mid-1999. Government databases in the South Pacific are not suited to generating information for waste management (Convard, 1993). Data on imports, for example, is usually stored in economic terms, rather than in terms of material types and flows (eg. this is true even for imports of pesticides).

The following table (**Table 2.3**) outlines waste generation (disposal) figures derived in various studies undertaken throughout the Pacific.

Table 2.3 Waste Disposal Figures for some Pacific Island Countries

Country ¹	Population ²	Average Waste generation rate (kg/person/day)	Organic / Biodegradable Content (%) ⁵
Cook Islands, (Rarotonga)	19600	0.19 ⁴	35
Federated States of Micronesia (Pohnpei)	134000	0.38 ⁴	19
Fiji, (Lautoka)	825000	0.92 ³	68
Kiribati, (South Tarawa)	76000	0.33 ³	20
Marshall Islands, (Majuro)	51000	0.38 ⁴	46
Papua New Guinea	4400000	0.41 ³	62
Samoa, (Apia)	170000	1.05 ³ 0.52 ⁴	61 59
Solomon Islands, (Honiara)	385000	0.62 ³ 0.38 ⁴	65 20
Tonga, (Nuku'alofa)	97000	0.82 ³ 0.68 ⁴	47 62
Tuvalu, (Funafuti)	10000	0.43 ³	52
Vanuatu, Port Vila	175000	0.65 ³	71
Average		0.55	49

Notes / Reference:

- (1) Cities in brackets refer to the place where waste studies were undertaken. It is recognised that these are urban areas and do not therefore reflect waste generation rates across the country.
- (2) Data from Kesaia Seniloli, Population Studies Program, University of the South Pacific, Suva, Fiji
- (3) SKM, 1999
- (4) UNEP 1999, subreference WHO, 1996
- (5) Excludes paper and cardboard.

While it is recognised that the two referenced surveys were undertaken a number of years apart, there is still substantial variability in the results for countries that have been surveyed twice for waste generation. It is noted that waste surveys have typically been undertaken over a limited period of time, probably at different times of the year, and for a limited survey group. It is thus recognised that data is indicative of the possible variation in waste disposal rates.

Compared to the waste generation (disposal) rates of other nations such as NSW, Australia, PICs have low waste generation (disposal) rates and the waste has a high organic content. Currently NSW's waste generation (disposal) rate is approximately 2.4 kg/person/day (Australian Waste Database, 1995/96) and organic biodegradable content is 30% (excluding paper and cardboard). The lower waste generation (disposal) rate means that waste disposal sites in PICs could be expected to have an extended life

relative to sites serving similar populations in Australia (although this is largely dependent on operational practices). This is also important to note from an aid organisation perspective, where gaining the best possible use of a solid waste disposal site should be a priority to improve the efficiency of aid money. As identified throughout this report, the establishment, maintenance and operation of solid waste management sites encounters many issues which makes the efficient use of any site a priority.

One reason why it is important to acquire specific waste generation (disposal) information is to enable the planning, design and management of the waste disposal sites.

2.4 WASTE MINIMISATION

Waste minimisation encompasses avoiding the generation of waste, waste reuse, recycling and reprocessing of waste material.

It is important to minimise waste, as it will reduce the quantity of waste requiring disposal eg. via landfilling. Waste minimisation will prolong the life of a waste disposal site and thus it will ultimately facilitate better use of aid and resources (as discussed above). The following section outlines some options for waste minimisation and how these have been applied in the PICs.

2.4.1 Waste Avoidance

The principle of waste avoidance aims to reduce the quantities of materials in the waste stream. Waste avoidance can be achieved in PICs through the use of products which generate minimal waste and by promoting the use of products made from used, recycled and reprocessed waste materials and the promotion of products which are recyclable or reprocessible. The education of the public in practices to avoid waste generation is of key importance.

Apart from education programs which have been implemented in many PICs, there are few activities undertaken which directly contribute to waste avoidance. Furthermore, most education programs with respect to waste management have focussed on the issue of reducing littering and illegal dumping, although others have been a bit more progressive. For example, MCPNG (Papua New Guinea) has been in the process of setting up a committee with representatives from the manufacturing industry as well as users, domestic representatives and regulators to promote the Reduce, Reuse and Recycle options. Similarly in Fiji, the sugar industry, which is a producer of large quantities of waste has been talking with USP and regulators about the entire issue of sugar processing waste management.

Consideration has been given in some countries to a tax on imported goods to support environmental initiatives. In Samoa a 30 sene tax is placed on all imported goods with 10 sene per container being reimbursed to the importer if it can be shown that the container is being re-exported. A similar tax / import duty was also proposed in the Solid Waste Management Plan for Tongatapu, with the revenue being used to fund (subsidise) export recycling programs.

Therefore the options for waste avoidance are public education programs to avoid waste generation, and a possible tax on imported goods to support environmental initiatives. It is considered that both of these options are likely to have a beneficial impact in most PICs.

In general however, the issue of waste minimisation is being addressed through the principles of waste reuse and recycling.

2.4.2 Waste Reuse

Waste reuse refers to the reuse of goods for the same or similar purposes without having to reprocess or re-manufacture the goods before use. The major identified waste reuse practice throughout PICs relates to the reuse of bottles. Use of returnable bottles, particularly beer and soft drink bottles, is reasonably common throughout most of the Pacific countries. Beer bottle recycling in particular has been successful in countries such as Vanuatu and Samoa where the relatively high refund for each bottle ensures a high return rate (In the order of 92 – 94% and 95% of bottles are returned in Vanuatu and Samoa respectively). Beer bottles are also reused in Tonga.

Waste reuse also occurs through scavenging at the waste depot although these quantities are believed to be limited. Most scavenging is undertaken with the intention of recovering valuable materials for reuse and recycling eg. building materials, aluminium cans, metal and plastic bottles (Fiji).

The PICs have generally practised reuse of items such as plastic bags, bottles and other reusable containers. For example, bottles, which are not subject to a container deposit levy, are used for bottling liquids such as juices and body oil, kerosene etc.

In most PICs old motor vehicles and other mechanical equipment are used for spare parts. This is undertaken by some householders and most motor vehicle repairers. However, the number of motor vehicles in PICs is increasing rapidly and the disposal of the old, unwanted vehicles and other large equipment is a major problem.

2.4.3 Recycling

Recycling is undertaken in nearly all Pacific Island countries to some extent. An overview of typical recycling of various materials is outlined as follows:

The recycling of aluminium cans has been established in many countries including Tuvalu, Niue, FSM, RMI, Kiribati and Tonga. Furthermore, general scrap metal recycling is undertaken in a number of countries including the Solomon Islands, PNG, Samoa, Tonga and Vanuatu. These countries have at least one company, if not more that have initiated metal recycling (although this may just be a backyard type of operation). These companies have typically found it profitable to recycle aluminium cans, copper, brass, aluminium, lead, stainless steel, hot water systems, batteries and radiators, (non-ferrous scrap metals). Ferrous metals from old motor vehicles, whitegoods, and other large equipment eg. earthmoving machinery, and ship bodies has not been found to be economically viable. Other countries such as Tuvalu has people who have identified the possibility and are exploring the feasibility of implementing such a business. While the quantities of metal recycled are not necessarily high (2 containers or 32 tonnes per year in Vanuatu), the continued operation of the companies suggests that the process must be profitable.

Waste oil is recycled for use as a fuel. While some countries do not use it themselves, major industries in some of the PICs accept quantities of waste oil from other countries. Some examples of this include waste oil from Vanuatu which is sent to Fiji (via Shell) for use as furnace feed while waste oil from FSM is sent to Nauru for use in the Phosphate industry.

The actual export recycling of glass is not generally considered feasible due to the high costs of transport. It is noted that reuse of the glass is undertaken extensively as discussed in Section 2.4.2.

No paper or cardboard recycling was identified in any of the PICs.

Plastic bottle recycling is undertaken to a small extent in countries such as Fiji and potentially Papua New Guinea. This may extend further as economics drives soft drink manufacturers to bottle the product in plastic.

It was advised that in Kiribati, most householders are reasonably resourceful with typical recycling activities including:

- (i) Battery chemicals as soil fertiliser, dyes for mat weaving leaves, kids' toys, etc. Local farmers have found that battery contents improve the soil fertility yet no scientific research has been cited;
- (ii) Car tires: used as coastal protection/walls, washing and bathing tubs, hammocks, roof weights against strong winds, children's toys, domestic animal's eating plates, etc.;
- (iii) Bottles: used for liquid (traditional juice and body oil, kerosene, etc) storage containers, dug-in decorations on ground around compound;
- (iv) Plastic bags: rewashed and used more than once as shopping bags. Re-used as rubbish bags;
- (v) Aluminium and steel roof sheets: garden walls, domestic animals enclosures, roofing extensions of traditional cooking huts (separate from main living house).

Therefore most favourable options are to recycle profitable metals (non ferrous such as aluminium) and recycle waste oil as a fuel. A well researched and efficiently run recycling operation for various materials may be a good alternative option for waste minimisation.

Obstacles to recycling in PICs include the high cost of transport, which is generally higher than the value of the commodity carried. The imbalance of imports to exports in most PICs could however be used to negotiate favourable shipping rates to return the recycled goods. (For example Tuvalu has an import/export imbalance and aluminium can collection / recycling activities are already undertaken making it an ideal opportunity for renegotiating rates)

Besides shipping costs, other significant costs to initiate a recycling program include provision of recycling equipment eg. sorting conveyor and compacting / bailing equipment (as appropriate).

While recycling will reduce the quantity of material going to landfill, the value of the recycled materials, processing and shipping costs all need to be considered prior to establishing and promoting wide scale recycled materials operations. It was proposed in the Solid Waste Management Plan for Tongatapu (Hassall & Associates, 2000) that the Government of Tonga should implement an import levy on packaged imported goods to rise revenue to fund the export recycling of plastic containers, glass containers, and ferrous metals including steel cans and motor vehicles.

2.4.4 Reprocessing

Reprocessing involves the processing of a waste material to produce a raw material for another process or a product direct. One waste reprocessing activity undertaken in some PICs is composting.

