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The impact of the Greenbag on waste generation in South Tarawa, Kiribati

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Acronyms

AMAK	Aia Mwaea Ainen Kiribati
ADB	Asian Development Bank
BKL	Bobotin Kiribati Ltd.
BPA	Broadcasting and Publications Authority
BTC	Betio Town Council
CDSP	Community Development and Sustainable Participation
ECD	Environment and Conservation Division (of MELAD)
FSPK	Foundation for the Peoples of the South Pacific Kiribati
GoK	Government of Kiribati
GUPS	Greenbag User Pays Scheme
IWCM	integrated coastal and watershed management
MISA	Ministry of Internal and Social Affairs
MELAD	Ministry of Environment, Lands and Agricultural Development
MRF	Materials Recovery Facility
NC	National Coordinator
NGO	non-governmental organisation
NZAID	New Zealand Agency for International Development
PET	Polyethylene terephthalate (Number 1 plastic bottles)
SAPHE	Sanitation and Public Health and Environment
SPREP	Secretariat of the Pacific Regional Environment Programme
TA	technical assistance
TCDC	Thames and Coromandel District Council
TUC	Teinainano Urban Council
UNDP	United Nations Development Programme
WHO	World Health Organization

Weights and measures

d	day
ft	foot
km	kilometre
m	metre
m^3	cubic metre
p	person
t	tonne
yr	year

1 Executive summary

1.1 IWP Kiribati overview

The International Waters Project (IWP) aims to strengthen the management and conservation of marine, coastal and freshwater resources in the Pacific Islands region. It is financed through the International Waters Programme of the Global Environment Facility, implemented by the United Nations Development Programme, and executed by the Secretariat of the Pacific Regional Environment Programme (SPREP), in conjunction with the governments of the 14 participating independent Pacific Island countries.

IWP is intended to address the root causes of degradation in Pacific Island waters. IWP has a coastal component that focuses on integrated coastal watershed management. In Kiribati (Fig. 1), IWP's coastal component is aimed at national and low-cost community-level actions to address priority environmental concerns relating to marine and freshwater quality. In Kiribati IWP has supported the establishment of a pilot project intended to address the root causes of degradation affecting marine and freshwater resources through a programme of waste reduction. IWP Kiribati's pilot project in particular promotes "low tech", low cost, community-based solutions, while national-level activities may involve activities that have a broader or more strategic focus.

1.1.1 IWP Kiribati pilot area and the Greenbag

The IWP Kiribati pilot project has been established in Bikenibeu West village on Tarawa Atoll, and provides a case study for addressing waste management in Kiribati more generally. A number of activities have occurred under the IWP in Kiribati, including community awareness meetings, water quality analysis, and participatory problem analysis. A major part of this work has included the trial of a biodegradable Greenbag scheme in which householders were encouraged to separate waste and send non-compostable and non-recyclable wastes to the Nanikai landfill. Previously, waste was piled up uncontained in the streets of Tarawa (something that still occurs in many places). This programme has now been extended throughout South Tarawa, in the area covered by the Teinainano Urban Council (TUC). The Greenbag is promoted not only as a rubbish containment and collection tool, but also as a means to encourage people to become aware of the different materials in the waste stream, and to separate out their wastes. The contents of the Greenbag are thus the materials that go to the landfill, with recyclables and organics having been separated at source in the household. The underlying purpose of this effort has been to encourage people to understand the nature of and recover resources from their waste.

1.1.2 Greenbag user-pays scheme

With the Greenbag being successfully used as a tool to promote separation of wastes, the IWP Kiribati team took the logical next step, and sought to create a user-pays system — a Greenbag User Pays Scheme (GUPS) — for waste collection. This is similar to the pre-paid garbage bag systems employed in many places around the world.

A major impediment to improved water quality in Tarawa has been inconsistent household waste collection in the past. A central cause has been the failure to pay and/or collect the household waste collection charges payable to the Local Council. In addition, garbage placed in the street for collection is typically not contained, making it more difficult to collect, and leading to increased pollution as uncontained waste is readily dispersed by wind, animals, etc.The use of a garbage collection bag that incorporates the cost of collection into the bag's

purchase price has been promoted as a low-cost, simple initiative that could significantly improve waste collection in Tarawa, and thus reduce water pollution levels.

This is a very fair approach: those who generate more waste — usually those with more money to buy imported, packaged goods — will pay more, while those who buy few packaged goods, and rely more local on foods and materials pay less. It was also expected that this would drive the organic component out of the waste stream, as people would be reluctant to pay to have leaves and sticks removed when they can be productively used on-site, through such mechanisms as the banana circle, also widely promoted by IWP Kiribati.

With the Greenbag — *Te Kiriin Baeki* — widely accepted in South Tarawa, the IWP Kiribati team has taken the programme to a much wider population: the more than 30,000 people who live in the TUC area served by the Nanikai landfill. The next stage is to predict the impact of the Greenbag scheme — if any — on the life of the Nanikai landfill.

1.2 Objective of this report

Assess the impact of the South Tarawa Greenbag scheme on the life of the Nanikai landfill. The information generated will be used to:

- Encourage adoption of the scheme by the waste removal agencies;
- Refine the scheme; and
- Support efforts to encourage householders to participate in the scheme.

This report will also trace the evolution of the Greenbag scheme, and provide background that can be compared to the results found by measuring the landfill wastes. In this way, the public awareness work conducted to change people's behaviour can be directly evaluated by examining how the Greenbag is actually used. This information is expected to be useful in developing programmes to continue to promote the GUPS, as well as determining useful lessons that can be drawn from the IWP Kiribati involvement in water pollution reduction in Kiribati. It is not often that one can measure directly the effectiveness of public awareness work, but the Greenbag does provide such an opportunity through actual measurement of bags and contents.

1.3 Report structure

This report contains two parts:

Part 1 details the public awareness programmes, and the history of the process to promote the Greenbag — as well as waste separation at source — in the households of Kiribati. The public awareness programme, conducted by successive projects and agencies, is the driving force for the information derived in Part 2. As such, an understanding of the campaign over the last few years is vital in understanding what has produced the results outlined in Part 2.

Part 2 examines the Nanikai landfill itself, and attempts to make direct measurement of the results of the public education described in Part 1. Measurement of waste is typically not a precise science: many of the figures offered are based in part on estimates; as a result, most figures in Part 2 are rounded. Also, different estimates may be offered using slightly different numbers to show the effect of particular assumptions being high or low. The reasoning behind various assumptions and estimates made should be apparent; in some cases, reference is made to other estimates from similar environments in the Pacific by way of comparison.

At the end of each section the key points are produced in summary, to assist the reader in drawing out the salient elements.

1.4 Key findings

1.4.1 Public awareness programmes

The IWP Kiribati programme in Kiribati has built extensively on previous waste-related work, conducted by the Foundation for the Peoples of the South Pacific Kiribati (FSPK), the Community Development and Sustainable Participation project (CDSP), and the Environment and Conservation Division (ECD). Some of these efforts and projects reach back nearly a decade, but there has been a clear continuum of effort, which has moved progressively down the same path.

One of the key early activities in all country programmes undertaken by IWP was to identify and report on previous or ongoing work in the area of action chosen by the local IWP project, with the goal of avoiding replication or conflict with related efforts. IWP Kiribati embraced this understanding very clearly, by not only identifying where other work had taken place, but by actively joining the coalition of projects and agencies that were working on decreasing solid waste pollution and related water pollution problems in Kiribati.

The IWP Kiribati not only participated in the informal coalition, but identified and then expanded a key element of the existing programmes to encourage containment of wastes. This was identified as having major potential, but was not directly addressed by the existing programmes, which focussed primarily on recycling (FSPK) and sanitation (CDSP). IWP Kiribati took the Greenbag (*Te Kiriin Baeki*) — which was gaining acceptance among the public on a simple, conceptual, level — and turned it into a true low-cost solution to solid waste. The simple Greenbag idea represents a potentially self-financing solution to three related issues: waste separation, landfill lifespan, and the recovery of organic waste as a resource. IWP Kiribati was able to test and refine the Greenbag idea through its Pilot project area in Bikenibeu (home to 1,800 people), and is now in the process of turning this into a larger scheme that can service some 30,000 people. Bags are currently sold for AUD 0.20 each (the longer-term aim is to sell for AUD 0.50 each); profits remaining after expenses will be directed to the TUC.

- IWP Kiribati has taken the existing Greenbag scheme and added an entirely new layer of value, so that much more has been achieved with the available resources than if IWP Kiribati had started from scratch and developed an entirely new programme.
- IWP Kiribati has used its pilot project area as a test-bed for Greenbag publicity and promotion, and is now in the processes of using that experience to target a far larger audience.

Greenbag distribution has proven to be a problem initially; the IWP Kiribati team have been running the distribution system themselves, but this has not been easy. They were aware that the distribution needed to change to use an existing system, especially given that the project had a limited lifespan, but they had been unable to gain the interest of a local distributor. This situation has resulted in a scarcity of Greenbags available to the population, and this looks to be the greatest constraint currently that implementing the GUPS faces.

- Distribution of Greenbags is currently inefficient and needs to be integrated with existing retail distribution systems.

To the team's credit, they took steps to address this problem as soon as it was bought to their notice, and during the course of this study, using information gained, a local distributor has been engaged who has a very wide distribution network of stores.

1.4.2 Impact on waste generation and Nanikai landfill

The IWP Kiribati waste reduction target was to achieve a 20% reduction in waste by the end of 2006.

- By the end of 2005 — a year ahead of schedule —IWP Kiribati has succeeded in achieving a 50% reduction in waste generated (to the landfill).

The Nanikai landfill was measured and estimates made regarding both the total waste capacity and the current filled area. The Nanikai landfill has been open for 1.5 years. During that time by vast majority of the waste disposed has been from Greenbags, as the TUC — which operates the landfill — has used it almost exclusively for disposal of collected Greenbags. Access has been closely controlled during most of that time, preventing other dumping. The public has also placed Greenbags outside the gate of the landfill, or thrown them over the fence from the road.

The TUC is still collecting large quantities of mixed wastes, but these are not generally placed in the landfill. The mixed wastes, collected from piles in the streets, typically have a very high organic content — consisting of palm fronds, leaves and tree trimmings — and these wastes are used for informal, small-scale land reclamation, as has been the practise for many years. While the situation may not be ideal, it does mean that the materials that are currently found in the landfill are in very large part derived from Greenbags.

A body of information is available from previous waste surveys in Tarawa, and also some analysis and photos from Nanikai produced over the life of the landfill. This material provides excellent reference material, enabling actual changes and progress to be clearly measured. Nevertheless, extrapolating figures out to years in the future inevitably involves some estimation: the rationale behind any assumptions is included in the body of the report. The estimated density of the waste compacted in the landfill is a crucial piece of information, but is very hard to measure accurately, as any effort to dig up part of the landfilled waste and measure it will result in major disturbance to the landfilled density. However, if the landfill continues to be used primarily for Greenbags, and the IWP Kiribati continues the Greenbag collection data programme that it has conducted recently, the information provided may allow further refinement of the estimates made here, as another nine months or so of data, combined with renewed measurement of the filled area of landfill, will provide a measurable lower limit to landfill density.

The essential information derived from this report indicates that:

- the contribution of household waste to the landfill has dropped around 60% in the two years to December 2005, through the removal of organics and recyclables; and

- the organic content of Greenbags is at a residual level (about 1%);

The Nanikai landfill has an estimated waste capacity of 21,000m³, excluding cover materials. The volume of the landfill currently filled (December 2005) is about 540 m³, or about 2.5% of the total capacity. The cost of construction of the Nanikai landfill is estimated at AUD 25/m³. The Nanikai landfill would be full in 2011 if (i) the entire TUC population used Greenbags, and (ii) all Greenbag waste went to Nanikai (assuming a density of 3 m³ per tonne of waste in the landfill, and a population increase of 5% per annum from 2000).

- Use of the Greenbag has the potential to save 60% of landfill space (i.e. up to AUD 100,000 per year in avoided landfill costs).

If Greenbag use was commonplace, the amount collected through Greenbag collection charges would exceed the amount that should be raised through the annual TUC household charge (at present the TUC household charge is commonly not paid). The two

TUC blue garbage trucks have sufficient capacity to collect all the Greenbags produced by the current population of the TUC area, should all household waste be in Greenbags.

- The Greenbag system has already saved (as of December 2005) at least $14,000 in landfill space through waste reduction.
- Comparison with historical data indicates continual improvement in waste reduction.
- Composition of Greenbags studied indicates a growing awareness by the public of the materials in the household wastes stream; this is a direct result of the public education programme.

1.5 Developing the Greenbag user-pays scheme

The current price per bag (USD 0.20) is useful as a means making the population accustomed to the idea of purchasing Greenbags for waste collection (plastic shopping bags also typically cost AUD 0.20 on South Tarawa). A retail price of 50c will be required to generate sufficient funds to replace the Councils' household waste collection charge, however, and in effect ensure full local government participation. Thus once people can easily access Greenbags, and once the benefits have spread across the TUC area, the price needs to be lifted incrementally to AUD 0.50. Do so will require coordination between the new importer/distributor and the councils, facilitated by IWP Kiribati. The landed cost of a bag is about AUD 0.14; both the importer/distributor and the retailer need to make AUD 0.05 each per bag, giving a total retail price of AUD 0.24. This would allow an AUD 0.26 collection fee from the sale of each bag (directed to the council by the importer/distributor), should the retail price be fixed at AUD 0.50 each. IWP Kiribati can facilitate setting up the payment system through a memorandum of agreement.

In South Tarawa there are two local government bodies, the TUC and the Betio Town Council (BTC). It should be fairly simple to direct the collection fee, collected by the distributor, to the appropriate council, depending on the location of the retail store that purchased the bag. A garbage bag is the kind of household item that is typically bought from a local store; indeed, South Tarawa is replete with a large number of small "corner stores" that provide daily basic needs, rather than supermarkets where people buy many items at once. Should it seem that there is significant overlap between Greenbag purchase and collection areas, then two different bags can be used, differentiated by printed message. This may help the public, retailers and waste collectors differentiate where particular bags are being sold and used.

1.6 Recommendations

1. **Ensure widespread distribution of Greenbags to retail outlets**

   The greatest constraint to the GUPS is poor availability of bags, if there is an inefficient distribution system. The distribution of Greenbags must use conventional wholesale and retail systems; this is currently being addressed by the IWP Kiribati.

2. **Find a commercial importer for the Greenbags**

   IWP cannot continue to act as the importer as it is not well equipped to do so; the project also has a limited lifespan. This issue is also being addressed.

3. **Manage the transition to an AUD 0.50 Greenbag through creative subsidy**

   IWP Kiribati should use its funds creatively to ensure that more Greenbags are imported, but not by IWP Kiribati. It should ensure that some money is directed to the TUC, and move the retail price to AUD 0.30 as quickly as possible. At that price IWP Kiribati must

vigorously promote to the public the reason for the increase to AUD 0.50, or alternately arrange for government subsidy, in recognition of government landfill-related savings.

4. **Remove the government worker waste collection charge**

   Remove the current levy on all government workers that is taken from each pay packet. When Government workers pay this levy, and then buy Greenbags, they pay twice and are disadvantaged. If people are reluctant to pay twice for waste collection, piles of uncontained wastes will still be commonplace in Government housing areas. If this measure is enacted, it must be done with some transitional arrangement for Council revenues.

5. **If Necessary, print two different Greenbags, for TUC and BTC**

   Should problems arise over distribution of funds from a GUPS, clearly differentiate the collection bags so that it is immediately apparent to consumers and waste collectors which local government area the bags are to be collected in. This should encourage people to buy the correct bag for their area, and avoid problems over division of collection fee funds.

6. **Compaction of wastes and use of cover material**

   The use of machinery every week to compact the material is essential to improve landfill life. While this will cost money, it is as effective as waste reduction efforts in extending landfill life.

7. **Research current costs of waste collections for Both TUC and BTC**

   Research should be conducted by IWP Kiribati to assist the Councils in identifying the real costs of waste collection and servicing landfill operations. This would also provide a more accurate analysis of savings from collection of wastes in bags instead of piles. This would also assist the Ministry of Environment, Lands and Agricultural Development (MELAD) with efforts to improve the waste situation on South Tarawa.

1.7 Conclusion

The Greenbag programme is clearly having a very marked effect on the type of waste that would go to the sanitary landfill in South Tarawa. Considerable progress has already been made toward establishment of an operational, bag-based user-pays system. The actual impact is measurable at the landfill, and the potential financial advantages are great, both in savings in landfill costs, but also in providing much needed resources to improve solid waste management (SWM) in South Tarawa. The costs to the community associated with pollution -- — in increased health costs, loss of fishing income, damage to coral reefs, and poetically magnified climate impacts — are significant, even though they may not currently be accounted for. Useful work has been done elsewhere by IWP and others to place dollar values on these external costs. Improved SWM will generate significant indirect savings to the community.

Direct pollution of the waters of Kiribati from uncontained and uncollected household wastes is readily apparent, with direct dumping of wastes in old wells, taro (*babai*) pits and directly on the beaches. The end result of improved SWM can only be a decrease in the water pollution that afflicts these crowded islets; however, it must be noted that this is only one of several major sources of water pollution affecting South Tarawa, and use of the Greenbag will not, on its own, cure this problem.

