

- Chinese Taipei is providing aid through assistance to improve garbage collection in Majuro (Republic of Marshall Islands). (Referenced in Asian Development Bank, Country Assistance Plan, 2001 – 2003).

### **3.3 REGIONAL ORGANISATIONS**

#### **3.3.1 South Pacific Regional Environment Programme**

##### **Activities**

The South Pacific Regional Environmental Program (SPREP) aims to provide a coordinated regional approach to environmental problems, serving as an information referral centre and providing technical assistance to its member governments among the Pacific Islands countries and territories. SPREP was established to promote co-operation in the South Pacific region and to provide assistance to protect and improve its environment and to ensure sustainable development for future generations.

Current and future relevant activities being undertaken by SPREP include:

- Landfill demonstration projects to promote good operation of landfill sites;
- Country awareness and country initiatives (eg. In Samoa a TV commercial was produced to discourage dumping, not use plastic bags, etc.). Created video, comic books and posters that were aimed at teenagers to encourage better waste management;
- Follow on from the POPs report (2000) whereby PCBs are to be picked up from 11 countries and taken to Australia (or similar) for treatment. The project is to be funded by AusAID (\$3M);
- Together with NZ ODA, SPREP have an alliance with an NGO called SPM, which is investigating public/private sector alliances.

##### **Issues**

SPREP recognise that ongoing funding (following provision of aid by aid agencies) is often an issue in ensuring project sustainability. (SPREP have observed that following an aid agency participation in a project, the project falls apart as soon as the aid agency walks away as there is no ongoing funding allocated by the recipient country for the ongoing operation of the project works).

SPREP recognise that government staff are generally capable people but are often seriously overloaded (have to respond to a lot of external requests such as conferences, aid donors etc.).

Assets provided by aid donors are often inadequately maintained due to the lack of technical capacity. It is acknowledged that assets can get taken over for other uses and that providing equipment/machinery with a dedicated use (ie that can't be used for other purposes) is a good idea.

#### **3.3.2 South Pacific Applied Geoscience Commission**

The South Pacific Applied Geoscience Commission (SOPAC) is a regional intergovernmental organisation of the Pacific.

## Activities

SOPAC's work for its member countries focuses on three key areas; resource development; environmental geoscience and national capacity development in the geosciences.

SOPAC's main activity in the Pacific region is in preparing methodologies for determining environmental viability / sustainability, especially in coastal assessment and planning, but they have also been looking at ways in which they can be involved in waste management sites. From a geological / hydrogeological / geotechnical perspective, SOPAC can play a very important role. (Note that for example, Tuvalu and Kiribati do not have geotechnical maps but SOPAC holds information with respect to this)

SOPAC has made contributions to solid waste management in the region based on its expertise in Resource Management and Environmental Geoscience. SOPAC, in collaboration with SPREP, developed a Solid Waste Management Plan for Funafuti, Tuvalu. SOPAC's involvement was critical given its expertise in the geotechnical side of waste site locations and management and its status as the regional repository of geoscientific data on the member countries.

## Issues

SOPAC encourages Pacific countries to learn from each other through the sharing of knowledge and experiences. Hands on training in the field, training attachments to the Secretariat, structured courses in conjunctions with the University of the South Pacific for member country nationals and technical workshops are commonly used to strengthen national capacities.

JICA could benefit from the input of SOPAC on any solid waste site management projects. SOPAC's expertise in Pacific Island geoscience is considered a valuable input for PICs where the high reliance on the natural environment (eg. for fresh water, crop growth) is particularly important.

### **3.3.3 Secretariat of the Pacific Community**

The Secretariat of the Pacific Community (SPC) has been operating in the Pacific region for over 50 years and covers the entire Pacific region including the territories. SPC aims are to develop the technical, professional, scientific, research, planning and management capability of Pacific Islands people to enable them to make informed decisions about their future development and well-being.

SPC's activities are focussed in the major areas of agriculture, health and fisheries. SPC is a regionally focused organisation and is funded by member countries including Australia, New Zealand, France, US and the UK plus some funding from aid organisations such as UNDP.

SPC's main interest in waste activities is more specifically focussed on the area of soil conservation and the impacts on agriculture. SPC do not generally provide infrastructure and therefore have not necessarily encountered the same problems as other aid agencies in relation to recurrent cost financing and asset maintenance. Recent relevant activities mostly relate to a study that looked at piggery wastes in atoll countries and volcanic islands. These countries have high pig populations (often higher than the human population) and this waste could be used for fertiliser and avoid the use of chemical fertilisers.

### **3.3.4 Forum Secretariat**

The South Pacific Forum consists of the Heads of Government of all the independent and self-governing Pacific Island countries, Australia and New Zealand. The administrative arm of the South Pacific Forum, is the South Pacific Forum Secretariat, and undertakes programs and activities under guidelines decided by the Forum leaders.

The Forum Secretariat's current programs are aimed at promoting regional cooperation among member states through trade, investment, economic development, and political and international affairs.

While no particular emphasis has been noted with respect to solid waste disposal site management, the Forum Secretariat does play a role in coordinating development activities to prevent duplication or a waste of resources. They are also involved in promoting cooperation between countries and organisations involved in economic development programs in the region.

(Source: Pacific Islands Forum Secretariat Web site [www.forumsec.org.fj](http://www.forumsec.org.fj))

It is therefore considered to be of substantial benefit for JICA to work in conjunction with the Forum Secretariat. This will enable JICA to ensure their aid money is well spent.

## **3.4 INTERNATIONAL ORGANISATIONS**

### **3.4.1 United Nations Development Program**

The United Nations Development Program (UNDP) is the implementing agency of GEF (Global Environment Facility).

#### **Activities**

Neither the UNDP nor GEF are currently undertaking any projects in the area of waste management in PICs although GEF are working with the USP to develop a regional project on POPs (Persistent Organochlorine Pollutants). This project was drawn up in 1999 but has not progressed significantly since.

From an organisation point of view, the UNDP indicated that they are moving away from capital works and focussing more on the issue of capacity building.

#### **Issues**

GEF emphasises sustainability. At the end of any project that GEF participates in, they make it clear that there is no guarantee or promise of ongoing funding following completion of the project. As such, new projects (Suva UNDP/GEF has 13 projects at a national level, not large regional projects) have built in financial sustainability. This is recognised as being difficult but integral to the projects.

UNDP believes that more coordination between donors would be useful when funding projects.

GEF consider that inadequate asset maintenance is a huge problem in PICs. GEF builds this into projects (renewable energy) by including training of local people to maintain the equipment. The UNDP are concerned that this isn't widely done by all donor organisations, thus setting a precedent of 'free aid' especially in the area of renewable

energy, which is not conducive to long-term sustainability ie. there is no need to maintain the equipment provided by donors as other donor organisations will provide a new one when this one breaks down.

GEF also raised the concern that while regional organisations often have in-house expertise there has to be a focus on the national/local level in terms of waste management. In-country capacity building is required if projects are to work successfully in the long-term.

While increasing specialist skills levels in a PIC is considered an ideal (by Egis); there are the recurrent issues of staff movements (away from positions for which they have training or into more highly paid areas) and sustainable funding which need to be first addressed. Furthermore, the low population base of these countries means that it is difficult to have specialists in all areas in the one country. It is therefore considered that building in-house specialist skills levels should be a long term rather than a short-term goal for the various agencies providing assistance to PICs.

### **3.4.2 United Nations Environment Program**

UNEP is the arm of the United Nations which aims to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations.

UNEP believes that an environmental agenda needs to be implemented that is integrated strategically with the goals of economic development and social well being - an agenda for sustainable development. The areas of concentration identified by UNEP globally include: environmental monitoring, assessment, information and research including early warning; enhanced coordination of environmental conventions and development of environment policy instruments; freshwater; technology transfer and industry; and support to Africa.

### **3.4.3 World Health Organisation**

#### **Activities**

The WHO is not an aid agency as such but provides technical assistance to developing countries. The most significant relevant activities of the WHO in the Pacific region relate to training. Any involvement, which the WHO may have with solid waste disposal site management, is more generally from a health perspective.

The WHO recognises that its role is mostly a reactive one as it is generally called in when there is a problem and do not really play a proactive role. The WHO's activities are mostly focussed around hospitals and concerns relating to public health. The WHO only provides infrastructure on a minor basis as well as some supplies and equipment.

The WHO undertakes a lot of work on trying to assist the various health departments to improve waste disposal site management. The WHO have produced reports with waste management considerations including the document "Healthy Cities – Healthy Islands, Document Series No. 6, *Guides for Municipal Solid Waste Management in Pacific Island Countries*", December 1996.

As noted, typically the assistance provided by the WHO is in a technical capacity only and the WHO do not typically provide funding, infrastructure or similar. It is noted that while such technical assistance is vital in improving waste management sites, the benefits will only extend so far if the other identified aspects of solid waste management (eg.

institutional arrangements, initial and ongoing funding etc.) are not considered and addressed.

### Issues

The WHO prefers to undertake in-country training and tries to keep training relevant.

With respect to environment or health standards, the WHO has indicated that they do not like to enforce particular standards on a country where they are undertaking works. But, the WHO does acknowledge that there is a need for some sort of standard to work to.

## 3.4.4 Asian Development Bank

### Activities

The Asian Development Bank (ADB) is a finance institution dedicated to reducing poverty in Asia and the Pacific. ADB does this by providing loans, technical assistance for projects, promoting and facilitating investment of public and private capital for development, and responding to requests for assistance in coordinating development policies and plans of its developing member countries

The ADB has projects in many of the Pacific Island countries with particular projects relating to waste management including:

- Facilitating sustainable and appropriate waste management practices in Rarotonga and Aitutaki, Cook Islands. This includes the construction of fully engineered landfill sites in Rarotonga and Aitutaki and the supply of operating equipment for each landfill as well as for recycling waste materials Aitutaki;
- Formulation of framework for urban planning and the environment in Vanuatu which will include capacity building in urban sanitation and environment;
- General environmental education and management as well as water supply and sanitation inputs into countries such as Kiribati, Federated States of Micronesia, and Republic of Marshall Islands.

Technical assistance provided by ADB is generally in the areas of:

- Capacity building;
- Infrastructure development;
- Reform programs;
- Skills development;
- Establishment of a Trust Fund for Outer Island Development;
- Other sector development.

During 1998, ADB provided 25 technical assistance grants for a total of \$16.57 million (presumed to be US\$). Some \$63.7 million in loans was provided from the Asian Development Fund (ADF) resources.

### **3.4.5 World Bank**

The World Bank is the world's largest source of development assistance. It uses its financial resources, highly trained staff, and extensive knowledge base to help each developing country onto a path of stable, sustainable, and equitable growth in the fight against poverty.

The World Bank provides project finance to eligible member countries in order to support country strategies and overall development goals. Project funds are also contributed by the country government, the private sector, and partners. The specific role of World Bank funding is to catalyse initiatives with high development impact, which might otherwise not be invested in.

The World Bank has not been particularly active in recent years in financing urban infrastructure and services in the Pacific. The most recent relevant project was a solid waste disposal site for Port Vila, Vanuatu (mid 1990's). Ongoing operation of the facility has been difficult with identified problems of equipment operation and maintenance.

The World Bank recognises the difficulties with waste management, particularly with respect to acquiring suitable land from landowners as well as the lack of attention paid to proper design and site operation.

### **3.4.6 Food and Agriculture Organisation**

The Food and Agriculture Organisation (FAO) of the United Nations was founded in 1945 with the aim of raising levels of nutrition and standards of living, to improve agricultural productivity, and to better the condition of rural populations. The FAO focuses its activities in the area of agriculture, forestry, fisheries and rural development.

#### **Activities**

While the FAO currently are not undertaking any specific activities relating to waste disposal sites, other relevant activities in the Pacific Region include:

- Dealing with the pesticide register (old pesticides, agricultural chemicals). It is noted that the FAO did not participate in the POPs study as they had already commenced their own study (the POPs report was more broad anyway);
- The FAO has offered to review quarantine legislation and bring it up to IPPC and STO requirements/standards;
- In general, activities include education, recordings, projects related to food, educating farmers (eg. with respect to compost).

#### **Issues**

FAO have adopted an approach (eg in food projects) of trialing activities on a small scale and when proven to be successful, it is expanded to a bigger project.

### **3.4.7 Other**

A number of other international organisations play a role in environmental issues in the Pacific region including WWF (World Wide Fund for Nature), IMO (International Maritime Organisation) and Greenpeace. IMO is a UN agency, similar to UNEP, FAO and WHO,

and has a major role in the SPREP program in relation to ship wastes. Greenpeace have input in pesticide management and also in the development composting toilets.

### **3.5 SUMMARY**

#### **3.5.1 Activities**

In summary, a number of specific solid waste disposal site management projects are currently being undertaken by various agencies in PICs through:

- EU input to new landfill outside Suva, Fiji;
- EU input to new landfill in Vava'u, Tonga;
- JICA input to solid waste management in Samoa;
- AusAID input to a landfill project in Niue (as part of sanitation project);
- AusAID input to new landfill in Tuvalu (as part of sanitation project);
- AusAID input to new landfill on Tongatapu, Tonga (as part of the Tonga Environmental Planning and Management Strengthening Project);
- AusAID input into composting trials to be undertaken in villages in Tonga;
- USEPA / US Dept. of Agriculture input to solid waste management works in Majuro, RMI (possible landfill reconstruction and incinerators). Works (in Majuro) are to be funded by the Rural Utilities Service (part of the Dept. of Agriculture).
- ADB input to fully engineered landfill sites in Rarotonga and Aitutaki, Cook Islands;

In addition, there are various agency inputs to waste awareness and education programs as well as a general consideration of recycling and composting activities in various countries throughout the Pacific.

#### **3.5.2 Issues**

##### **General**

All organisations had some comments on the issue of sustainability and how best to go about achieving such in the delivery of aid. This included comments about the difficulties with recurrent cost financing, asset maintenance and environmental and safety standards (less so). The issues raised are summarised in the following sections.

##### **Recurrent Cost Financing**

Recurrent cost financing for ongoing operation and maintenance has often been an issue encountered by most organisations. In many cases, the lack of recurrent cost financing has meant that the moment the input of the agency ceases (eg. the provision of infrastructure), the lack of ongoing funding has meant that the infrastructure is operated until it breaks down and the equipment then becomes unserviceable / inoperable.

This issue has been addressed by a number of agencies through total project planning to ensure project sustainability. Example approaches of this are as follows:

1. Do nothing but provide the aid and hope the recipient government takes responsibility for the resulting infrastructure / facility / equipment;
2. Require the recipient Government to sign an MOU that requires them to commit to maintaining ongoing finance for the proper operation and maintenance of the infrastructure / facility / equipment;
3. Require the recipient Government to contribute part of the costs either through direct funding or provision of services for part of the project (eg Suva landfill). This will hopefully promote greater ownership of the resulting infrastructure / facility / equipment and a greater reluctance to allow the infrastructure / facility / equipment to be neglected;
4. Assist the recipient Government to set up an arrangement / system for them to obtain on going funding (eg. through taxes, charges, fees, government allocation) for the proper operation and maintenance of the infrastructure / facility / equipment. This will also likely require assisting the recipient government to establish the appropriate institutional and administrative arrangements, but this will also ensure appropriate management of the project.