Composting

Composting is another mechanism for reducing the amounts of material requiring landfilling, while at the same time producing a valuable and potentially saleable resource. Composting was a traditional activity in Pacific Island societies, as the only wastes produced were biodegradable. While it is still widely practised in rural areas, composting is much less common in urban areas due to lack of space, infrequent cropping, and time constraints. Given the high proportion of biodegradable material in the urban waste stream (Refer to Section 2.3) the question to be considered is not whether composting should be used as a waste management tool, but what techniques will be best in any given community. (eg. should this be done as a community exercise or at the household level). In the Solomon Islands, demonstration projects and education programs have been implemented which focus on households and housewives while in Tonga, programs have involved workshops with selected community groups to promote composting.

Composting also can involve the use of chicken and pig manure, and possibly sewage and septic sludges. The products are particularly valuable in Pacific Island situations, as regional soils are often low in organic matter (with low water holding capacity), deficient in certain essential nutrients, and fertilisers are expensive to import. Fiji's Youth Composting Project, based in Nabua and Wailoku, has young people converting organic waste into compost that is sold for use in community gardens. While the principles of composting are well known, research into Pacific community systems, such as is being done by the Foundation for the Peoples for the South Pacific in Kiribati (Sylvia Linggi, personal communication, March 1997), is needed.

In addition, cultural problems relating to the use of the compost have been identified. For example, in Tonga, composting used to be a common practice. Following problems with beetles, a program was undertaken to discourage composting on Tongatapu (although it is still commonly undertaken in rural areas). A program is currently being funded by AusAID to promote home composting in Tonga, as part of the Tonga Environmental planning and Management Strengthening Project. In Kiribati, concerns about underground services have also discouraged the practice of composting, particularly in urban areas (typically composting in a number of these countries involves the burial of the organic waste underground to control vermin and insects).

The use of composting is becoming more common with groups such as the FAO promoting the practice. In Samoa, composting is also being undertaken by 2 "organic" farms while a women's group has also expressed interest in undertaking a composting operation.

Shredding organic material for use as mulch is also recognised as a beneficial practice. In Samoa, a recent donation by JICA has allowed the Flower Growers Association to purchase a shredder to produce mulch and compost. Vanuatu, a company called Rainbow gardens has also been operating a municipally owned mulcher / grinder to produce compost.

In most PICs, food scraps are typically fed to household animals such as pigs, chickens or dogs although this practice is more common in rural areas.

Composting is seen as very important tool in the waste management area and is considered a particularly important option in PICs for reducing waste quantities and producing a valuable product. In many of the PICs (such as the soil poor islands such as atolls), compost is a particularly valuable option for use as a soil enhancer.

2.5 WASTE STORAGE, HANDLING AND COLLECTION

Residential

Waste storage at residential premises throughout most PICs is generally in household 44gallon (200L) drums (either half or full drums) or in plastic bags/various containers. In a limited number of countries including Papua New Guinea, Niue and Vanuatu, mobile garbage bins are also used although this is not standard throughout the country. In RMI, communal bins are provided for the public to dispose of their wastes. In Kosrae there is no collection service and wastes are to be deposited directly at designated waste disposal sites in four villages.

The issue of animals and vermin accessing stored wastes is commonly addressed by placing wastes on elevated platforms. While this limits the access of animals such as pigs, dogs and chooks, it does not restrict insects and other vermin.

Government responsibility for waste management services varies throughout the PICs (this is discussed further in **Section 2.8**). While the local council is often the responsible party for waste collection this service is often contracted out to the private sector (Fiji, Samoa, Solomon Islands, PNG, Niue). A number of Councils in countries such as Tuvalu, Kiribati and Vanuatu undertake their own waste collection. The state of the equipment and efficiency of the service varies substantially with the rate of collection varying between one and three times per week.

The extent of waste collection services is limited in most PICs to urban areas. Rural areas are typically left to their own devices with respect to waste management with the options of incineration, burial on site, transport to the nearest waste depot or dumping at sea or a lagoon being the only available options. The Samoan government has recently adopted a goal of providing a similar level of service to all residents. Currently all wastes in the Apia CBD and immediate surrounding areas are collected by private contractor (3 private contractors operate in this area) however it is planned for the waste collection service to be expanded to country-wide by May 2001. Niue also provides a collection service to every domestic household on the island

It is considered that the current widespread practice of waste storage and collection from steel drums raises both occupational health and safety issues (due to the moving/lifting of heavy 44gallon drums) as well as sanitary issues. (Odour and vermin are potential sanitary issues).

It is however acknowledged that such a system does provide a relatively inexpensive waste disposal storage method and offers considerable advantages over the storage of waste in plastic bags only (or similar).

Institutional, Private, Government

Across most PICs, institutional, commercial and industrial premises are generally allowed access to the same facilities as the residential premises and generally utilise the same or similar types of waste receptacles.

Additional fees are charged in some countries for waste servicing of these types of premises although in others, the fee is included as part of rates, taxes or other form of incomes.

Occupational health and safety issues and sanitary issues should be considered similarly to the residential waste storage, handling and collection.

2.6 WASTE TREATMENT AND DISPOSAL

2.6.1 General

Common waste treatment and disposal practices in PICs encompass the following:

- Open burning (commonly in the backyard);
- Burial of waste materials (commonly in the backyard);
- Indiscriminate dumping of waste on vacant land, in mangroves, creeks, lagoons, the ocean, and on roadsides;
- Disposal of waste materials at a common, dedicated dumping site (landfill waste disposal site). The condition and operation of these sites vary greatly.
- Incineration (of special wastes eg. medical / clinical waste and quarantine waste);

These activities are described in the following sections.

2.6.2 Backyard Burning and Burial

The burning and burial of waste materials on site (in the backyard) is a very common method of waste disposal in most PICs. Most households have a pit / area in their yard where household waste, garden waste, paper, cardboard, plastic and other combustible waste is burned or buried. This is often the case even when a household receives the waste collection service. Issues associated with these practices include:

- Health effects of burning plastics and other synthetic materials which generate smoke and toxic fumes;
- The nuisance created by the smoke – most burning occurs in piles, which often contain wet materials, and is very inefficient; and
- The attraction of vermin and insects, and potential public health risks, particularly if the burning / burial is not undertaken regularly.

In rural areas, where the range and quantity of waste requiring disposal is usually small, open burning and burying are also common practices, especially for items that cannot be fed to the household animals and will not compost, eg. plastics, paper, cardboard, metal cans, large pieces of wood, disposable nappies.

2.6.3 Indiscriminate Dumping of Waste

Littering and indiscriminate dumping of solid waste is a common problem in and around most urban areas in PICs. Dumping of solid waste commonly occurs on unoccupied land. This includes the road side, mangrove areas, parks and reserves, and vacant lots of land.

In rural areas, commonly waste that cannot be burned is dumped on the outskirts of the village, on vacant land, or into the ocean.

Issues associated with this practice include:

- Public health risks presented by the exposed waste;
- The attraction of vermin, insects and pest, and potential public health risks; and
- Poor visual amenity, particularly in regard to the tourism industry.

Most PICs have conducted community education programs to combat littering and dumping of solid waste, and conditions are improving, however, it is recognised that often enforcement of regulations is required. A common problem with many PICs is insufficient resources to combat the littering and dumping of waste through enforcement of legislation and regulations. In addition, the process of prosecuting those caught dumping solid waste is often ineffective. For example, in Tonga, the authorised officers are firstly required to issue a notice to clean up / remove the dumped waste and then take the person to court if the waste is not removed. More often than not, the dumped waste is cleaned up after issuing a ticket to appear in court. However, often it is not possible to determine who dumped the waste. Commonly, on the spot fines can not be issued in PICs.

2.6.4 Landfill Waste Disposal

Landfill waste disposal operations in PICs are generally very unsatisfactory. Landfill sites can vary from uncontrolled tipping/dumping, to controlled tipping, to a basic sanitary landfill, to a modern engineered sanitary landfill site.

There are no modern, engineered sanitary landfill sites in the Pacific region at this time, although a few are currently being developed eg. Tapuhia Waste Management Facility on Tongatapu, in Tonga, the Vava'u Landfill in Tonga, and the new waste disposal facilities being developed to service Suva, Fiji and Rarotonga, Cook Islands. A few of the existing landfill waste disposal sites (eg. Port Vila, Vanuatu; and Rarotonga, Cook Islands) could be described as basic sanitary landfill waste disposal sites. Most landfill waste disposal sites (eg. Suva's Lami dump, Lautoka's dump, Fiji; Apia, Samoa; Nuku'alofa, Tonga; Pohnpei, FSM; Honiara, Solomon Islands; Port Moresby, PNG; Majuro, RMI) are controlled or semi controlled tipping operations (some albeit very poorly controlled). Others (eg. all sites on Kiribati; Chuuk and Kosrae, FSM; Funafuti, Tuvalu; various sites on Niue; Vava'u, Tonga) are currently uncontrolled dumping sites.

A selection of photographs of landfill waste disposal sites in PICs is provided in **Appendix F**.

The poor condition of many of these landfill waste disposal sites is a major concern as many of these operations lie on or near the coast, or are close to sensitive water resources (surface or ground). As a result, waste materials, surface runoff and leachate can enter the adjacent water bodies creating significant public health and environmental

risks. Many of the landfill waste disposal site are unsupervised, permitting dumping in a haphazard fashion and unauthorised / uncontrolled scavenging.

There is an urgent need in the region to improve landfill waste disposal, particularly . Many of the existing problems are related to financial or institutional constraints, but others are the result of poor planning (short-term and long-term), access to suitable land, lack of equipment, and lack of technical training. What is needed is recognition that landfill planning must be a 'start to finish' exercise, encompassing water management, provision of cover material, closure of the site and final use of the site, in addition to how to handle the materials brought to the site on a day to day basis.