Part I: The Greenbag promotion on South Tarawa

Sections 2 and 3 address three essential issues:

- How has the Greenbag built on previous efforts to improve waste management in South Tarawa?
- Has the public been exposed to the Greenbag concept sufficiently that the programme is likely to be successful?
- Is there sufficient public knowledge and acceptance of the system to justify taking the Greenbag User Pays Scheme (GUPS) to a wider population?

2 Background

2.1 International Waters Project in Kiribati

The International Waters Project (IWP)[1] is a 7-year, USD 12 million initiative concerned with management and conservation of marine, coastal and freshwater resources in the Pacific islands region. The project includes two components: an integrated coastal and watershed management (ICWM) component, and an oceanic fisheries management component (the latter has been managed as a separate project). It is financed by the Global Environment Facility under its International Waters Programme. The ICWM component is implemented by the United Nations Development Programme and executed by the Secretariat of the Pacific Regional Environment Programme (SPREP), in conjunction with the governments of the 14 independent Pacific island countries: Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu. The ICWM component of the project has a 7-year phase of pilot activities, which started in 2000 and will conclude at the end of 2006.

The International Waters Project in Kiribati (IWP Kiribati) was designed to focus on addressing the root causes of degradation of the waters around South Tarawa. Actions were carried out under the auspices of IWP's ICWM programme. This was to be achieved through action at the community level to address priority environmental concerns. The IWP Kiribati project confirmed that there were two high priority areas to be identified for immediate intervention:

- improved waste management
- better water quality

To address these concerns IWP Kiribati supported the establishment of one pilot community project (of which the IWP Greenbag scheme is a major part) within the South Tarawa area and has worked with the community to not only identify how local actions have harmed the environment but also how local actions can positively improve the environment. Recognizing that environmental threats cannot be addressed through community level actions alone, the project has also engaged the Tarawa Urban Council, the Ministry of Environment Lands and Agriculture Development, the Health Inspection Unit of the Ministry of Health & Medical

[1] IWP is formally titled Implementation of the Strategic Action Programme of the Pacific Small Islands Developing States.

Services and the Water Engineering Unit of the Ministry of Public Works and Utilities in pilot activities. The project has partnered with local stakeholders through the establishment of a National Task Force in order to address in a collaborative way the root causes of environmental concerns in South Tarawa. Community participation at all stages of the project cycle has been a central element of the pilot activities.

The Bikenibeu West community project was designed specifically to build on existing environmental activities being undertaken by nongovernmental organisations and other development assistance agencies that were and/or are active in the community.

2.2 Recent history of waste reduction programs in Kiribati

It is important when looking at the IWP Greenbag programme to understand the history of solid waste education over the past decade in South Tarawa. The Greenbag programme has arisen by successfully building on many previous projects and the efforts of many people and organisations. The IWP Greenbag programme is a natural extension of those past efforts.

2.2.1 Kiribati environmental education program

In the late 1990s, The Foundation for the peoples of the South Paccific - Kiribati (FSPK) ran a programme called KEEP: Kiribati Environmental Education Programme. This project primarily promoted the concepts of waste separation, recycling, composting, and containerisation of rubbish. KEEP ran waste awareness workshops on a regular basis from 1997 to 2000 and reached many people including schoolteachers, church leaders, and council workers. Recycling was a major component of this work. Several posters were produced that have been widely distributed on the issue. KEEP also placed oil drum waste bins in a part of Bikenibeu West as part of a clean up programme. The bins were pivoted between two posts set in the ground to facilitate emptying. This “pilot area” also participated in the waste survey of 1999 conducted by Sinclair Knight Merz (SKM) under the auspices of SPREP, and eventually became part of the larger IWP Kiribati pilot community. This work by FSPK was conducted in conjunction with the Environment and Conservation Division (ECD) of the Ministry of Environment, Lands and Agricultural Development (MELAD) — at that time called the Ministry of Environment and Social Development (MESD) — and the logo of the waste octopus was developed. During this period the Environment Act was drafted and subsequently passed by Parliament (in 2000).

2.2.2 Kiribati Te Boboto Coalition

FSPK renewed its waste-related efforts in 2002 with a feasibility study for recycling in Kiribati (FSPK 2003). At this time the Community Development and Sustainable Participation (CDSP) project[2] commenced operations. CDSP was a technical assistance (TA) programme associated with community participation and supported by the Asian Development Bank (ADB), as part of the ADB loan-financed Sanitation and Public Health and Environment (SAPHE) public works programme; it operated out of the MESD Offices in Bikenibeu. In addition, the women’s organisation Aia Mwaea Ainen Kiribati (AMAK) actively participated in these activities, as improved waste management was seen as a key issue to improving the standard of living of women. Indeed, it was at a FSPK workshop with AMAK that the name *Kaoki Mange* was first coined for the recycling system. The FSPK project worked closely with AMAK, the CDSP and IWP Kiribati in formulating the strategy to mesh the various programmes into a coherent whole. This cooperative approach was to prove very fruitful in maximising the effects achieved with the available resources.

[2] Community Development and Sustainable Participation Project, TA 3838-KIR ADB SAPHE 2002 – 2004.

The coalition of FSPK, CDSP, AMAK and IWP Kiribati in 2003 developed a slogan to encourage people to improve the existing waste arrangements and clean up their surroundings. This slogan was *Kiribati Te Boboto*, (essentially: Make Kiribati Beautiful) and it was subsequently arranged to have this printed on the garbage bags that were being ordered from New Zealand. The particular Greenbag was chosen as it is biodegradable, meaning that "loose" bags would not add to the longer-term trash problems, as they degrade into pieces after exposure to the elements over a month or two.

Figure 1: TUC Greenbag roll-on/roll-off collection truck

At the same time that the grassroots waste education and recycling efforts were gaining momentum, the SAPHE Project, financed largely through an ADB loan to the Government of Kiribati (with which the CDSP TA was affiliated) was constructing the Nanikai landfill. The SAPHE Project also supplied two new garbage collection trucks to the TUC, which added markedly to the TUC's ability to collect waste. Previously, collection was done with slow tractors and trailers; the TUC area covers some 30 kilometres (km) of South Tarawa, and the limitations of the tractors meant in effect that large parts of the TUC area were without waste collection.

As the SAPHE Project Office was closely involved with the coalition, the SAPHE Project Manager arranged to have the bins on the new trucks painted with the slogan *Kiribati Te Boboto Use the Green Bag*, thus creating a clear link in people's minds between the Greenbags and the waste collection system. The garbage trucks are of the roll-on/roll-off type, with a small skip (bin) that is easily removable from the truck, allowing the skip to be left in the street for filling.

2.2.3 Coalition's waste strategy

The Coalition of FSPK, CDSP, AMAK and IWP Kiribati developed an overall strategy to tackle waste, combining the various aspects of their project programmes. The strategy comprised:

- Legislate and set up a Container Deposit programme — the **Kaoki Mange** — to maximise recovery of drink cans and bottles and so push them out of the waste stream.
- Promote the use of printed biodegradable garbage bags — the **Greenbag** — so that large organic wastes would also be pushed out of the collected waste stream (these wastes do not fit in the bags).

- Promote simple composting methods that to utilise the organic wastes, primarily consisting of the **banana circle** concept.

An additional longer-term aim was to turn the garbage bags into a user-pays system, whereby the cost of waste collection was built into the purchase price of the bag (also known as a pre-paid garbage bag). This was seen as a way of sustaining the availability of garbage bags after the various projects had finished, and also as a way of engaging the councils in a universal approach to waste collection; at that time Council waste collection was only done in selected areas where there was government worker housing, as these households paid a collection fee as a wage deduction from Government pay packets. This restricted waste collection system was a major impediment to improved waste management in South Tarawa.

The coalition produced a "road map" to a designated Greenbag Day, after which the TUC would only collect waste in Greenbags (the timeline proved to be a bit ambitious; see Fig. 2).

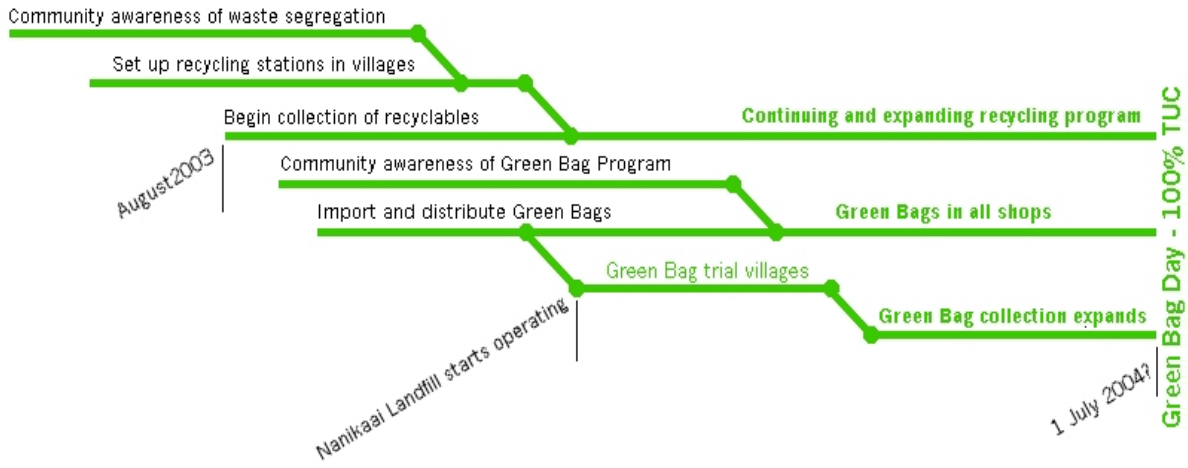

Figure 2: A Roadmap to Greenbag Day (at which point the TUC Has 100% of municipal garbage in biodegradable Greenbags)

Active promotion of the Greenbag commenced in this period (the latter half of 2003). Prospective stakeholders such as the TUC were engaged in the issue, and strategies to promote the Greenbag as a tool for waste reduction and separation were developed.

3 Greenbag promotion

3.1 Rationale

The FSPK project had become aware of a system used by some New Zealand local governments that utilised a specific, locally-purchased garbage bag for their waste collection.[3] This system allowed the cost of waste collection to be attached to the bag at time of purchase; thus the cost of collection was already paid for any bag put on the street for collection. One of the major stumbling blocks to improved waste collection in Tarawa that had been identified was that the Councils collected waste only from households that had paid for collection, through the annual Household Service Charge fee. Most households did not pay, as they claimed that the councils never collected their waste. In fact, the system was hampered by a holdover from the colonial era, when government workers were provided with housing, and also had to pay a fee, taken from their wages each pay day, for garbage collection. The Councils had no outside fee collection arm, so people had to go to the council to pay their fee.

[3] The Thames and Coromandel District Council is one example. See Appendix B.

The TUC had only three working tractors and trailers to cover about 30 km, but the vehicles were much too slow to allow coverage outside of the main village centers, where the government housing was located. The result was that only the main, dense Government housing areas received much attention.

Figure 3: Bikenibeu West Ocean Loop Road rubbish pile, July 2003

The councils even failed to collect the waste effectively from government housing when it was located in peripheral areas. This was born out by personal observation on the part of the author when living in an area of government-owned houses for three months 2002–2003, in what subsequently became part of the IWP Kiribati pilot area in Bikenibeu; there was not a single collection during that period in that street.[4] Figure 3 shows a photo taken in mid-2003 at this location

3.2 History of the Greenbag promotion

The Greenbags were first promoted by FSPK and CDSP to the population of South Tarawa in September 2003, after a shipment of 10,000 bags had been received from New Zealand. The aim from the outset was to divert some of the large organic waste that was being picked up by the councils out of the waste stream, through the use of the Greenbags. This potential was graphically demonstrated at a workshop with the TUC garbage collectors in November 2003, when a typical pile of waste near the TUC office was separated out into plastic bottles and aluminium cans, and organic (green) and inorganic waste. A large pile of waste that might take 15 minutes for the collectors to pick up was converted into two bags of inorganic waste in garbage bags, which could be picked up in seconds. This was a demonstration of the three-part waste stream strategy being formulated and promoted at that time by the coalition.

3.2.1 Distribution of Greenbags

Greenbags were distributed free from FSPK and CDSP offices, through the women's nongovernment organisation (NGO) AMAK, and the TUC offices. The TUC also distributed boxes of bags to Ward Councillors, to further redistribute to their constituents.

Figure 4: Te Toamatoa use the Greenbag as part of their Waste Play

Announcements were placed in stores, and also in the newspapers. The SAPHE Project Office also distributed Greenbags to government ministries, and

[4] Oceanside Loop Road, Kaibanaki, Bikenibeu West.

FSPK and CDSP staff took Greenbags to workshops and public events. AMAK had become more involved, as a project officer of the Kaoki Mange was employed under a separate funding arrangement with AMAK, in order to promote improved waste management in the home through the women's movement. The project officer at CDSP was also President of the National Council of Women, and worked very closely with AMAK. Through this mechanism, all thirteen NGO members of the AMAK umbrella group also become onward distributors of the Greenbag.

More bags were imported in 2004. The Kaoki Mange recycling system was established, and satellite collection points also distributed the bags, meaning the Greenbags were widely distributed. The Greenbag was incorporated into the Waste Play performed by Te Toamatoa theatre group (Fig. 4), and *Te Kiriin Baeki* became part of the language. Te Toamatoa visited all South Tarawa schools with the play, many twice, and each time a box of 250 Greenbags would be delivered for school use and distribution after the performance.

At Independence Day celebrations in 2004, Greenbags were given out to all the small stalls that were set up for two weeks around the Bairiki Stadium. Prior to Independence Day, which was the Silver Jubilee, the people had been encouraged to clean up for the celebrations, and use the Greenbag for inorganic wastes.

3.2.2 Early media promotion

The Greenbag was first promoted by the coalition through simple notices placed on shop doors and other public noticeboards, and through advertisements in newspaper and on the radio (see Appendix B). This wider programme of promoting the Greenbag commenced in April 2004, as funds became available for this work. The advertisements and radio spots were periodically modified, but during the next year, a radio spot promoting the Greenbag would have been heard on the FM station at least once a day. The entire Kaoki Mange/Banana Circle/Greenbag programme was promoted using four radio spots per day on the FM station, and usually two per day on the Broadcasting and Publications Authority (BPA) AM station. The three newspapers carried a quarter page advertisement for the Greenbag in most issues over the next year. Most of this work was paid for using funds raised by Kaoki Mange, particularly by late 2004 and into 2005, once the CDSP had closed.

This blanket exposure approach has resulted in the term "Greenbag" becoming ubiquitous in Tarawa, and it is hard to find someone who does not know the term. The IWP Kiribati has continued this use of media and radio, with extensive exposure of the Greenbag in both media (see below). IWP Kiribati has also pioneered new ways of promoting the Greenbags.

3.2.3 TUC acceptance of the Greenbag

In May 2004 the SAPHE project held a workshop with the TUC and BTC on the theme of landfill management for South Tarawa. The workshop was held at the SAPHE project office in Betio, and looked at user pays charges for landfill waste. A range of examples from New Zealand and Australia were examined, including landfill tipping fees that are paid at the gate of the landfill, and a user-pays bag system. The user-pays arrangement was familiar to TUC through the ongoing contact between TUC and Kaoki Mange; indeed, a TUC representative had attended most working group sessions of the CDSP programme, where the Greenbag idea was developed.

Kaoki Mange and the CDSP held several workshops with both TUC and BTC garbage workers and management staff during 2004, with more effort going toward the TUC, as it was more readily engaged on the issue. Thus both the underlying concept behind the Greenbag and the reasons for moving to a user-pays system were very familiar to the TUC workers and management by the end of 2004. This acceptance was demonstrated by the readiness of the

TUC to encourage Greenbag use, by designating Tuesdays and Thursdays as Greenbag collection days.

To encourage the continued cooperation of the TUC in collecting Greenbags of rubbish from households that had not paid for waste collections, and to try and engage the BTC in this programme, the Kaoki Mange made a presentation of AUD 2,000 to each Council in November 2004, consisting of the remaining New Zealand Agency for International Development (NZAID) funding for the Kaoki Mange programme, which had been specifically targeted at improving waste management in the home as an improvement to the wellbeing of women in the community.

3.3 Continuation of Greenbag programme by IWP Kiribati

A contrasting situation developed in late 2004: Greenbags were plentiful, but the ability of the Coalition to promote the Greenbag programme was reduced. Large numbers of Greenbags were purchased toward the end of 2004, as remaining NZAID funding for Kaoki Mange and final CDSP project funds were channelled into Greenbag purchases. But as the Kaoki Mange refund system entered an operational test phase, and the Materials Recovery Facility (MRF) was established, the capacity of FSPK to promote the Greenbag was reduced. At the same time — September 2004 — the CDSP project was completed. The CDSP and FSPK had worked together very closely, at times pooling available funds in order to buy shipments of Greenbags. Funds raised by FSPK had been drawn from a variety of sources, and no one fund had supplied all the Greenbag money. The availability of CDSP funds for purchase of Greenbags depended on the funding requirements of other project activities that also focussed on improved community waste management. By September 2004, Kaoki Mange was being financed almost entirely through United Nations Development Programme (UNDP) funds, which were mostly slated for recycling system operations. So while a comprehensive programme promoting and distributing the Greenbag for free had been put in place, funds and the required project capacity to further the programme were now constrained.