Both of the approaches nominated in options 3 and 4 require significant ownership of the project by the recipient country. Greater ownership and responsibility by the aid recipient are considered to be highly beneficial in any project and a significant factor in ensuring project sustainability in regard to recurrent funding. The down side of these options is that they may require additional time and resources to be spent by the providing organisation which in turn may have serious implications throughout the course of a project. This may mean that such options are not possible, however Option 2 is also considered a viable alternative. Unfortunately if the aid recipient lacks the backing and experience to implement changes and provide ongoing funding, an MOU may have been signed with the best of intentions but without the capacity to honour it.

#### **Asset Maintenance**

An issue directly related to the above issue of recurrent funding is the problem encountered with asset maintenance. While problems with asset maintenance may be the result of problems of resourcing / financing, it has also been noted that often asset maintenance problems may be due to a lack of skills / knowledge / experience and equipment to properly operate and maintain the asset / equipment, and the difficulty of obtaining spare parts. All agencies spoken to have generally recognised this and try to ensure that appropriate training, maintenance equipment, and critical spare parts accompany the provision of any equipment or infrastructure (although training is a major issue as discussed below). Furthermore, it was generally agreed that assets / equipment must be appropriate for the conditions in which they are to operate. In many cases donated equipment items have been deemed unsuitable for the sometimes harsh climatic (or operational) conditions of PICs.

In conclusion, it is generally recommended that prior to the provision of any assets / equipment that the providing organisation assess 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.

### **Environmental and Safety Standards**

The decision of appropriate environmental and safety standards to adopt on various projects is a common issue faced by organisations providing assistance to PICs. In the absence of environmental standards in the developing country, the organisation is left to determine what standards should be applied to a project. National donor organisations typically have established safety and environmental standards in their home country but these are generally seen as being much more stringent and are often not appropriate or affordable (sustainable) in developing countries.

By applying the environmental standards of a donor country or internationally recognised standards can mean that the cost of a project becomes prohibitively expensive and the recipient country is not able to afford to properly operate and maintain the facility / equipment. For example, some European landfills are very highly engineered to absolutely ensure no impacts on nearby residents or the environment (groundwater, surface water etc.). To build a similar landfill in a developing country would significantly exceed the budget available from a donor organisation and hence the project would not be undertaken at all and the existing very poor waste disposal operation would continue.

Most of the organisations spoken to during this study seem to take a pragmatic approach to this issue. Environmental impacts are always considered in the design and implementation of a project, and typically a project will be given the approval to go ahead so long as there is an overall net environmental benefit ie. the environmental situation is improved over the existing situation. This may occur even though the standards applied on the project may not necessarily meet home country or international standards. The project is seen as a step toward to achieving the higher standards. For example, a new landfill in Samoa, which does not have a double or triple liner as required in the US or Europe but does have a clay liner, will significantly reduce the potential for contamination of surface water and groundwater relative to the current situation.

NZ ODA personnel indicated that any project could be 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.

The possibility of developing environmental standards for the Pacific region was discussed with a number of organisations. While there was general support for the idea, it was recognised that given the diversity of the countries it would be difficult to gain agreement on such a set of standards.

The provision of infrastructure is typically assessed under the existing guidelines of the donor organisation. Generally the provision of aid will usually lead to an improvement on the existing situation and will lead to an improvement in environmental quality (although we stress that this should always be assessed as part of the planning and design of a project). The adoption of lower environmental standards on an aid project (compared to standards in developed countries) can therefore be seen as a step in any developing country's development process. This could be defended on any project by outlining the staged development (process, time lines, inputs, outputs etc.) to achieve final (international?) environmental standards.

It is recognised that aid projects are typically undertaken within well-defined economic constraints. It is therefore recommended that any aid projects relating to the improvement of solid waste management sites adopt a staged approach as described in **Section 4**, which will progressively result in an improvement in the management and environmental performance of the waste disposal site, as funding becomes available. If aid funding can be obtained to more rapidly improve the existing waste disposal situation then this should occur, and the recipient Government should ultimately decide what environmental or safety standards they should adopt by considering all relevant local issues.

### **Training / Human Resources**

Extensive training is undertaken by various agencies throughout PICs. Training ranges from individual scholarships at foreign universities to local group training that is project focussed. A common problem encountered is that following completion of the training the people involved in the training (typically from the recipient government) move on to another government department or potentially even leave the country and do not therefore fully utilise or pass on the training they have received.

This problem has been addressed by a number of organisations through "technical backstopping". It has been found that by training a group of people from a group or government division will ensure that if one person moves on, there are still people with the new technical capability. Some organisations have accepted that with the low populations of the Pacific Island countries, the issue of retaining staff will always be difficult.

A further problem encountered with training is in ensuring it is relevant, undertaken by the right people and that the training is put into practice. One organisation (SPC) has, on occasions, adopted an approach of training someone and then following up on the training 6 months later. The trainee is not certified as having completed the course until the aid agency (or trainer) has assessed the trainee as having practically applied the skills learnt in the course.

Training which is held close to the source has also been identified as ensuring that the course stays practical and relevant to Pacific Island issues.

Many organisations continue to provide wide spread training (to nominated / targeted candidates) in the hope that in the long term the training will filter through government departments and a high level of education will exist within the appropriate departments. To prevent the loss of human resources / valuable education, a number of methods have been identified which may make this more effective including:

- Ensuring training is long term and applicable by reassessing course attendees after a nominated period (6 – 12 months) to assess their use of the course work in their workplace. Satisfactory completion of the course is only acknowledged at this time.;

- Undertake in-country training – training at the source;
- Undertake training of a number of people from the relevant organisation(s) in the recipient PIC so that if a person leaves, they don't take all the knowledge with them;
- Training in the operation and maintenance of new assets / equipment should always be provided as part of the project.

As identified in **Section 2.10** it is considered that there is a need for training 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 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.

### **Institutional Issues**

Institutional issues, which apply to waste management in PICs, are similar to the institutional issues, which apply in other areas. Institutional functioning could be improved by assessing and implementing recommendations for the following:

- Legislation that is up-to-date and appropriate for the country with accompanying policies and regulations that can be relatively easily modified (e. g. the level of fines)
- Regulation enforcement could be strengthened by having fewer but better trained enforcers, increased fines and ensuring that "examples " of regulation infringement were successfully prosecuted and publicised.
- Operation and management of the waste management function should be a core function of the Department within which it is located. These functions should be located in one Department only and monitoring of the function should be located outside the Department with responsibility for operations
- Planning and monitoring of waste management needs to be coordinated by one Department. Planning should involve key stakeholders in a consultative process. An up-to-date database should be maintained as part of the planning and monitoring operations and it may be necessary to "buy in" high level expertise from time to time to assist with planning and data collection
- Waste management operations should be funded on a cost recovery/fee for service basis with provision of subsidy from the government to ensure equity.

## **4. RECOMMENDED APPROACH TO IMPROVING LANDFILL WASTE DISPOSAL IN PACIFIC ISLAND COUNTRIES**

### **4.1 GENERAL**

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).

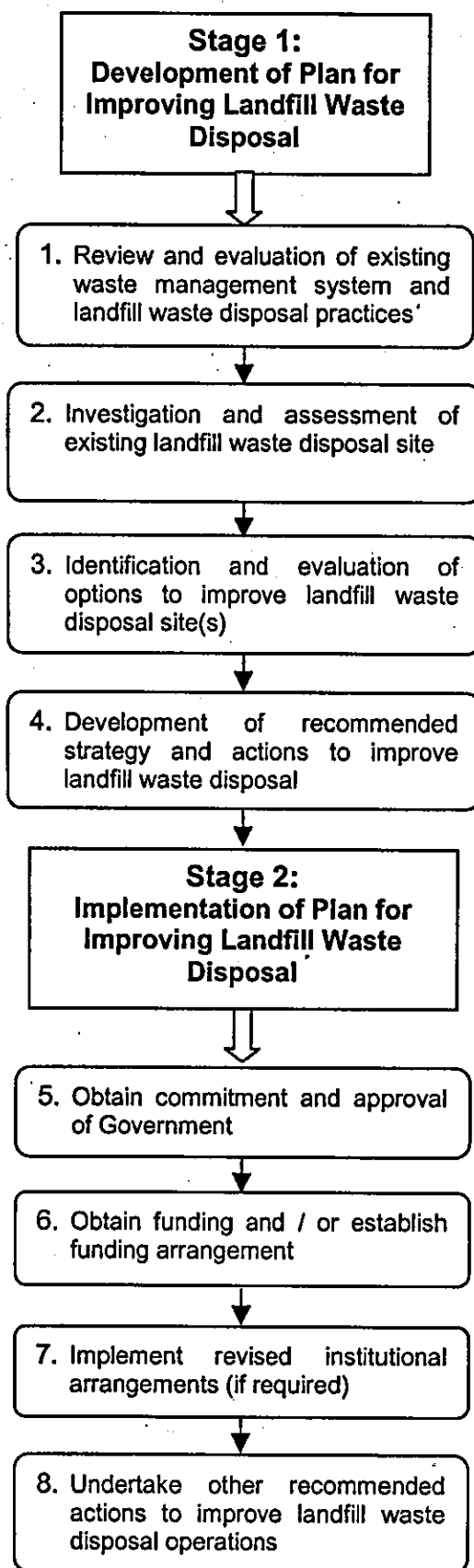
Many problems associated with the existing poor waste management situation in PICs stem from a lack of funding and effective institutional arrangements to change the situation. These two problems need to be addressed and overcome (ideally before taking further steps) if there is to be a long term and 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 4.1**. An outline of the recommended 2 staged approach is contained in this section. Details of specific steps in the process are provided in the Guidelines and summarised in the **Section 5**.

It will be necessary to identify and appoint a lead Government agency and lead person(s) to drive the process to prepare and implement the plan to improve landfill waste disposal. The lead agency will differ from country to country, however, it is suggested that the lead agency form a small working group that comprises representatives from relevant PIC Government agencies to guide the process. The objective of this action is to involve all relevant government agencies in the preparation of the Plan, and thus develop a broad ownership of the plan, and to draw on all available relevant expertise, which in PICs is often spread across several Government agencies. It is desirable to have persons within the working group with relevant expertise / experience who can address the following:

- Effecting institutional change / optimising existing institutional arrangements, if required;
- Funding arrangements for implementing the plan eg. from Government and / or donor agencies, and from self-funding mechanisms eg. charges and fees for services;
- Obtaining approvals for the plan and any subsequent works
- Engineering design and construction, for any required upgrading works;
- Management and operation of a sanitary landfill waste disposal site;
- Public health issues related to landfill waste disposal operations; and



**Figure 4.1 :**  
**Recommended Approach to Improving Landfill Waste Disposal in Pacific Island Countries**

- Environmental issues related landfill waste disposal operations.

It would be beneficial for PICs to obtain the assistance of a donor agency that can provide funding and / or technical expertise to develop and implement the plan.

#### **4.2 STAGE 1 – DEVELOPMENT OF A SPECIFIC PLAN TO IMPROVE LANDFILL WASTE DISPOSAL**

Development of a specific plan to improve landfill waste disposal should encompass the following:

1. Undertake a review and assessment of the existing waste disposal situation ie. relevant government policies and plans, legislation, regulations, institutional arrangements, as well as existing waste collection and disposal practices – to obtain a complete understanding of the current situation and determine existing problems, issues and possible barriers to improving landfill waste disposal;
2. Undertake an investigation and assessment of existing landfill waste disposal activities, including institutional arrangements and funding as well as site location(s), management and operations;
3. Identification and evaluation of options to improve landfill waste disposal, including options for:
  - Improving institutional arrangements / overcoming institutional problems;
  - Establishing a mechanism for sustainably funding waste management 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).
4. Development of a recommended strategy and actions for improving landfill waste disposal;

The above activities are described in some detail in the Guideline document and are summarised in **Section 5**.

The resulting Plan to improve landfill waste disposal should include the following:

- A description of the existing situation, including existing problems, issues and possible barriers to improving landfill waste disposal;
- A description of any proposed changes in institutional arrangements, including a clear definition of the roles and responsibilities of the various stakeholders / parties eg Government agencies;
- A description of the proposed funding mechanism, including estimates of the capital and ongoing operating and maintenance costs;
- A recommended strategy and specific actions to improve landfill waste disposal ie. measures to upgrade the existing operation or establish a new waste disposal facility;

- An implementation program, including a clear definition of the roles and responsibilities of the various Government agencies and other stakeholders;

### **4.3 STAGE 2 - IMPLEMENTATION OF THE PLAN TO IMPROVE LANDFILL WASTE DISPOSAL**

Implementation of the Plan to improve landfill waste disposal activities will differ from country to country but will generally involve the following:

5. Obtaining the commitment and approval of the PIC Government for implementation of the proposed Plan;
6. Obtaining funding (from Government and / or donor agencies) and / or establishment of a self-sustaining funding mechanism eg. fees and charges, for implementation of the Plan;
7. Establishment of revised institutional and legislative arrangements, if required; and
8. Implementation of other recommended activities / actions to improve landfill waste disposal activities, which may encompass obtaining various other approvals eg. development approval, undertaking environmental studies, engineering design, and construction.

As the above process will vary from country to country the Guideline has focused on Stage 1 – development of a specific plan for improving landfill waste disposal.

## **5. MEASURES FOR IMPROVING SOLID WASTE DISPOSAL SITES**

### **5.1 GENERAL**

There is a wide range of measures 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 to improve the situation at that landfill waste disposal site. A recommended approach to developing and implementing a specific plan to improve a solid waste disposal site in a PIC is described in **Section 4**. The following sections outline the recommended measures to improve landfill waste disposal sites in PICs. Further details are provided in the Guidelines.

### **5.2 INVESTIGATION AND ASSESSMENT OF THE EXISTING WASTE MANAGEMENT SYSTEM AND LANDFILL WASTE DISPOSAL ACTIVITIES**

#### **5.2.1 General**

The investigation and assessment of the existing waste management system and landfill waste disposal activities should encompass the following 3 aspects:

- i) Institutional arrangements;
- ii) Funding; and
- iii) Landfill site location(s), management and operations.

The objective of the investigation and assessment process is to obtain a thorough understanding of the existing situation and to identify existing problems, issues and possible barriers to improving landfill waste disposal operations.

Further details of the investigation and assessment tasks are provided in the Guidelines.

#### **5.2.2 Opportunities for JICA Assistance**

JICA could assist PICs to identify the problems and issues with existing landfill waste disposal sites, and to identify potential barriers to improving the situation by providing the following:

- Technical Assistance (TA) to undertake a detailed review of the existing waste management situation;
- TA and funding to investigate and assess existing landfill waste disposal sites;
- TA and funding to undertake solid waste disposal surveys, where required.

Countries (larger urban centres) where it is suggested that JICA could provide the above assistance include Kiribati (South Tarawa), Federated States of Micronesia (Kosrae, Chuuk), Marshall Islands (Majuro, Kwajalein), Samoa (Apia, Savai'i), Fiji (Lautoka/Nadi), PNG (Port Moresby), and Vanuatu (Luganville).