The problems of landfill waste disposal are particularly acute on highly populated, 'low' atoll islands, eg. South Tarawa, and Majuro, where:

- Groundwater is used to supply potable drinking water – restricting the location of potential landfilling operations;
- There is little / no land available above the high tide mark for landfill waste disposal – restricting landfilling to low lying, tidal reef flat areas;
- There is no available, cheap source of cover material, for covering the deposited waste and maintaining sanitary conditions;
- Income levels are relatively low and the ability to pay for waste management services is lower;

In response to the above concerns there are currently a number of projects being undertaken in PICs that include improving the overall management of solid waste as well as the landfill waste disposal depot. These include:

- Establishment of a new engineered sanitary landfill to serve Suva and surrounding areas (Fiji) – being funded by the EU. The EU has plans to construct a similar facility for Nadi / Lautoka (Fiji) once the Suva project is successfully completed;
- Establishment of a new modern waste management facility to serve Tongatapu (Tonga) which incorporates an engineered sanitary landfilling operation – being funded by AusAID;
- Rehabilitation of Nuku'alofa's existing dump site (Tonga) once the new waste management facility is established – being funded by NZQDA;
- Upgrading of the landfill site in Vava'u (Tonga) – being funded by the EU;
- Establishment of new landfill facility for Funafuti (Tuvalu) - being funded by AusAID;
- Establishment of a new engineered sanitary landfill to serve Rarotonga, Cook Islands – being funded by ADB
- Establishment of a new engineered sanitary landfill to serve Aitutaki, Cook Islands – being funded by ADB

In summary, the common causes of the current poor management of solid waste disposal sites in PICs include:

1. Lack of funding, for both capital works and equipment and the ongoing operation and maintenance of the site and equipment. This particularly includes funding for management and supervision of the site and funding for equipment to undertake compaction and covering of the deposited waste;
2. Ineffective / inappropriate institutional arrangements, including:
 - conflict of interest – regulation and operation of the waste disposal site; and
 - lack of appropriate resources – suitably skilled and experienced staff and equipment;
3. Inappropriately located landfill sites eg. located immediately adjacent to residential areas, located in unsuitable hydrological / geological setting (permeable soils, high groundwater table, no cover material available on site), or located in an environmentally sensitive area (mangroves, reef flats, adjacent creek or river).
4. Difficulties in siting and establishing a new, sanitary landfill waste disposal sites due to:
 - Lack of land for landfill waste disposal activities (particularly on small, highly populated atoll islands);
 - Land ownership arrangements, which make resumption or purchase difficult or impossible; and
 - NIMBY. No body wants a dump, as they know it, next door.

This results in limited availability of land for waste disposal activities. Generally, waste disposal activities are restricted to Government owned land, which is often limited and commonly below the high tide mark.
5. Lack of planning of the landfill waste disposal site operation;
6. Lack of management and supervision of the landfill waste disposal operations, which is often due to the institutional problems and / or lack of funding; and
7. Lack of public health and environmental management measures, including compaction and covering of deposited waste, stormwater drainage and leachate management measures – generally as a consequence of above factors.

2.6.5 Incineration

Incineration has been advocated and practised widely as a regional waste management option for clinical / medical wastes and for quarantine wastes. Large scale incineration of mixed solid waste has generally not been advocated due to the very high capital and operating costs, the complexity of the facilities, and the widespread problems with the simple incinerators used to treat clinical / medical waste and quarantine waste.

In general, incineration has not been particularly successful in many PICs. In many PICs the waste incinerators are out of action for substantial periods of time as a result of the lack of funds, improper operation, poor maintenance, lack of spares, lack of trained staff, or poor choice of facility in the first instance. As with landfilling, much more effective

planning is needed prior to selecting a system, with investigations of waste streams, potential users, pricing policies, ongoing operation and maintenance being required.

In one or two locations, where land for waste disposal is extremely scarce and the amounts of combustible waste are large (eg. Majuro and Ebeye, Marshall Islands or South Tarawa Kiribati), large scale incineration may technically be a good option as it substantially reduces the need for land for landfill waste disposal and reduces the impacts of the landfilling operation. However, even in these situations, other options should be carefully examined first, as the potential problems with incineration (the process itself) and the management of the ash and air emissions are considerable. Also, the costs are unlikely to be affordable or sustainable. Still, the EPA in Majuro has identified the establishment of an incinerator for mixed solid waste in its waste management plan (Mechem, 1996).

2.6.6 Biogas

NZODA through SPM has been working on PPP (Public Private Partnering) Projects to review the feasibility of implementing a biogas project. A project is being undertaken which is reviewing the construction of a pit at the Tafa'igata landfill (Apia, Samoa) to enable the collection of biogas. The process relies on the degradation of the organic fraction of the solid waste stream to produce a biogas. The biogas can then be used as a substitute for the more expensive and imported LPG. The project will not avoid waste to landfill but will achieve a beneficial by-product in the process of waste disposal. A pilot plant for the project is expected to have commenced before the end of the year.

Waste to energy facilities are gaining greater popularity in many developed countries and they may also have a role to play in less developed countries where energy costs are high. Typically such facilities require large continuous waste quantities (with high organic content) to be economically viable. However, due to the small population of PICs, it is not considered likely that such option would be viable. The pilot scale nature of the NZODA funded project will serve as a valuable tool in gauging the likely applicability to PICs.

2.7 MANAGEMENT OF SPECIAL WASTES

Special wastes commonly include clinical / medical wastes, quarantine wastes, unused chemicals and pesticides, waste oil, old munitions, used batteries, radioactive materials, contaminated foods, septage, sludges from industrial processes, confidential documents, highly odorous / putrescible food processing waste, etc. These wastes present particular hazards to people and the environment and need to be handled and disposed of with special care.

As discussed above incineration is commonly used throughout the Pacific to treat clinical / medical waste and quarantine waste, and there have been numerous reported problems with such operations eg. South Tarawa, Apia, Nuku'alofa, Majuro, Niue. As a consequence, often the clinical / medical waste and quarantine waste is disposed of at the landfill waste disposal site. In many cases the waste is simply disposed of along with the general mixed solid waste. No separation or special handling is implemented eg. in Nuku'alofa. This practice may present a significant public health risk, particularly to people scavenging at the site. At some landfill waste disposal site the waste is kept separate from the general mixed solid waste eg. Apia. However, the waste should be immediately covered to prevent public health risks due to exposure to the waste.

Septage and industrial sludges are also commonly disposed of at existing landfill waste disposal sites in PICs. In some cases the septage / sludge is deposited in dedicated

drying beds / pits, separate from the general mixed solid waste. However, generally these facilities are poorly designed and managed and contaminated effluent escapes into the surrounding environment eg. Apia, Nuku'alofa.

Most other special wastes generated in PICs are also disposed of at the landfill waste disposal site, without the required special handling and care. As with other waste management issues, many of the problems with management of special waste result from a lack of funding, poor planning, lack of appropriate resources (skilled personnel and equipment).

There is limited information available on the sources, types and quantities of special waste generated and disposed of in PICs. Additional data is required so that appropriate management measures may be developed and implemented.

Paper trails in waste management are almost non-existent in the Region. Often one hears that wastes were 'taken away by a contractor' but the destination or management is unknown (and in some cases the waste generators do not want to know). This should be a major concern to governments, particularly when hazardous materials / wastes are being handled in this way.

The establishment of procedures for tracing wastes must be addressed in waste management planning if serious environmental problems are to be avoided. The procedures for waste tracing are as below:

- waste types;
- waste quantities;
- waste generation origin;
- waste transport methods; and
- waste disposal method / facility.

One particular problem is that many PICs do not have the facilities for proper disposal of special wastes, particularly the more persistent organic pollutants. The safe destruction of such contaminants can be carried out in a number of ways (eg. gas-phase reduction, thermal base-catalysed decomposition), but for treatment the technology must be brought to the Pacific countries or the contaminants must be collected and transported to a central processing facility (in Australia or USA), eg. the Marshall Islands shipped PCBs to USA in 1995. The use of a transportable/mobile disposal facility that could move through the Region handling the most serious problems in each country in turn, has been proposed, but whether this can be a one-off operation or is needed on a more permanent basis needs further consideration. A recent project has been undertaken which identified Persistent Organic Pollutants (POPs) in Pacific Island countries (SPREP, 2000). The project recommended options for addressing the POPs and these recommendations are now being implemented through funding provided by AusAID.

An urgent initial need in Pacific countries is the provision of suitable long-term storage of hazardous materials while disposal mechanisms are being determined. Such facilities must have a good site design, be leak proof and cyclone proof, and secure against disturbance and theft.

In summary, the common causes of the current poor management of solid waste disposal sites include unsafe / poor management of special wastes eg. medical waste, septage / sludges, highly degradable and odorous waste eg. offal, food scraps from markets etc.

2.8 LEGAL AND INSTITUTIONAL FRAMEWORK

The legal and institutional framework in PICs varies from country to country. Most countries, however, do not have specific waste management legislation, often relying on outdated unspecific legislation, eg. public health acts, litter laws. This is sometimes supported by EIA legislation that requires new industries to consider waste issues, hopefully leading to good management and preferably to on-site treatment facilities. Some environmental licensing does occur, but like all other aspects of environmental legislation, unless enforcement is carried through regular checks that licence conditions are being maintained, the legislation is ineffective. This is an important area where JICA may be able to provide support.

In general, enforcement of existing waste related legislation is poor as a result of a number of factors including:

- the responsible officers do not usually have the skills, status or authorisation to undertake regulatory activities. In addition the limited number of officers will often be busy both by choice and by direction in undertaking other activities;
- the level of fines is often extremely low as a result of fines being incorporated into legislation, rather than being part of a regulation which can be easily updated; and
- certain cultural difficulties related to status in a hierarchical culture, obligations to extended family members and a reluctance to be involved in negative interactions with others.

The major responsibility for waste collection and disposal in major urban areas in PICs is outlined in Table 2.4.