With the CDSP closed, and the Kaoki Mange occupied with recycling work, it fell to IWP Kiribati to continue the Greenbag programme. On the ground, the effect of the freely available bags was clearly visible around South Tarawa, as piles of uncontained rubbish rapidly decreased. The effect was perhaps most marked in Betio, where the BTC garbage collectors acted as distributors of bags in March–April 2005. This Greenbag activity coincided with the introduction of the full container deposit-based recycling system,[5] which removed a large quantity of cans and Polyethylene Terephthalate (PET) bottles from the streets and lands of South Tarawa.

The TUC had embraced the concept of the Greenbag and a user-pays type of system beginning with the workshop held in November 2003. The FSPK project officer (Uarai Koneteti) negotiated an agreement with the TUC to pick up any Greenbags found by the roadside, whether or not a pick up had been paid for. The TUC has now followed this policy for almost two years. At first pick ups were infrequent, and bags might be left by the road for some time. But IWP involvement in the Greenbags helped to reduce these inefficiencies, and a regular schedule of Greenbag pick ups was started, with Greenbags being collected in the TUC area on Tuesday and Thursday mornings. This programme has been adhered to for the last year, as IWP Kiribati has invested the time and effort in the Greenbag work to keep this schedule in place and effective through very regular and constant interaction with the TUC. Observations in December 2005 showed that bag pick ups were on time and effective.

[5] The relevant Container Deposit Act became law in February.

3.4 IWP Kiribati promotional competitions

IWP Kiribati has used competitions to promote both the Greenbag and improved waste management to households. Previously, the coalition had run a Tarawa Tidy Towns contest around Christmas 2003, which had been effective in promoting a general cleanup, and this had used free Greenbags as an incentive.

3.4.1 Akeatemange competition

From October to December 2004 IWP Kiribati ran the Akeatemange (Zero Waste) Competition in the IWP Kiribati pilot area. This competition encouraged people to separate wastes into recyclable, organic and landfill wastes. Organics were directed to banana circles, the recyclables to the Kaoki Mange, which had recently opened the MRF in Betio (and had a Collection Point open in Bikenibeu in November 2004), and other materials into the Greenbags for disposal in the landfill. This competition was primarily aimed to get people to look at what was in their waste stream, and begin identifying and separating wastes. The Greenbag was only a single component of this competition, and the emphasis was on banana circles and recyclables as identified resources that could be removed from the waste stream. Prizes were given for the best household waste management, including use of wastewater and organics use for compost and gardening.

3.4.2 The Greenbag competition, February 2005

As the Akeatemange Competition finished in December, it became clear from roadside monitoring that Greenbag use was dropping off. The pilot area Local Project Committee and IWP Kiribati decided to hold another competition in February 2005, targeted solely at Greenbags. Part of the aim was also to conduct a big clean up of the pilot area, so as to give the whole community a sense of real achievement, and create a benchmark that could be maintained for the future. The objectives of the Greenbag Competition were to (IWP Kiribati 2005):

- promote the use of Greenbags for the safe collection and disposal of inorganic rubbish;
- clean up Bikenibeu West and give the area good facelift;
- encourage the people of Bikenibeu West to collect inorganic rubbish beyond their household boundary (in the streets, on the beaches and the informal rubbish dumps); and
- ensure the message on the use of Greenbag was retained in people's minds, i.e. "for Kiribati Te Boboto, use the Greenbags for unusable rubbish."

This competition collected 2,333 Greenbags in ten days (from 14–24 February 2005). A total weight of around 14 t of waste was collected; 47 households participated, with each household producing an average of fifty Greenbags. The effort was also measured by community grouping, mostly along religious lines, so that individual household amounts also counted in group totals. The collection system provided by the TUC was overwhelmed by this competition.

3.5 Greenbag user-pays scheme

As IWP Kiribati took on the role of promoting the Greenbags, it decided to also move towards a user-pays scheme. As described above, the Greenbag had been envisioned as becoming a system where the bags were purchased from stores, with the price of collection included in the cost of the bag. This would eliminate one of the main barriers to improved SWM in South

Tarawa: that of people not paying the Household Service Charge because the Councils did not pick up the waste, and the Councils not picking up the waste because the people didn't pay the Service Charge. With a user-pays system, the pick up charge would already been paid for all Greenbags of rubbish placed by the side of the road. In order to promote this concept, and move the Greenbags into a user-pays system, IWP Kiribati developed the Greenbag User Pays Scheme (GUPS).

The GUPS plan called for the Greenbags to ultimately sell for a retail cost of AUD 0.50, with about half of this sum going to the Council that picks up the bag. This would relieve the councils of collecting the Household Service Charge fees, and also nullify any arguments as to whether houses had paid for collection of waste. A full price breakdown of the Greenbag is included at Section 3.9.1.

In May 2005 free distribution of Greenbags was halted, and the bags were sold for AUD 0.20. Initially, IWP Kiribati invited stores to sell Greenbags in return for media promotion of those stores, but this resulted in only two stores taking up the offer. IWP Kiribati then decided to offer AUD 0.04 to the stores for each bag sold at AUD 0.20c and travelled through the TUC area with a truck float promoting this offer. This resulted in 25 stores taking up the Greenbags for sale in the Temeiku to Bairiki area. Most stores would only accept 25 bags at once, due to the cost of purchase and cash flow, and IWP Kiribati sold the bags to stores — for resale — for AUD 0.16 each, or AUD 4.00 for 25, with a retail price of AUD 0.20 promoted via radio and newspapers. Take up was slow, and the difficulties of the distribution system, and accounting and dealing with the cash, meant that overall GUPS got off to a slow start. A competition was proposed to increase visibility of the programme in September, (see below), and the distribution issue has been addressed during the course of this study (see Section 3.7)

3.5.1 Greenbag user-pays scheme competition October 2005

At the beginning of October 2005, it was decided to launch a new Greenbag Competition, as part of the promotion of a Greenbag User Pays Scheme (GUPS). The competition is ongoing at the time of writing, and engages the TUC area of South Tarawa on the council ward level, and in so doing dramatically broadens the reach of previous competitions, which promoted the Greenbag only to the IWP Kiribati pilot area. Prizes are to be awarded for the best of each council ward, judged in part internally within the ward. The President of Kiribati launched the GUPS at the main Stadium in Bairiki in September.

Objectives of the GUPS competition[6] are to:

- promote the Greenbag User Pays Scheme as a new way of improving waste management in South Tarawa;
- encourage the waste collectors to adopt a user-pays scheme for households in place of the service fee;
- encourage households to buy the Greenbag;
- encourage people to put only inorganic rubbish (and no organic waste) in the Greenbag;
- encourage government departments to adopt the Greenbag User Pays Scheme;
- improve efficiency of the waste collection system; and
- discourage people from putting their rubbish into open heaps at the roadside.

[6] IWP Kiribati internal briefing paper, 9 September 2005.

The distribution points for the Greenbag Competition are the councillors participating in the competition and the Kaoki Mange Collection Points. IWP Kiribati stocks up these points with the Greenbags as and when required. At the beginning of each week, IWP Kiribati collects the funds raised from selling the Greenbags and 50% of those funds are set aside and paid to the TUC for picking up the bags.

A total of 692 households or about 23% of the 3,050 total households (National Statistics Office 2000) registered for the competition; the 692 households have 5,365 members, and involve every village in the TUC (except Teaoraereke). All Greenbags checked and measured by the author at the Nanikai landfill on December 22 (see Section 4) were produced in the competition area.

3.6 Use of media by IWP Kiribati for Greenbag promotion

IWP Kiribati has conducted a major media push over the last eight months to promote the Greenbag. Half of the project expenditures are now going toward public communications work.[7] A journalist with experience in print and radio has been hired on a short-term contract to assist in this work. Radio news broadcasts are regularly sponsored, allowing the IWP Greenbag song to be played after the evening radio news, a prime-time audience. Also, the main newspaper (the Uekera) carries the IWP newsletter and weekly stories centering on improving waste management. Two songs have been recorded and are regularly played on the both stations AM and FM radio stations. The primary target audience of this mass communication effort is the estimated 31,500 people in the TUC.

The project also uses posters to good effect. Posters have evolved through four different designs and messages over the course of more than a year; the posters are now designed locally and printed in Fiji. Many projects suffer from attempting to print a beautiful poster at the early stage of the projects, only to find that they would have had designed their message differently had these been produced later. The IWP Kiribati team have learned from the social marketing exercises conducted in 2004, and have developed and tested their messages carefully, building their experience as they go. They have now reached the point where they are able to conduct a complex media campaign as well a large competition.

3.7 IWP Kiribati distribution of Greenbags

Beginning in May 2005, IWP Kiribati conducted their own Greenbag distribution by visiting stores and encouraging them to buy Greenbags for resale. This is a very time consuming task, however, especially when a single product is being promoted. IWP Kiribati staff have kept careful records of where Greenbags have been placed for resale, but it is clear that the system is cumbersome, especially as the staff have many other tasks, and retail distribution is not a core skill. Availability of Greenbags is crucial to the success of the programme.

At the beginning of this study, many stores were visited to determine the availability of Greenbags. Casual enquires were also made regarding access to Greenbags; many people asked the consultant where Greenbags could be obtained. In particular, visits to stores in the IWP Pilot area found that only one store had Greenbags for sale. Many stores had sold out, but replenishments had not arrived. Clearly there was a problem in that most stores did not have Greenbags for sale, and this is a major constraint to the programme.

This issue was raised with the IWP Coordinator, who had been away for some time attending an IWP workshop. She agreed that it was a problem for the office to keep the distribution serviced along with all the other work. Indeed, servicing many small stores is not easy: the stores usually only wanted to buy a small number of bags at a time, as their cash flow is

[7] Pers comm., IWP Kiribati National Coordinator, 28 December 2005.

limited, and so required regular servicing. Also, many stores would not participate without credit arrangements. The IWP staff have no experience in retail distribution, and so it is not surprising that this proved difficult. After a short discussion, it was agreed that the role of distributor would be better served by one of the large wholesale distributors on South Tarawa, who service these small stores through a network of light trucks. The Greenbag is in particular the sort of item purchased from the local corner store at the time it is needed in the home; as such, it is very important to target these small neighbourhood stores for distribution. It is interesting to note that both in the vicinity of both the FSPK and IWP offices (which both serve as distributors of Greenbags), that Greenbags were a very common sight on collection days.

A meeting was arranged with the Manager of Bobotin Kiribati Ltd (BKL), the largest importer and wholesaler of groceries in Kiribati. It was agreed that BKL would distribute Greenbags to the small stores across South Tarawa; it would purchase existing stocks of bags at AUD 0.10 each from IWP Kiribati, and sell these to the stores for AUD 0.15 each. The stores would then sell for AUD 0.20 each, as promoted by IWP Kiribati. This was decided as an interim measure, with the manager being aware that in time, the intention was to lift the price to AUD 0.50 each and direct the excess funds to the Councils. BKL indicated that a markup of AUD 0.05 per bag for BKL, and the same for the retail stores, would provide an acceptable pricing structure, given BKL's experience in the retail and wholesale business in Kiribati. It was also discussed that BKL could be the importer of Greenbags. This approach would remove IWP Kiribati from any logistical involvement in the programme, which is important as the Project will end in 2006; it will also allow the AUD 0.26 councils contribution to be sent direct from BKL.

3.8 Total Greenbag imports

Overall, some 147,000 Greenbags have been imported into Kiribati, and virtually all of these have been used in South Tarawa. Table 1 provides information on Greenbag imports. Bags have typically been imported in quantities of 20–30,000; the bags are made of EPI, a plastic material that degrades in sunlight and weather exposure, and are manufactured in New Zealand. The first shipment of 10,000 was of the New Zealand "Kiwi Green" type, but subsequent orders have all been printed with a commissioned printing plate so that they all read "Kiribati Te Boboto" in large letters. Examples of all the bags are in Fig. 5.

Table 1: Greenbag imports into Kiribati

Date Arrived	Number	Importer
Aug 2003	10,000	FSPK
Nov 2003	11,500	FSPK/CDSP
April 2004	22,750	FSPK/CDSP
Sept 2004	31,000	FSPK/CDSP
March 2005	11,650	FSPK
Sub total	*86,900*	
May 2005	31,750	IWP Kiribati
Aug 2005	28,750	IWP Kiribati
Sub Total	*60,000*	
Total	147,000	

Figure 5: Four different types of Greenbag, imported in different batches

3.9 The built-in bag charge of a Greenbag user-pays scheme

The landed cost of Greenbags in Tarawa is between AUD 0.132–0.137 each, with the price difference depending on the quantity imported (Table 2).

Table 2 shows that the price does not change significantly per unit depending on quantity. However, the effort required to order, pay for and clear customs of 10,000 is essentially the same as 100,000. This cost has not been included in the price analysis.

Typically, a GUPS would import bags at about AUD 0.135 each (a figure of AUD 0.14 per Greenbag will be used to allow for any price increases). The bags come in cartons containing 250 bags. Using the assumed GUPS payment of AUD 0.14 per bag, landed in Tarawa, a box of 250 will cost AUD 35. Each carton contains ten sets of 25 bags attached to a tear-off strip. The minium wholesale amount sold to a small store would thus be 25 bags. It has been proposed that the final retail price of the Greenbag would be AUD 0.50 each.

Table 2: Essential Greenbag costing elements

Element	Costs (AUD)	Costs (NZD)
Bag price (per 1000)		96.00
Freight Charges (per m^3)		390.00
Additional shipping costs (fixed fees per shipment)		
Documentation		25.00
Export Entry		25.00
Export Entry Transaction		5.75
Outward Cargo Transaction Fee		5.00
Total		60.75
Outer Island Import Levy (per m^3)	25.00	
KPA handling charge (per m^3)	23.00	
Cost per m^3 (10,500 bags or 44 boxes of 250 bags each)	1,379.00	
Additional fixed shipping cost per shipment	57.85	
Cost per shipment	1436.85	
Cost per bag (when importing per m^3, or 10,500 bags)	0.137	
Cost per bag (when importing 100,000 bags)	0.132	

3.9.1 Proposed cost breakdown scenario

The Greenbag importer should also be the main distributor. They will sell the bags at AUD 0.45 each to the retail stores, and keep AUD 0.05 per bag as a markup. With the retail price of the bags at 50c, the retail stores can also mark up each bag AUD 0.05, which is slightly greater than the usual 10% markup rate of small corner stores in Tarawa. The retail store thus buys bags for $112.5 per box; the minium purchase of 25 bags would cost AUD 11.25. The remaining AUD 0.26 per bag (AUD 65/box) would be directed to the Councils, direct from the distributor (Table 3).

As there are two councils, it would be necessary for the importer/wholesaler to direct the AUD 0.26/bag to the relevant council in the area where the bag was sold to the retailer. Alternatively, there could be two different printed bags, should the first approach be difficult to implement for some reason.

Table 3: Greenbag cost breakdown

Element	Amount per bag (AUD)	Amount per box of 250 (AUD)
Greenbag landed cost in Tararwa	0.14	35.0
Importer/distributor markup	0.05	12.5
Retailer markup	0.05	12.5
Council contribution	0.26	65.0
Retail price	0.50	125.0

The money collected through the sale of Greenbags can effectively substitute for the current Household Service Charge levied by Councils from households,[8] which is currently paid only by Government workers (as they have no choice, it being automatically deducted from their pay).

The 147,000 bags imported so far could have provided AUD 38,220; 100,000 bags would generate AUD 26,000. Typical import of 30,000 bags would cost AUD 4,200 at AUD 0.14, and would raise AUD 7,800 for the Councils.

If people buy Greenbags, but the Councils fails to collect them, people will cease buying Greenbags, decreasing Council income. This longer-term effect should mitigate any potential short-term disincentives that might serve to discourage the Councils from picking up Greenbags. Indeed, those disincentives already exist in the current Service Charge system. It is hoped that when the population finds that Greenbags are an effective and inexpensive solution to their waste problems — and people come to appreciate cleaner surroundings — more inorganic waste will be placed in Greenbags, thus increasing sales and Council revenues. The increased Council revenue will be dependant on the Council picking up Greenbags, if it is to be sustainable.

This approach should overcome the problem that many areas receive no waste collection because they have not paid the Household Service Charge fee. Much of the waste that goes uncollected ends up dumped on the coast, thrown into old *babai* (taro) pits and wells, or blows around as litter.

It should be noted that, where available (and they can be very hard to find) garbage bags in Tarawa had typically been sold for AUD 2 or AUD 2.50 for five, or AUD 0.40–0.50 each. In a large New Zealand supermarket[9] various types of similar sized bags were found to be about NZD 2.0 for 5, or NZD 0.40 each.

[8] Typically AUD 10/annum, see Section 6.1.
[9] Grey Lynn Woolworths, Auckland, 29 January 2006.

Part II: Impact of the Greenbag on Nanikai landfill

The Greenbag User Pays Scheme aims to:

- push organic waste out of the waste stream;
- decrease the quantity of waste going to the Nanikai landfill;
- save the government money in avoided landfill costs; and
- generate sufficient funds to make a true user-pays waste collection system.

These targets are measurable (see Sections 4–6 for measurements and resulting estimates).

4 Waste generation data for South Tarawa

The data collected during the course of this survey is best understood in the context of relevant historical data, so that changes over time — and particularly improvements resulting from use of Greenbags — can be discerned.

4.1 Overview of past waste analyses

Four waste stream analyses were conducted in the decade prior to the IWP project in Kiribati. The two earlier studies (1994 and 1996) used different methodologies, while an attempt at consistency was made with the two latter studies (1997 and 1999). The 1996 study appears to have been a desk study, and the actual raw data and methodology was only available for the 1997 and 1999 studies. A very brief look at the results follows.