## 5.3 IMPROVING INSTITUTIONAL ARRANGEMENTS

### 5.3.1 General

Commonly legislation and institutional arrangements for waste management in PICs are not the most effective. Typical problems include:

- Lack of, or inadequate and outdated legislation and regulations, which do not address current issues;
- 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.

The Guidelines describe a suggested process for improving institutional arrangements so as to improve the landfill waste disposal operation. The objective of the process is to identify the most appropriate agencies to undertake the various waste management activities and to develop and implement a plan to change the existing situation.

The assessment of the roles and responsibilities of the various agencies should consider each component of the waste management system and the following factors:

- The resources / personnel available– number of and qualifications / knowledge / skills / expertise of the available personnel;
- Available equipment;
- Available funding;
- Training requirements;
- Capacity to collect and manage fees / funding for the provision of waste management infrastructure and services; and

- The involvement of the private sector, eg. in waste collection or operation of the landfill waste disposal site.

The results of the review of the existing waste management situations in most of the PICs indicate that where the local government undertakes waste management activities the system appears to work better. Possible reasons for this include:

- Waste management is a core activity of local government. As a result waste management is not competing with health, education or public works (roads) for funding;
- Local government has its own source of funds (property rates), independent of central government, which it controls. Funding priorities are generally determined on local issues such as waste management.

**The most effective institutional arrangements for waste management will differ from country to country depending on many factors. The best people to determine what is the most effective institutional arrangement in a particular PIC are representatives from the relevant Government agencies, under the guidance of an independent party. Figure 5.1 shows the institutional arrangement proposed to be adopted in the Kingdom of Tonga for operation of the proposed new integrated waste management facility.**

The Guidelines also outline some options for addressing some of the common institutional problems in PICs.

### **5.3.2 Opportunities for JICA Assistance**

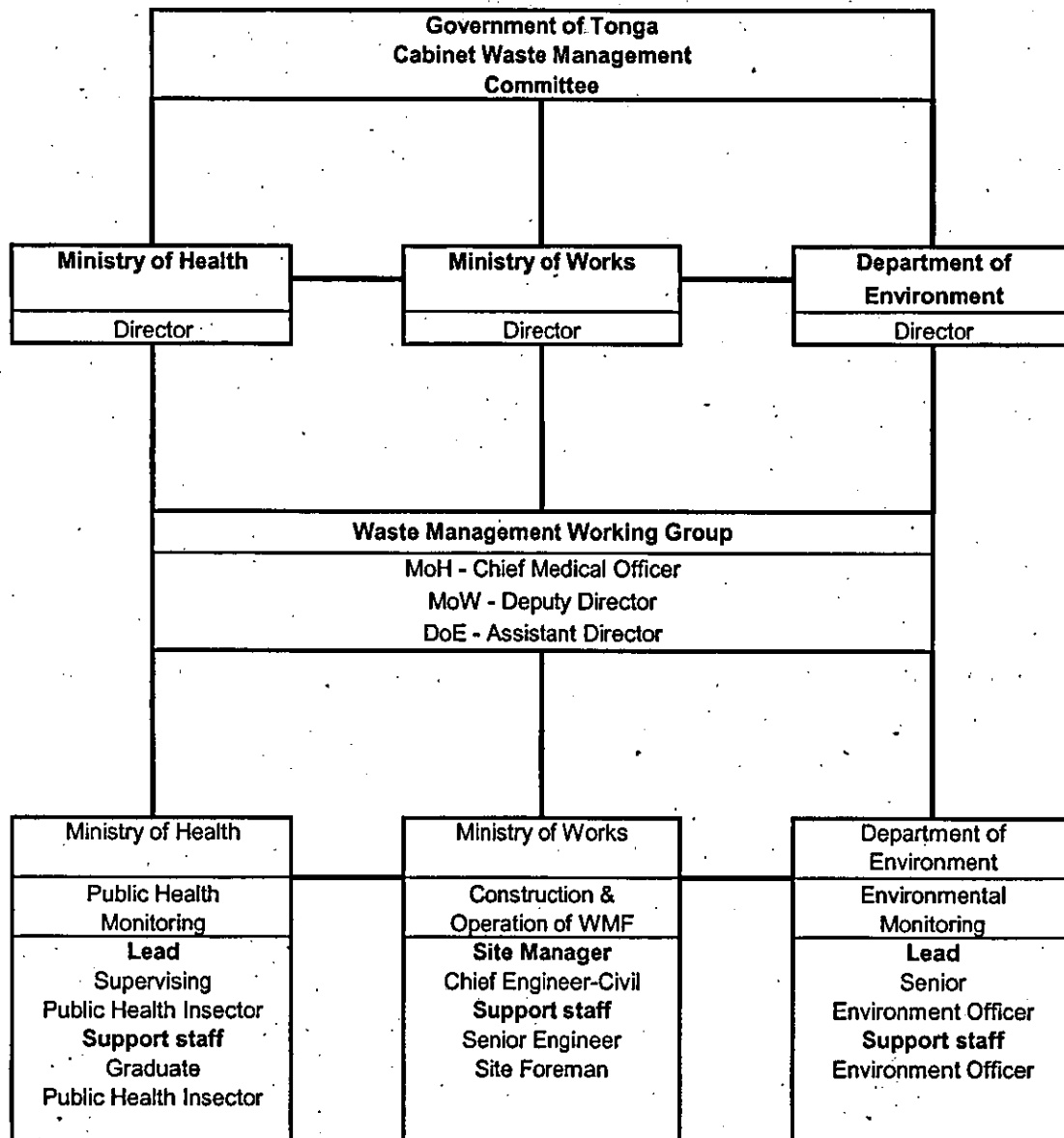
JICA could assist PICs to improve existing institutional arrangements in relation to waste management and landfill waste disposal by providing Technical Assistance (TA) to determine and establish the most effective institutional arrangements for waste management. Specific tasks could include:

- assisting PIC Governments to develop draft enabling legislation addressing waste management;
- developing or updating accompanying regulations; and
- determining the best organisational structure and working arrangements to facilitate implementation of waste management improvement programs.

Such TA would need to be provided by individuals who had a working knowledge of relevant legislation (waste management, public health and environmental), working knowledge of the existing waste management systems and practices, a strong command of English (preferably as a first language), experience in PICs, and the ability to work in partnership with counterparts in PICs.

The completion of this TA and demonstration of commitment by partner PIC governments by enacting legislation and regulations and providing resources to implement such will contribute to the sustainability of subsequent waste management projects in PICs.

Countries (larger urban centres) where it is suggested that JICA could provide the above assistance include Kiribati (South Tarawa), Federated States of Micronesia (All states



**Figure 5.1  
Proposed Management and Operation Structure  
Tapuhia Waste Management Facility**

capitals) Marshall Islands (Majuro, Kwajalein), Samoa (Apia), Tonga (Tongatapu), Fiji (Lautoka/Nadi), and the Solomon Islands (Honiara).

## **5.4 IMPROVING FUNDING OF WASTE DISPOSAL ACTIVITIES**

### **5.4.1 General**

Commonly in PICs waste management services are provided free of charge or for a minimal fee and funding for waste management activities is obtained direct from government revenue. This is particularly the case in regard to waste disposal. The rationale behind the provision of a free service is the fear of widespread littering and dumping of waste if charges are imposed. However, a consequence of this decision is a lack of sufficient funding for waste management activities, particularly in regard to the provision of new infrastructure and equipment. A lack of funding is one of the primary causes of the current poor existing waste management situation in most PICs.

Development of a sustainable funding mechanism for waste activities is critical to the successful and sustainable provision of waste management infrastructure and services. Sufficient funding needs to be obtained for all aspects of waste collection and disposal including:

- Provision of garbage bins (desirable);
- Waste collection and transportation, including equipment replacement costs;
- Landfill site upgrading or establishment of a new facility, including capital works, equipment, and training;
- Operation of the Landfill Waste Disposal site, including:
  - Site staffing / labour costs;
  - Equipment costs – purchase, operation, maintenance and replacement costs;
  - Cover material costs – onsite extraction or importation of suitable material;
  - Public health and environmental management costs, including leachate management costs;
  - Monitoring costs – public health and environmental monitoring;
  - Ongoing maintenance costs;
- Landfill site closure and rehabilitation costs ie. capping and revegetation; and
- Landfill post closure management and monitoring costs – possibly for more than 20 years.

However, it should be recognised that many PICs will not be able to afford to purchase and operate modern waste collection vehicles or to operate a modern, integrated waste management facility that incorporates an engineered sanitary landfill waste disposal site. It is necessary to determine what standard of waste management infrastructure and services a PIC can realistically afford and then

develop a funding mechanism that will generate the revenue required to fund the selected services.

The Guidelines outline a range of options for improving the funding of waste disposal activities (direct and indirect) as well as provide examples of how to determine sustainable fees for waste collection and disposal activities, and identify some of the issues that need to be addressed if fees for services are to be implemented.

## **5.4.2 Opportunities for JICA Assistance**

The authors of this document are not aware of any PIC currently charging fees or recovering revenue to sustainably operate a reliable waste collection service or a sanitary landfill waste disposal site. Although there is a move to implement charges for waste management services, many PICs still fund waste management activities from government revenue. In addition, where charges have been imposed often there is no basis for the charges ie. they have not been based on the standard of landfill they wish to establish / achieve. Consequently there is an opportunity for JICA to provide Technical Assistance to PICs to develop and implement a sustainable funding mechanism for the provision of waste management services. Such TA could be provided to all PICs (perhaps excluding Tonga). Depending on the PIC, the scope of TA could include:

- Determining the capital and operating costs of the desired standard of waste disposal site;
- Determining the capital and operating costs of the desired standard of waste collection service; and
- Determining the fees necessary to sustainably fund the desired waste disposal site and waste collection service;

Alternatively, the TA could assist a PIC to determine what standard of waste disposal site and waste collection services it can afford.

Countries (larger urban centres) where it is suggested that JICA could provide the above assistance include Kiribati (South Tarawa), Federated States of Micronesia (All states capitals) Marshall Islands (Majuro, Kwajalein), Samoa (Apia), Tonga (Vava'u), Fiji (Lautoka/Nadi), Tuvalu (Funafuti), and the Solomon Islands (Honiara).

## **5.5 IMPROVING THE PLANNING, MANAGEMENT AND OPERATION OF EXISTING LANDFILL WASTE DISPOSAL SITES**

### **5.5.1 General**

Upgrading an existing landfill waste disposal site can be an expensive and technically challenging process. Every landfill waste disposal site / operation is different. There will be different issues and constraints to address, and consequently it is necessary to develop of a specific plan for upgrading a particular landfill waste disposal site / operation.

Common problems with existing landfill waste disposal operations in PICs include:

- **Lack of funding** to effectively operate the waste disposal site;

- **Lack of planning the landfill waste disposal operation**, including a lack of the data necessary to plan the landfilling operation ie. types and quantities of solid waste to be disposed of;
- **Lack of suitable resources** for undertaking the landfilling operation, environmental management, monitoring or regulation of the activities.
- **Lack of knowledge and (hands on) experience** in sanitary landfilling operations. This includes all levels of personnel: managers, supervisors and equipment operators;
- **Lack of equipment** (to compact and cover waste materials) and support systems eg. for maintenance.
- **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).
- A large number of small, uncontrolled / informal dumping grounds;
- **Lack of management and supervision** of the landfill waste disposal operations, which is often due to the institutional problems and / or lack of funding;
- **Lack of health and environmental management measures** at the site, 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.

- **Unsafe / poor management of special wastes** eg. medical waste, septage / sludges, highly degradable and odorous waste eg. offal, food processing wastes
- **Increasing quantities of waste materials** requiring local management / disposal, particularly imported packaging materials and vehicles, which are consuming scarce landfill waste disposal space. This is particularly an issue for small, highly populated atolls such as South Tarawa (Kiribati) and Majuro (RMI);

The first step to improve a landfill waste disposal site is to review the existing waste management situation as well as the existing and landfill waste disposal site in some detail (see **Section 3 of the Guidelines**).

The next step is to identify and establish the most effective institutional arrangements and to identify and establish the necessary funding arrangements (see **Sections 4 & 5 of the Guidelines**). This step is essential to ensuring the success of any upgrading works /

activities at the landfill waste disposal site. **An important aspect of this step is to determine what standard of waste management infrastructure and services the PIC can sustainably afford. This includes the standard of the landfill waste disposal site.**

Once the financial constraints are determined a plan to improve the landfill waste disposal site can be developed. **The plan should reflect the funding available – both for capital works and for operations - and could encompass a number of stages - as available funding increases.**

The Guidelines outline the following:

- The recommended process for developing and implementing a plan to upgrade an existing landfill waste disposal site. To ensure ownership of the Plan by the PIC, the Plan should be prepared by the relevant agency in the PIC ie. that agency responsible for operating the waste disposal site, with the assistance of a suitable expert. The expert should have relevant experience in the design, construction, management and operation of landfill waste disposal sites in developing countries;
- A recommended 4 stage process for upgrading an existing landfill waste disposal site, as funding becomes available, encompassing the following:
  - i) Improving control over the landfill waste disposal operation (***uncontrolled dumping to controlled tipping***);
  - ii) Developing a basic plan for the landfilling operation and establishing sanitary conditions at the waste disposal site (***controlled tipping to basic sanitary landfill***). Generally the focus of this stage is on reducing public health risks by establishing and maintaining sanitary conditions at the waste disposal site;
  - iii) Developing and implementing a management and operation plan for the landfill waste disposal site that incorporates basic public health and environmental management and monitoring measures (***basic sanitary landfill to improved sanitary landfill***). Generally the focus of this stage is on introducing measures to control / reduce environmental impacts.
  - iv) Developing and implementing a management and operation plan for the landfill waste disposal site that incorporates comprehensive public health and environmental management and monitoring measures (***improved sanitary landfill to modern engineered sanitary landfill***). Generally the focus of this stage is on improving measures to control / reduce and monitor environmental impacts.
- The details of each of the 4 stages of the upgrading process.

For further details see the Guidelines.

## **5.5.2 Opportunities for JICA Assistance**

### **Investigation and Assessment of Existing Landfill Waste Disposal Activities**

JICA could assist PICs to identify the problems and issues with existing landfill waste disposal activities, and to identify potential barriers to improving the situation by providing the following:

- Technical Assistance (TA) to undertake a detailed review of the existing waste management situation;
- TA and funding to investigate and assess existing landfill waste disposal activities / sites;
- TA and funding to undertake solid waste disposal surveys, where required.

Countries (larger urban centres) where it is suggested that JICA could provide the above assistance include Kiribati (South Tarawa), Federated States of Micronesia (Kosrae, Chuuk), Marshall Islands (Majuro, Kwajalein), Samoa (Apia, Savai'i), Fiji (Lautoka/Nadi), PNG (Port Moresby), and Vanuatu (Luganville).