Table 2.4: Waste Management Institutional Arrangements in PICs

Country	Regulation / Regulator Overview	Planning	Management & Operations
Federated States of Micronesia	Chuuk EPA Solid Waste Regulations: Sets standards for the operation, location, penalty, etc for solid waste management in Chuuk State, including hazardous wastes.	Chuuk Environmental Protection Agency is responsible for approval of new dumping sites only after an EIA is completed.	Chuuk State Department of Public Works is responsible for operation and maintenance of dumping site.
	Kosrae – Environmental Pollution Regulation: prohibits pollution of the environment and thus provide civil penalties for such pollution. It became effective in August 2000.	Plan proposed to establish a Solid Waste Management Division under the Department of Public Works. Development Review Commission: Responsible for environmental monitoring and assessment of the site.	The Municipal Governments manage three of the designated sites with one managed by the Dept. of Public Works. Under new plans, Municipal governments will no longer be responsible for solid waste management.

Country	Regulation / Regulator Overview	Planning	Management & Operations
	Yap State Environmental Protection Agency enforces the State's environmental laws, which regulate waste management and pollution sources.	Yap State Public Service Corporation has developed waste management policies and regulations.	Yap State Dept. of Public Works & Transportation/State Government is responsible for maintaining the existing landfill site
	Pohnpei State EPA is understood to be the department responsible for environmental regulatory issues	Waste Management Plan prepared by consultants (Bagley and Munro) for Pohnpei State Government	Private Company – Pohnpei Waste Management Services under contract to Pohnpei State Dept. of Resource Mgmt. and Development
Fiji	Department of Environment are somewhat regulatory (although this is enacted through other government departments – Ministry of Health). Mostly play an advisory role.	Dept of Environment are heavily involved in the establishment of the new landfill facility in their advisory role capacity. But generally undertaken by local government	Local Councils (eg. Lautoka City council, Nadi City Council, Suva City Council, Lami Town Council).
Kiribati	The Ministry of Environment and Social Development (MESD) is responsible for implementation of the Kiribati Environment Act 1999 through its Environment and Conservation Division (ECD).	The Ministry of Home Affairs and Rural Development, (Lands Management Division), is responsible for approving foreshore usage and reclamation (ie for waste disposal sites). The Ministry of Health advises Councils on siting of rubbish dumps relative to dwellings and threat of groundwater pollution.	Waste management responsibilities lie with the Ministry of Health & Family Planning (MHFP), Ministry of Environment & Social Development (MESD), Lands Management Division and the respective Councils, BTC and TUC (waste collection activities). The lead role has not been identified yet.
Marshall Islands	The RMI EPA adopted solid waste management regulations in 1989 The regulations prescribe basic standards for solid waste and litter collection and disposal and establish a permitting program for disposal facilities.	Integrated Waste Management Plan for Majuro prepared by US EPA for RMI EPA	Majuro Local Government is responsible for waste collection and disposal system in main urban areas in Majuro. The Ministry of Public Works maintains responsibility for waste disposal activities, such as operation of disposal sites (Rairok)
Niue	No details available – presumed to be Department of Health.	Waste Management Plan prepared by AusAID consultant and endorsed by Cabinet of Niue but no details available on responsible government dept.	Department of Health: responsible for waste collection and disposal
Papua New Guinea	DEC and NCDC but they lack resources to enforce regulations	Department of Environment & Conservation (DEC): Funding and waste management issues stakeholder.	National Capital District Commission (NCDC) – responsible for waste collection and disposal of Port Moresby.
Samoa	DEC – Division of Environment and Conservation are somewhat regulatory but lack resources, legislation and regulations.	DEC developing a National Waste Management Policy / Strategy	Division of Environment and Conservation within the Department of Lands, Survey and Environment (National Government level, no local government)

Country	Regulation / Regulator Overview	Planning	Management & Operations
Solomon Islands	Environment and Conservation Division and the Environment Advisory Committee established under Environment Bill 1998 & the Environment Act 1998	No information available	Local council (Honiara Town Council) responsible for all aspects of waste collection and disposal
Tonga	Ministry of Health (National Government) Advice of environmental issues provided by Department of Environment	Cabinet Committee on Waste Management / Waste Management Working Group chaired by Ministry of Health (National Government) Recent waste management plan for Tongatapu prepared by AusAID consultant with input from all relevant Govt agencies	Ministry of Health (National Government) Ministry of Works are soon to take over operation of the new waste management facility
Tuvalu	There is no particular authority responsible for waste management although the following have an interest: - Ministry of Natural Resources and Environment - Ministry of Home Affairs & Rural Development	The Waste Management Plan for Funafuti, Tuvalu was prepared by SOPAC and Opus International Consultants in Jan 1998, for the Government of Tuvalu	Local Councils (Funafuti Town Council) responsible for waste collection and daily maintenance of the landfills (borrow pits)
Vanuatu	The Environment Unit (Dept. of Lands, Survey and Natural Resources) is responsible department for waste management but only has resources to act in an advisory role at present. Solid waste is covered under the Draft Environment Act; Draft Waste Management Act and new Envntl. Legislation.	An advisory committee is to be established under the National Waste management Policy which will include the Environment Unit, Dept. of Health, Council, Dept. of Provincial Affairs, Chamber of Commerce and FSP.	Local council (Port Vila Municipality)

Waste management, like many other environmental issues is multi-sectoral in nature and such issues are often poorly handled by regional administrations. For example, the siting of dumps in Kiribati is under the jurisdiction of the Ministry of Home Affairs and Rural Development, which has no technical expertise in any aspect of landfill design or management, but has control through the Foreshore Act of 1977.

Typically waste management systems are managed by national or local government authorities, although it is noted that some PICs do not have local governments. It has generally been found that when waste management is a responsibility of the local government, it is a higher priority issue (ie. their attention and funding is not diverted to other issues such as health or education services). This is also favourable from the viewpoint that then the waste management provider (local government) is not the regulator (the role of regulator typically remains with the national government in these cases). It is important that monitoring and regulation of waste management activities be undertaken by a body independent from that undertaking the waste management operations, to ensure all potential public health and environmental issues are properly managed, and reported when necessary.

Where responsibility for waste management resides with a Department of Ministry where it is not regarded as a core function, the allocation of funds for and the administration of the activity are not regarded as a priority. Placing responsibility for waste management in a department or ministry where it is a core function will not automatically result in better management and an increase in funds. (For example, it is noted that the recent transfer of EPACS which was under the Department of MNSLR to the Department of Environment under Ministry of Works in Tonga has not resulted in an increase in funds). Functions allocated to Departments and ministries have often depended on historical precedent but are also the subject of political concerns related to the funds which accompany the functions and the priority they are accorded by politicians and the community. Waste management is generally not regarded as a desirable function unless it is accompanied by aid funds.

Transfer of the waste management function from one Department or Ministry to another is likely to require a change in legislation and can only be achieved by the responsible government. Many projects in the Pacific have not reached the levels of success originally envisaged because their success was dependent upon the passage of legislation to give full effect to the project's achievement. An example of this is the current Environmental Institutional Strengthening project currently being undertaken in Tonga. (TEMP – Tonga Environment Management and Planning Strengthening Project). A key to the project's success was the passing of Environmental Impact Assessment (EIA) legislation which to date has not been passed.

At the Regional level, waste management issues are addressed in the SPREP Convention, the Waigani and Basel Conventions, which have provisions requiring good management of wastes for protection of the natural resources of the Region. A number of countries still have to ratify these conventions.

In summary, the common causes of the current poor management of solid waste disposal sites include ineffective and / or inappropriate institutional arrangements and limited institutional capacity. Specific problems include:

- Lack of, outdated or inadequate legislation and regulations, particularly in regard to littering and indiscriminate dumping of solid waste and the establishment and regulation of new landfill sites;
- Lack of enforcement of existing legislation, particularly in regard to the prevention of littering and indiscriminate dumping of household and industrial waste;
- The wrong or no Government Department is managing waste disposal. Often the operation is not a core function of the Department or Ministry in which it is located.;
- Conflict of interest - often the health or environmental departments, who are meant to be regulators, are undertaking the waste management activities eg. Tonga, Samoa;
- Lack of communication and support between relevant Government agencies eg. those with the equipment do not cooperate with those responsible for operating the waste disposal site or those with an understanding of the environmental issues are not involved;
- Lack of suitable resources for undertaking the landfilling operation, environmental monitoring or regulation of the activities, including appropriately skilled / experienced staff and equipment;

- Lack of personnel with knowledge and (hands on) experience in planning, managing and operating a sanitary landfilling operation. This includes all level of personnel: managers, supervisors and equipment operators; and
- Lack of equipment (to compact and cover waste materials) and support systems eg. for maintenance.
- Planning is generally not undertaken. When it is undertaken it is undertaken through funding from a donor agency
- There is virtually no monitoring of the waste management situation. There is a paucity of data on which to base decisions regarding waste management

It is important that any aid projects addressing solid waste management sites ensure that appropriate legal and institutional arrangements are in place prior to implementation of the project. Consideration of institutional and financial arrangements should ensure that the above listed, specific problems are addressed.

2.9 WASTE MANAGEMENT POLICY AND PLANNING

Most PICs do not have a formal policy on the management of solid waste. It is important that governments provide clear directions waste management and allocations of responsibility. One mechanism for dealing with this is to develop an integrated waste management policy, and following that, an implementation strategy or plan. Without such an integrated approach, new initiatives in waste management have a low probability of long-term success.

Although they have no policy most PICs generally have some sort of strategy or plan addressing the management of solid waste. These documents have often been prepared by aid organisations as part of a larger sanitation or environmental project, but some have been prepared by the PIC governments. However, many of these plans have not been fully implemented. The specific reasons for this need more detailed investigation, but some obvious reasons include lack of financial resources / financial sustainability, unrealistic / impractical plans and proposals, cultural insensitivity of the strategies, and the difficulty of implementing multi-sectoral projects. The lack of community and other stakeholder involvement may also be a factor in the failure of the plans/strategies.

Whilst many of the plans address waste minimisation and recycling, waste collection and disposal, there are few truly integrated waste management plans or strategies, addressing the whole issue ie. "cradle to grave" management of waste or life cycle issues. This would involve identification and quantification of the types, quantities, sources, pathways, and final disposal of wastes, considering wastewater, solid waste and hazardous wastes in an holistic manner, moving across traditional government sectors and requiring high-level support.