4.1.1 1994 SPREP survey

A SPREP-sponsored report (Gangaiya 1994) in 1994 found that the bulk of the waste consisted mainly of organic materials, (80%) and metals (7%). The organic materials were mainly dry leaves and palm fronds. The metals consisted mostly of beer cans and food tins. The study recommended that methods of composting using the organic materials be encouraged in the community. A per capita waste generation rate is not available from that study; the study was not available for direct citation (reported in ADB 2001: 2.3). It seems that this data was collected from analysing piles of waste in the street.

4.1.2 1996 ADB Royds survey

The Royds Report (see ADB 1996) produced figures of 62% organic waste and 7% metals. Paper (14%) and plastics (12%) were significant components of the waste stream (both were present at low (2% each) amounts in the SPREP study). Royds estimated a mean bulk density of 100 kg/m³, and an estimated waste generation of 6,500 t per annum. Household generation was estimated at 4.2 kg/day, or 0.53 kg/person/day (kg/p/d).[10] This study formed the basis for the subsequent SAPHE project that built Nanikai landfill. The study was not available for direct citation.[11]

[10] Extrapolated from Gangaiya 1994: see ADB 2001: 2.3).
[11] Reported in ADB 2001: 2.3.

4.1.3 1997 ADB ISEU survey

In 1997, an ADB TA assisting the Environment Unit[12] also looked at Tarawa's SWM problems, and their study revealed 76% organics, 10% metals, with paper and plastics 5% each. This TA set the course for the Environment Act of 2000. This study appears to have conducted a practical survey, but was not available for direct citation.[13]

4.1.4 1999 SPREP WASTE survey

In September 1999 the European Union- (EU) funded WASTE Project report (Sinclair Knight Merz 2000) looked at household waste generated from Bikenibeu West in the original KEEP pilot area, and landfill waste from the Betio Red Beach landfill. Household waste was collected by a daily bag method similar to that employed by the IWP Kiribati March 2004 waste survey. This study found 51% organics, metals at about 10%, plastics and papers at 7% each. This study produced a per capita generation rate of 0.33 kg/p/d, and a total estimated production from South Tarawa of 3,410 t.[14] Waste density was found to be 130 kg/m^3, giving 26,200 m^3 per year, or, if compacted by half as the study assumes, a landfill requirement of around 13,000 m^3/yr. A draft version only of this report was available for direct citation.

4.1.5 Methodologies used

Note that in these studies metals are not separated by type, and the aluminium content would be high, particularly as at the time these studies were made, virtually all beverages came in aluminium cans; also, as noted, the 1999 WASTE Project report used a bag for household collection, and this would have pushed out the larger organic component commonly seen in the street. This would likely account for the differences in organic content seen in the other reports (which reported 75–80% organics vs. 51% in the 1999 study); those reports may well have been measuring piles of waste in the street. The piles of mixed waste being collected from the street by the Councils also a very high organic content; this condition persists even today (see Fig. 6). If the 1994 and 1997 reports had measured waste piles in the street, they would agree with the FSP determination at the time of the Kaoki Mange Feasibility Study in 2003 that street waste collections were 75-80% organic, with many coconut palm fronds and tree trimmings being included.

Figure 6: Truckload of mixed street waste in Nanikai dump (December 2005) showing high organic content

[12] Institutional Strengthening of the Environment Unit, ADB TA-2199, MBA International, 1997.
[13] Reported in ADB 2001.
[14] Based on a 1995 population of 28,350.

The results generally show plastics becoming more prevalent over time, which is to be expected as plastic bottles for water and cooking oil have become common.

The 2001 SAPHE Landfill Design Report (ADB 2001) based subsequent calculations as to waste quantities on the 1999 SPREP survey (Sinclair Knight Merz 2000). The SAPHE report was used in developing the design of the Nanikai landfill, and uses 130 kg/m³ as a working density figure for landfill design; it indicates that a degree of compaction would occur in the landfill, bringing the density to 211 kg/m³. Waste generation in the TUC area only, using the 2005 estimate for population, would be 3,800 t/yr, according to the data used for the Nanikai landfill design. Landfill space required would vary from 14,600–29,200 $m^{3,}$ depending on the density of the landfill waste (see Table 4).

4.2 IWP Kiribati survey data

The IWP Kiribati survey of Bikenibeu West (IWP Kiribati 2005) used a similar methodology as the 1999 SPREP survey, using garbage bags collected from households over a week, but sorted metal and plastics by specific materials, rather than as general categories. This survey was conducted fairly early in the Greenbag promotion programme (within six months of the first bags being freely available), but people in the area were already being encouraged to keep organic waste out of the Greenbags. The real aim of this survey was to determine the inorganic content, and characterise the actual household waste stream, rather than assess the total quantity of waste. It was clear from observation of the waste piles collected by the Council at the time that the overall organic content was very high. As households were provided with bags to put the waste in, larger organic items, such as palm fronds from coconut trees, and trimmings from small trees — both very common in the council waste collections as can be seen from the photos — were effectively pushed out of this survey.

The survey found 48% of this bagged household waste was organic (mostly leaves); 19% was metals; 15% glass; and 8% plastics (all figures by weight). This survey in particular carefully detailed the inorganic content; it is interesting to note that while aluminium cans constituted only 10% of the metals by weight, they comprised 2 of 6 bags of metals collected, or one third of the volume. Similarly, PET bottles represented 19% of the weight of plastics, but were equal in volume to a quantity of glass that weighed nearly ten times as much. This is very important to bear in mind, for when assessing landfill space, the volume and density of waste are crucial parameters.

The IWP Kiribati survey of Bikenibeu West found the waste generation rate to be 0.2 kg/p/d. The population of South Tarawa according to the 2000 census (National Statistics Office 2002) was 36,717, with the TUC area (South Tarawa less Betio) having 24,449.[15] The growth rate is 5.17% per annum, which suggests a 2005 population of about 31,500 people in the TUC area.[16] That population would generate 2,300 t/yr of waste in the TUC area, which the Nanikai landfill serves. It is important to note that this figure has excluded the larger organic wastes that are a large part of the waste that the council still picks up. But this large organic waste should not be going to landfill: indeed, taking any organic waste to the landfill in the poor soil environment of an atoll is effectively further depleting already poor soils. The resultant landfill area required varies from 8,850–17,700 m^3, depending on the density (see Table 4).

[15] South Tarawa, Report on the 2000 Census, Statistics Office, Gov. of Kiribati.

[16] Editor's note: provisional results of the 2005 Census (released after completion of the report) give a population for the TUC area of 27,802. See National Statistics Office 2005.

Table 4: Landfill volume required

Study	Annual waste generation in the TUC area in 2005 (t)	Landfill volume required (m^3)		
		Low density (130 kg/m^3)	Medium density (211 kg/m^3)	High density (260 kg/m^3)
SAPHE Landfill Design Report	3,800	29,200	18,000	14,600
IWP Kiribati Survey	2,300	17,700	10,900	8,850

4.3 Comparison with other places studied by IWP

In 2004, the IWP in the Marshall Islands conducted a waste survey in the urban area of Majuro Atoll (Chutaro 2005) and found waste generation rates of 0.48 kg/p/d. Given the commercial goods available in Majuro, where the culture is heavily influenced by American consumer habits, the increased figure is not surprising. Casual inspection of garbage in dumpsters in Majuro reveals a large quantity of material that cannot be purchased in Tarawa. In Nauru, IWP conducted a waste stream analysis (Lenny 2004) that produced a figure of 0.17 kg/p/d, but this waste stream had a low organic content of only 11%. Nauru was undergoing a severe financial crisis at the time with many people owed back pay, and household purchases were highly constrained as a result.

4.4 Estimated waste density

Estimates of landfill waste density vary considerably. Some items in the waste stream are very light and bulky, and do not compress well (e.g. PET bottles); some are light and bulky, but will compress somewhat (e.g. aluminium and steel cans). Some items (such as disposable diapers and woody items) are heavy and small. The degree of compaction that takes place in a landfill is a major contributing factor. Waste density in the landfill is not easy to measure, as the act of digging the waste up disturbs the density. Ongoing monitoring of weight deposited and subsequent area filled yields the best answer in any particular instance.

Royds estimated mean bulk density of waste on Tarawa was 100 kg/m^3. In Hawaii a general overall mixed waste density of 600 kg/m^3 for waste (Pacific Waste Consulting 2004: 121) has been used, while WHO (Hassan 2005) has made calculations for the landfill waste in Chuuk at a density of 200 kg/m^3. A small investigation of Greenbags in Nanikai landfill in May 2005 by IWP Kiribati and the Kaoki Mange Project found a density of uncompacted Greenbag waste of 130 kg/m^3,[17] but the sample consisted of only 32 Greenbags. This agrees with the 1999 SPREP survey (Sinclair Knight Merz 2000) figure of 130 kg/m^3 at collection. This figure might represent density of waste at pickup, but once in the landfill, some compaction will occur through stacking, even without machinery. The SAPHE Design Report (ADB 2001), which described the design of the Nanikai landfill, uses a figure of 130 kg/m^3 as a working figure for landfill design, but also refers to a value of 211 kg/m^3. Note that the 1999 SPREP survey (used by SAPHE for per capita waste generation figures) used a density of 260 kg/m^3 in the landfill.

4.5 Nanikai landfill density measured with Greenbags

On December 22 2005 fieldwork was conducted at Nanikai in order to further examine landfill density. The TUC had been asked the week before not to bulldoze waste in the landfill, so that an analysis of the organic and recyclable content of the Greenbags recently placed there could

[17] May 31 2005 joint survey by ECD, IWP, and KSWMP at Nanikai landfill.

be made. At the same time an effort to estimate waste density was conducted. A 100 kg spring scale was used for this work, with 0.5 kg graduations, and weights were taken to the nearest 0.5 kg. Two steel and wire frames were also used, one of 0.32 m³ volume, and one of 0.075 m³ volume.

4.5.1 Average weight and estimated density of a Greenbag at collection

The sample used was 100 Greenbags taken from the pile (amounting to virtually all the bags available). Little non-Greenbag waste was seen, mostly cardboard cartons. Only three coconut palm fronds were visible on the surface of the dump, and very little other organic material (Fig. 7). The figure for an average weight of a Greenbag was calculated by weighing each bag, and then the bags were placed in a pile on the ground, so that a rough figure for density of collected Greenbag waste could be found, without any compaction. From the sample of 100 bags, the average weight of a Greenbag was found to be 5 kg. The total sample weighed 501 kg. This figure agrees well with the 32 bag sample at the landfill taken in May, of 4.75 kg average weight each.

Figure 7: Very low organic waste content in Nanikai landfill Greenbags, December 2005

The pile of 100 bags was estimated at 4.8 m³, giving an uncompacted rate of 21 Greenbags per m³, and raw density of 104 kg/m³, or just over 100 kg/m³. This would give about 200 bags per tonne; 1000 Greenbags full of waste would weigh about 5 t (see Table 5).

Table 5: Basic landfill and waste data

Parameter	Value
No. of Greenbags weighed	100
Total weight of bags	501 kg
Average weight	5.01 kg/bag
Maximum weight	15.5 kg
Minimum weight	1 kg
Volume of 100 bags	4.8m³ (4m x 2.4 x 0.5)
Density	104 kg/m³ (~ 100 kg/m³)
Bags per m³	20 (as collected at approx 100 kg/m³)
Bags/t	200
1000 bags (weight and volume)	5 t, compacted at 200 kg/m³ = 25 m³
108,000 Greenbags (weight and volume)	5t, compacted at 200 kg/m³ = 2,700 m³
Notes:	Only 3 palm fronds evident on surface landfill. Organic content low.

- The average weight of a Greenbag was found to be 5 kg.
- Density at collection, and uncompacted, of Greenbags is about 100 kg/m³

4.5.2 Separation of organics and recyclables and quantities found

The two frames were used for the next part of the process. The larger — 0.32 m³ in size — was used to compact the landfill waste in a simple crude way, to get some idea of potential compaction in landfill. The second, smaller, frame of 0.075 m³, was used to measure recyclables and organics.

The bags were then emptied and any cans and bottles that would be acceptable to the Kaoki Mange recycling system were removed (i.e. PET and aluminium cans). Items that were damaged or perhaps too dirty to be acceptable to the recycling system at the point of being put in the Greenbag were included in the landfill waste. No lead-acid batteries were found. Any organic material such as leaves and coconuts was also removed (a single Greenbag was found that contained only leaves, but organic content generally was extremely low). A single small frame of recyclables was obtained, and the organic content also filled one small frame.

PET bottles are of varying sizes: 0.06 m³ of PET bottles were removed, along with 31 aluminium cans. Thus the total, uncompacted, recyclable content was approximately 0.075 m³, with a weight of less than 1 kg. Recyclable aluminium cans and PET bottles were less than 0.2% by weight of the sample, and less than 3% by volume (uncompacted).

The organic material, uncompacted, amounted to another frame of approximately 0.075 m³; weight was approximately 3 kg (0.6% of the total weight, and approximately 3% by volume uncompacted). Half the organic waste component (by volume) was from the single Greenbag with leaves, which would compact very well. Some other organics were found: a few coconut shells, and chewed Pandanus segments being common, and heavy.

It is interesting to note the very low quantities of organic material in the Nanikai waste stream. For comparison, the brief study undertaken in May 2005 found around 10% organics in Greenbags, and around 3% recyclables. The incidence of organics in Nanikai landfill was clearly higher in October 2004 (Fig. 8) than in December 2005 (Fig. 9). Recyclable aluminium cans and PET bottles were approximately 0.2% by weight of the sample, and approximately 3% by volume uncompacted.

Figure 8: Nanikai Landfill showing higher organic content (October 2004)

Figure 9: Nanikai Landfill with low organic content (December 2005)

- Organic material was 0.6% of the total weight, and approximately 3% by volume uncompacted.
- The Greenbags contain very low levels of organics and recyclables.

4.5.3 *Simple compaction of inorganic landfill material*

An attempt was then made to determine what degree of compaction might exist in the landfill. The first step was a simple compaction by brute force of a boot. The Greenbags were emptied into the large frame, and compacted using a simple pusher and by means of the author's boot as it was filled. 100 bags were discharged into 7.5 frames (frame size 0.32 m³; Fig. 10). It can be seen that the compaction achieved was not great, with plastic bottles uncrushed, and many air pockets.

The estimated 4.8 m³ at collection was compacted to a total of 2.4 m³ of landfill waste. The weight of this landfill waste was 496.5 kg. The density of the landfill waste after simple compaction was 207 kg/m³. The Greenbags were discarded to assist with compaction, and may account for the half kilogram (there is also a margin of error due to the coarse scale.

Thus it is seen that merely through the expedient of simple compaction by foot, the density can be approximately doubled. Indeed, densities of 255 kg/m³, 266 kg/m³, and 284 kg/m³ were achieved in three frames out of the eight.

It was clear from looking at the "compacted" frames that considerably more compaction was possible. Air gaps were clearly visible. It should be noted that this process does not crush tin cans well, or plastic bottles. Plastic bottles with the tops on did not compact at all during this process; if a bulldozer was driven over them we can expect a considerable amount of air to be lost from plastic bottles and tin cans. These items can clearly be seen to have been crushed on the surface of the landfill where the bulldozer has been working. It is estimated that a density of 300 kg/m³ would not be difficult to obtain. The landfilled area was considerably harder to dig into after the bulldozer has been over it than it was to dig into the waste in the frame. The frame could be emptied by the simple expedient of pulling waste out, something that is not possible to do in the landfilled area worked by the bulldozer.

Figure 10: Simple compaction of Greenbag waste

It is suggested that a figure of at least 300 kg/m³ is thus easily obtainable for landfill waste. In order to simplify subsequent calculations, and in keeping with the necessarily approximate nature of this work, a figure of 3 m³ per tonne of landfill waste will be used. Even this is a conservative estimate, as indicated by the figure of 600 kg/m³ used in Hawaii (Pacific Waste Consulting 2004: 121). The Hawaiian waste stream may contain a much higher degree of construction waste, which is dense; but then would also contain much more packaging waste, especially Styrofoam and plastics, which are both very light. Comparing photos taken in

October 2004 (Fig. 10) and December 2005 (Fig. 11) supports this supposition. The area of landfill filled has not altered significantly, suggesting a large amount of compaction is taking place. A number of Greenbags were distributed in the TUC area during this time, and many of them will have gone into Nanikai landfill. In total some 100,000 bags have been distributed in the TUC area, and many of which have gone into Nanikai landfill between mid-2004 to December 2005.

In summary:

- The density of the landfill waste after simple compaction was 207 kg/m³.
- Indications are clear that actual density in the landfill is markedly greater than that achieved using the frame.
- A figure of 3 m^3 per tonne of landfill waste will be used subsequently as a figure for landfill density after being continually compacted by the bulldozer.