### **Stage 1 – Improving Control over the Landfilling Operation**

JICA could assist PICs in this first stage of upgrading a waste disposal site by providing the following:

- TA to assist with the identification and development of sustainable mechanism for funding waste disposal activities, if required;
- TA to assist with the development and implementation of the improvement measures;
- Funding for the necessary capital works to improve the waste disposal operation eg:
  - Upgrading the site access road;
  - Site fencing and gate;
  - Gatehouse / shelter;
  - Trenches, bundwalls, gabion walls for containing the deposited waste;
- TA to develop and implement the necessary community education and staff training programs;
- Provision of funding for the community education and staff training programs;

Commitment of the PIC government to the process of upgrading waste disposal operations is essential to the success of any assistance JICA may provide. Of particular importance is the allocation of funding for personnel to supervise the waste disposal operation. It is recommended that JICA require such a commitment from PIC governments as part of the agreement to provide assistance.

Countries (urban centres) where JICA could provide the above assistance include South Tarawa (Kiribati), FSM (possibly excluding Pohnpei), and Savai'i (Samoa).

### **Stage 2 – Developing a Basic Plan and Establishing Sanitary Conditions**

JICA could assist PICs to upgrade existing landfill waste disposal sites to a basic sanitary landfill by providing the following:

- Funding to undertake a detailed topographical survey of the defined landfill waste disposal sites;



- TA to assist with the development and implementation of a basic plan for a sanitary landfill waste disposal site, including assistance on funding options / mechanisms;
- Funding for capital works eg.
  - Upgrading the site access roads;
  - Site fencing;
  - Gate house / shelter;
  - Establishment of defined waste disposal cells eg trench excavation, rock filled gabion walls / barriers;
  - Surface water drainage works;
  - Litter control fencing;

It is recommended that JICA require recipient PIC countries to allocate adequate, ongoing funding for the operation and maintenance of the waste disposal site prior to undertaking the above works;

- Provision of suitable landfilling equipment, a storage / maintenance shed, maintenance equipment and training. It is recommended that JICA require recipient PIC countries to allocate adequate, ongoing funding for the operation and maintenance of the landfilling equipment prior to providing the equipment;
- Provision of suitable equipment to shred garden / wood waste and training. It is recommended that JICA require recipient PIC countries to allocate adequate, ongoing funding for the operation and maintenance of the landfilling equipment prior to providing the equipment;
- TA to provide the following training:
  - Landfill planning and design – waste disposal site managers and supervisors;
  - Landfill management and operations – waste disposal site managers and supervisors;
  - Operation and maintenance of the landfilling equipment, including hands on training in effective spreading, compaction and covering of landfilled waste;
  - Operation and maintenance of the garden waste / wood waste shredding equipment
- TA and funding to develop and implement a community education program addressing:
  - The upgraded landfill waste disposal site;
  - The fees for disposal of waste, if required;
  - Littering and indiscriminate dumping of waste;

Countries (urban centres) where JICA could provide the above assistance include:

- All those identified previously, which also require Stage 1 upgrading; and
- Majuro (RMI), Lautoka and Nadi (Fiji), Port Moresby (PNG), Apia (Samoa), and Honiara (Solomon Islands);

### **Stage 3 – Upgrading to an Improved Sanitary Landfill**

JICA could assist PICs to upgrade existing landfill waste disposal sites to an improved sanitary landfill by providing the following:

- TA and funding to undertake a detailed assessment of the landfill site;
- TA and funding to prepare a basic management and operation plan for the landfill site;
- TA and funding to improve improvement environmental management and monitoring measures at the site
- TA and funding to develop and trial leachate management measures at landfill sites on atoll islands;
- Funding for installation of a weighbridge;
- TA and funding for further training and education programs for relevant PIC government personnel.

All PICs could benefit from the above assistance, perhaps excluding those urban centres where similar projects are already being undertaken eg. Tongatapu (Tonga), Suva (Fiji), Funafuti (Tuvalu) and Rarotonga (Cook Islands).

### **Stage 4 - Upgrading to a Modern Engineered Sanitary Landfill**

JICA could assist PICs to upgrade existing landfill waste disposal sites to a modern, engineered sanitary landfill site by providing the following:

- TA to assess the financial viability / sustainability of undertaking this stage of upgrading a landfill site;
- TA to upgrade the Management and Operation Plan, including the engineering design drawings, specifications for the works, cost estimate, and operation and maintenance procedures, schedules and checklists;
- TA and funding to implement the upgraded Management and Operation Plan, including construction and commissioning of the additional upgrading works
- Training of relevant PIC Government personnel in management and operation of the waste management facility, particularly in regard to the leachate management system – site manager, site supervisor, equipment operators, other site staff;
- Funding for fire fighting equipment, including training in the use and maintenance of the equipment;

- TA and funding to assist PIC implement environmental monitoring programs for landfill waste disposal sites, including provision and equipment and training of relevant personnel;

All PICs could benefit from the above assistance, perhaps excluding those urban centres where similar projects are already being undertaken eg. Tongatapu (Tonga), Suva (Fiji), Funafuti (Tuvalu) and Rarotonga (Cook Islands).

## **5.6 DEVELOPMENT OF A NEW LANDFILL WASTE DISPOSAL SITE**

### **5.6.1 General**

In some circumstances it may not be feasible to upgrade an existing landfilling operation or it may be less costly to establish a new landfilling operation at a new site. However, finding a site to establish a new landfilling operation is often more difficult in a PIC than a highly populated developed country. Reasons for this include:

- Lack of land, particularly on smaller, highly populated atoll islands such as South Tarawa (Kiribati) and Majuro (RMI);
- Native land ownership arrangements, which make it very difficult to resume, lease or purchase land. In most PICs land is generally owned by the traditional landowners, who have complete control over the land. Often the government only owns / controls a small proportion of the land (<20%). And commonly this includes the land below the high tide water level (this is one of the reason why many landfills are located on the reef flat); and
- NIMBY (Not In My Back Yard) syndrome - nobody wants a "dump" next door – due to a history of uncontrolled waste dumping operations that regularly catch fires and attract vermin and insects.

The Guidelines outline a typical process for establishing a new landfill waste disposal site. The most difficult step in the process is obtaining the identified site and the initial approvals to proceed with the development. This can take a lot of time and requires the commitment and support of the PIC government (and the majority of politicians), and extensive consultation with and education of the community (this includes the politicians).

### **5.6.2 Site Selection Issues**

When undertaking a process to locate a new landfill waste disposal site in a PIC the following issues need to be considered and addressed:

- Native land ownership arrangements;
- Not In My Back Yard (NIMBY) syndrome;
- On small atoll islands there are a number of additional issues that need to be considered at the site selection stage;
  - Often the groundwater is the primary source of drinking water. Consequently, locating a landfill over the drinking water should be avoided;
  - The limited amount of dry that can be spared for waste disposal activities;

- The geological / hydrogeological setting ie. very permeable sandy soils, no clay soils, a high groundwater table (<2m deep) and therefore limited scope for excavation and a high risk for contaminating the groundwater;
- The lack of / limited amount of soil available for use as cover material and the need to identify an alternative source eg. shredded / composted garden waste, sand dredged from the lagoon or ocean;
- The limited buffer distances to residential areas / premises;

Rarely is the best site available for use as a landfill waste disposal site. Most commonly the best available site is chosen and the deficiencies of the selected site managed / addressed in the design development process.

### 5.6.3 Other issues

Other issues that need to be considered and addressed when establishing a new landfill waste disposal site in a PIC include:

- The limited technical knowledge, capability and experience of many relevant PIC Government personnel to undertake such a project, particularly if is intended to develop and modern, engineered sanitary landfilling operation. This includes limited knowledge, capability and experience in the following:
  - Investigating, evaluating and comparing potential landfill sites;
  - Investigating and assessing a potential landfill site;
  - Developing the concepts for the proposed waste disposal site, including the public health and environmental management and monitoring measures;
  - Assessing the costs and funding arrangements for a waste disposal operation, including the feasibility of the proposal;
  - Undertaking an environmental impact assessment of a proposal to establish a landfill waste disposal site;
  - Undertaking the detailed engineering design and preparing construction documentation for a landfill waste disposal facility;
  - Preparing and implementing a detailed operation and management plan for the waste disposal facility;
  - Constructing and commissioning the waste disposal facility, particularly in regard to the leachate containment system and the leachate treatment and disposal system;
  - Operation of the waste disposal facility, particularly in regard to the leachate containment system and the leachate treatment and disposal system; and
  - Rehabilitation of the old landfill site;
- The lack of a formal regulatory process for undertaking an environmental assessment of proposed developments such a landfill waste disposal site, in many PICS. A

checklist for undertaking an environmental impact assessment of a landfill waste disposal site is provided in the Guidelines.

- The limited availability of equipment to construct the waste disposal site (in some of the smaller countries, and particularly in regard to a compactor suitable for compacting clay and the installation of geological investigation bores and groundwater monitoring wells);
- The limited thought given to the closure and rehabilitation of an existing landfill waste disposal site. This particularly includes the lack of planning for the closure and consideration of funding. There is also a lack of knowledge and understanding of the hazards presented by a completed landfill eg. from landfill gas, and the need for ongoing management and monitoring (for a period probably greater than 10 years);

#### **5.6.4 Opportunities for JICA Assistance**

JICA could assist PICs to identify and establish a new waste disposal site by providing the following:

- Training of relevant PIC Government personnel on how best to identify and establish a new landfill waste disposal site, particularly in regard to the technical issues / aspects;
- TA and funding to identify and establish a new site for a landfill waste disposal facility, when requested by a PIC. This includes all aspects of the process, from initial planning through to construction and commissioning;
- TA and funding to close and rehabilitate the existing landfill sites;

All PICs would benefit from the above assistance.

## **6. IMPROVING THE MANAGEMENT OF SPECIAL WASTE**

### **6.1 GENERAL**

“Special Waste” is a term that is commonly used to describe waste that, because of its nature (hazardous, highly odorous, dusty, difficult to handle / dispose of), requires special handling and disposal procedures. Special wastes commonly include the following waste types:

- Clinical / medical waste;
- Quarantine waste;
- Septage (sludge / solids from septic tanks);
- Commercial and industrial sludges (from waste water treatment processes);
- Waste oil (lubricating oil, hydraulic oil, cooking oil);
- Old / used vehicle batteries;
- Old vehicles and other large bulky items;
- Old / waste chemicals
- Waste Paint;
- Offal and other food processing waste;
- Asbestos waste;

In PICs there are generally few alternatives other than to dispose of special wastes at the local landfill waste disposal site, which is often an uncontrolled dumping operation. This practice can present significant public health risks as well as cause adverse impact on the local environment.

The following sections outline recommended methods for disposing of special wastes at a landfill waste disposal site, and possible alternative disposal methods.

### **6.2 CLINICAL / MEDICAL WASTE**

Clinical / medical waste presents significant public health risks and should preferably be sterilised prior to disposal. Common treatment options include:

- Autoclaving;
- Incineration;
- Microwave disinfection; and
- Chemical disinfection;

The treated waste material may then be disposed of at a landfill waste disposal site safely.

Most PICs have an incinerator, generally located at the hospital, which is used to treat clinical / medical waste generated at the hospital. The resulting ash is then generally disposed of at the landfill waste disposal site. It should be noted that the ash may still contain sharps (scalpels, needles). However, in many PICs the existing incinerators are no longer operational (due to old age, poor maintenance, poor design, lack of funding to operate – buy fuel), and the clinical / medical waste is now disposed of untreated at the local waste disposal site. Often the waste is simply disposed of in the general waste disposal area along with other mixed solid waste.

Other common problems with management of clinical / medical waste in PICs include:

- Lack of separate / special management of clinical / medical waste at landfill waste disposal sites, which presents a significant public health risk;
- Lack of security at existing separate, dedicated clinical / medical waste disposal areas – allows public access to disposal areas where waste is left exposed;
- Lack of staff on site to manage / supervise the controlled disposal of clinical / medical waste;
- Lack of equipment to undertake immediate deep burial / covering of the clinical / medical waste;
- Uncontrolled disposal of medical / clinical waste from doctor's surgeries, medical clinics, and dental surgeries, along with general mixed solid waste (no segregation);

Where waste treatment is not available the WHO recommend that clinical / medical waste should be landfilled in a controlled manner to minimise the potential hazards presented by the waste – see procedures in **Appendix G of the Guidelines**. Ideally, the waste should be disposed of in a separate, secure area that is not accessible by the public. The waste should be placed in a prepared pit and immediately covered with soil.

Possible solutions to the existing problems include:

- Disposal of medical waste at another incineration facility on the island eg. the quarantine waste incinerator (which most PICs have);
- Replacement / repair of existing waste incinerators, provision of a new incinerator, or provision of other appropriate treatment equipment eg. autoclave, microwave. It should be noted that it is generally not desirable to locate an incinerator at the hospital due to potential impacts of the air emissions.
- Education and training of the medical community about the hazards presented by clinical / medical waste, and how to properly manage their waste;
- Implementation of controlled landfilling procedures for clinical / medical waste – see **Appendix G of the Guidelines**.
- Installation of security fencing around separate, dedicated medical / clinical waste disposal area and provide secure bin for receipt (storage) of medical / clinical waste, until the waste can be buried;

- Implementation of charges to generate income to fund the necessary staff and equipment for controlled landfilled waste disposal of the clinical / medical waste;
- Implementation of guidelines and controls for the management and disposal of medical / clinical waste from doctor's surgeries / medical clinics

### 6.3 QUARANTINE WASTE

Quarantine waste comprises materials deemed by Quarantine officials to present a quarantine risk to the PIC, and illegal materials seized by customs. These wastes commonly include imported food and animal products. Typically these waste are generated at the international airports and shipping ports. In most PICs quarantine waste is incinerated. Commonly there is an incinerator at the international airport and at the shipping port. Ash from the incinerators is usually disposed of at the local waste disposal site. The experience of the authors of this report indicates that most quarantine incinerators in PICs seem to be operating quite well.

Some existing problems with quarantine waste management in PICs include:

- No incinerator to treat the quarantine waste;
- Incinerator not operational (old, poor maintenance, lack of funds for fuel);
- Incinerators are too small to handle large loads of quarantine waste;
- Lack of funds to operate and maintain the incinerator;
- Lack of special management procedures for the safe disposal of the quarantine waste at the landfill waste disposal site eg. immediate burial and covering

Possible solutions include:

- Provision of a suitable incinerator to treat the quarantine waste;
- Implementation of charges for disposal / treatment of the quarantine waste ie. charge the airlines and shipping companies;
- Implementation of procedures for the controlled landfilling of the quarantine waste – see **Appendix G of the Guidelines**

### 6.4 SEPTAGE

Septage is the sludge and solids that are periodically removed from domestic and commercial septic tanks.

Typically in PICs septage is disposed of in drying (infiltration) beds at the waste disposal site. Commonly these beds are not covered, which allows rainfall entry causing the beds to overflow. This can lead to significant public health risks and impact on the local environment.

Domestic and commercial septage should be beneficially used in agriculture / horticulture. This can be safely undertaken by application of the liquid septage to the selected site in a controlled manner, which avoids impact on local surface or ground waters.



Liquid septage should not be deposited directly in the landfilled waste. If it cannot be beneficially reused then it should be dried and then deposited in the landfill site in a controlled manner – see **Appendix G of the Guidelines**. In most PICs existing septage drying beds need to be upgraded / replace by facilities that do no leak / infiltrate into the ground and that have a roof to prevent rainfall entry.