Two of the most recently completed waste management plans are:

- Solid Waste Management Plan for Tongatapu, Tonga (March 2000);
- Solid Waste Management Program for Funafuti, Tuvalu;

The preparation of both these plans was funded by AusAID, and the plans are now being implemented with further funding assistance from AusAID.

SKM also recently completed (1999) a number of "Waste Characterisation Studies and Management Plans" for Samoa, Tonga, Solomon Islands, Papua New Guinea, Vanuatu, Tuvalu, South Tarawa (Kiribati), and Fiji. The reports included the results of the waste characterisation studies but the plans were very general in nature and provided only general recommendations on how to improve waste management.

Landfill waste disposal is currently an integral component of all waste management systems in PICs – acting as the final repository for discarded waste material. And this will likely remain the situation for some time due to the low cost and relative simplicity of such operations (compared to alternative waste treatment processes). Currently, there are a number of projects focused on improving landfill waste disposal operations in PICs, as identified previously in **Section 2.6**.

Further details of the existing waste management plans in PICS are provided in the country reports in **Appendix G**.

2.10 TRAINING

Specific training in waste management is currently limited in the region. Some relevant training does occur through trade training courses in regional technical institutions and in a few university programs (eg. civil / environmental engineering and public / environmental health). Part of the difficulty is that waste management is generally not seen as a separate career activity and so no training programs aimed at preparing workers for careers in the field exist. An example is in the management of landfills - there are programs to train bulldozer operators, but these courses do not generally address the specific issues of effective operation on a landfill site, which requires skills not normally acquired by a competent bulldozer driver. It should be noted that this is not a Pacific specific problem, it is common throughout the region, with most developed countries also having little formal training in landfill management operations.

Regional training programs for environmental health officers have been going on for many years, but they are limited to addressing only certain health aspects of waste management. For example, little is done on landfill design, site rehabilitation, business aspects of waste management, as these have not been the responsibility of health officers.

Some donor organisations have funded training of relevant PIC Government personnel in some aspects of waste management. This includes both JICA and AusAID. Some of this has been in country and some has been through courses run outside the region.

Considering the knowledge, skills and experience of people met by the authors of this report, it is considered that there is a need for training in the following areas of waste management:

- Waste management planning;
- Waste minimisation, recycling and reprocessing, including mulching and composting of food and garden waste;
- Alternative waste treatment processes, including waste to energy facilities;
- Landfill planning and design;

- Landfill management and operation, including leachate management and operation and maintenance of landfilling equipment;
- Costs and funding of waste management activities / operations;
- Environmental management and monitoring of waste management activities;
- Planning and management of waste collection services;
- Operation and maintenance of waste collection vehicles;
- Contract preparation and management – for waste collection operations and operation of waste disposal sites;

The training should focus on local / regional issues and include plenty of practical hands-on experience. This is considered to be one of the most critical aspects to ensure the highest benefit is achieved by providing the training. Where possible the training should be done in country / in the region and use local examples / case studies.

Much of the training required is on-the-job type training, with a work attachment. This type of training often benefits from a structured task analysis and assessment process. Tools such as Training Needs Analysis (TNA) could be highly beneficial in assessing current skills levels and further training required.

It was reported that the next stage of the Tapuhia Waste Management Facility Project (Tonga) will include a comprehensive training component as part of the construction and commissioning of the facility, encompassing the following:

- Preparation of the detailed operation and maintenance procedures for all necessary aspects of the WMF, including operation and maintenance of all equipment;
- Comprehensive training of all proposed WMF staff in the all aspects of management and operation of the WMF, as part of the facility commissioning process, particularly in regard to training for the following:
 - Overall management of the WMF ie. the site manager;
 - Supervision of day to day activities on the WMF site ie. the site foreman;
 - Operation of the steel wheeled loader / landfill compactor – to achieve effective compaction and covering of landfilled waste;
 - Operation and maintenance of the leachate containment, collection, treatment and disposal system;
 - Operation and maintenance of the garden and wood waste processing facility;
- Comprehensive training of relevant MoH and DoE staff in monitoring of a waste management facility;
- Funding and training for equipment to allow the DoE to undertake all environmental monitoring of the WMF, particularly in regard to groundwater sampling and landfill gas monitoring;

- Provision of ongoing assistance after the opening of the WMF, for a period of 12 – 24 months.

2.11 PUBLIC AWARENESS AND EDUCATION

Regular waste management education takes place in almost all Pacific countries. Experience in western cultures and in some PICs has shown that education to change community attitudes will need to take place over many years and to be effective needs to be institutionalised into the education system. It would appear that the formal education system is having some impact as, in many countries, young people are much more aware of waste issues than their elders. Part of this may be a result of personal experiences and perceptions. Waste is perceived differently by Pacific Islanders and people with a western oriented education. In addition, older Pacific Islanders grew up in a situation where almost all wastes were biodegradable, and so waste disposal was not a concern as all wastes returned to the land. The introduction of non-biodegradable materials has led to a change in the nature of wastes, without the associated change in attitudes.

In order to be effective, community education regarding waste management needs to:

- be incorporated into the school curriculum;
- be conducted at the village and general community level;
- to develop programs directed to civil servants; and
- to include specially designed and targeted information for Members of Parliament who are the real decision-makers regarding waste management issues.

An approach, which includes both a top down, and bottom up approach to community education and consultation is most effective.

NGOs are also playing a strong role in community education on a range of environmental issues, including waste management. Their work is a combination of workshops and practical demonstrations (eg. Vakasiuola, 1993), through which the repetition of the message leads to a gradual change in attitude. The role of practical demonstrations cannot be over-emphasised, as there is little point in asking people to change their attitudes and activities without providing them with a workable viable alternative.

In all these activities, it is important to convey the message that 'litter is not the only problem' – waste management is a much bigger issue. The 'out-of-sight-out-of-mind' syndrome must also be overcome if the problem is to be taken up by the general public.

There has been significant number of education, however, the education for any changes to the waste management practices should be emphasised eg. change of collection system and waste receptacles should be accompanied by an education program.

SPREP undertook an Environmental Awareness and Education Programme for the Pacific region. Funding for the programme was provided by the EU with the initial objective of the project being to improve the behaviour in ACP states in order to minimise waste production and disposal. Consideration was given to the development of multimedia regional program of general waste awareness and education and the collection of background information including data on solid waste production and composition.

In Tonga the DoE has undertaken numerous community awareness and education programs on a wide range of environmental issues including waste management. This includes working with NGOs, radio programs, TV programs and interviews, community drama shows and other activities. The main focus of their recent Environment Week program was "The Status of Waste Management in the New Millennium". In addition, as part of the project to establish the new Tapuhia WMF an extensive community education program will be undertaken addressing the following:

- Encouraging households to sign up for the improved household waste collection service;
- The opening and operation of the new Tapuhia WMF;
- The need for fees and charges for waste collection and waste disposal;
- Littering and indiscriminate dumping of waste;
- Waste minimisation, recycling and reprocessing, including mulching and composting of food and garden waste.

2.12 FUNDING OF WASTE MANAGEMENT ACTIVITIES

Lack of funding is probably the most significant cause of the current poor condition of waste disposal sites in PICs. No PICs have a sustainable funding program for waste management activities. And of great concern is the fact that most of the recent plans / documentation on waste management contains little or nothing on this key issue. One exception is the Management & Operation Plan developed for the proposed Tapuhia WMF in Tonga (Hassall & Assoc 2001), which sets out the fees for disposal of waste at the facility. This will include charging other government agencies for using the facility. The fees have been determined to allow for the following:

- The cost to establish / upgrade the waste disposal facility;
- The waste disposal site operating costs, over the whole life of the site, including labour and equipment operation, maintenance and replacement;
- Landfill site closure and rehabilitation costs, ie. for capping and revegetation; and
- Landfill post closure management and monitoring costs – possibly for more than 20 years.

Most PICs charge fees for waste collection including Fiji, Tonga, PNG, Solomon Islands (commercial and industrial premises only), Kiribati, Tuvalu, Vanuatu, FSM (commercial and industrial premises only) and Samoa (household collection as well as commercial and industrial). Other PICs (also) charge fees for waste disposal (Fiji, Samoa, Cook Islands, PNG, and Vanuatu). See Country Reports in Appendix E for details.

However, the fees charged for waste collection and disposal are generally very low and do not provide sufficient funds to effectively operate and maintain the waste collection equipment, or waste disposal facilities and equipment eg. in Tonga waste collection charges were recovering only 20% of the costs of running the service (which is very unreliable due to the poor condition of the existing equipment). Often the operations are subsidised by funding from the Government. Rarely is sufficient revenue generated by the fees charged to fund regular maintenance and replacement of equipment – generally

assistance is sought from donors to replace equipment when required. No where is money set aside for the closure, rehabilitation, and post closure management and monitoring of landfill waste disposal sites.

Consequently, most waste management operations are significantly underfunded, and as they are government programs, the responsible officers have to make do with the resources provided, even though this may lead to significant environmental problems.

Based on the review of existing waste management activities, it would appear that those waste management operations undertaken by local government generally appear to be better funded and managed than those operated by national government for the following reasons:

- Local government has its own source of funds eg. property rates / taxes and charges levied for services provided;
- Provision of waste management services is a core activity; and
- Waste management is not competing for funds against other higher priority Government funded activities eg. health care and education

Many PICs do not have a local government structure but have set up local authorities to manage services for specific urban areas. Where these exist, they would be the favoured authority to operate waste management activities.

There are numerous ways in which waste activities can be funded. Apart from funds obtained from national or state government, public sector reforms occurring in the region are leading to the adoption of a 'user pays' approach, and to privatisation or outsourcing of government activities. Potential sources of funding include:

- increased in current waste collection fees;
- introduction of fees to dispose of waste materials in a landfill;
- revenues from sale of recyclable materials (minor, if any);
- sale of compost (minor if any);
- fees for use of incinerators;
- increased fees for disposal of special wastes;
- the imposition of appropriate tariffs / duties / taxes, on imported items that are likely to create waste management problems eg. large items such as motor vehicles, tyres, waste oil, chemicals, disposable nappies, and products in non-recyclable (locally), non-biodegradable packaging eg. plastics, glass, steel cans. In Samoa a deposit is charged on all glass bottles which is effective in minimising glass bottle waste. Also in Samoa a 30 sene tax is placed on all imported goods with 10 sene per container being reimbursed to the importer if it can be shown that the container is being re-exported. A similar tax / import duty was also proposed in the Solid Waste Management Plan for Tongatapu, with the revenue being used to fund (subsidise) export recycling programs. This topic is one that needs serious consideration by PIC governments in developing their waste management strategies.