4.6 Density of recyclable cans and bottles in landfill and when recycled

How might the 3% of recyclables compress in the landfill? Aluminium cans are measured by volume in the Kaoki Mange refund system: the refund payments are based on AUD 0.04 per individual whole, uncrushed, can, and cans are measured using a volume measure, with a 0.305 m³ measure holding 500 cans (or 1,640 cans per m³); 500 cans weigh 7.57 kg (about 15g each). The density of uncrushed aluminium cans equals about 24.8 kg/m³. SAPHE estimates the cans have a bulk density of 60 kg/m³ in landfill (ADB 2001: 4.5.5), which is a compaction rate of about 2.4:1. Cans sent for recycling in Australia using the current small press in the recycling system in Tarawa are compacted to around 300 kg/m³, a compaction ratio of about 12:1.[18] A larger press, that can put about 16 t into a container, would give a compaction ratio of around 19.5:1.

PET is much harder to measure, as the bottles are of varying sizes. SAPHE (ADB 2001) uses a figure of 45 kg/m³. The Kaoki Mange has been pressing PET bottles with a small press with a platen force of 4 tons, and this gives around 2 t per 33 m³ (20 foot) container. Given that the container has a lot more empty space in it than a container full of crushed cans, a crushed density of around 80 kg/m³ is estimated. PET and other plastic bottles are hard to crush and keep crushed, as they tend to spring back to some extent after compaction.

This indicates that both aluminium cans and PET bottles are of low density in a landfill environment, and the exclusion of these materials from a landfill is a major saving in landfill space. For example, if the estimated 4 million aluminium cans used in Kiribati per annum were all disposed of in the landfill (which they clearly are not and never would be), they would take up around 1000 m³ of landfill space at 60 kg/m³! Indeed, the Kaoki Mange has exported 230 m³ of *crushed* cans in a little over a year. PET is even more bulky, with the Kaoki Mange exporting around 160 m³ of crushed bottles, which would fill about 300 m³ in the landfill (at 45 kg/m³).

The 7.5 kg of recyclable PET and aluminium cans found in the IWP Kiribati 2004 waste survey (from a total sample of 212 kg, or 1.6 m³ at 130 kg/m³). If this recyclable material was disposed of in the landfill, it would comprise, using the SAPHE-estimated material densities, about 0.15 m³, or about 10% of the volume of the waste analysed in the IWP Kiribati 2004 waste survey.

PET and aluminium cans have a low density in landfills:

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[18] At 10,000 kg/20ft container, 66,000 cans/t.

- Densities used for shipping PET after pressing are 80 kg/m³, while the density of PET in a landfill may be half this (45 kg/m³).
- Densities used for shipping aluminium cans after pressing are 300 kg/m³. The density of aluminium cans in the landfill may be five times less (60 kg/m³).
- Keeping this material out of the landfill considerably improves landfill density.
- Aluminium cans and PET bottles are estimated to comprise 10% of the IWP Kiribati 2004 waste survey volumes.

4.7 Overall waste reduction based on density

The analysis conducted above indicates that each tonne of waste takes up 3 m³ in the landfill (after being flattened repeatedly by the bulldozer). The organic content of the Greenbag waste is very low, and appears to be falling, while the amount of recyclable material (accepted in Tarawa for recycling) in Greenbags is also very low. If these results are considered in conjunction with the data from the 2004 IWP Kiribati survey, it is estimated that there has been a 50% reduction in organic wastes, and 10% reduction in recyclables.

Thus where the Greenbag is used:

- A 60% reduction in household waste generation to the landfill has taken place between early 2004 and December 2005, with household waste generation reduced to 0.08 kg/p/d (December 2005) from 0.2 kg/p/d (February 2004).
- Household waste generation of 0.08 kg/p/d equals 29.2 kg/person/yr, or 0.088 m³/p/yr by volume, where landfill compaction reaches 3 m³/t (333 kg/m³).

Where the Greenbag is not used:

- Household waste generation would be 73 kg/person/yr in weight, which equals 0.22 m³/p/yr by volume, where landfill compaction reaches 3 m³/tonne (333 kg/m³).

The potential total effort required to collect *all* the household waste in the TUC area would be at least halved if all that waste went into Greenbags, and the Greenbag use pattern discerned at Nanikai was universal in the TUC. As picking up bags is easier than shovelling piles of waste into a truck or trailer, the effort of collection should also be considerably less.

There may well be some element of “early adopters” influencing the results of the Greenbag contents, but it was interesting to note the consistency of Greenbag contents in the December 2005 survey compared to May 2005. It was noticeable in December that disposable nappies (diapers or Kimbies) were commonly put together in separate bags, and that quantities of tin cans were not large. These points are only anecdotal, and were not measured: the nappy separation suggests greater awareness on behalf of households concerning their waste production, while the tin cans may well be going into banana circles to provide minerals to banana plants, as encouraged by the public education campaign.

5 Nanikai landfill economics

Having addressed waste densities, reductions that the Greenbag and the recycling system have provided, and estimated per capita waste volume, we next consider the capacity of the current Nanikai landfill.

5.1 Landfill capacity at Nanikai

The capacity of the Nanikei landfill was projected to be 24,000 m³ (ADB 2001), with an expected life of 10 years when operating in conjunction with other landfills in South Tarawa. However, at the time of writing, it is the only engineered landfill facility available to the TUC, as the Bikenibeu landfill was damaged by a storm in early 2005 and has still not been repaired (it has never been used). A third landfill at Bairiki was projected at the time of the SAPHE report, but has not been built. The Bikenibeu landfill was built to hold 27,000 m³ of waste. Thus, under the SAPHE projections, the expected lifetime of the Nanikai landfill operating alone (and accepting all waste) would be around 5 years.

It was estimated by SAPHE that 26,000 m³ of waste would be compacted to 16,000 m³ once in the landfill, (i.e. density would increase to 211 kg/m³) and that an additional 5,000 m³ of cover materials would be added. The original design dimensions were 29 m × 276 m × 3 m, giving a capacity of 24,000 m³.

5.1.1 Measured capacity

The Nanikai landfill consists of two cells: one that is currently receiving waste materials, (Cell A), and one that contains sand to be used for cover material (Cell B). Cell A is approximately one third the size of Cell B, and it is understood from previous conversations with the SAPHE Project Manager[19] that Cell B would be divided in half at a later date by a wall — similar to that separating A from B — so as to convert the entire landfill area into three cells, as described for the proposed Bairiki Landfill in the SAPHE Design Report. The Bairiki Landfill was not built as it was decided that the proposed location was not suitable (ADB 2001).

The landfill was measured with a tape measure on 22 December 2005. The overall measured area was 220 m × 42 m, which includes the wall separating Cells A from B. Cell A was measured to be 73 m × 42 m × 3 m, giving a capacity of 9,200 m³. Allowance was made for the sloping walls in this measurement. Cell B was measured at 145 m × 2 m × 1.8 m, giving a current capacity of 11,000 m³. Cell B has a quantity of sand in it; but a floor of cement was placed at the bottom of the landfill at a depth of 3m during construction, so it is assumed that the actual capacity of the landfill is 18,200 m³. Currently, there are approximately 7,300 m³ of sand fill in Cell B. The sand in Cell B is not even, so this is a rough estimate. If we divide that sand fill by three and portion it between the two current cells, then we might expect that 2,500 m³ might go to Cell A, with the remaining 4,800 m³ going to Cell B. The total available volume of the two cells of Nanikai landfill is estimated at 27,400 m³.

Table 6: Measured capacity of Nanikai landfill

Landfill element	Volume, in m³
Cell A	9,200
Cell B	18,200
Nanikai landfill total volume (Cells A + B)	27,400
Total cover sand volume	7,300
Sand volume absorbed into waste (20%)	1,460
Capacity of Nanikai landfill to accept waste	21,500
Capacity of Nanikai landfill to accept waste, assuming no sand absorption takes place	20,000

[19] Pers comm., SAPHE Project Manager, October 2003.

If all the sand in cell B is used as cover in the entire landfill, and accepting that some of the sand — perhaps 20% — is absorbed into waste volumes (as the waste is less dense than the sand, and the sand will be driven into air gaps by the bulldozer), it is estimated that the waste capacity of Nanikai landfill is 21,500 m³;[20] see Table 6 for summary).

5.1.2 Current filled area

Nanikai landfill has been accepting waste since June 2004, although initially very little waste was placed in the landfill, after a clean up of the immediate surroundings. Waste has been deposited in the gap between the access roadway constructed to provide vehicle access to the floor of the landfill, and the ocean side (southern) wall. Most of the waste placed there has come from Greenbags collected by the TUC. The TUC does not usually dumped mixed, uncontained waste in Nanikai landfill (e.g. the high organic content waste, as found piled in the streets)[21]. This mixed waste is used for uncontrolled land reclamation and behind seawalls. After the first few months, and over the next year or more, the gates were kept locked, so that the public did not have access for a considerable period. The landfill is now open to the public, as a watchman has been appointed for the landfill. The public dumps some rubbish; during the day spent working in the landfill as part of this study (22 December 2005), the author recorded five visits by the public over a span of about six hours. Waste being dumped varied from cardboard boxes to several large bags of waste. Use by the public is a fairly recent phenomenon; all visits were by people with vehicles,[22] and the waste volumes deposited were not large. All wastes currently are deposited in Cell A, with none going to Cell B.

Table 7: Summary of current filled area figures

Summary of	
Cell A filled volume	540 m³
Proportion of Cell A	20%
Proportion of Nanikai landfill total volume	6%
Weight at 3 m³/t (or 333 kg/m³)	180 t
Number of Greenbags to equal filled volume (at 5 kg each)	36,000
Greenbags per week (since October 2004)	560

Part of Cell A that is receiving waste has been filled, and was measured and calculated at 540 m³.[23] A bulldozer has been driven over this area regularly, usually after each deposition of Greenbags. An estimate of the density of waste in the filled area, drawn from the work detailed above, would be at least 200 kg/m³, but probably over 300 kg/m³, given that it appears very well packed down. Some cover sand has also been applied. At 3 m³/tonne (using the rationale detailed in Section 4.5.3), this area would represent about 180 t of waste. At that density, and assuming that all the waste came in Greenbags (average weight per bag 5 kg), the filled volume potentially represents 36,000 Greenbags.

If we further assume that a steady stream of Greenbags has been going into the landfill since October 2004,[24] this would equal about 560 Greenbags per week. Photos taken in November

[20] This assumption is supported by observations of sand in the landfill waste that has been worked by the bulldozer (sand can easily be driven into the air gaps in the waste, if this is done very regularly with a bulldozer). Note that the density of water is 1000kg/m³. The density of concrete is typically 2000kg/m³. The density of coral sand, typical of sandy atoll soils, would be somewhere in between.

[21] Although in the last week of December 2005 a truck load of such mixed wastes was deposited (see Fig. 6).

[22] Vehicle ownership rates are low on South Tarawa.

[23] Landfill area calculation: Landfill dimensions 42 m wide at both ends. Cell A (current landfill cell): 73 m × 42 m × 3 m deep = 9,200 m³.
Cell B (unused landfill cell): 145 m × 42 m × average 1.8 m deep = 11,000 m³. Potential room if empty = 145 × 42 × 3 = 18,300m³. Current fill: 145 × 42 × 1.2 = 7,300 m³. Volume Nanikaai Landfill if empty = 18,300 + 9,200 = 27,500m³. Volume Nanikai landfill if cover materials utilised on site: 9,200 + 11,000 = 20,200m³.

[24] Pers. obs., Alice Leney (resident in Tarawa 2004 and much of 2005).

and December 2004 (Figs. 11 and 12) show far more Greenbags in the landfill than the current IWP Kiribati data indicates for current Greenbag collections. It must be noted that during this time, the TUC picked up Greenbags from all over their area, while IWP Kiribati data at that time was collected *only* from the pilot area in Bikenibeu West. Certainly the pictures do show — and personal observation bears out — that the greater part of waste deposited in Nanikai landfill has been in Greenbags. Some waste was placed in the landfill at the opening of the landfill, and this came from waste material that had been dumped on the causeway outside the landfill construction site while the landfill was under construction.

Figure 11: Greenbags at Nanikai November 2004

Figure 12: Greenbags at Nanikai December 2004

5.2 Cost of Nanikai landfill construction

The cost of landfill space (in dollars per cubic metre) is a very useful measure to determine savings achieved through waste reduction strategies. The cost of collecting waste and depositing it in the landfill must also be considered; this depends on the cost of running collections. There is also a range of potential savings associated with the costs of poor SWM, but an analysis of those factors is beyond the scope of this report. However, a basic, measurable benchmark is easily found by dividing the cost of landfill construction by the number of cubic metres of landfill space available.

In the case of Nanikai landfill, direct construction costs under the SAPHE project works are not available, but the Betio and Nanikai landfill works together are budgeted at USD 495,423.25 The works scheduled for Betio Red Beach Landfill comprised the installation of leachate pumps, and wire cyclone fencing and gates. Red Beach already had a sea wall before

[25] Aide Memoire of the ADB Loan Review Mission Loan No. 1648-KIR, Oct 2002 and ADB 2001.

the SAPHE works. The cost of the Bikenibeu Landfill was budgeted at USD 462,386; Bikenibeu Landfill is a construction very similar in size and design to the Nanikai facility.
The construction works at Nanikai took place from November 2002 to April 2004. It is therefore conservatively estimated that Nanikai landfill used its entire budget, and cost approximately USD 400,000. This allows USD 95,000 for works at Betio Red Beach of leachate pump installation and fencing. If this figure is used in conjunction with the estimated measured capacity of 21,500 m³, the cost of landfill space at Nanikai landfill is USD 18.60/m³. Thus it is conservatively estimated[26] that the cost of landfill space at Nanikai is AUD 24.80/m³, or approximately AUD 25/m³.

If the volume of the landfill was decreased by discounting the assumed 20% absorption of sand fill, waste capacity would be 20,100 m³; if the fairly minor works at Betio Red Beach were costed lower (giving some USD 430,000 as the cost of the Nanikai landfill), the cost of the latter would be USD 21.40/m³, or AUD 28.50/m³. An estimated cost of AUD 25/m^3 will be used for this analysis (see summary in Table 8).

By way of comparison, a recent study in the Marshall Islands by a large international engineering consultancy (BECA International Consultants Ltd. August 2003) indicated new landfill costs of between USD 27 and USD 33 per cubic yard (USD 35–43 per m³). Three potential sites were looked at in this report, all similar to the Nanikai works, requiring construction of landfill walls into sea areas. These sites were also bigger than Nanikai, and it might be expected that some economies of scale may apply. The estimated cost of the Nanikai landfill space is not expensive by these measures.

Table 8: Cost of Nanikai landfill Construction

Parameter	Low estimate	High estimate
Total estimated cost of the Nanikai landfill	USD 400,000	USD 430,000
Cost if capacity is 21,500 m^3	AUD 24.80/m³	AUD 26.70/m³
Cost if capacity is 20,100 m^3	AUD 26.50/m³	AUD 28.50/m^3
Assumed cost for purposes of analysis	AUD 25/m³	

5.3 Landfill savings

One of the aims of waste reduction programmes is to decrease the cost of dealing with waste. Many of the costs of poor waste management are very hard to determine, being not directly visible. This has been demonstrated in the IWP Tonga report (Lal and Takau 2006), which examines the costs to Tonga of poor waste management (estimated at 5.6 million Tongan paanga/yr). Here, the analysis will extend only to the directly measurable landfill savings.

If, as assumed above, a cubic metre of Nanikai landfill space cost AUD 25 to build, it follows that every cubic metre kept out of the landfill is a saving of at least AUD 25; given the rise in energy costs, landfill space in the future can be expected to cost more to construct (the analysis ignores inflationary pressures, however).

5.3.1 Landfill lifespan is all generated waste is deposited

If the estimated total household waste generated by the TUC area population was deposited in the landfill, it would amount to 0.2 kg/p/d × 31,500 people × 365 days = 2,300 t/yr; which at 200 kg/m³ (simple compaction), would amount to 11,500 m³/yr of landfill space. The Nanikai landfill would last about two years if all this waste were placed there.

[26] Using an exchange rate of 0.75 USD = 1 AUD, which is generous given the prevailing exchange rates during the construction period.

5.3.2 Reduction in waste stream

However, as we have seen, the IWP Kiribati Greenbag programme appears to have successfully eliminated organic waste from the landfill, with the remaining organic waste being purely residual. The Kaoki Mange recycling system has also removed a large quantity of bulky recyclable waste material from potential landfill space.

Returning to the waste stream analyses, it has consistently been found that 50% of the household waste stream is organic, with an estimated additional 10% being attributable to PET plastic bottles and aluminium cans (see Section 4.6). If a figure of 60% is accepted for this diverted component of the waste stream, and the overall waste generation rate of 0.2 kg/p/d (as found by IWP Kiribati in 2004) is used, then the total waste to landfill in the area and population served by TUC waste collection services (see Section 4.2) will equal 40% of 2,300 t/yr, or 920 t/yr. This is equivalent to 184,000 Greenbags per year (this assumes all the waste is deposited in the landfill, which it not currently is not).

5.3.3 Landfill lifespan given reduced waste stream

The reduced waste stream scenario suggests an eight year landfill life for Nanikai, at 920 t/yr (and a density of 3 m^3/t, or 2760 m^3/yr). This assumes all waste goes to the landfill, and density equals 333 kg/m^3 (or 3m^3/t), following compaction by bulldozer. This figure uses a static population number. If it only 80% of that waste is collected, and density increases to 500 kg/m^3, the landfill life would be about 750 t/yr at 1,500m^3/yr of space, with a landfill life of 14 years.

The actual figure may in fact lie somewhere between these two extremes. The population growth rate over the next ten years will have a significant impact. In the past 40 years, population growth rates on South Tarawa have varied between 6.7–2.2%, with the last census in 2000 showing a rate of 5.17%. A new census was conducted in 2005, but the data are not yet available (see footnote 22).