## 6.5 INDUSTRIAL SLUDGES

Sludges generated by industrial premises may contain contaminants that generally preclude their beneficial reuse eg. like domestic septage. Industrial sludges should be dried and disposed of to landfill in a controlled manner – see **Appendix G of the Guidelines**. As for septage drying facilities, drying facilities for industrial sludges in PICs generally need to be upgraded to prevent leaking / infiltration into the ground, and prevent rainfall entry ie. roof over.

## 6.6 WASTE OIL

Waste oil presents a significant management problems in PICs. According to SPREP (2000) "the environmental effects of waste oil are primarily caused by its non-miscibility with water. Thins layers of waste oils can act as a barrier to many of the transfer processes that form an essential part of biological life".

The primary sources of oil in PICs typically includes the island's power station (generally diesel powered), shipping repair / maintenance activities, motor vehicle repair shops and home mechanics (lubricating oil and hydraulic oil), and commercial food processing / cooking premises (waste cooking oil).

The disposal of waste oil in a landfill waste disposal site is not desirable as it can contribute significantly to the pollution of local groundwater and surface waters, leading to potential public health risks and detrimental impact on the local environment. However, it is probably better to dispose of the oil at the waste disposal site than directly into local surface waters or the ocean.

Waste oil should be collected, stored and returned to the oil companies for recycling and or disposal. It is known that one of the major oil companies (Mobil) is taking back waste oil from a number of PICs and supplying the oil to the steel works in Fiji for use as a fuel. Note, mineral oils (lubricating oil, hydraulic oil) should be kept separate from vegetable oils (cooking oil). According to SPREP (2000), the only oil recycling plant in the region is privately owned and is located in Samoa, however, the plant is not operational for a number of reasons.

Other options for the disposal of waste oil include:

- Use as a supplementary fuel in the islands power station, clinical / medical waste incinerator, quarantine waste incinerator, or other industrial furnaces / burners on the island;
- Incineration at a facility dedicated for waste oil disposal. A new incinerator has just been commissioned in Nuku'alofa, Tonga to burn waste oil generated by shipping activities. The facility is located at the main port and will also be used to dispose of other waste oil;

## 6.7 VEHICLE BATTERIES

Old vehicle batteries contain two hazardous components: acid and lead. The deposition of these materials in a landfill waste disposal site can present both a public health hazard and risks to the local environment. These materials should preferably not be deposited in a landfill waste disposal site.

SPREP (2000) recommend the following method of disposal:

- Draining the acid from the battery;
- Neutralising the acid eg. by diluting with water and adding agricultural lime;
- Recovering the lead for recycling. Most PIC countries have some level of metals recycling and lead is a valuable metal;

The plastic casing of the drained battery can be disposed of to the landfill waste disposal site.

## 6.8 OLD VEHICLES AND OTHER LARGE BULKY MACHINERY

Old vehicles and other large bulky machinery eg. earth moving equipment, also pose a problem in regard to disposal in PICs, particularly on small atoll islands. The large physical size of the waste makes handling and disposal difficult and results in efficient use of landfill space. Old vehicles and other large equipment should be drained of all oil and stripped of useful parts. The stripped parts should be reused or reconditioned for local use. The resulting shell (mostly steel) should be crushed and recycled. Unfortunately, the current value of common steel / iron is lower than the costs of recovering the steel from PICs for recycling. Consequently, to be viable the recycling operation needs to be subsidised. Subsidy options include:

- Obtaining funding from a donor;
- Establishing and implementing an import levy on motor vehicles and other large bulky equipment, to raise funds to subsidise the recycling operation.

An alternative disposal option is ocean disposal or use in the formation of artificial reefs. These options are not really long-term options considering the ever-increasing number of motor vehicles in PICs.

If the above are not possible it is recommended that the old motor vehicle / large equipment be dismantled, cut up, or broken up, and crushed prior to deposition in the landfill site.

## 6.9 CHEMICALS

A range of chemical wastes may be generated in PICs that require management and disposal. These include paints and resins, old fertilisers, acids, alkalis, pesticides, herbicides, and other poisons.

Ideally, chemicals should be used as intended, according to the manufacturer's recommendations. All of the chemical should be used and consequently only the empty container requires disposal. However, waste chemicals are generated in PICs and require disposal. Proper management of the waste chemical depends on the type,

characteristics and quantity of waste chemical requiring disposal. Preferably the waste chemical should not be disposed of at a landfill site. However, in PICs there are often few other alternatives.

Old / waste paint should be used. The empty container can be disposed of to landfill once dried out.

Resin should be allowed to harden prior to disposing to landfill.

Old fertilisers should be used. If not they can be disposed of to a landfill site but under controlled conditions – see **Appendix G of the Guidelines**.

Acids and alkalis should be neutralised and resulting neutral liquids disposed of.

Pesticides and herbicides should be used as per the manufacturer's recommendations. The empty containers should be rinsed (3 times) prior to disposal to the landfill site. The rinsate should be used as per the product. An alternative suggested by SPREP (2000) is a pesticide disposal pit. SPREP (2000) (Annex C.4) also provides guidance on the disposal of specific pesticide wastes. In some cases it may require the collection, storage and export to Australia or NZ for disposal. It was reported that SPREP are currently managing a project that is looking to collect and dispose of many waste chemicals and other hazardous wastes generated in PICs.

## **6.10 OFFAL AND OTHER FOOD PROCESSING WASTE**

Offal and other food processing waste can putrefy rapidly and generate substantial odours. The wastes can also attract vermin and insects and present significant public health risks particularly if left exposed at a landfill site. These wastes should be disposed on in a controlled manner - see suggested procedure in see **Appendix G of the Guidelines**.

## **6.11 ASBESTOS WASTE**

Asbestos was used for many years in some building materials including wall and roof sheeting, pipes, and insulation. It was also used in brake and clutch linings. Inhalation of asbestos dust can lead to serious lung disease ie. asbestosis.

Asbestos containing materials can be safely disposed of at a landfill waste disposal site, however, special handling and packaging procedures are required – see **Appendix G of the Guidelines**.

## **6.12 OPPORTUNITIES FOR JICA ASSISTANCE**

JICA could assist PICs to improve the management of special wastes at landfill waste disposal sites by providing the following:

- Training of relevant PIC Government personnel in the proper management of special wastes at landfill waste disposal sites;
- TA and funding to implement controlled landfilling procedures for special wastes, including clinical / medical waste, quarantine waste, highly odorous wastes, dried septage and sludges, and asbestos;

- Provision of a new incinerator or other appropriate treatment equipment for clinical / medical waste, quarantine waste, and waste oil;
- TA and funding to examine the rationalisation of incinerator operations in PICs;
- Training of the medical community in the hazards presented clinical / medical waste and in the proper management of clinical / medical waste;
- TA and funding to upgrade existing hospital waste management systems and practices. The focus should be on low cost, practical systems and practices, that will work in the situation presented;
- TA and funding to develop and implement a system for controlled management of clinical / medical waste generated at private medical facilities;
- TA to determine the real costs of operating incinerators and to develop sustainable charges for the use of the incinerators;
- TA and funding to upgrade existing septage and sludge drying facilities;
- TA and funding to promote the beneficial use of septage eg. in agriculture and horticulture;
- TA and funding to develop and implement a waste oil collection and recycling / disposal system;
- TA and funding to establish a battery recycling operation, including training of relevant personnel the handling of the hazardous materials ie. acid and lead;

## **7. WASTE MINIMISATION AND RECYCLING**

### **7.1 GENERAL**

Land for the disposal of waste is scarce in most PICs, and particularly so on small, highly populated atoll islands such as South Tarawa (Kiribati) and Majuro (RMI). In addition, existing land ownership arrangements make it very difficult to establish a new landfill waste disposal site even when there is land available eg. on the larger islands such as Viti Levu (Fiji), Upolu (Samoa) and Tongatapu (Tonga).

As a consequence, there is a critical need to minimise the amount of waste requiring landfill disposal in PICs, and thus maximise the life of the existing landfill waste disposal sites. As PICs develop this will become even more important as the quantity of imported goods (and packaging) increases as well as the quantities of waste per capita increase.

In addition to substantially reducing the quantity of waste landfilled, removing the organic waste from the landfill will substantially reduce the level of organic derived contaminants in the leachate generated by the landfilled waste (which are one of the primary contaminants of concern eg. ammonia). Removing the organic waste will also prevent the generation of hazardous landfill gases.

**Table 7.1** shows the results of recent studies on the composition of waste disposed of to landfill in a number of PICs.

From the results of the studies it can be seen that for most PICs the largest component of the waste stream is generally organic waste ie. garden waste and food waste (54.5% by weight, on average). According to the data garden waste typically comprises half the organic waste. The next most significant components of the waste stream in PICs are paper and cardboard (18.4%), plastics (9.9%), metals (7.6%) and glass (4.9%).

The specific results for each country should be used to guide the focus of waste minimisation efforts. It is recommended that the primary and initial focus be placed on those waste types that comprise the large proportion of the total waste stream ie. food and garden waste and paper and cardboard. Combined they typically represent more than 60 – 70% of the total waste stream.

The following sections outline some of the options for minimising the landfill disposal waste in PICs and the issues that need to be addressed.

Table 7.1: Composition of Waste in Pacific Island Countries (% by mass)

Primary Waste Classification	Samoa	Fiji	Vanuatu	PNG	Solomon Is.	Tonga	Kiribati	Tuvalu	Average
Paper	5.3	14.7	11.4	11.8	5.9	31.3	56.5	10.4	18.4
Plastic	12	8.1	7.7	12.7	16.8	5.2	7.3	9.3	9.9
Glass	4	2.7	3.3	8.9	4.5	3.3	3.1	9.5	4.9
Metals	7	3.2	3.6	12.2	6.1	8	11.1	9.8	7.6
Biodegradable	61	67.8	71	50	64.6	47.2	22.1	52.4	54.5
Textiles	7	3	1.6	1.5	1.8	3.7	0	2.2	2.6
Hazardous	1.4	0.2	0.7	2	0.1	<1	0	0.6	0.7
Construction & Demolition	0.6	0	0.7	0.9	0.1	1	0	3.2	0.8
Other	2.6	0.2	0	0	0	0.3	0	2.5	0.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: SKM (2000)

## 7.2 ORGANIC WASTE

Minimising the quantity of organic waste disposed of to landfill presents the greatest opportunity in PICs. Potential options for minimising the landfill disposal of organic waste in PICs includes:

- Feeding kitchen food wastes to household animals eg. pigs, chickens, dogs (already occurs)
- Home composting of kitchen food waste and some garden waste;
- Worm farming of kitchen food waste, at domestic and commercial premises;
- Backyard burning of garden waste (currently occurs);
- Separation of garden waste and wood waste and processing at the landfill site or other suitable site eg. shredding / mulching composting, burning / incineration, and gasification;
- Provision of a separate waste collection service for garden and / or food waste, to all premises, and processing at the landfill site or other site eg. shredding / mulching, composting, worm farming or incineration, gasification, and digestion;
- Provision of a separate waste collection service for food waste to commercial premises, and processing at the landfill site or other site eg. shredding / mulching, composting, worm farming or incineration, gasification, and digestion;

Feeding of kitchen food wastes to household animals already occurs in most households in PICs. However, as PICs develop and the keeping of household animals declines, additional waste will be disposed of to the local landfill waste disposal site.

### **Home Composting**

Home / backyard composting is a simple process that can be used to process most kitchen food wastes and some garden waste. Due to the lack of pretreatment ie. shredding, to reduce the size of the organic waste being composted, and the general lack of control over the process, home composting is only suitable for treating small, readily biodegradable organic materials eg. kitchen (vegetable) food waste, grass clippings, leaves and small prunings. Composting of meat wastes is not recommended due to the potential propagation of maggots and the increased attraction of vermin and insects. Palm fronds, coconut tree fronds, banana leaves, tree branches and other woody and fibrous garden waste that have a high lignin content and are not readily biodegradable are not suitable home composting. This represents a significant proportion of the garden waste in most PICs. Despite these limitations, home composting is a possible option for those households that do not have household animals, and is attracting considerable interest and support from numerous organisations across the region.

### **Worm Farming**

Worm farming is also an effective method of processing selected organic waste and producing a useful horticultural product ie. worm castings. Worm farming has been successfully used to process organic waste from both domestic and commercial premises, small scale and large scale, including mixed domestic waste. However, like composting,

worm farming is most suitable for readily degradable organic materials such as kitchen food (vegetable) waste or pretreated (partially composted) material. Worm farming is not suited for processing domestic garden waste typical of Tongatapu eg. Palm fronds, coconut tree fronds, banana leaves etc. As a consequence, like home composting, to be most effective at reducing landfill waste disposal, any program for home worm farming should focus on those premises that do not feed their food scraps to domestic animals.

### ***Backyard Burning Of Garden Waste***

Backyard burning of garden waste is currently a very common practice in many PICs. This practice significantly reduces the amount of waste material requiring disposal at the local landfill waste disposal site. However, such practice is the cause of significant neighbourhood nuisance ie. from smoke and odour, and may lead to potential health impacts (depending on exposure and on what is being burned – if PVC plastic is included in the fire, hazardous emissions can occur). These problems are primarily the result of the inefficient combustion of the garden waste – which is commonly wet and burned in an open pile or a pit that restricts airflow. These problems could be minimised by keeping the waste dry and using a simple incinerator to improve the combustion process. However, many households do not have a dry, covered place to store garden waste and the cost of a suitable home (backyard) incinerator would be significant for most households. Another approach to reduce nuisance from backyard burning would be to ban burning in open piles or pits. However, given the wide spread practice of backyard burning there would likely be significant community protest, and the quantities of waste then requiring disposal off site ie. at the landfill site, would significantly increase. Should a facility be established at the landfill site for processing garden waste, then a ban and / or an education program to discourage backyard burning should be considered, particularly in urban areas (to reduce the nuisance and potential health impacts).

Provision of a separate collection service for garden and / or food waste would increase waste service costs

### ***Separation and Centralised Processing of Garden Waste***

An option to reduce the quantity of garden waste being landfilled would be to establish a suitable processing facility at the landfill site, or other site nearby, and to encourage / require people who deliver waste to the site to separate their garden waste and wood waste for processing.

There are a number of processes / types of equipment available for processing garden waste. Options include:

- a mobile high speed chipper (trailer mounted);
- a mobile tub grinder (hammer mill) (truck mounted); and
- a stationary, slow speed, shredder (driven by electric motors).

Each type of equipment has advantages and disadvantages. It is considered that a shredder would probably be the most appropriate due to its robustness, flexibility, and simple operation. However, their effectiveness at shredding palm fronds and coconut tree leaves for composting should be confirmed. Mobile high speed chippers have the advantage of being able to process the material at source, however, they are most suited to processing tree loppings and are not very effective at processing leafy material. They



are also very fragile. Tub grinders are also high speed, but more robust. But they are very costly to purchase and require a high level of maintenance.

The capital cost of a shredder capable of processing up to 3000 tonnes of garden waste per year would be of the order of \$150,000.