Two other points should be noted. Introducing fees or higher fees for waste collection and disposal services will likely lead to an increase in littering and indiscriminate dumping of solid waste. Measures will need to be implemented to combat this including community education programs and the introduction / enforcement of financial penalties for those caught dumping waste.

The second point relates to economic principles - the concept of saving on landfill space does not seem to fit well with normal economic planning, but is an important aspect of waste management planning. Extending the life of a landfill may be extremely beneficial financially, in the long term, particularly in island countries where available land is extremely scarce.

In summary, the common causes of the current poor management of solid waste disposal sites include limited financial resources and the lack of a sustainable funding mechanism for operating the solid waste disposal site. This includes a lack of funds for capital works, equipment, imported cover soil, other operating costs and site rehabilitation and post closure management costs. Often this lack of funding is associated with the institutional arrangements ie. waste management is not a core function of the Government agency responsible for such as Department of Health, and as a result waste management is not a priority issue and does not receive the necessary funding.

2.13 INFORMATION SOURCES ON WASTE MANAGEMENT ISSUES

Like many other environmental issues in the South Pacific, the information available on waste management presents a dilemma. On the one hand, there are numerous reports on various aspects of the problem, but often they are difficult to access as they are in what is commonly referred to as the 'grey' literature. As a result, unless one knows the details of the report (author, agency, and date) it is difficult to locate and examine the documents. Many of the reports have been produced by international agencies (eg. WHO, UNEP, UNDP, ADB) that distribute them to the countries concerned, but, in most cases, no record is entered into international databases, accessible by computer searching.

Regional agencies such as SPREP and the Secretariat of the Pacific Commission (SPC) also receive copies of many of these reports and will make them available to countries on request. SPREP's Information Resource Centre catalogues all literature and reports received. Workers in individual countries, however, must be aware of the existence of the documents in order to take full advantage of such services.

Many of these 'grey' literature reports contain very valuable information. Some are the results of short country visits by technical experts, and while they may be relatively short documents (< 10 pages), many contain valid recommendations for action and some contain the only specific technical information available on an issue in that country. Other reports are longer, containing results of more detailed investigations, and as such may represent the best available information for waste management in a country.

There are numerous textbooks available on waste management. Unfortunately, only one of these (Sakurai and Hoo, 1996), focuses on the issues arising in small island countries, especially low-island countries; almost all are North America/Europe/Asia oriented. Many also lack the practical 'on-the-job' skills needed for many aspects of waste management work.

Therefore, establishing a good database with easy access to the general public (most likely an Internet based system) for all available papers and reports on the PICs' waste management issues, will benefit future waste management planning.

2.14 HEALTH AND ENVIRONMENTAL IMPACTS

The impacts of waste management on the Region's environments can be dramatic (Morrison and Brodie, 1985). Apart from the obvious visual and aesthetic problems, there are numerous health and environmental impacts resulting from contamination of air, land and water.

Typical health and environmental issues associated with landfill waste disposal operations include:

- Public health risks associated with unsanitary conditions at waste disposal sites. This includes potential injuries and a exposure to wide range of diseases, for users of the facility and on site workers;
- Contamination of surface waters and ground water, and consequent detrimental impacts on the community (health impacts) and the environment; and
- Contamination of land / soil;
- Nuisance to adjacent land users due to odours, litter, dust, smoke, and vectors (vermin, insects, bird and other pests / feral animals)

UNEP (1996, Appendix 1), provides a good overview of the public health hazards and risks of poor municipal waste management, including those presented by landfill waste disposal sites. These can include injuries and chronic diseases; bacterial, viral and parasitic infections; and tropical diseases transmitted by water borne vectors. A summary of these is shown in Table 2.5.

Table 2.5 – Summary of Potential Health Impacts due to Waste Site Operations

Activity	Impacts
Landfills	Direct Impacts – accidents, fires, explosions, dust, smoke, noise, odours, insects, rodents, stray animals Indirect Impacts – surface water pollution by runoff from the landfill and underground water pollution by leachate
Incinerators	Direct Impacts – occupational accidents and chronic diseases, air pollution by particulates, heavy metals, and toxic chemicals Indirect Impacts – soil pollution by fly ash falling down, chemical water pollution from acid wastewater and leachate from ash disposal in landfills
Composting	Direct Impacts – minor occupation impacts from dust, sharp objects and small amounts of infectious wastes
Injuries and Chronic Diseases	- cuts and infective wounds from sharp waste - burns from fires generated in wastes - Trauma from collapses of huge waste piles - Burns or wounds from hazardous chemicals in waste - Toxication and cancers from exposure to hazardous waste - Chronic respiratory diseases from exposure to dust

Bacterial, viral or parasitic infections	<ul style="list-style-type: none">- Bacterial or viral blood infections resulting from injuries caused by infected sharp waste- Eye and skin infections from waste generated infected dust- Respiratory infections from exposure to waste generated infected dust- Vector borne diseases, viral or parasitic, transmitted by vectors living or breeding in waste-generated ponds; and worm infestation transmitted by contact with polluted soils- Bacterial, viral or parasitic enteric diseases, transmitted either by rodents and insects, accidental ingestion of waste food, drinking water contaminated by leachate from waste- Zoonosis carried by stray animals and rodents feeding on waste
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Once a contaminant enters surface waters or the groundwater it can be rapidly transported within the hydrologic cycle, leading to contamination of the local water supply, sediments, rivers, lagoons, mangroves and reefs (Naidu et al, 1991). Transport of pathogens, nutrients and metals occurs, but evidence has been observed for movement of organic substances including persistent organochlorine compounds (Morrison et al, 1996b). Poorly managed landfills have led to the formation of pollutant 'halos' around them, eg. the Lami dump in Fiji has produced a halo of heavy metals in Suva harbour (Naidu and Morrison, 1994). These contaminant movements, if allowed to continue, may lead to ecosystem changes, including adverse biodiversity variations. The potential impact of these changes on tourism developments also cannot be overemphasised.

Contamination of soils has been recently reviewed by Morrison et al (1996a), who found that poor waste management was a major contributor to soil and land contamination by oils, pesticides and heavy metals.

Other environmental problems include the impact of windblown and floating plastics on birds and fish life, smoke from poorly managed landfill operations, windblown dust and wastes, hazards from old munitions, the use of unused pesticides for 'illegal' fishing, and the occurrence of hazardous materials dumped on landfill sites with no special care. In several countries, sewage is collected and discharged untreated into near shore waters, where the impacts on reefs may be considerable, but such conclusions are often limited by the lack of pre-discharge data (Kaly, 1996). The overall impact is considerable and may be of the same order of magnitude, in terms of environmental and health impact, as poor quality water provision or poor sanitation.

In summary, the common causes of the current poor management of solid waste disposal sites include the lack of health and environmental management measures, including:

- Lack of compaction and covering of deposited waste to maintain sanitary conditions at the landfill waste disposal site. This may be due to a lack of funds, lack of equipment, or lack of a suitable cover material. The lack of soil for cover material is a particular problem for small atoll islands;
- Lack of stormwater and leachate management control measures - resulting in contamination of surface waters and groundwater; and
- Lack of odour, litter, duct, fire and vector control measures / programs.

These problems are commonly a result of the lack of funding.

Measures to improve these aspects of a landfill waste disposal operation are described in Section 5.

2.15 SOCIAL AND CULTURAL ASPECTS

In all development activities in the Pacific, social and cultural issues require careful attention if progress is to be made. This is particularly important in this period of change, where there is a degree of loss of family/traditional values particularly in urban areas. As noted earlier, there is a distinct difference between many Islander perspectives on waste and those from other cultures. These differences relate to land ownership or tenure, the attitudes towards human and animal waste and beliefs relating to the responsibility for "looking after the environment".

One important component of all waste management planning is land tenure. In PICs most land is communally owned and land use decisions are community based. This leads to significant problems in acquiring land for any waste management activity (including landfill waste disposal), as governments are not in a position to control many land use decisions. This is also seen in the care and maintenance of family compounds - those where a family is living are usually well maintained and clean, while areas under public control are often the scene of extensive littering and dumping waste.

The use of human and animal wastes in agriculture and forestry is another sensitive cultural issue. While this is widely practised in most of Asia, there has been very limited application in the Pacific. Attitudes are changing slowly, but much more education and awareness on the benefits of using these materials is required. This also applies to composting toilets and the use of the compost provided by them (Rappaport, 1996). The use of composting toilets has not been economically feasible or culturally acceptable when applied to individual households. There has been some success where they have been installed in schools and an authority is responsible for maintaining and cleaning them.

Another traditional activity that is waste related but may have major environmental impacts is lagoon use for family bathing as a toilet, instead of using a pit latrine or other land-based toilet system. This is particularly evident on atolls, but also occurs in coastal areas on some of the larger islands.

Domestic animals (particularly pigs and chickens) also present a cultural problem in terms of waste management. In the past food wastes were fed to domestic animals, thus reducing the household waste stream. Some governments (eg. Samoa) have legislated to prohibit domestic animals (pigs) within urban areas to limit the environmental and health impacts, and others are proposing to do so. Other changes include proposals to keep pigs penned, which may lead to other problems, as many of the pens will be on the edges of lagoons, rivers, or the ocean, leading to pollution of water bodies.