- Every cubic metre of waste kept out of the landfill represents a saving of at least AUD 25, or around AUD 75/t.
- If the Greenbags are not used, and all household waste produced in the TUC in 2005 was put in the Nanikai landfill, with little compaction (i.e. density of 200kg/m^3), the Nanikai landfill would last about two years. Population growth would not affect this result significantly as the fill rate would be so rapid.
- If all households in the TUC used Greenbags in 2005, and compaction with the bulldozer raised the density to 333 kg/m^3 (3 m^3/t), the Nanikai landfill would last about eight years (at the assumed 2005 population level).
- If 80% of the household waste in the TUC was collected through Greenbags, and continual application of sand and bulldozer reached a compaction of 500kg/m^3, the landfill would last about 14 years (at the assumed 2005 population level).

Note that landfill life is dependant on (i) the percentage of total waste that is collected and deposited in the landfill; (ii) changes in population growth and per capita waste generation rates of the TUC area; (iii) the rate of compaction through application of the bulldozer and cover; and (iv) the degree of Greenbag use (which pushes organics out of the waste stream). The greatest variable at present is the percentage of the total household waste that is collected and put in the landfill. Population growth is a significant factor over time.

5.4 Comparison of waste collection scenarios

There are many variables in calculating scenarios of what might happen in the future, not least of which is how the population of the TUC might change. The other variables when calculating impact on the landfill are the degree of compaction of wastes (i.e. density) achieved, and the amount of household waste collected as a percentage of the total household waste generated.

A chart of a simple population projection (Fig 13) offered with the strong qualification that the author is not a demographer; the population estimates assume a simple 5% per annum increase, which may be (and hopefully is) a high estimate.[27] It is important to note that the figure for 2005 used in this report is itself a 5.17% extrapolation of the 2000 census figure; thus any extrapolation to 2020 is necessarily speculative. For comparison, in the Marshall Islands population growth was around 5% at the beginning of the 1990s, but today is closer to 2.5%. This projection has a dramatic effect on the result. However, the population of South Tarawa approximately doubled in the period 1980 to 2000 (National Statistics Office 2000). Under the projections used, the population of the TUC area would double in around 15 years.

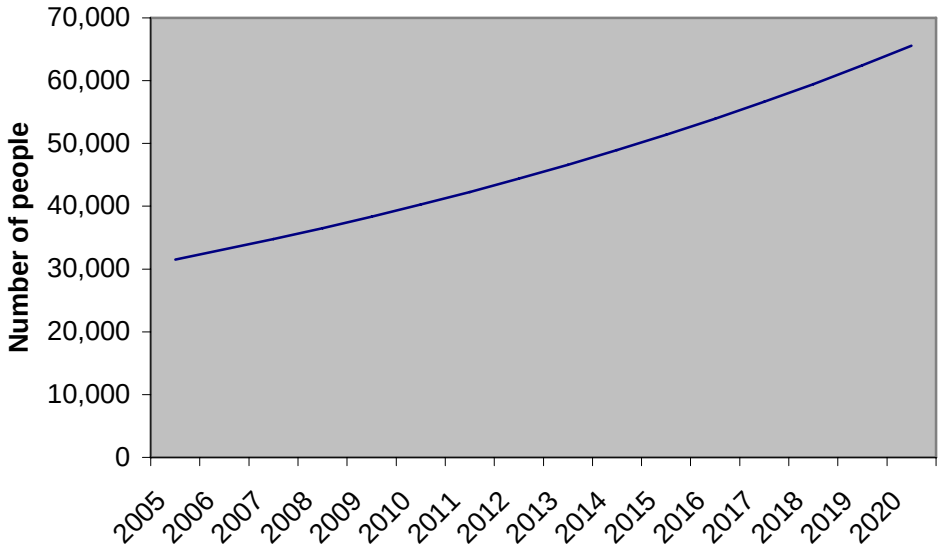

Figure 13: Population of TUC area, extrapolated from current estimated TUC population, at an increase of 5% per year

The figures in Figure 13 have been used to estimate the waste generation projections in Figures 14 and 15, which illustrate how waste volumes may change over time. Note that another major variable is the percentage of household waste actually collected and taken to landfill. Currently, not all waste is collected, and not all of that which is collected is taken to the landfill. This collection rate will definitely be affected by Greenbag use, as the more Greenbags that are used, the higher collection rate that can be expected, as Greenbag waste is much easier and faster to collect. In addition, only Greenbags are usually placed in the landfill, and not used for casual landfilling elsewhere in the TUC, as now happens with loose waste. It may also be easier to increase landfill density with Greenbag use, as the materials may be easier to compact, as the organics are removed, and use of the bags compacts the waste already to some extent. By buying Greenbags people are paying for a given volume; hopefully they will economise by compacting their wastes by hand to some degree (e.g. by flattening Tetrapaks and cutting the ends out of and flattening tin cans.

[27] Editor's note: provisional results of the 2005 census indicate a growth rate for the TUC (between 2000 and 2005) of approximately 2.7%. See National Statistics Office 2005.

5.4.1 Household waste projections in tonnes per annum

The quantity of waste requiring collection every year increases more slowly with Greenbag use than without (Fig. 14). The quantity of waste requiring collection per annum determines the equipment and staff required to pick up the waste. If the quantity increases more slowly, the need for extra collection capacity is delayed. Use of the Greenbag to contain waste also increases collection efficiency, compared to collection of uncontained wastes: waste can be picked up more quickly with bags than when it must be shovelled into collection vehicles. Greater collection gains will be realised with Greenbag use than would be suggested from a simple reduction in quantity. This is especially important given that the resources available to pick up waste are limited.

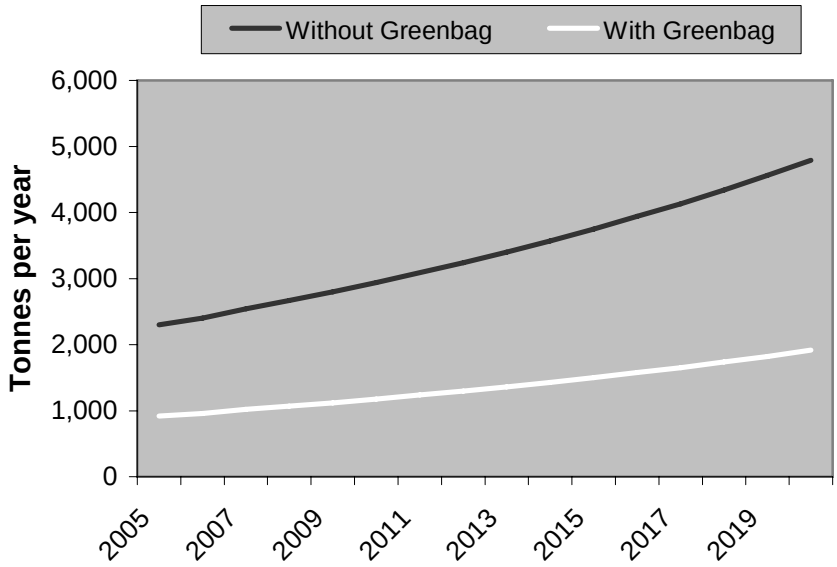

Figure 14: Estimated household waste per annum, independent of collection rates, showing impact of Greenbag use.

5.4.2 Cumulative household waste volumes at different densities

The waste volumes shown in Fig. 15 assume 100% collection, which is unrealistic when dealing with uncontained waste. However, they demonstrate the difference that density has on waste volume over time. It should be noted that uncollected wastes have a density of about 100 kg/m^3; should all wastes remain uncollected for the next 15 years, the total would amount to perhaps 500,000 m^3 of waste spread over the land and waters of the TUC, with the attendant pollution. These figures assume no Greenbag use, and so use a 0.2 kg/p/d waste generation rate. This could be seen perhaps as a worst-case result, yet it does not account for any increase in per capita waste generation rates, which might also occur. Note that this is a cumulative projection; each year is added to the next as the landfill fills up (base year 2005).

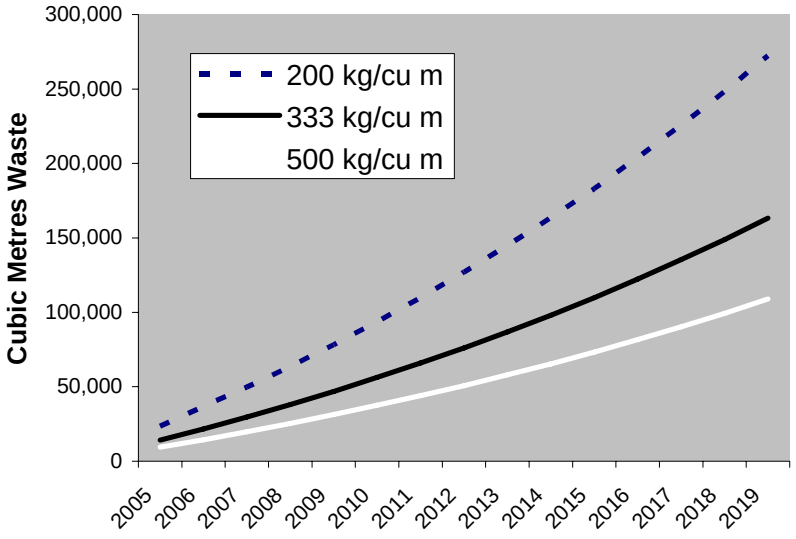

Figure 15: Estimated cumulative waste volumes, at different densities, without Greenbag use but assuming 100% collection.

With lower per capita generation rates realised when using Greenbags (a result of Greenbag use pushing organics out of the waste stream), and assuming 100% collection of household waste, volumes sent to the landfill can drop significantly (Fig. 16). This effect is especially marked if a serious effort is conducted to pack the material into the landfill with a bulldozer. Figure 16 shows that even with the waste volumes that might be produced from a rapidly increasing population, it may still be possible to pack all the waste into the existing landfill by 2020. This assumes that Bikenibeu Landfill comes into operation, and that a landfill density of 500kg/m³ is achieved. Continual application of the bulldozer to wastes in the landfill, with sand cover, may well be able to achieve this. Figure 16 also assumes a 100% recovery rate, which is far more achievable using a Greenbag scheme.

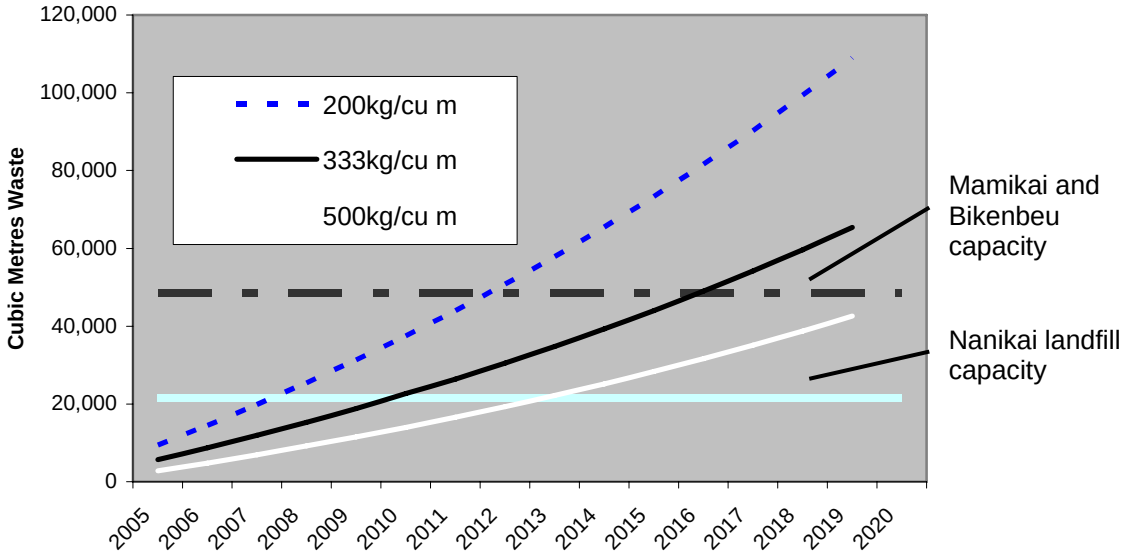

Figure 16: Estimated waste volumes to 2020, with Greenbag use, also showing landfill capacity.

5.5 Avoided landfill costs

The cost of not having to do something, in economic analysis, is termed the "avoided cost". Avoided costs can be very significant, and usually arise through taking certain actions that save money in the future. Maintenance of a vehicle may result in avoided costs of replacement, for example; energy efficiency with electrical equipment will result in avoided costs shown as savings in electricity purchases (electricity not bought). Looking at Avoided costs helps policy makers attach real dollar values to actions that will save money in the future. The savings in eliminating organics and recyclable can and bottles from the landfill waste stream in South Tarawa is a classic case of avoided cost savings.

In order to calculate the avoided costs, it is simply necessary to calculate what the cost is with and without the mitigating action: in this case, the cost of disposing of all the waste in the landfill, as opposed to only disposing off the waste collected in Greenbags. The calculations are complicated by the differing densities of the materials, the difficulties of measuring volumes of mixed wastes, and difficulties of getting a good estimate of true landfill density. Thus, by making some informed estimates, the following analysis is offered, using 2005 estimates of population and waste generation rates.

Using the IWP Kiribati waste survey data and density estimate produced here, it was found that the TUC population is producing about 2,300 t/yr, or 6,900 m³/yr of waste. This would cost, at AUD 25/m³, AUD 172,500 per annum in landfill space (assumes density in the landfill of 3 m³/t, or 333 kg/m³. This also assumes that all waste is collected and put in the landfill).

Assuming use of Greenbags achieves a 60% reduction in waste to the landfill, the potential total of 31,500 people (at a density of at 3 m³/t) would use just 2,750 m³ of landfill space per year. The cost, at AUD 25/m³, equals AUD 68,750 per annum, amounting to a savings of AUD 103,750, or a potential avoided cost (or savings) to the government of approximately AUD 100,000 per year. This is a potential 60% savings through use of the Greenbag. It is possible — and indeed likely — that a higher proportion of household waste is collected through the Greenbag system than might otherwise be collected, but this is a benefit, as part of the aim of the programme is to get the waste into the landfill, and improve the collection rates, so as to ultimately reduce the pollution to the waters of Kiribati. This reduction in water pollution is, of course, the overall aim of the IWP Kiribati project. Savings at the landfill could be maximised by decreasing waste collections. But the cost of poor waste management, as Tongan example suggests, can be great. Any savings generated through decreased waste collections would appear elsewhere as costs.

Not all the waste generated by the population in the TUC area does actually go to the landfill. The volume of the landfill already used is calculated to be 540 m³. If no waste diversion had taken place, this volume would have been up to 120% greater (or 1,350 m³). The organic content of the Greenbag waste was previously found to be higher,[28] however, so a direct doubling (100% increase) may be a better estimate;[29] this suggests that in the absence of waste diversion, about 1,100 m³ would have been deposited in the landfill, equal to 5.2% of the total landfill space. The cost of 1,100 m³ of landfill at Nanikai is estimated to be AUD 27,500; the cost of the area actually filled is estimated at AUD 13,500. The resultant avoided cost at Nanikai landfill amounts to about AUD 14,000.

The filled area has been estimated to comprise 36,000 Greenbags, deposited over a period of 1.25 years. During that time, at 100% use of Greenbags, it would be expected that 230,000 Greenbags might be used (at 184,000/yr, see Section 6.2.1). At this rate, only 16% of potential TUC household waste has been disposed of in the landfill, assuming the density is only 333

[28] May 2005 Nanikai landfill survey of Greenbags.
[29] Some of the Greenbags contained a higher organic content, thus decreasing the savings.

kg/m³. This may be an indicator that the actual landfill waste density is higher[30] (see Figures 17 and 18).

Figure 17: The filled area extends to the arrow shown. The filled area is shown bounded by the black line.

If 36,000 Greenbags (landed cost of AUD 5040) save AUD 14,000 in landfill space, it makes economic sense for the Government to buy the bags and distribute them for free as the savings would markedly exceed the costs (this ignores the distribution cost; see Section 6). If landfill density is greater, meaning more Greenbags went into the filled area, the difference between cost of bags and landfill saving is less. Thus if the density is 500 kg/m³, 54,000 bags would be used, costing AUD 7,560, and saving AUD 6,440 in landfill costs.

- Current 2005 household waste produced in the TUC, if it was all sent to Nanikai, would cost, at AUD 25/m³, AUD 172,500 per year in landfill space.
- A potential avoided cost saving to Government of around AUD 100,000

Figure 18: Filled area of Nanikai Landfill in October 2004. Note water in the bottom right corner, indicating that filled area is less than the access roadway in the centre of the picture.

[30] This supposition regarding density is supported by the author's own casual observations over two years regarding the number of Greenbags that have been handed out in the TUC area, and the apparent number of bags required to make the current filled area. There was significant Greenbag distribution in Betio for only a brief period (March–April 2005); those bags would have gone to the Betio landfill. Over 100,000 have been distributed in South Tarawa, and it is likely that more than 36,000 have been deposited in the Nanikai landfill. This would result in an increased density of the landfill.

per year is possible **if** all the 2005 household waste went to landfill and if all that waste used the Greenbag correctly and diverted the organics and recyclables.