Composting of the shredded garden waste could be undertaken using a simple windrow method. The windrows would need to be turned every few days using a front-end loader. It would be possible to mix septage sludge from domestic and some commercial premises in the compost heaps. This would assist the composting process and provide a practical means of disposing of septage. However, such an operation can be very odorous and may create nuisance for nearby neighbours if the composting operation is not undertaken properly.

It would be necessary to develop and implement an education program to encourage people to separate their garden waste for processing. As a further incentive to encourage people to separate their garden waste, some of the mulch / compost produced could be offered free to those people who separate their garden waste. Alternatively, if a fee (charge) for dumping garbage at the waste disposal facility is introduced, clean separated garden waste could be accepted free of charge.

An alternative to shredding and composting is to burn / incinerate the separated garden waste. This used to be a common practice in Australia but has slowly been phased out due to air pollution problems, particularly in urban areas.

#### ***Separate Household Collection and Centralised Processing of Garden Waste and other Organic Waste***

The provision of a collection service to household and commercial premises for domestic garden waste and other organic waste eg. food waste, would achieve the most significant decrease in the quantity of organic waste disposed of to landfill, due to the convenience of such a service. However, the cost of providing such a service would be very high. There would be a need to provide additional waste collection vehicles for the service as well as a facility suitable for processing the collected waste. If food waste is included in the range of materials collected a more complex processing facility eg. in-vessel composting, is required to overcome problems with odour and the attraction of vermin and insects.

Other possible processing options include incineration, gasification, and digestion, all of which could be used to generate electricity.

Considering the financial problems with funding existing waste collection services and disposal service in most PICs, the provision of a separate collection and waste processing service for garden waste and other organic waste is not considered feasible at this time, but may be something to consider in the future.

#### ***Large Scale Centralised Worm Farming***

Large-scale worm farming is currently being developed as an effective means of processing organic waste and producing a useful horticultural product ie. worm castings. It has been used to process clean organic waste streams (from both domestic and commercial sources) as well as mixed domestic solid waste. However, most success has been with clean organic waste from commercial sources, which have a low level of contaminants. Benefits of the process include low capital and operational costs, simple operation, and high value horticultural product. Limitations of the process include

ineffectiveness at processing large organic items (unless they are pretreated – to reduce their size) and high lignin content organic materials.

### **Conclusions**

It is considered that the most feasible and realistic approach to diverting organic waste from landfill disposal in PICs is to promote and develop a mix of activities to suit the PIC in question. This should include the following:

- Feeding kitchen food wastes to household animals eg. pigs, chickens, dogs;
- Home composting of kitchen food waste and suitable garden waste;
- Worm farming of kitchen food waste, at domestic and commercial premises;
- Improved backyard burning of garden waste;
- Separation of garden waste and wood waste and processing at the landfill site or other suitable site eg. shredding / mulching, windrow composting, and possibly burning;

### **7.3 PAPER AND CARDBOARD**

Potential options for minimising the landfill disposal of paper and cardboard in PICs include:

- Export recycling;
- Local reuse;
- Burning / incineration;
- Composting with garden and food waste; and
- Education programs to minimise generation of waste paper and cardboard.

These options are discussed in the following paragraphs.

#### **Export Recycling**

Paper and cardboard are low value waste materials on the international recycling markets, particularly mixed paper and cardboard. As a result, the cost of collecting the paper and cardboard in PICs and transporting it to the nearest markets for sale exceed the revenue generated by the sale of the recovered materials. Consequently, to be viable an export recycling scheme for paper and cardboard would need to be subsidised and the cost of collection and transportation need to be kept as low as possible.

Funds to subsidise paper and cardboard recycling activities could be raised by placing a "waste" levy on imported paper and cardboard products and goods and products packaged in paper and cardboard.

A low cost collection program for paper and cardboard could involve drop off centres for paper and cardboard and the use of schools or community organisations.

### ***Local Reuse Options***

There are a number of local reuse activities that could be undertaken to reduce the quantity paper and cardboard disposed to landfill in PICs. This includes:

- Reuse of waste office paper in schools or homes;
- Reuse of cardboard boxes for local or export packaging;
- Small scale paper making (craft) using waste paper and cardboard;
- Use of the paper and cardboard as a supplementary fuel for home cooking;
- Printing / copying on both sides of paper.

Development and implementation of the above will require a substantial amount of organisation and education of the community. A local organisation or Government Department will need to be the champion of the cause.

### ***Burning / Incineration***

To avoid filling valuable landfill space paper and cardboard could be burned. This could be done on site / in the back yard or at a centralised incinerator eg. at the landfill waste disposal site. This could be done in conjunction with garden and wood waste. Obvious concerns with these types of activities are the air pollution caused.

### ***Composting***

It is possible to mix waste paper and cardboard with other organic waste material and compost the mixture. However, as paper and cardboard is not readily biodegradable (containing a high level of lignin) the proportion of paper in the mix must be kept quite low (<10 - 20%) to ensure effective composting.

### ***Community Education Programs***

Community education programs could be used to discourage the generation of waste paper. One popular issue in PICs (and the world) is disposable nappies (diapers), which are primarily paper and do present a significant public health risk if not properly disposed of, and are left exposed at waste dumping grounds as currently occurs in many PICs. Education programs could be run to discourage the use of disposable nappies.

### ***Conclusions***

There are few simple / easy options that will significantly reduce the quantity to paper and cardboard that is disposed of to landfill sites in PICs. Perhaps the most promising is export recycling however, to be viable in PICs it would need to be subsidised.

## **7.4 PLASTICS AND GLASS**

Potential options for minimising the landfill disposal of plastics and glass in PICs include:

- Maintain / re-establish local glass bottle reuse schemes for soft drinks and beer;

- Implement import restrictions requiring all imported beer and soft drink to be packaged in aluminium cans instead of glass and plastic, or place a levy on products that are packaged in plastic or glass;
- Export recycling
- Community education programs;
- Encouraging local commerce to implement a charge for plastic shopping bags;
- Reuse of glass containers in the home;
- Separation and crushing of glass for use in local road works and for making concrete (mixed with the sand);

These options are discussed in the following paragraphs.

#### ***Local Glass Bottle Reuse Schemes***

There are a number of good examples of local glass bottle reuse schemes in PICs. These primarily involve the local brewery eg. Vailima beer in Samoa and Royal Beer in Tonga, where there is a refund paid for returned beer bottles and the bottles are reused. Many soft drinks used to be locally bottled in glass and the bottles reused. However, there has been a recent change to PET bottles by both the major soft drink suppliers ie. Coca Cola and Pepsi Co. Despite promise by these companies the recycling of the PET has not yet occurred, except perhaps in Fiji. All collected PET needs to be shipped to Australia for recycling.

PIC government should encourage the use of local glass bottle reuse schemes by placing a levy on imported beverage

#### ***Import Restrictions / Levies***

PICs could encourage the use of other packaging eg. aluminium cans that can be viably recycled (without subsidy), by placing restrictions or levies on the importation of goods packaged in plastic and glass.

#### ***Export Recycling***

Like paper and cardboard, plastics and glass are also generally low value materials on the international recycling markets (perhaps excluding PET plastic, which has recently exceed \$500/tonne). As a result the costs of collection and transportation from PICs to market generally exceeds the value of the recovered product. As a result, to be viable an export recycling scheme for plastics or glass would need to be subsidised and the cost of collection and transportation need to be kept as low as possible.

Funds to subsidise recycling activities could be raised by placing a "waste" levy on imported goods and products packaged in plastic and glass.

A low cost collection program for plastics and glass could involve drop off centres for and the use of schools or community organisations.

### ***Community Education Programs***

Community education programs could be run to:

- to encourage the public to avoid products packaged in glass and plastic;
- to encourage the public to buy, fresh local product, rather than imported, packaged product;

### ***Crushing and Re-use of Glass***

Waste glass can be crushed and mixed with sand and used as drainage aggregate, mixed with local aggregate and used in road construction works, or mixed with aggregate and used in concrete. It would be necessary to obtain and establish a crusher suitable for processing the waste glass, as well as establish a suitable collection system. The collection system could involve a community based system the same as that described for recycling, in which the community could be paid a small amount to collect the glass. If the community was paid it could be funded by a levy placed on imported products packaged in glass. The levy could also be used to fund the purchase and operation of the crusher. It should be noted that there are a number of occupational health and safety issues associated with the crushing and handling of crushed glass that would need to be managed. Considering the relatively small amount of glass available, it may not be economic to undertake this type of activity. More analysis of this options needs to be undertaken, including costing a suitable crusher.

### ***Conclusions***

There are a number of promising options to reduce the quantity of plastic and glass being disposed of to landfill in PICs. This includes the following:

- Encouraging local glass bottle reuse schemes for soft drinks and beer, perhaps by using financial incentives / disincentives;
- Export recycling, subsidised by an import levy on packaged goods;
- Separation and crushing of glass for use in local road works and for making concrete (mixed with the sand); and
- Community education programs;

The viability, suitability, and likely success of each of the above options need to be examined for each individual PIC.

## **7.5 METALS**

Currently non-ferrous metals such as aluminium, copper, brass, and lead are commonly recycled in PICs, albeit in an ad-hoc manner with no formal recycling programs. This is due to the high value of the recovered metal (generally > \$800/tonne) which exceeds the cost of collecting and transporting the metal to the nearest recycling markets. However, the value of ferrous scrap including old cars, whitegoods and equipment is low and does not cover the costs of collection and transport of the material to market.

Potential options for further minimising the landfill disposal of metals in PICs include:

- Establishment of a more formal recycling program for non-ferrous metals, and promoting the program;
- Subsidising the export recycling of ferrous scrap;
- Establishment of a more formal vehicle wrecking and export recycling operation (subsidised by an import / environment levy); and
- Establishment of a resource recovery / waste reuse centre for old appliances, white goods and other waste materials.

The disposal of old vehicles and other large steel equipment is currently a major problem in most PICs. The only option is dumping at the local landfill site or elsewhere on the island. An option to minimise the landfill disposal of these problem wastes is to establish a more formal wrecking program in conjunction with an export recycling program. Such a program could involve the establishment of a depot where old vehicles / equipment are stripped of useful parts and the scrap vehicle / equipment is crushed and exported for recycling. As the export recycling of scrap steel, including old vehicles, is not currently economically viable, the program would need to be subsidised or funded through some other mechanism. This could involve implementing a duty / environmental levy on all imported vehicles. Alternatively, funding may be raised by placing an environmental levy (waste disposal charge) as part of vehicle registration. An assessment needs to be undertaken to determine the amount of the levy, which would need to take into account the size and weight of the vehicle / equipment, the market value of scrap steel, recovery costs and revenue (from sale of car parts), shipping costs, etc. To encourage the recovery of the old vehicles / whitegoods / steel equipment, a payment could be made for all vehicles / whitegoods / steel equipment delivered to the depot for stripping and export recycling eg. \$50 - \$100 per vehicle (funded by the levy / tax). The export recycler would be paid for each tonne of scrap steel exported for recycling, to make the operation economically viable (also funded by the levy / tax).

## **7.6 OTHER OPTIONS**

It would be beneficial to establish local waste reuse / waste recovery centres at landfill sites to divert waste materials from the landfill eg. used furniture, whitegoods, household appliances, used building materials etc. This activity could incorporate a formal scavenging program (from the landfill). The reuse /recovery centre could be provided as a free service by the PIC government or operated as a business, with the business selling the recovered materials / equipment.

## **7.7 OPPORTUNITIES FOR JICA ASSISTANCE**

JICA could assist PICs to improve waste minimisation and recycling activities by providing the following:

- TA and funding to investigate and determine the best mix of options for minimising the landfill waste disposal of organic waste;
- Provision of equipment to process garden waste and wood waste;

- TA and funding to determine the levels of subsidy required for an export recycling program (for paper and cardboard, plastics, glass, and steel) and to develop a mechanism for raising funds to subsidise the operation eg. waste levy on imported goods;
- TA and funding to examine in more detail the opportunities for local glass reuse in PICs;
- TA and funding to examine in more detail opportunities for recycling ferrous scrap including old motor vehicles, white goods and large equipment / machinery.

The above projects could be undertaken as regional projects as all PICs need assistance to improve waste minimisation.

## **8. SOCIAL AND CULTURAL ISSUES**

### **8.1 ISSUES**

As noted in Section 2, social and cultural issues require careful attention if progress is to be made with respect to development activities in the Pacific. There is a distinct difference between many Pacific Islander perspective's on waste and those from other cultures.

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

- One critically 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. Such an issue is not easily solved and will require community education programs explaining why a change in attitudes is necessary.
- Changing community behaviour / waste management practices, no littering and indiscriminate dumping of waste. This also particularly relates to these community based societies and is 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 of waste. Again, education is likely to be the most successful avenue for addressing this.
- Impact of fees for waste management services. While it has been observed that a number of waste management problems are the result of underfunding, it is again noted that, in cash terms, most Pacific Islanders are relatively poor. In these circumstances, it will be difficult for households to dramatically increase their payments for waste management services. However, funding is critical to financing waste management improvements. If a 'user pays' approach to waste management services is adopted, then it should be applied in a sensitive manner to avoid unnecessary hardship to low-income households. Furthermore, by advising people of the potential benefits associated with solid waste disposal sites (health benefits, environmental benefits, aesthetics etc.), may provide increased acceptance of the fees.
- Composting – particularly of human waste products. The use of human and animal wastes in agriculture and forestry is a sensitive cultural issue. Attitudes are changing slowly, but much more education and awareness on the benefits of using these materials is required.

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. Consideration should be given to all the cultural and social aspects that may be associated with projects prior to their implementation.

### **8.2 OPPORTUNITIES FOR JICA ASSISTANCE**

Addressing the social and cultural issues associated with current waste management practices is likely to be a slow process. In order to gain greater waste management



acceptance in PICs will require extensive community education and training. This is detailed further in the following chapter.

In undertaking projects, JICA could 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. For example, the communities' willingness to pay for improved waste management services could be gauged and the project implemented accordingly. (ie. the community may only be happy to pay a certain amount for waste services which would only sustainably fund a basic sanitary landfill and not a fully engineered landfill – the project manager would then need to assess whether a fully engineered landfill should be built with the likely available funds).

## **9. EDUCATION AND TRAINING**

### **9.1 GENERAL**

Education and training are vital for planning, designing, establishing, operating and managing a successful solid waste disposal site in PICs. The education and training relates to two main areas:

1. Education to raise awareness of the community to change and accept new waste management practices, recognise the health and environmental implications if they don't and to improve the acceptance of costs associated with waste management.
2. Training and education of relevant PIC Government personnel directly or indirectly associated with waste management including those at the actual landfill itself, through to senior government officials/ministers who are responsible for decision making processes and allocation of funding to various activities.

The Guidelines outline the possible scope of the required program and the issues associated with implementing such.

**It is recommended that specific programs need to be developed for each PIC considering the circumstances within each country. Education programs should be ongoing and not just considered a short term exercise.**

### **9.2 OPPORTUNITIES FOR JICA ASSISTANCE**

JICA could provide assistance in community education and training through the provision of funding, trainers and TA in almost all of the nominated areas of education and training. As noted the training should generally be undertaken in country using local examples and include a high component of practical application of skills learnt (particularly in relation to training of landfill site staff).