Finally, as noted earlier, in any consideration of the social aspects of waste management, it is important to remember the cross-sectoral nature of the issue. While it has been observed that a number of waste management problems are the result of underfunding, it must be remembered that, in cash terms, most Pacific Islanders are relatively poor, with household incomes usually less than A\$75-100 per week. These limited incomes together with a lack of knowledge about the health implications and often-held beliefs that it is not the responsibility of the individual to look after these wastes are constraints to implementing user-pay systems. Funding is essential to financing waste management improvements and strategies to overcome the social and cultural constraints to a user-

pays system. This should allow the 'user pays' approach to be applied in a sensitive manner to avoid unnecessary hardship to low-income households.

2.16 SUMMARY OF ISSUES

The management of solid waste disposal sites in PICs is, in the whole, generally quite poor. There are a number of reasons for this including inadequate / ineffective waste management planning, inadequate data to effectively plan waste management activities, inadequate legislation or inefficient enforcement / application of existing legislation, and a lack of awareness in some countries of the seriousness of the resulting problems. In most PICs the inadequacies are often caused by a lack of funds for waste collection and waste disposal operations and / or ineffective institutional arrangements. While most governments, for example, do pay reasonable attention to the provision and protection of drinking water and electric power supplies, few resources and funds are expended on waste management activities.

In summary, the common causes of the current poor management of solid waste disposal sites include:

1. Ineffective and / or inappropriate institutional arrangements and limited institutional capacity. Specific problems include:
 - Lack of, or inadequate legislation and regulations;
 - Lack of enforcement of existing legislation, particularly in regard to the prevention of littering and indiscriminate dumping of waste;
 - Wrong (inappropriate / ineffective) Government Departments are managing the waste disposal site – not a primary / core function;
 - Conflict of interest - often the health or environmental departments, who are meant to be regulators, are undertaking the waste management activities eg. Tonga, Samoa;
 - Lack of communication and support between relevant Government agencies eg. those with the equipment do not cooperate with those responsible for operating the waste disposal site or those with an understanding of the environmental issues are not involved;
 - Lack of suitable resources for undertaking the landfilling operation, environmental monitoring or regulation of the activities.
 - Lack of knowledge and (hands on) experience in sanitary landfilling operations. This includes all level of personnel: managers, supervisors and equipment operators; and
 - Lack of equipment (to compact and cover waste materials) and support systems eg. for maintenance.
2. Limited financial resources and the lack of a sustainable funding mechanism for operating the solid waste disposal site. This includes a lack of funds for capital works, equipment, the ongoing operation and maintenance of the site and equipment including costs of cover soil, other operating costs, site rehabilitation costs, and post closure management and monitoring costs. This particularly includes funding for

management and supervision of the site and funding for equipment to undertake compaction and covering of the deposited waste. Often this lack of funding is associated with the institutional arrangements ie. waste management is not a core function of the Government agency responsible for such eg. Department of Health, and as a result waste management is not a priority issue and does not receive the necessary funding.

3. Inappropriately located landfill waste disposal sites eg. located immediately adjacent to residential areas, located in unsuitable hydrological / geological setting (permeable soils, high groundwater table, no cover material available on site), or located in an environmentally sensitive area (mangroves, reef flats, adjacent creeks or rivers).
4. Difficulties in siting and establishing a new, sanitary landfill waste disposal sites due to:
 - Lack of land for landfill waste disposal activities (particularly small atoll islands);
 - Land ownership arrangements, which make resumption or purchase difficult or impossible; and
 - NIMBY. No body wants a dump, as they know it, next door.

This results in limited availability of land for waste disposal activities. Generally, waste disposal activities are restricted to Government owned land, which is often limited and commonly below the high tide mark.

5. Lack of planning of the landfill waste disposal site operation, including a lack of data to undertake such;
6. Lack of management and supervision of the landfill waste disposal operations, which is often due to the institutional problems and / or lack of funding;
7. Lack of health and environmental management measures, including:
 - Lack of stormwater and leachate management control measures - resulting in contamination of surface waters and groundwater
 - Lack of soil to cover deposited waste (and maintain sanitary conditions). This is a particular problem for small atoll islands;
 - Lack of covering and compaction of the deposited waste.
 - Lack of vector control measures / programs;

These problems are also usually a function of the lack of funding.

8. Unsafe / poor management of special wastes eg. medical waste, septage / sludges, highly degradable and odorous waste eg. offal, food processing wastes
9. Increasing quantities of waste materials requiring local management / disposal, particularly imported packaging materials and vehicles, which are consuming scarce landfill waste disposal space.

Particular problems commonly encountered with waste disposal sites on populated, atoll islands include:

- The lack of land for undertaking landfill waste disposal activities. This is particularly the case in highly populated, and growing, atolls such as Tarawa (Kiribati) and Majuro (Marshall Islands). Landfill waste disposal on these islands occurs on both ocean side and lagoon side reef flats, with minimal environmental controls, which is having an adverse impact on the reef.
- The geological / hydrogeological setting – permeable soils and bedrock, high groundwater table, which is used as a source for potable water. Landfilling activities present a groundwater contamination risk, dependent on the level of environmental management and monitoring measures implemented.
- The limited availability of soil for covering the deposited waste, to maintain sanitary conditions.

Measures for overcoming these issues are identified and evaluated in **Section 5**.

3. ACTIVITIES OF AID DONORS, REGIONAL AND INTERNATIONAL ORGANISATIONS

3.1 GENERAL

There are many organisations (both Government and Non-Government Organisations (NGOs)) operating in Pacific Island countries. The areas of interest of these organisations vary widely with activities being undertaken in areas such as health, environment, agriculture, finance and education. Some of the organisations cover a number of these areas while others focus on a particular area.

As part of this project most relevant organisations operating in PICs were contacted – see **Appendix C & D** for details of contacts. A brief description of the activities and issues raised by these agencies in Pacific Island Countries has been outlined in the following sections. Further details of activities of each of the organisations spoken to during the course of this project are outlined in **Appendix G**. A separate (brief) report has been completed for each organisation. Information was compiled from discussions with each organisation (both in-country and by phone), literature provided by the organisations and literature published on organisation web sites. The reports also outline problems or major issues encountered by the organisations in the administration of aid and how the agencies work to overcome these problems / issues. (Note that where an organisation was visited/spoken to in two separate countries, typically Fiji and Samoa, a separate report has been compiled for each. This reflects the different work being undertaken by each of the offices and the variation in identified issues).

Development assistance provided to Pacific Island nations in 1997 was as follows:

Country	A\$ m
Japan	147.7
Australia	114.0
New Zealand	87.5
European Union	34.7
Asian Development Bank	33.9

Source: AusAID (2001)

The organisations discussed in the following sections can be categorised as being on a national, regional or international level. The distinction between these categories reflects the activities of the organisation and (if applicable) how aid is administered (ie what activities, countries and how projects/input is undertaken). Interaction does occur between the various organisations but this is not always undertaken within a well organised framework.

The following sections provide a brief overview of the activities of these organisations, the issues that arise in their works, including sustainability, environmental and safety standards, recurrent cost financing, and assets maintenance, and how they are attempting to address these issues. Further details are provided in **Appendix G**.

3.2 NATIONAL DONOR ORGANISATIONS

3.2.1 Japan International Cooperation Agency

JICA has undertaken a number of activities with respect to solid waste management in the Pacific region. They have an association with SPREP activities and provide funding to this body. Some of the past and present activities undertaken by JICA include:

- Funding this Project;
- Funding a Project Identification Study on Waste Management in Samoa in 1998;
- Providing staff and volunteers who have worked in or had an association with the waste area including placement of a volunteer with the DEC, Samoa specifically concentrating on waste management issues. A JICA specialist in waste issues has also recently been placed with SPREP;
- Commenced South Pacific training course in Okinawa in January 2001. The course covered areas such as compost making, waste characterisation studies and included a visit to a regional waste facility;
- Considering the provision of a waste incinerator for medical waste in Samoa and in the western region of Fiji (Nadi, Lautoka);
- JICA, Samoa provided a grant to the Flower Growers Association in Samoa, which was used to purchase equipment (chipper etc.) for use in composting. The composting operation uses garden waste and brewery waste;
- Provision of small incinerators for health care waste to Kiribati, Vanuatu, Solomon Islands, and FSM.

Some of the activities to be undertaken in the near future by JICA include:

- Conduct of a waste management workshop in March 2002 in Samoa, which will be attended by representatives from a number of Pacific countries;
- construction of a training centre in Samoa to commence operation in January 2002. The facility will be run by SPREP but is funded by JICA for use by SPREP and the Samoan government;
- Placement of a volunteer with the DEC (Samoa) from April 2001. This volunteer will be concentrating on the area of waste management.

3.2.2 AusAID

Activities in the Pacific Region

AusAID is the Australian donor agency and undertakes a large number of activities in the Pacific region. Recent projects, which are relevant to waste management activities, include:

- A waste management project in Tuvalu. This is a 3 year project and includes a waste characterisation study, waste minimisation approaches, establishment of a landfill, recycling (compost etc.) and other facets of waste management;
- The Tonga Environmental Planning and Management Strengthening Project, which includes addressing the issue of waste management. This project incorporated the preparation of an integrated solid waste management plan for Tongatapu and the identification and design of a new, modern waste management facility that incorporates an engineered sanitary landfilling operation. In May 2001 the Government of Australia agreed to fund the next stage of the project which will involve the final design, construction and commissioning of the facility, including the finalisation of a management and operation plan and training of all relevant Government of Tonga personnel. In addition, the project is also about to commence undertaking a series of composting trials in village situations;
- Development of a waste management system in Niue. This project was undertaken as part of a water supply and sanitation project and is understood to have included the construction of a new landfill site that should be nearing completion of construction;
- Water supply and sanitation project in Kiribati, Christmas Island that includes 2 waste management facilities. One of these was dedicated for domestic waste disposal while a second facility was lined and is to be used for hazardous waste. While design guidelines have been completed for the landfills the status of this project is not known (ie it is suspected that construction has not yet been undertaken);
- Water supply and sanitation project in Nauru under a Rehabilitation and Cooperation Development Program. This project included construction of a waste management facility. Construction of the facility is believed to be nearing completion;
- Project into the identification of POPs (with SPREP) and subsequent (current) project for their removal from these countries;
- Range of public sector/service reform approaches in various PICs, including the Cook Islands, Samoa, Niue, Tuvalu, and Vanuatu;
- Range of public health activities in various PICs. Typically all significant health projects have included a component which considers disposal of medical wastes;
- Conduct of a hazardous waste workshop (March/April 2001 for FSM).