Estimated savings at the Nanikai landfill to date amount to avoided cost savings of AUD 14,000 at 333 kg/m³ (3 m³/t) of waste. The estimated AUD 14,000 savings could have been achieved with AUD 5000 worth of Greenbags, given the 333 kg/m³ density assumption. If these were distributed free, savings would still equal about AUD 9,000. A density of 500 kg/m³ in the filled area would require AUD 7,500 worth of Greenbags.

If the Greenbag system continues, savings in avoided costs resulting from Greenbag use can be readily calculated by multiplying the filled area (calculated at AUD 25/m³) at any time by a factor of 2.5, representing the 60% reduction in wastes that the Greenbag has delivered.

6 Waste collection economics

If GUPS is to prove a viable option for Tarawa waste collections, then the costs of collection must be considered, in addition to the potential revenue generated and avoided landfill costs.

6.1 TUC waste collection costs

In February 2005 the ECD provided data to the TUC[31] regarding monthly costs of operating the fleet of two trucks, two tractors and trailers, including staffing costs for 1 supervisor, 11 collectors and 4 drivers. This information (Table 9) indicates that normal wage costs might be estimated at around AUD 740/wk, or AUD 2,964 in wages per month. There are periods when significant overtime accrues;[32] to accommodate this a labour cost of AUD 3,300/month is assumed. The fuel cost is assumed to be AUD 1,750 per month.[33] The estimated monthly cost of TUC garbage collection (for wages and fuel) is about AUD 5,100/month, or AUD 61,000 per year.

Table 9: Yearly salary costs for TUC waste collectors

Position	Salary	No.	Total (AUD)
Supervisor	3,843	1	3,850
Driver	2,429	4	9,720
Collector	2,000	11	22,000
Total			35,570

These figures do include other operational and maintenance costs associated with the two trucks and tractors, or administrative costs; these costs are estimated at AUD 14,000, for a total annual cost of AUD 75,000 per year for waste collection by the TUC.

To finance its waste collection work, the TUC charges institutions and businesses on a set scale (Table 10)**.** It is reported by SAPHE (ADB 2001) that the TUC receives about AUD 75,000 per annum from these charges, which agrees closely with the data above. The TUC also receives income from the Government through the Ministry of Internal and Social Affairs (MISA). It is unclear if the $75,000 reported by SAPHE as being received by the TUC includes money levied from Government worker pay packets as a waste levy.

[31] Tabled by the ECD at an IWP Kiribati-convened meeting at ECD on 25 February 2005; the author was present.

[32] E.g. prior to a visit by the President of Taiwan, AUD 784 was spent in overtime payments, for the teams to work an additional 34 hours.

[33] At the time of the visit by the President of Taiwan, AUD 1,440 was spent on fuel in two weeks. This was an exceptional circumstance; here it is assumed that normal expenditures equal 60% of this amount.

It must be noted that that the TUC waste collection is currently funded, and that income from Greenbag sales would be in addition to existing income, unless existing income is reduced in some way. It is also important to note that the existing waste collection that picks up large piles of uncontained waste using shovels is very inefficient. As noted previously, the overriding issue in South Tarawa has been the failure of the TUC to regularly collect from non-government households; households consequently do not pay their fees, reinforcing the TUC's decision not to collect. One aim of the Greenbag was to break this impasse.

- In summary, the annual cost of waste collection to the TUC is estimated at about AUD 75,000 per annum.

Table 10: Council's Waste Collection and Household Service Charges

BTC Rates per annum:	AUD
Local Housing	17.9
Permanent House	29
Store: Branch & Private	50
Store: Main Public and Coop	300
Store: Companies	300
Warehouse: small	300
Restaurants, cafes, clubs	300
Maneaba	50
Big Building (office, warehouse, etc.)	600

TUC Rates per annum:	AUD
Local Dwelling	10
Private local dwelling	10
Business local dwelling	40
Business permanent dwelling	50
Store: Private/branch	100
Store: Religious group	100
Store: company/ Coop main	300
Hotel, Restaurant, café, club, bar	300
Govt Office, workshop, small school	400
Hospital building, dispensary	400
Warehouse, workshop, large school	600
Hospital, Prison	600
Aircraft	100

6.2 Future Greenbag collections

Here we address two questions: does the TUC have sufficient physical capacity to collect all household waste generated if it was in Greenbags, and what level of income could a GUPS generate?

6.2.1 Current collection capacity

If the (estimated) 31,500 people in the TUC produced 2,520 kg of waste per day (at 0.08 kg/p/d, as seen in surveyed Greenbags, and equal to 40% of the 2004 figure), this would equal to 504 Greenbags per day, or 184,000 Greenbags per year; on a weekly basis this equals 3,540/wk, or about 700 per day, five days a week. The capacity of a blue collection truck[34] is just over 8 m³, or about 160 bags at 20 bags to a cubic metre. If a Collection truck can carry up to 160 Greenbags, that would require five truck trips (4.4 full loads) to the landfill each day. There are two trucks available. The tractors and trailers are excluded from this calculation, as their ability to cover distance is limited, but they also reflect excess capacity in the system. This analysis applies to a situation in which *all* household waste generated by the TUC population goes into Greenbags; organic waste is not collected, with only residual recyclables and organics remaining in the Greenbag flow. Trip length would vary, with some much longer than others (Nanikai landfill is only 3 km from Bairiki, but some 25 km from Tanaea). If Bikenibeu Landfill were operating the trip length, time taken, and fuel cost would all be reduced. This would also increase capacity for extra trips per day.

Given that 100% collection has not yet been achieved in South Tarawa, capacity to handle the waste flows clearly exists. Currently Greenbags are picked up on Tuesdays and Thursdays

[34] The truck has a removable bin of 3.6 m x 1.9 m x 1.2 m, giving a total volume of 8.2 m³. The bin is rated at 4,800 kg, and the Greenbags would weigh less than a tonne.

only; given the current restricted Greenbag distribution, this is usually completed in a morning run by a single truck.

- If all the people in the TUC used Greenbags for all non-organic, non-recyclable waste, they would use 184,000 Greenbags per year, or 700 Greenbags per day (assuming five collecting days per week). Collect all the Greenbags would require five trips per day, five days per week. The TUC's two trucks have the capacity to make these trips and collect this number of Greenbags.

6.2.2 *Income generating capacity*

The sale of the 184,000 bags estimated to be required to collect all waste (Section 6.2.1) would generate AUD 47,840 per annum for the TUC, assuming Greenbags are sold for a retail price of AUD 0.50 each (Section 3.9.1) and if AUD 0.26 from each sale is directed to the TUC. If Greenbag usage reached only 50% of the possible total, the income to the TUC would be around AUD 24,000/yr (92,000 bags, with TUC income of AUD 0.26 each).

The number of households in the TUC area in 2000 was 3050 (2000 Census).[35] The Household Service Charge for a house in the TUC area is $10 (Table 9). The 3,050 households would generate $30,500 per annum if all paid the charge, which is extremely unlikely given the current system. In order to raise that same amount of money, 117,300 Greenbags would need to be sold each year (i.e. about 38.5/household/yr; or one bag every 9.5 d). An estimated eight people per household producing 80g of Greenbag waste each per day would normally use 1 bag about every 8 (7.8) days. Thus it might be expected that a GUPS could generate sufficient funds to replace the current household charge in the TUC area, assuming a 64% acceptance rate of Greenbags by the population (i.e. two out of three households).

Assuming a household of eight people produces waste at the average rate for Tarawa, buys Greenbags for AUD 0.50 each, and uses them only for inorganic landfill wastes, they would pay AUD 23.50/yr for waste collection using Greenbags. They would be using about 47 (46.8) Greenbags/yr/household.

- Given an income of AUD 0.26 per Greenbag, to raise a sum equivalent to the TUC household charge, given 2005 population estimates would require sale of 117,300 Greenbags; or 38.5 Greenbags/household/yr, or one bag every 9.5 d.
- If waste generation were at expected levels, each average household would produce one bag of waste every 8 d.
- Cost per/household/yr, if all inorganic waste went into Greenbags, equals AUD 23.50, comprising the cost of garbage bags for waste plus the collection cost.

If a household primarily eats local foods and compresses wastes well, the cost would be lower; households buying more heavily packaged goods — usually those with more disposable income ——would face higher costs. This is an equitable system that charges people in proportion to their household waste generation.

Since first being introduced in South Tarawa, some 147,000 bags have been imported and about 108,000 distributed.[36] These have been imported over a two year period, but Greenbag distribution reached its potential for only three months during early 2005, when some 10,000 Greenbags per month were distributed; even then distribution was far less systematic than would be expected from an efficient retail distribution system.

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[35] Editor's note: provisional results from the 2005 Census (National Statistics Office 2005) give a figure of 3743 households in the TUC area in 2005.

[36] 39,000 remain as of 28 December 2005: these have been delivered to BKL for distribution.

6.3 Extending the Greenbag user-pays scheme to all of South Tarawa

The above analysis has only considered a GUPS for the TUC area of South Tarawa. South Tarawa consists of two Local Government areas, the TUC and the BTC. The BTC area covers only the island of Betio, at the west end of Tarawa atoll; in 2000 the population was 12,268, which by 2005, at annual 5% increase, would be around 15,650.[37]

Those people would generate an estimated 450 t of waste per annum, or 1,370 m^3 (at 3 m^3/t at the landfill). This waste would be deposited in the Betio Red Beach Landfill, which has a capacity (ADB 2001) of approximately 54,000 m^3. This landfill had a retaining wall built around it in 1997 by the PWD, and in 2003, the SAPHE project constructed a cyclone fence, gates, and a leachate pumping system. This landfill is rapidly filling up.

If Betio households also adopted Greenbags, an estimated 90,000 Greenbags/yr would be used, generating AUD 23,400 in income for the BTC, in addition to funds collected for waste from businesses and institutions in the BTC. It should be noted that both councils also receive significant income from the Government through MISA.

The BTC Red Beach landfill has a much higher organic content (Fig. 19) than the Nanikai landfill, and any reduction of waste quantities to the landfill (by pushing organic waste out of the landfill stream), would be very beneficial. Recyclable content in the Betio stream is expected to be very low, as there are known to be several people in Betio who make a full-time living out from extracting recyclables from the waste stream; the BTC waste collection crews are daily visitors to the Kaoki Mange MRF with recyclables they have removed from waste put out for collection.

Figure 19: Organic Waste in Betio Landfill, December 2005

Division of any money collected from Greenbag sales (i.e. the proposed AUD 0.26/bag), would best be conducted on the basis of where the Greenbags were purchased. It would be possible to have two different types of bag, one for each Council area. This would be simple to do, as a printing plate for printing the slogan on the bags costs only about AUD 250.

6.4 Increasing Greenbag retail prices

The problem facing the Greenbag programme at the moment is how to move from the current AUD 0.20 retail price to an AUD 0.50 retail price (or another price acceptable to the government, the Councils, and of course, the consumers).

[37] Editor's note: Provisional results from the 2005 Census give a population for Betio of 12,509 (growth rate of .36%)

It has been demonstrated that an AUD 0.50 retail price, with some AUD 0.26 directed to the Councils, would provide an income that should match the Household Service Charge (if that money were normally paid and collected). The AUD 0.26 identified here also leaves a cent or so for price adjustment as required.

If, as seems likely, BKL takes over the distribution of the Greenbags, they will initially distribute these at AUD 0.15 to retail stores, with stores selling them for AUD 0.20, giving a (retail) markup of AUD 0.05. BKL's markup is also expected to be AUD 0.05/bag.[38] The 39,000 bags delivered to BKL at the end of December are thus worth AUD 0.10 each to the IWP Kiribati. IWP Kiribati can initiate import by BKL in the following way: IWP should invoice BKL for AUD 3,900 (39,000 bags at AUD 0.10 each), but not collect, instead agreeing with BKL that IWP will not collect the funds *if* BKL uses the AUD 3,900 to import an additional 28,000 Greenbags; in this way IWP Kiribati can effectively subsidise a further import of Greenbags while making no new financial demand on its resources, while also extracting AUD 0.10 per BKL bag to further IWP aims. A roadmap outlining how to proceed is included in Fig. 20.

Figure 20: Roadmap to 50c Greenbag

It may be decided by IWP Kiribati that additional funds may be provided to BKL to support additional Greenbag imports; this must be determined in light of expenditures, available resources and sales data.

IWP Kiribati will need to continue to direct money to the TUC; this can be an effective way to subsidise the programme (rather than by means of Greenbag imports). It should be noted that it makes sound financial sense for the Government to be contributing to an initial subsidy as well, should that be necessary, as the savings at the landfill will likely exceed Greenbag costs.

IWP Kiribati would continue to vigorously promote Greenbags under this scenario, and closely monitor the system for problems. IWP Kiribati must also determine the timing of each step: while a timeline is shown in Fig. 5, the actual timing could only be determined at the time, mindful of conditions such as stocks of Greenbags and level of stakeholder participation.

IWP Kiribati will need to work with BKL on directing excess income (i.e. any amount collected that is in addition to the sum of the landed cost and BKL and retail mark-up) to the respective Council, depending on the location of the store that is retailing the Greenbag. In so

[38] As detailed previously, the landed cost of a bag is about AUD 0.14; with both the importer/distributor and the retailer making AUD 0.05/bag, the minimum retail price (to recover costs) is AUD 0.24 (rounded to AUD 0.25). Selling at a retail price of AUD 0.20 thus requires a subsidy by IWP of AUD 0.04–0.05.

doing, it may help to have a slightly different bag for different areas (stores in Betio would purchase BTC bags, while stores in the TUC area would purchase TUC bags). BKL would direct funds to the Councils (at AUD 0.26/bag) on the basis of the number of TUC or BTC bags sold.

The overall constraint is the date at which the IWP Kiribati project ends (December 2006); this realistically means that a final price should be achieved by September 2006, if adequate resources are to be available. The IWP Kiribati publicity programme must in particular be careful to inform the public as to Greenbag price increases, and the reasons for the changing prices. It may be able to spread the price increase over a longer period, but then it will necessary for another agency to take responsibility for managing the Greenbag price transition.[39]

If Greenbag price reach AUD 0.25 each, import and distribution costs will be covered. While this end price would not provide any excess funding to the Councils (and thus not constitute an actual user-pays scheme), it would be beneficial in that it would (i) save the government money (in landfill costs), (ii) improve the waste collections across Tarawa (assuming widespread use of Greenbags) and as a result (iii) reduce pollution in the waters of Kiribati stemming from waste. This would also be expected to provide savings or benefits in other areas not covered by this report, such as fishing and health.

6.5 Is the 50c Greenbag the only means of improving SWM in South Tarawa?

6.5.1 Advantages of the Greenbag

Any action taken to contain rubbish that is currently dumped in uncontained piles in South Tarawa would improve the situation. Other types of garbage bags, as well as old rice, sugar and copra sacks would help with collection, sorting and pickup. The Greenbag has provided several things other bags do not:

- a focus for public education efforts to sort out organics;
- an easily identifiable symbol;
- the potential to raise money for waste collection through the waste collection process itself; and
- a built-in incentive to the Councils to pick up bags and increase revenues. If Councils pick up Greenbags efficiently, it can be expected that the public will buy more Greenbags, thus directing more money to the Councils.
- The use of any bag for rubbish collection should be encouraged, and care taken not to discourage use of old sacks instead of Greenbags; any bag is much better than no bag at all. But the supply of old sacks is likely to be far less than the potential number required.

Is it necessary to have an AUD 0.50 Greenbag? The effective minimum sale price of a Greenbag in South Tarawa must be AUD 0.25, as the combined cost and wholesale/retail markup is AUD 0.24 (5 cent coins are the smallest denomination used). Garbage bags are not readily available on South Tarawa, but where they are, prices of AUD 2.00–2.50 for five[40] have been recorded, giving an effective price of AUD 0.40–0.50 each. Normal shopping bags

[39] Having a single waste management authority on Tarawa would simplify coordination of programs and the interaction between the Councils, government, the public and the business sector.
[40] Pers. obs. Antenon, June 2003.

commonly cost AUD 0.20 each in South Tarawa. That price has been maintained for many years in small stores, although several larger stores give them out free. It can thus be assumed that the market can bear AUD 0.20 for small bags; otherwise the price would be expected to drop to AUD 0.15 or AUD 0.10 (the unit cost is under AUD 0.10 to a retailer), but this has not happened. Garbage bags are typically sold in packs of three or five in small stores in other countries, and unit cost is comparable[41].

When looking at the cost of Greenbags it is important to remember that normal garbage bags cost money, and that garbage bags are the cheapest way of providing containment to the wastes currently piled in the streets of South Tarawa. Uncontained wastes are vastly more polluting than contained wastes, cost more to pick up by Council, take longer to pick up, and so reduce overall waste collection capacity. Garbage bags alone, with no pick up, are highly unlikely to cost less than AUD 0.30/bag (retail) in Tarawa. If the majority of the garbage continues to be uncontained, the costs to the society are large.

7 Conclusions: Success of the Greenbag programme

7.1 Programme Activities

The IWP Kiribati Greenbag programme of activities has built on previous work and effort; IWP Kiribati has actively and creatively developed the materials they started with, and *Te Kiriin Baeki* has become a part of the vernacular language in South Tarawa.