Some suggested particular activities that could be undertaken include:

- Assist in establishing a coordinating committee within the government that is responsible for waste management. If the coordinating committee comprises a number of government departments, this may enable better cooperation between the groups. Further, if the committee contains senior government staff, any training which the committee receives will ensure good high level decisions are made and have the best possible impact in filtering down to less senior staff.
- Develop organisational chart of responsibilities, lines of communication with respect to waste management. By helping government members work through and develop responsibilities will ensure the government can undertake waste management activities with the greatest efficiency.
- Assist in structuring the process to improving waste management (solid waste disposal site management) by developing a program of meetings to undertake planning and monitoring and identifying essential performance indicators and outputs

It is noted that prior to providing assistance with respect to training, it is necessary to ensure that the training will be of benefit. For example, training in the use of a dozer

would only be of benefit if a dozer is going to be provided (and that the dozer is operated and maintained satisfactorily).

Much of the nominated training will typically require highly specific trainers that may be difficult to source given the specific social and cultural requirements of the situation. For example where training relates to senior government personnel, it is considered that a senior person who is familiar with PICs would be the most appropriate.

## 10. CONCLUSIONS

### 10.1 EXISTING WASTE DISPOSAL SITUATION

The management of solid waste disposal sites in PICs is, in the whole, generally poor. There are a number of reasons for this including 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.

The status of solid waste management in urban areas does vary throughout PICs. Some countries could be described as having a basic sanitary landfill (eg. Port Vila, Vanuatu, and Rarotonga, Cook Islands) while others are best described as uncontrolled dumping (eg. South Tarawa, Kiribati). Properly engineered, sanitary landfills to the standards of a developed country such as Australia are essentially non-existent in the Pacific, although preparations are under way for the design and construction of such a facility in a number of countries ie. Suva (Fiji), Tongatapu (Tonga) and in the Cook Islands.

It is considered that basic sanitary landfills as a minimum are essential for protecting human health while (generally) fully engineered landfills are a necessity for protecting the environment. It should be noted that the degree to which the environment is protected is based on both the design / construction of the waste disposal facility and its operation.

A number of common issues associated with the current poor management of the solid waste management sites in PICs have been identified. These are summarised as follows:

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.

A summary table of the situation in each country has been compiled and the results are shown in Table 10.1.

## **10.2 ACTIVITIES OF DONORS, LOCAL, 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.

Table 10.1: Summary of Existing Situation in Various Pacific Island Countries

A	Country	Cook Islands	Fiji	Kiribati	Federated States of Micronesia	Nauru	Niue	Papua New Guinea
B	<b>PRIMARY INSTITUTION RESPONSIBLE FOR WASTE SITE MANAGEMENT</b>	National government - Ministry of Works, Environment and Physical Planning.	Local Councils (eg. Lautoka, Nadi and Suva City Councils). The Dept. of Environment (National Govt.) is the regulator and is involved in the establishment of a new landfill	Local Councils (eg. Tarawa Urban Council, and Betio Town Council),	Municipal (local) Government although the responsibility is soon to be taken over by the Department of Public Works (National Government)	Not available	Department of Health	District Council (National Capital District Commission) - Port Moresby
C	<b>FUNDING</b>	Funded through a national government budget allowance	Waste collection and disposal funded through property rates and fees collected at the landfill gate	Waste collection and disposal funded through fees collected by Council specifically for waste services. Additional grant or subsidy received from national Government on an annual basis	Waste services are funded by through a national government budget allowance	Not available	Waste services are funded by through a national government budget allowance	Waste services funded through collected fees
D	<b>LANDFILLING OPERATIONS</b>	Rarotonga has a single waste depot which involves the filling of a water reservoir (never used as such). Periodic compaction and covering of the waste occurs. Site is generally reasonably run with good covering of waste. Almost considered a basic sanitary landfill.	Lutoka and Lami dumps - above ground landfilling, no stormwater/leachate controls, irregular covering. Lami dump council owned dozer, Lautoka dump uses contractor. Basic waste quantification undertaken (vehicle numbers). New Suva dumpsite to be a sanitary, engineered landfill.	Wastes dumped at informal dump sites along coast line. No control measures, no quantification	Open dump sites, no control measures, no covering, some environmental monitoring undertaken, no pesticides accepted	Not available	A number of dumpsites across main island. Some waste control (pushing, covering) and some waste burning. Dump sites generally unsightly	Two main landfills with a degree of controlled dumping and burning. Bulldozer and backhoe used but generally inadequate compaction, minimal soil cover, no leachate collection
	<b>OVERALL LANDFILL CONDITION</b>	Rarotonga - currently basic sanitary landfill to be upgraded to engineered sanitary landfill	Lami, Lautoka - Controlled/Semi Controlled landfilling. Lami dump (Suva) to be upgraded to engineered sanitary landfill	Uncontrolled dumping site	Uncontrolled dumping site	Unknown	Some uncontrolled dumping sites, some semi controlled dump sites	Controlled / semi controlled dumping site
E	<b>MAJOR SOLID WASTE SITE, AID ACTIVITIES (CAPITAL EXPENDITURE)</b>	ADB project for the construction of fully engineered landfills in Rarotonga and Aitutaki including operating equipment and recycling facilities in Aitutaki (2001-2003). Alternative NZODA PPP proposal also being considered	EU project for the construction of fully engineered landfill and institutional/funding arrangements for solid waste disposal in Greater Suva area (Naboro). Plans to expand this to Lautoka if successful. JICA considering incinerator for Nadi/Lautoka region	AusAID funded design for Kiritimati Island landfill. Further status of project (ie. construction) unknown. (Waste policy and plan under preparation through loan provided by ADB)		AusAID sanitation project with Landfill considerations	AusAID sanitation project with Landfill considerations	
F	<b>GENERAL ASSISTANCE REQUIRED</b>	<input type="checkbox"/> Local government take responsibility for waste management  <input type="checkbox"/> Establish user-pay funding system for self sustainable waste management <input type="checkbox"/> Continue support for engineered landfills and recycling operations	<input type="checkbox"/> Facilitate proper, engineered closure of the Lami dumps  <input type="checkbox"/> Establish control measures at the dump sites  <input type="checkbox"/> Continue support for engineered landfills  <input type="checkbox"/> Continue support for disposal of special waste	<input type="checkbox"/> Continue support for engineered landfill at Christmas Island  <input type="checkbox"/> Provide control measures and method of quantifying waste at the landfills.	<input type="checkbox"/> Recommend continuation of waste management responsibility to local government rather than national government <input type="checkbox"/> Establish user-pay funding system for self sustainable waste management <input type="checkbox"/> Support establishment of engineered landfills in the future <input type="checkbox"/> Provide control measures and method of quantifying waste at the landfills.	<input type="checkbox"/> Support solid waste site management activities as required	<input type="checkbox"/> Support establishment of engineered landfills in the future  <input type="checkbox"/> Local government take responsibility for waste management <input type="checkbox"/> Establish user-pay funding system for self sustainable waste management <input type="checkbox"/> Provide control measures and method of quantifying waste at the landfills.	<input type="checkbox"/> Continue support for engineered landfills  <input type="checkbox"/> Provide control measures and method of quantifying waste at the landfills. <input type="checkbox"/> Support landfill operation such as equipment and compaction

Table 10.1: Summary of Exis

A	Country	Republic of Marshall Islands	Samoa	Solomon Islands	Tonga	Tuvalu	Vanuatu
B	<b>PRIMARY INSTITUTION RESPONSIBLE FOR WASTE SITE MANAGEMENT</b>	Local government (eg. Majuro Atoll Local Government)	Department of Environment and Conservation within the Department of Lands, Survey and Environment (National Government level, no local government)	Local council (Honiara Town Council)	Ministry of Health (National Government)	Local Government (eg. Funafuti Town Council)	Municipal Councils (local government) (eg. Port Vila Municipality)
C	<b>FUNDING</b>	Information not available	Costs of providing waste collection services are worn by the government. Government funding is derived from income tax, GST, import tariffs, corporate tax. Landfill fees are collected at the gate	Information not available	Waste services funded by fees collected by national government specifically for waste collection and disposal.	Waste Collection fee of Aus\$30/yr for the private residents and various amounts for commercial / industrial residents	Waste services are funded through property taxes and waste collection and tipping fees
D	<b>LANDFILLING OPERATIONS</b>	Waste disposal depot located on the ocean side reef flat at Rairok, wastes contained through the use of wire cages filled with coral	Upolu serviced by the Tafaigata Landfill which has poor access, no stormwater or leachate controls. New dump site being considered for Suva'i. Some records on waste is kept, Dedicated areas for special wastes (medical, sludges), Some periodic compaction and covering of wastes	Open dump landfill (Honiara) located on flat reclaimed land adjacent to mangrove swamps, in Ranadi industrial area. Used for all waste types, periodic covering, access difficulties, some waste burning undertaken	Area style filling operation in mangrove area, no landfilling equipment based at the site and consequently the waste is not compacted or covered on a regular basis, no regular compaction and covering of the dumped waste, no stormwater controls, no leachate controls, A new solid waste disposal site at Tapahio has been designed and will be implemented in the next few months	Waste (Tuvalu) disposed in borrow pits, water infiltration at high tide. New, engineered landfills being trialled, Special wastes (medical, hazardous) disposed of separately	Port Vila Landfill (Bouffa) is a recently (1995) constructed landfill and was designed with outside expert help and has a life of 15 - 20 years. No leachate control as the ponds for leachate/SW collection have been used for haz. waste disposal. Filling method is by trench operation. Were GW monitoring bores but these have been lost. Weekly covering of waste, burning of quarantine waste and some non-controlled burning occurs.
	<b>OVERALL LANDFILL CONDITION</b>	Controlled / semi controlled dumping site	Controlled / semi controlled dumping site	Controlled / semi controlled dumping site	Vavau (Tongatapu) - currently uncontrolled dumping to be upgraded to engineered sanitary landfill	Uncontrolled dumping site	Port Vila - Basic sanitary landfill
E	<b>MAJOR SOLID WASTE SITE, AID ACTIVITIES (CAPITAL EXPENDITURE)</b>		NZODA proposal for PPP project involving controlled waste degradation to produce biogas for use as a fuel being considered. JICA considering incinerator for medical waste		AusAID project for the construction of fully engineered landfill in Tongatapu. EU project for small landfill design and waste characterisation in Vavau	AusAID project includes waste characterisation study, establishment of a landfill, recycling (compost etc.)	
F	<b>GENERAL ASSISTANCE REQUIRED</b>	<input type="checkbox"/> Support establishment of engineered landfills in the future  <input type="checkbox"/> Establish user-pay funding system for self sustainable waste management <input type="checkbox"/> Provide control measures and method of quantifying waste at the landfills. <input type="checkbox"/> Support landfill operation such as equipment and compaction	<input type="checkbox"/> Local government take responsibility for waste management  <input type="checkbox"/> Establish user-pay funding system for self sustainable waste management <input type="checkbox"/> Continue support for engineered landfills  <input type="checkbox"/> Continue support for disposal of special waste	<input type="checkbox"/> Support establishment of engineered landfills in the future  <input type="checkbox"/> Establish user-pay funding system for self sustainable waste management <input type="checkbox"/> Support landfill operation such as equipment and compaction	<input type="checkbox"/> Provide control measures and support landfill operations such as equipment and compaction  <input type="checkbox"/> Continue support for engineered landfills  <input type="checkbox"/> Local government take responsibility for waste management	<input type="checkbox"/> Provide control measures and support landfill operations such as equipment and compaction  <input type="checkbox"/> Continue support for engineered landfills and waste characterisation study <input type="checkbox"/> Continue support for disposal of special waste	<input type="checkbox"/> Provide control measures such as leachate control measures, environmental monitoring, restrict uncontrolled burning  <input type="checkbox"/> Continue support for disposal of special waste



### 10.3 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 organisation 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.

## **11. RECOMMENDATIONS**

### **11.1 HOW TO IMPROVE SOLID WASTE DISPOSAL SITES**

Generally most 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 must be addressed and overcome prior to proceeding to actually improve landfill waste disposal operation. 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 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. A summary of the steps in each of the stages is given below.

#### **Stage 1 – Development of a Specific Plan to Improve Landfill Waste Disposal**

1. Undertake a detailed review and assessment of the existing waste management situation – to determine existing problems, issues and possible barriers to improving landfill waste disposal;
2. Identification of the most effective institutional arrangements and development of a plan to establish such;
3. Development of a sustainable funding mechanism for the provision of solid waste management infrastructure and services;
4. Development of a specific Plan for improving landfill waste disposal encompassing:
  - Upgrading the existing landfill waste disposal operation / site; and / or
  - Establishment of a new, modern waste management facility that incorporates a sanitary landfilling operation (and rehabilitation of the existing dump site).
5. Obtaining the commitment and approval of the PIC Government for implementation of the proposed Plan;

#### **Stage 2 – Implementation of the Plan to Improve Landfill Waste Disposal**

6. Obtain funding and / or establishment of a sustainable funding mechanism for implementation of the Plan;
7. Establishment of the proposed institutional arrangements;
8. Implementation of the Plan.

A more detailed description of the approach is contained in the Guidelines, which also provide details, tools, and examples to assist with each step in the process.

## 11.2 OPPORTUNITIES FOR JICA TO IMPROVE SOLID WASTE DISPOSAL SITES

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 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.

## 12. REFERENCES AND BIBLIOGRAPHY

- ADB, 1992. *Environment and Development - a Pacific Island Perspective*. Asian Development Bank, Manila, 334 p.
- ADB, December 2000, *Country Assistance Plan 2001 – 2003*, RMI, Cook Islands, Samoa, Tuvalu, Republic of Vanuatu, Republic of Nauru, Federated States of Micronesia, Kiribati, Republic of the Fiji Islands
- ADB, July 1999, *Asian Development Bank Operations in the Pacific, An Overview*
- ADB/GWS, 1996. *Urban Development Strategy - Apia, Western Samoa*. Integrated Urban Development Project TA No. 2480-SAM. Asian Development Bank, Manila, 3 Volumes.
- AGRICO (1993). *Integrated Development Plan for the Northern Line Islands, Republic of Kiribati*. Report prepared for the Asian Development Bank by AGRICO, New Zealand.
- AusAID, 1999, *Asset Maintenance: The Impact of the Underfinancing of Recurrent Costs*, Quality Assurance Series No. 13, May 1999
- AusAID, *Pacific Program Profiles 2000-01*, January 2001
- AusAID, *Pacific Regional Waste Management Study*, April 1997
- Bagley, G.A. and Munro, A.J. *State of Pohnpei: Solid Waste Management Plan*. Unpublished Report, Pohnpei, 47pp.
- Brodie, J.E., Arnould, C., Eldredge, L.G., Hammond, L.A., Holthus, P., Mowbray, D. Tortell, P. 1990. *Review of the State of the Marine Environment: South Pacific Regional Report*. Regional Seas Reports and Studies No. 127, UNEP, Nairobi, 59 p.
- Butler, R. 1993. *Scrap metals in Micronesia*. AESOP, Canberra, 11 p. + appendices.
- CMPS&F, April 1998, Project Identification Study on Waste Management in Samoa, prepared for JICA
- Convard, N. 1993. *Land-Based Pollutants Inventory for the South Pacific*. SPREP Reports and Studies Series No. 68, SPREP, Apia, 167 p.
- Cumberland, K.B. 1956. *Southwest Pacific: a geography of Australia, New Zealand and their Pacific Island Neighbours*. McGraw-Hill, New York, pp 8-12.
- Dahl, A.L. and Baumgart, I.L. 1983. *The State of the Environment in the South Pacific*. Regional Seas Reports and Studies No.31, UNEP, Nairobi, 30 p.
- Dahl, A.L. 1984. Oceania's most pressing environmental concerns. *Ambio*, 13: 296-301.
- DDSMS, 1996. *Pacific Waste Oil Study*. Final Report. Report No. RAS/94/03C, Energy Planning and Management Branch, United Nations Department for Development Support and Management Services, New York, 165 p.