AusAID estimate their aid flows to the Pacific region during the 2000/2001 year to be of the order of \$145M of which some \$35.2M will go towards regional programs. Australia's aid is largely directed to the seven independent Pacific island nations - Fiji, Solomon Islands, Vanuatu, Samoa, Tonga, Kiribati and Tuvalu. Australia provides only limited assistance to the other countries and territories of the region that have close economic and constitutional ties to their former administrators. Of the aid provided by AusAID to PICS in the past financial year (1999/2000), the majority of this was spent in the areas of Economic Reform and Governance (24%) and Education and Training (29%).

The regional programs supported by AusAID include donations to the Forum Secretariat, SPREP, SPC, USP and SOPAC.

AusAID's projects are generally focussed on poverty alleviation. Where environmental pollution or degradation (through waste management activities) is likely to have a bearing

on poverty levels, AusAID is likely to become more involved in waste management activities.

Issues

The recent AusAID project for a landfill in Tuvalu involved the study of waste characteristics and the willingness of people to pay for waste services (if the service was undertaken well). The study did not just provide a landfill without considering the social and financial issues surrounding it. The study found that by reducing the quantity of waste requiring disposal (through separation of organic waste), the system can be made reasonably economic and may actually be sustainable to the point of being able to afford to buy major equipment such as trucks. This was considered by AusAID to be a successful approach to ensuring project sustainability. AusAID did, however, indicate that they had not specifically requested that the government set aside funds for future operation and maintenance of the Tuvalu facility, although the project manager has a responsibility to ensure that the facility is as sustainable as possible.

AusAID have indicated that any new projects they undertake will generally have a component that focuses on the institutional arrangements for a project. AusAID recognise that they could just go into a country with a technical solution but this is not sustainable unless the institutional solutions are first identified and implemented. AusAID noted that the long term outcomes of this approach are yet to be determined but it is anticipated that the approach will result in a more sustainable outcome with respect to project financing and operation.

AusAID believes that their role in Pacific Island countries is in undertaking projects rather than core activities of the government – for example AusAID may help by providing funding for the one-off construction of a landfill but would not provide annual, ongoing funding for waste collection services.

AusAID recognise the importance of asset maintenance having commissioned the publication "Asset Maintenance: The Impact of the Underfinancing of Recurrent Costs", Quality Assurance Series No. 13, May 1999. This comprehensive report assessed this issue with a focus on Recurrent Cost Financing (RCF). The key recommendations (outlined in the report) to AusAID to address the issue of asset maintenance were to:

1. Project and program design – consider project time-frame, size and O&M capacity. Emphasis a commitment to O&M in MoUs. Undertake fewer, larger long-term aid projects;
2. Donor co-ordination in the South Pacific – projects undertaken in cooperation with other donor agencies are more likely to achieve significant results;
3. Recurrent cost Financing – consideration must be given to recurrent budgets in key sectors – health, education and public works;
4. Governance – provide advice on financial economic and planning issues (particularly where they affect the use of investment resources).

AusAID do not generally adopt Australian standards unless it is assessed as being appropriate for a given aid project. It is noted that for each AusAID project a minimum of a brief EIS is undertaken.

All of these are considered equally relevant to JICA activities.

3.2.3 NZODA

Activities

New Zealand through its Official Development Assistance (ODA) program contributes to social and economic development that is environmentally sound and sustainable. NZODA have not yet been significantly involved in activities which are directly related to waste management in PICs, however, major areas of activity undertaken by NZ ODA in the Pacific region include

- Capacity building, institutional strengthening and education/training;
- A recent project funded by NZ ODA is being undertaken by SPM. This is examining the possibilities of public/private sector partnerships. This is considering such issues as using private sector involvement in running the landfill. They are also considering a municipal waste to energy facility – biogas/cooking gas;
- Most of the NZ environmental money goes through SPREP.

In addition, NZODA, through SPM, has been working on PPP (Public Private Partnering) Projects to review the feasibility of implementing a biogas project. A project is being undertaken which is reviewing the construction of a pit at the Tafa'igata landfill (Apia, Samoa) to enable the collection of biogas. The process relies on the degradation of the organic fraction of the solid waste stream to produce a biogas. The biogas can then be used as a substitute for the more expensive and imported LPG.

Recently, NZODA have also agreed to fund the rehabilitation of the existing Nuku'alofa dump site, in Tonga, once the proposed new waste management facility has been established.

For the 2000/2001 year, NZODA has allocated some \$67M (\$NZ) for bilateral aid in the south Pacific (Tokelau, Papua New Guinea, Samoa and Solomon Islands are the recipients of most of the aid). A further \$11.4M (\$NZ) has been allocated to south Pacific regional programs including the south Pacific agencies of Forum Secretariat, SPC, USP, SPREP and SOPAC.

Issues

With respect to environmental and safety standards, NZ ODA adopts an approach of it is better to do a project to get things a bit better rather than to try and install a "prestige" type of system at the outset. It is recognised that they may have some problems defending this to environmentalists but it is somewhat defensible if it is regarded as a staged process with the ultimate goal of meeting international standards.

To ensure project sustainability, NZ ODA have adopted an approach in that prior to the spending of Aid monies, a Memorandum of Understanding (MOU) is signed by the relevant parties (government and Aid donor). One of the aims of this is to commit the government to ongoing financing and certain requirements (eg asset maintenance). It is; however, acknowledged that the worth of these documents has not been fully tested.

With respect to asset maintenance, NZODA recognise that the provision of appropriate equipment is very important to ensure best value for aid monies.

3.2.4 European Union

Activities

The European Union is the collaboration of a number of European countries. (It is noted that this collaboration could mean that the EU may be described as an international organisation). Activities in the region being undertaken by the EU include:

- A waste education and awareness program which is coming to an end (this was done through SPREP);
- Waste awareness baseline study in Fiji, Samoa and Kiribati that assessed the current level of awareness. Also involved in waste characterisation studies. EU are keen for the developed awareness material to continue to be used by bodies such as SPREP;
- Financed design and waste characterisation study for a small new landfill site in Vava'u in Tonga. Construction work is about to commence on this project – also funded by the EU;
- An Environment Project involving the establishment of a new, engineered waste management facility to serve the Greater Suva area (including Suva and Lami, around 200,000 people). Financing agreements have not yet been signed but work has commenced on the engineering design of the waste management facility. The EU indicated that an awareness and education campaign has been included as part of the project;
- Depending on the success of the Suva project, the EU indicated that they would consider funding a similar facility to service the Nadi / Lautoka region.

Total EU aid commitments to the Pacific region in the ten year period to 1998 was 704 m Euro (approx. \$1,154M Aus) or an average of 70.4 m Euro per year (\$115M Aus).

Issues

The EU's recent approach in undertaking the Environment Project in Fiji (including design and construction of a new, engineered landfill) has been to assign specific responsibilities to the involved parties (aid agency, government departments and contractors as applicable). This approach was outlined in a Term of Reference (TOR) for the entire project and was signed by the parties prior to project commencement. The TOR essentially commits each of the parties to a certain amount of spending and input to the project. The project can not progress until each party has completed their works as required. By requiring the government to undertake works on the project increases government ownership of / involvement in the project and should ultimately improve the chances of sustainable ongoing operation and maintenance of the facility.

The project also involves an institutional study which will / has examines the best way to run the landfill in terms of financing and management. It has not yet been determined if the Suva landfill will be privately or publicly run. The study will examine the costs of landfill operation, financing options and whether the operation is best undertaken by the public or private sector. The success or otherwise of this approach is yet to be determined.

The EU wants to promote ownership of projects by the recipient country and are therefore encouraging secondments between aid agencies and government employees.

The EU have indicated that the Pacific region would benefit if there was an organisation responsible for holding all information on a particular type of activity (such as waste management) in the region. They indicated that it should probably be SPREP with input from SOPAC.

The EU has adopted a flexible approach to the adoption of environmental standards. The ideal is to implement international standards, however, if a limited budget means a slight non-compliance with such standards then the EU would undertake this.

3.2.5 Others

A number of other countries also provide funding and assistance in the Pacific region including:

- The UK which provides aid through such organisations as SPC, Forum Secretariat and the EU as well as the UK DFID (Department for International Development). (Note their Pacific Region Strategy Paper did not identify any projects in the waste management area. Projects relate more to education and rights and good governance. At present, the UK is a smaller donor in this region compared to the other donors);
- The USA which provides aid to US-related countries through such organisation as SPC and USAID. USAID is the principal U.S. agency that extends assistance to countries recovering from disaster, trying to escape poverty, and engaging in democratic reforms. The USEPA also works on environmental protection with three independent island nations: the Republic of the Marshall Islands, Federated States of Micronesia and the Republic of Palau. It is understood that the USEPA/ US Dept. of Agriculture undertook a study (1996) looking at solid waste management including landfill reconstruction and incinerators. Works (details are still to be received) in Majuro are to be funded by the Rural Utilities Service (part of the Dept. of Agriculture);
- France which provides aid through such organisations as SPC, SPREP, SOPAC and EU. It was also reported that France was soon to provide two new garbage trucks to the Government of Tonga;
- The Canadian International Development Agency (CIDA) currently has 4 project running in the Pacific:
 - The Canada-South Pacific Ocean Development (C-SPOD II) project, which addresses marine pollution reduction. This project is being run in partnership with FFA, FS, USP, and SPREP. CIDA also undertook the UVIC/USP link project in 1991-1996;
 - The Eco-woman project, which is designed to help women participate in environmental management and sustainable development;
 - The Canada Fund for Local Initiatives, which is aimed at financing small. Community level projects (providing economic, educational, technical, and social development assistance)
 - The NGO Strengthening Project, which is designed to complement the Canada Fund initiatives.

.Canada also provides aid through such organisation as SPREP, SPC and SOPAC;