Individually, a competition, poster, or radio jingle may not have a significant effect, but IWP Kiribati has understood that public education and behaviour change require persistence and time. It is important to continually push a simple, central message — in this case the Greenbag — framing it in new ways, but retaining the central point. "Don't Drink and Drive" campaigns, which have gone on for decades in many countries, illustrate clearly that a long-term commitment to behaviour change, and a consistent message, can succeed.

The fact that half the programme budget is now going to public relations work is very encouraging. It is clear from the landfill measurements that the many campaign tools used by IWP Kiribati have had a major effect. If a modern city to could achieve what has been achieved here — virtual removal of organic wastes from the waste stream — the effect would be extraordinary. The IWP Kiribati team can only be commended for this excellent result.

7.2 Evaluation of the Greenbag objectives

Objective	Results
Push organic waste out of the waste stream	Previously, around 50% of household waste was organic. Organic material has been found to comprise 0.6% of the total weight, and approximately 3% by volume uncompacted, or about 1% of compacted volume. The latest Greenbag survey indicates that organic components in Greenbags are at residual levels.
Decrease the quantity of waste to the Nanikai landfill	The TUC is almost exclusively dumping Greenbags in the Nanikai landfill. The filled volume indicates that waste volumes have decreased through diversion of organics. Comparing waste densities from previous work (and density achieved during this study) indicates the Nanikai landfill density is improving. This is due in part to regular application of the bulldozer over the waste.
Reduce landfill costs	Landfill space at Nanikai is worth at least AUD 25/m^3; by diverting

[41] Three Elldex biodegradable bags bought in Thames Pak'n'Save supermarket in New Zealand in 2003 cost NZD 1.60.

Objective	Results
	50% of the landfill waste, landfill life is at least doubled. By increasing waste density, landfill life is further improved. The regular use of machinery at the landfill site to compact waste and provide some sand cover is essential. Use of Greenbags has the potential to save the Government up to AUD 100,000 per year in saved landfill space. Current savings (based on the filled area) are at least AUD 14,000.
Replace Household Service Charge with Greenbag funds	A GUPS could generate sufficient funds in the TUC area to replace the current household waste charge (which is paid by few people). This would increase TUC revenues for waste collection and disposal.
Reduce water pollution	Greenbag waste is disposed of in the Nanikai landfill. Waste that is uncontained (typically containing a high proportion of organic waste) in piles on the street is used by the TUC as land reclamation fill material; it is usually dumped either into, or adjacent to, a body of water. Greenbag use will not deal with all the water pollution problems of South Tarawa: there are several major sources of pollution, including domestic animals and poor human sanitation arrangements. The public's greater understanding regarding the impact of waste may help educational efforts to address these other issues.
Does the TUC have the capacity to collect all the Greenbags, if used by every household?	The two blue SAPHE supplied roll-on trucks have the combined capacity to collect all the waste in the TUC area, if it went into Greenbags and maintained its current Greenbag composition. This situation would be improved if the Bikenibeu landfill were opened for use.
Would the TUC gain by operating the Greenbag User Pays Scheme?	Through the Greenbag levy (paid to the TUC direct from the Greenbag importer/wholesaler), the TUC could receive income from households that may not now be paying the Household Service Charge.

7.3 Essential facts

Parameter	Results
Quantity of household waste deposited in landfill	Decreased by about 60% in two years, through the removal of organics and recyclables.
Organic content of waste	Greenbag use is driving organics out of the waste stream; organic content is residual (around 1%).
The cost of a cubic metre of Nanikai landfill	Estimated at $25/m³.
Action required to ensure sufficient landfill capacity for the next 15 years.	Increase landfill density.
Action required to address effect of population increase on waste generation.	Reduce impacts through Greenbag use and landfill compaction.
Date Nanikai landfill full to capacity.	2011 (if *entire* TUC population used Greenbags, and *all* waste went to Nanikai; assumes 5% per annum population increase from 2000).
Current filled area of the Nanikai landfill	About 540 m³, or 2.5% of the entire landfill. This represents 36,000 Greenbags at 333 kg/m³, or 54,000 at 500kg/m³.
Annual production of Greenbags from the TUC area in 2005	Estimated at 184,000, if all household waste went into Greenbags.

7.4 Recommendations

The following recommendations are offered to improve delivery of advantages that a full GUPS might provide.

1 Ensure widespread distribution of Greenbags

The greatest constraint to the GUPS is the poor availability of bags, and this comes from an inefficient distribution system. This issue is already being addressed by the IWP Kiribati NC through negotiations with Tarawa's largest grocery distributor.

2 Find a commercial importer for the Greenbags

Following from the point above, IWP cannot continue to act as the Greenbag importer, as the project has a limited lifespan. IWP Kiribati may need to subsidise the import of one more shipment of Greenbags to facilitate the transmission to an AUD 0.50 system.

3 Manage the transition to an AUD 0.50 Greenbag through creative subsidy

As described in Section 6.4, the IWP Kiribati should use its funds creatively to ensure that more Greenbags are imported (but not by IWP Kiribati). They should ensure that some money is directed to the TUC, to maintain their engagement, and move the retail price to AUD 0.30 as quickly as possible (at that price each all costs are covered, with an AUD 0.06 surplus). At that point, IWP Kiribati must vigorously promote (to the public) the reason for an increase to AUD 0.50c, or alternately, arrange for government subsidy (in recognition of avoided landfill costs, and thus savings gained by government).

4 If required print two different Greenbags, for TUC and BTC

Should problems arise over distribution of funds from a GUPS, clearly differentiate the collection bags so that it is immediately apparent to the public, retailers and waste collectors which Local Government area the bags are to be collected in. This can be done best through a different printed message (but still incorporating the Kiribati Te Boboto message).

5 Remove government worker waste collection charge

Remove the current levy on all Government workers. When Government workers pay this levy, and also buy Greenbags for their waste collection, they pay twice and are disadvantaged. Also, all Government office cleaners, and cleaners at government-owned businesses and schools, should be directed to use the Greenbag, and all wastes produced by those institutions should be from now be on put out for collection only in bags. If the charge is to be removed, there must be arrangements to manage the transition from one system to another, so that Council revenues have time to adjust.

6 Facilitate an M.O.U. between BKL and the Councils

The IWP Kiribati can act as facilitator to ensure that an equitable agreement is in place between the distributor of the Greenbags, and the BTC and the TUC, so that any money due to the councils for Greenbags purchased from stores in their area is directed to the respective council.

7 Compaction of wastes and use of cover material with the bulldozer

The use of machinery every week to compact landfill material is essential to improve landfill life, as can be clearly seen from the charts showing the effects of density over time. While this will cost money, it is as effective as waste reduction efforts in extending landfill life. A problem arises in that the TUC has been given the Nanikai landfill to operate, but has no additional funding for those operations. This issue needs to be addressed, but is outside the scope of this report. A Waste Management Authority might be of assistance in addressing this.

Good compaction in the landfill will also be of benefit once the landfill is full. Sand must be mined from the second cell, and used as cover in the first, and in this way slowly provide a working area in the second cell in readiness for the time that the first cell is full. This serve to improve the quality of the landfilled area; poor compaction can become a liability should a storm or high tide breach the retaining wall,42 causing poorly compacted wastes to flood into the lagoon. This is not unusual with informal landfilling of seawalls with waste, but would be a disaster for both the villages Nanikai and Teaorarereke.

8 Research income and costs of waste collections for TUC and BTC

Research could be conducted by IWP Kiribati to assist the Councils identify the real costs of waste collection and servicing landfill operations. Previous requests to the Councils for this information indicates is not separately presented in Council budgets or accounts. The amount of money levied from Government workers for waste collection, and the subsequent distribution of that money, is essential information to determine the true cost of SWM for South Tarawa. This would provide a more accurate analysis of savings from collection of wastes in bags instead of piles. This would certainly assist MELAD with efforts to improve the waste situation on South Tarawa.

[42] Several informal landfills behind seawalls on the lagoon side of Bikenibeu suffered this fate in February 2005, when a storm coincided with a very high tide (A. Lenny, pers. obs.).

References

ADB. 2001. Kiribati SAPHE Project: Solid Waste Management Design Report. Manila: Asian Development Bank.

ADB. 1996. Environmental Improvement for Sanitation and Public Health Project. Manila: Asian Development Bank.

Bakineti R. 2005. Campaigning the Greenbag in Bikenibeu West. Kiribati: IWP Kiribati.

BECA International Consultants Ltd. 2003. Solid Waste Management in Majuro. Majuro, Marshall Islands.

EEP, ECD and FSP. 2000. Monitoring and Evaluation Report of Waste Collection and Compost Pilot Project.

FSPK. 2004. 'Recycling in Kiribati' Design Report: The Pathway to a Self Financing Recycling Operation. Kiribati: Foundation for the People of the South Pacific, Kiribati.

Lenny, A. 2004. The way ahead: an assessment of waste problems for the Buada community and strategies toward community waste reduction in Nauru. IWP-Pacific Technical report No. 9. Apia, Samoa: Secretariat of the Pacific Regional Environment Programme.

Gangaiya, P. Land based pollution sources in Kiribati: A case study. SPREP Reports and Studies No 81. Apia, Samoa: Secretariat of the Pacific Regional Environment Programme.

Hassan, M. 2005 Draft Action Plan for Waste Management in Chuuk, prepared for the World Health Organization.

Lal, P. and L. Takau. 2006. Economic Costs of Waste in Tonga. IWP-Pacific Technical Report no. 33. Apia, Samoa: Secretariat of the Pacific Regional Environment Programme.

National Statistics Office 2005. Kiribati 2005 census of population and housing: provisional tables. Accessed online (12/10/06) at www.spc.int/prism/Country/KI/Stats/Census2005/seltables.htm

National Statistics Office 2002. Kiribati Statistical Yearbook. Tarawa, Kiribati: Government of Kiribati.

National Statistics Office 2000. Report on the Kiribati 2000 census. Tarawa, Kiribati: Government of Kiribati

Pacific Waste Consulting. 2004. Honolulu Solid Waste Integrated Management Plan. Honolulu.

Saito, S. 1997. Knowledge, Attitudes and Practices on Selected Environmental Issues for the Kiribati Environmental Education Programme. Kiribati: Foundation for the People of the South Pacific, Kiribati.

Sinclair, Knight Merz. 2000. Solid Waste Characterisation Study and Management Plan For South Tarawa. Apia, Samoa: Secretariat of the Pacific Regional Environment Programme.

Teiwaki, R. 2005. Preliminary socio-economic baseline survey and waste stream analysis for Bikenibeu West, South Tarawa, Kiribati. IWP-Pacific Technical Report no. 14. Apia, Samoa: Secretariat of the Pacific Regional Environment Programme.

Tulega, L.C. 1994. A Waste Management Study in Kiribati. Apia, Samoa: Secretariat of the Pacific Regional Environment Programme.

Appendix A: Examples of Greenbag Public Awareness Materials

Figure B1: Newspaper advert from early 2004

Figure B2: How to use the Greenbag Poster from early 2005

Figure B3: Sign at shops selling Greenbags

Figure B4: Latest Greenbag Poster

Figure B5: IWP Kiribati Green Bag Publicity Truck

Appendix B: User-pays garbage bag scheme in New Zealand

On 7 October 2005, Alice Leney met with Mr. Greg Hampton,[43] Solid Waste Manager for Thames and Coromandel District Council (TCDC) in Thames, New Zealand. TCDC introduced a User Pays garbage bag system in 2002. The Council lets a contract for collection of household waste and recyclables in the District. The Contractor is only obliged to pick up the specified Blue Bag (figure G1). Households are also supplied with an open green bin of about 25 litres capacity into which all recyclables acceptable can be placed. Recyclable bins are emptied at the same time as bags are collected, by the same contractor. Blue bags cost NZ$1.20 each, and are very widely available in stores across the council District.

The Council has been faced for many years with great difficulty identifying new sites for landfill. Also, the TCDC district covers a large rural area of about 100 km × 20 km. Roads are winding, and travel times are long; waste collection costs are high.

The Council sought to reduce the quantity of waste being produced in the TCDC area. They recognised that much of what was going to landfill could go elsewhere (as is true in Kiribati). They decided that a user-pays bag scheme, called here an Official Pre-Paid Refuse Bag, was the most effective way to address this waste minimisation issue.

The Contractor, Onyx Group, is required to meet a target of waste to landfill. The contractor is responsible for bag distribution (this is contracted out). If the Contractor exceeds the waste target, they get a percentage of any income from recyclables that are collected. If they fail to reach the waste minimisation target, all the money from recyclables collected in the kerb-side goes to the TCDC. The Contractor is also responsible for the public education and publicity programme.

There was a phase-in period, that involved publicity, a specified date at which the Blue Bag would be only acceptable, and an unofficial grace period where non-Blue Bags were collected. While there was some initial resistance and complaints after a year compliance was very high. People can take other — unofficial — garbage bags to local waste transfer stations at the normal tipping charge rates.

Figure G1: Thames and Coromandel District Council Official User-Pays Blue Bag

The TCDC is very pleased with the overall result, and the Contractor is currently meeting targets and receiving income from the recyclables.

Auckland City Council is also using a pre-paid bag system for waste collections.

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Appendix C: Terms of reference for the study

Consultant to assess the expected impact of the Tarawa green bag scheme on the Nanikai landfill.

Background

The Strategic Action Programme for the International Waters of the Pacific Small Island Developing States (SAP/IWP) involves 14 participating Pacific Island Countries: Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.

The IWP is intended to address the root causes of degradation in Pacific island international waters. It is intended to do this through the use of regionally consistent, country-driven, targeted actions that integrate development and environment needs (GEF/UNDP 1999). The IWP has two main components: (i) an oceanic component which focuses on the management and conservation of tuna stocks in the western central Pacific and (ii) a coastal component that focuses on integrated coastal watershed management. These terms of reference refer to work for the coastal component of the IWP only.

The coastal component of the IWP is aimed at national and community-level actions to address priority environmental concerns relating to:

- marine and freshwater quality;
- habitat modification and degradation; and
- unsustainable use of living marine resources.

To address these concerns at the local level, the IWP will support the establishment of 'pilot' or demonstration projects, one in each of the 14 participating countries. Each pilot project is intended to address the root causes of degradation affecting marine protected areas, coastal fisheries, freshwater resources and or waste reduction.

Community based activities may include low tech solutions to addressing environmental degradation while national level activities may involve activities that have a broader or more strategic focus.

Under the IWP in Kiribati, a pilot project has been established to address waste management. At the community level, the project is hosted by Bikenibeu West village which provides a case study for addressing waste management generally in Kiribati. A number of activities have already occurred under the IWP in Kiribati including community awareness meetings, water quality analysis, participatory problem analysis and the trial of a biodegradable 'green bag' scheme in which householders throughout South Tarawa are being encouraged to separate waste and send non compostable/non recyclable waste to the Nanikai landfill. See attachment. The trial of the green bag scheme as supported under the IWP has now been extended to include a user pays component. The next stage is to predict the impact of the green bag scheme – if any – on the life of the Nanikai landfill.

Objective

To support the work of the IWP in Kiribati through an assessment of the impact of the south Tarawa Greenbag scheme on the life of Nanikai landfill. The information generated will be used to:

- encourage adoption of the scheme by the waste removal agencies;
- refine the scheme; and or
- support efforts to encourage householders to participate in the scheme.

Outputs

The outputs from the assessment will be information on:

- the effectiveness of the IWP-Kiribati green bag trial in south Tarawa; and
- the extent and nature of impact, of any, of the trial on landfill usage.

Tasks to be performed

The consultant will liaise with the national coordinator IWP-Kiribati and IWP lead agency to:

- Review work completed to date in relation to IWP-Kiribati, especially the work on the Greenbag scheme and any other relevant reports and activities, including the IWP socioeconomic and waste stream analysis work;
- Review the operation of the Nanikai landfill site and its original expected lifespan, based on the assumptions of managers and designers of waste generated;
- Assess the current impact of the Greenbag scheme on waste generation in South Tarawa, noting the volume and nature of waste generated prior to the scheme and that generated during and after;
- Assuming that the Greenbag scheme was extended to the whole of Tarawa, predict the likely impact of the scheme on waste generation across all Tarawa;
- Predict the likely impact of the Greenbag scheme on the life of Nanikai landfill, if the scheme remained limited to South Tarawa and if it was extended to all of Tarawa. Take into account the notion that the scheme may have increased the volume of waste being put out by householders for collection and disposal at the landfill – and that this may not have been considered in the original estimates of the lie of the landfill;
- Note assumptions used in calculations and make comment on the robustness of the estimates generated;
- Submit a report to the national coordinator (IWP-Kiribati) and SPREP (PCU) documenting activities conducted, findings and, where relevant, recommendations for future action (information gaps to be addressed etc.);
- Incorporate input from the national coordinator (IWP-Kiribati) and SPREP (PCU).
- Submit a final report. (See Reports required.)

Reports Required

The report will be prepared in plain English and will:

1. contain an Executive Summary providing a general overview of objectives, activities, findings and recommendations as relevant;
2. provide a description of the impact on the nature and volume of waste generation arising as a result of the green bag trial in South Tarawa and its potential extension throughout Tarawa. Include calculations and assumptions and relevant sensitivity analyses;
3. contain an explanation of the how the landfill is impacted by the scheme, and note how the likely impact is estimated, on which assumptions the estimation if based and the robustness of the assumptions;

4. provide recommendations for any further action such as research to address gaps in information; and
5. provide other relevant findings or recommendations as appropriate.

IWP-Pacific Technical Reports published in 2004 & 2005

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