Dever S (Egis Consulting Australia), *Tonga Environmental Planning and Management Strengthening Project, Working Paper 33 - Report on the 3<sup>rd</sup> Visit of the Solid Waste Management Adviser*, March 2000

Dever S (Egis Consulting Australia), *Tonga Environmental Planning and Management Strengthening Project, Working Paper 44- Report on the 4th Visit of the Solid Waste Management Adviser*, February 2001

Dever S (Egis Consulting Australia), *Tonga Environmental Planning and Management Strengthening Project, Working Paper 56 - Report on the 5<sup>th</sup> Visit of the Solid Waste Management Adviser*, April 2001

Dever S (Egis Consulting Australia), *Tonga Environmental Planning and Management Strengthening Project, Working Paper 60 - Report on the 6<sup>th</sup> Visit of the Solid Waste Management Adviser*, June 2001

Dever S (Egis Consulting Australia), *Tonga Environmental Planning and Management Strengthening Project - Solid Waste Management Plan for Tongatapu*, March 2000

European Commission, *Terms of Reference for the Naboro Landfill – Consultancy Services*, Fiji, 1999?

Gangaiya, P. 1994. *Land-based Pollution Sources in Kiribati: A Case Study*. SPREP Reports and Studies Series No. 80, South Pacific Regional Environment Programme, Apia, 35 p.

Government of Kiribati (MESD) (1999), *Kiribati Environment Act 1999*

Government of Kiribati (1994), *Environmental Legislation Review: Report for the South Pacific Regional Environment Programme (SPREP) and Republic of Kiribati*

Hanashima M, *Pollution Control and Stabilisation Process by Semi-Aerobic Landfill Type: The Fukuoka Method*, Proceedings of Sardinia 99, Seventh International Waste Management and Landfill Symposium, October 1999

Hassall & Associates, *Tonga Environmental Planning and Management Strengthening Project, Working Paper 57 – Tapuhia Waste Management Facility Management and Operation Plan, Final Draft*, June 2001

Japan International Cooperation Agency and Ministry of Housing and Local Government, Malaysia, *A Road to Sanitary Landfill*, October, 1990

Kaly, U. 1996. *IEE and EIA Report, Environmental Improvement for Sanitation and Public Health Project: TA: 2641-KIR Republic of Kiribati*. Report prepared for the Asian Development Bank, Manila.

Matsufuji Dr Y, "The Road to Sanitary Landfill", International Environmental Planning Centre (INTEP) Newsletter, October 1993

Matsufuji Y, *What is the Fukuoka Method?, ????*

Mechem II, F.R. & Lovelace, N.L. (1996) *Republic of the Marshall Islands Majuro Integrated Waste Management Program – Conceptual Integrated Waste Management Plan* for Ministry of Resources and Development, Republic of Marshall Islands.

Morrison, R.J. and Brodie, J.E. 1985. Pollution problems in the South Pacific: fertilisers, biocides, water supplies and urban wastes. In: A.L. Dahl and J. Carew-Reid (Editors): *Environment and Resources in the South Pacific*. Regional Seas Reports and Studies, No. 69, UNEP, Nairobi, 69-74.

Morrison, R.J., Gangaiya, P. and Koshy, K. 1996a. Contaminated soils in the South Pacific Islands. In: R. Naidu, R.S. Kookana, D.P. Oliver, S. Rogers, M.J. McLaughlin (Editors) *Contaminants and the Soil Environment in the Australasia - Pacific Region*, pp 659-675 Kluwer Academic Publishers, Amsterdam.

Morrison, R.J., Harrison, N.L. and Gangaiya, P. 1996b. Organochlorins in the estuarine and coastal marine environment of the Fiji Islands. *Environmental Pollution*, 93: 159-167.

Morrison R.J. and Munro A.J, 1999. Waste management in small island developing states of the South Pacific: An overview. *Aust. J. Envir. Management*, 6, 232-246.

NZODA, *Programme Profiles 1999-2000, Programme Profiles 2000-2001*

Naidu, S.D. and Morrison, R.J. 1994. Contamination of Suva Harbour, Fiji. *Mar. Poll. Bull.*, 29: 126-130.

Ogawa, H. 1992. *Assessment of solid and hazardous waste management in Rarotonga, Cook Islands*. Mission Report No. RS/92/0110, WHO PEPAS, Kuala Lumpur, 12 p.

Ogawa, H. 1994. *Solid Waste Management - Apia, Samoa*. Mission Report RS/94/0109, WHO Environmental Health Centre, Kuala Lumpur, 12 p.

Ogawa, H. 1996. *Solid waste management in Pohnpei and Kosrae*. Mission Report RS/96/0103, WHO Environmental Health Centre, Kuala Lumpur, 14 p.

Opus International Consultants, *Solid Waste Management Plan for Funafuti, Tuvalu*, January 1998

Original Engineering Consultants (2000), *Improvement Plan of Solid Waste Management in South Tarawa, Executive Summary*

Original Engineering Consultants and PPK (2001), *Sanitation, Public Health and Environment Improvement H(SAPHE) Project*, (ADB Loan No. 1648-KIR SF); Draft EIA Report

Rappaport, D. 1996. Aerobic composting toilets for tropical environments. *BioCycle*, July 1996, pp 77-82.

Sakurai K (Institute for International Cooperation, JICA), *Improvement of Solid Waste Management in Developing Countries*, December 1990

Sakurai, K. and Hoo, T. 1996. A Practitioner's Guide for Municipal Solid Waste Management in Pacific Island Countries. WHO Environmental Health Centre, Kuala Lumpur.

Sinclair Knight Merz (1999), *Solid Waste Characterisation and Management Plan, Final Fiji*, for SPREP

Sinclair Knight Merz (1999), *Solid Waste Characterisation and Management Plan, Final Tonga*, for SPREP

- Sinclair Knight Merz (2000), *Solid Waste Characterisation Study and Management Plan for South Tarawa, Kiribati*, for SPREP
- Sinclair Knight Merz (1999), *Solid Waste Characterisation and Management Plan, Final Samoa*, for SPREP
- Sinclair Knight Merz (1999), *Solid Waste Characterisation and Management Plan, Final Tuvalu*, for SPREP
- Sinclair Knight Merz (1999), *Solid Waste Characterisation and Management Plan, Final Solomon Islands*, for SPREP
- Sinclair Knight Merz (1999), *Solid Waste Characterisation and Management Plan, Final Papua New Guinea*, for SPREP
- Sinclair Knight Merz (1999), *Solid Waste Characterisation and Management Plan, Final Vanuatu*, for SPREP
- South Pacific Applied Geoscience Commission (SOPAC), *Trip Report 248: Tuvalu Solid Waste Management Plan*, July 1997
- SOPAC and Opus International Consultants, *Solid Waste Management Plan for Funafuti, Tuvalu*, January 1998
- South Pacific Regional Environment Programme (SPREP), *Management of Persistent Organic Pollutants in Pacific Island Countries – Waste and Obsolete Chemicals and Chemical Contaminated Sites*, May 2000
- South Pacific Regional Environment Programme (SPREP), 1994. *The South Pacific Regional Pollution Prevention, Waste Minimisation and Management Programme*. SPREP, Apia, 125 p.
- South Pacific Regional Environment Programme (SPREP), 1996. *Action Plan for Managing the Environment of the South Pacific 1997-2000*. SPREP, Apia, 24 p.
- United Nations Environment Program, *Waste Management in Small Island Developing States in the South Pacific*, Proceedings of Regional Workshop, Canberra, May 1997
- United Nations Environment Program, 1999, *Pacific Islands Environment Outlook*
- United Nations Environment Program, International Environmental Technology Centre, 1996, *International Source Book on Environmentally Sound Technologies for Municipal Solid Waste Management*
- Vakasiuola, S. 1993. *Ko E Founga Hono Ngaahi E Fafanga Fakalelei Kelekele Faka-E-Natula* (The Method to Improve the Quality of the Soil in the Natural Way). Tonga Community Development Trust, Nuku'alofa, 14 p.
- Wolff, G. (2000) *Waste Management Plan – Niue* October 2000 (Endorsed by the Cabinet as the Waste Management Plan for Niue on 21 December 2000)
- World Bank, country Department III, East Asia and Pacific Region, Feb, 1995 *Managing Urban Environmental Sanitation Services in Selected Pacific Island Countries*

World Health Organisation, Western Pacific Region, Healthy Cities – Healthy Islands,  
Document Series No. 6, *Guides for Municipal Solid Waste Management in Pacific Island  
Countries*, December 1996.

## ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
AusAID	Australian Agency for International Development
CBD	Central Business District
CDL	Container Deposit Legislation
CIDA	Canadian International Development Agency
C-SPOD II	Canada – South Pacific Ocean Development project
DEC	Department / Division of Environment and Conservation
DLSE	Department of Land, Survey & Environment
DoE	Department of Environment
EHC	Environmental Health Centre (WHO)
EPACS	Environmental Planning Assessment and Conservation Section (Tonga Ministry of Lands Survey and Natural Resources)
EU	European Union
EC	European Commission
FAO	Food and Agriculture Organisation
FSM	Federated States of Micronesia
JICA	Japan International Cooperation Agency
MAF	Ministry of Agriculture and Forests
MoH	Ministry of Health
MoW	Ministry of Works
MLSNR	Ministry of Lands, Survey and Natural Resources
NZ	New Zealand
NZODA	New Zealand Official Development Assistance
OH&S	Occupational Health and Safety
O&M	Operation and Maintenance
PCBs	Polychlorinated Biphenyl's
PET	Polyethylene Terephthalate (plastic)

PIC	Pacific Island Country
PNG	Papua New Guinea
POP	Persistent Organic Pollutants
PPP	Public Private Partnership
PVC	Polyvinyl Chloride (plastic)
PWD	Public Works Department
RMI	Republic of Marshall Islands
SIDs	Small Island Developing States
SKM	Sinclair Knight Merz Pty Ltd
SOPAC	South Pacific Applied Geoscience Commission
SPC	Secretariat of the Pacific Community
SPM	Sustainable Project Management
SPREP	South Pacific Regional Environment Programme
SWMP	Solid Waste Management Plan
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
USP	University of the South Pacific
WHO	World Health Organisation

## DEFINITIONS

Aquifer	A saturated, permeable geological unit that can transmit significant quantities of groundwater under ordinary hydraulic gradients
Commercial / Industrial Waste	Waste derived from commercial and industrial activities
Compactor truck	A waste collection vehicle which is able to compact / compress the collected waste materials, and consequently is able to carry more waste material.
Composting	The controlled aerobic decomposition of organic materials
Construction and demolition waste	Waste generated from construction and demolition activities
Daily Cover	Soil, earth, rock, mulch or like material which is placed over the exposed waste at the end of each day to ensure that it is covered to minimise litter, odour, fires and vermin
Domestic solid waste:	Solid waste generated at private residences / households
Garden Waste	Organic waste from gardens (such as clippings, grass, etc)
Geosynthetic Clay Liner	A manufactured product combining the benefits of a geosynthetic membrane or fabric with (usually) a bentonite clay to form a low permeable barrier to water / liquids.
Green Waste	Organic wastes including garden waste, food and wood wastes
Industrial premises:	Food manufacturing, sheet metal and steel fabricators, furniture makers, screen printing, paint making, automotive repair shops, fibre glass makers, tank manufacturing, petrol and oil distributors etc
Institutional premises:	Government offices, schools, colleges, hospitals etc
Landfill	Facility where wastes are buried for disposal
Landfill Cell	A constructed section of the landfill.
Landfill Fire	The combustion of landfilled wastes due to spontaneous combustion or human ignition causing high heat, smoke, vapour, and flames.
Landfill Gas	Gaseous emissions resulting from the decomposition of organic matter within the landfilled waste mass. The gas typically comprises 60% methane and 40% carbon dioxide
Landfill Liner System	The low permeable barrier that minimises the risk of leachate escaping from the landfill cell. Often the liner systems are

	constructed of clay or a combination of clay and a secondary layer such as GCL.
Leachate	Water that has percolated / migrated through landfilled waste and generally contains contaminants absorbed from the waste material
Methane	A colourless, odourless gas that is explosive when mixed with air in the range 5% - 15% methane.
Putrescible Waste	Waste which undergoes rapid biodegradation eg. household and commercial food waste, food processing waste
Recycling	The collection of selected waste materials, usually packaging, for making the same but new packaging eg. waste glass bottles to make new glass bottles, waste aluminium cans to make new aluminium cans
Reprocessing	The conversion of waste materials into another product / material eg. composting, which converts organic waste materials into compost
Re-use	Re-use of waste materials eg. Used glass jars for storing home made jam or spreads
Sanitary Landfilling	An engineered method of disposing of solid waste on land in a manner that protects the environment, by spreading the waste in thin layers, compacting it to the smallest practical volume, and covering it with compacted soil by the end of each working day or at more frequent intervals if necessary (ASCE, 1976)
Scavenging	Recovery of waste materials from the active tipping face of the waste landfill
Septage	Solids and liquid from septic tanks
Shredder	A machine designed to reduce the size of a range of materials including garden and wood waste through a cutting / shearing action
Sludge	Solids and liquid from waste water treatment plants
Small Vehicle Waste Disposal Facility	A facility specifically designed to provide a clean and convenient process for the disposal of waste delivered by small vehicles
Solid Waste:	Garbage, rubbish, trash, (in solid form)
Spadeable Sludge	A sludge which has dried sufficiently so as to be able to be moved using a spade.
Special wastes	Any waste which requires special management and includes but is not limited to customs wastes, biomedical waste, chemical waste, liquid wastes, highly odorous wastes, oils and batteries
Tipping Face	The area of the landfilling operation where incoming waste is



	deposited
Transfer Station	A facility designed to receive waste from a range of vehicle and to compact the received waste into larger containers / vehicles for transport to the waste disposal site
Vermin, insects and pests	Unwanted rats, insects (flies, mosquitoes, other), dogs, cats, pigs, goats, and birds
Waste management facility:	A facility which manages waste materials and may encompass a recycling centre, landfilling operation, and composting operation
Waste minimisation	Waste management measures encompassing the upper levels of the waste management hierarchy ie. waste avoidance, waste re-use, recycling, and waste reprocessing
Watertable	The surface of the underlying groundwater