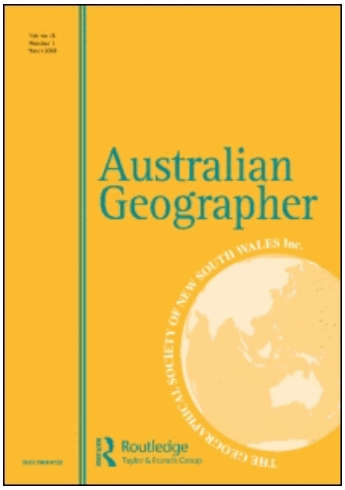

Australian Geographer
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713403176

Kiribati: an environmental 'perfect storm'

Donovan Storey[a]; Shawn Hunter[b]
[a] University of Queensland, Australia [b] Foundation for Development Cooperation, Brisbane

Online publication date: 07 June 2010

To cite this Article Storey, Donovan and Hunter, Shawn(2010) 'Kiribati: an environmental 'perfect storm'', Australian Geographer, 41: 2, 167 — 181
To link to this Article: DOI: 10.1080/00049181003742294
URL: http://dx.doi.org/10.1080/00049181003742294

Australian Geographer, Vol. 41, No. 2,
pp. 167–181, June 2010

Kiribati: an environmental 'perfect storm'

DONOVAN STOREY & SHAWN HUNTER, *University of Queensland, Australia; Foundation for Development Cooperation, Brisbane*

ABSTRACT *Recent environmental discourses and headlines on small island developing states (SIDS) have heralded the grave and impending threats of global warming and associated sea-level rise. These are undoubtedly significant challenges for SIDS, including atoll nations such as Kiribati. Nevertheless, securing small island state futures also requires a renewed commitment to addressing the obvious and immediate threats of urbanisation, pollution and sanitation. Looking at pressures of development on freshwater, this article argues that the future survival of small island states and their societies also greatly depends on managing the impacts of development. Approaches which can concurrently strengthen the resilience of communities and their ecosystems will result in mutual benefits for both sustainable development and climate change adaptation.*

KEY WORDS *Environmental policy; sustainability; urbanisation; climate change; Kiribati.*

Kiribati: a case study of multiple vulnerabilities

The threats to small island developing states (SIDS) from global climate change and associated sea-level change have been well publicised in recent years and have re-ignited debate and concern regarding the future sustainability and even viability of small island states (Barker 2008; Barnett & Adger 2003; Connell 2003; Hood 2008; UNFCC 2008; United Nations 2005). This article does not deny the very real and frightening threats posed to atoll nations such as Kiribati from such scenarios. Rather, we argue that the impacts of unmanaged urbanisation, a continuing crisis of inadequate sanitation, a lack of solid waste disposal controls and ineffective freshwater management offer equal threats to sustainability, even if they proffer less 'sensational headlines' (Carden 2003). Dealing effectively with these growing pressures and demands is not only critical in itself but also illustrates the dynamic interaction between classic 'brown' agendas of waste management and pollution with contemporary challenges facing SIDS in the form of climate change. We argue that the future sustainability of Kiribati requires effectively managing both. This argument also has relevance for other vulnerable atoll nations undergoing simultaneous challenges of unsustainable development and climate change (e.g. the Maldives and the Marshall Islands) (ADB 2009; Ghina 2003).

In SIDS, policy makers, planners, donors and communities alike are tasked with reconciling growing expectations and demands for 'development' while acting to

ISSN 0004-9182 print/ISSN 1465-3311 online/10/020167-15
DOI: 10.1080/00049181003742294

limit or prevent the impacts of socio-economic change on fragile environments. These pressures are particularly evident in meeting basic needs of potable water, in solid waste management and in developing effective sanitation systems. In 2000, the United Nations General Assembly in its Millennium Declaration resolved to halve by the year 2015 the proportion of the world's population that is unable to reach or afford safe drinking water and to stop the unsustainable exploitation of water resources. Following, in 2002 the World Summit on Sustainable Development in Johannesburg also set a new target of halving, by 2015, the proportion of people who do not have access to basic sanitation. While these targets seem ambitious enough, it is important to be reminded of the specific challenges in meeting these goals for SIDS, which experience additional problems relating to both water supply and sanitation (United Nations 2005). Potential solutions are made more difficult by the remoteness of many island states, a lack of capital, the paucity of trained people and the constraints of terrestrial ecosystems (e.g. for infrastructure).

These challenges are particularly acute for atoll nations such as Kiribati (ADB 2007; Moglia *et al.* 2008; White *et al.* 2007a). The physical geography of Kiribati provides a number of serious development predicaments, including limited arable soils, which constrain agriculture options; isolation, which impedes competitiveness in the global or even regional market; as well as a plethora of environmental vulnerabilities which are exacerbated by population growth, demographic concentration and resource use patterns (Thomas 2003). Consisting of 32 low-lying atolls and reef islands and one raised limestone island (Banaba), the Republic of Kiribati encompasses a total area of over 5 million km^2. It is one of three atoll nation-states ranked as a Less Developed Country (LDC) (alongside Tuvalu and the Maldives). The total land area is only slightly more than 800 km^2. Kiribati is broken into three island groups—Gilbert, Line and Phoenix. The Gilbert group has 16 atolls and reef islands and Banaba while the Line and Phoenix each have eight atolls and reef islands (see Figure 1). Of all the islands, 12 are not permanently inhabited because of their small size and/or inadequate freshwater resources.

Most of Kiribati's population resides within the Gilbert group with approximately half of the national total living on Tarawa alone. Environmental pressure and degradation is particularly evident in the rapid urbanisation that Tarawa is experiencing and the relative failure of planning to offset these impacts (Falkland 2002; Jones & Lea 2007; Kuruppu 2007). South Tarawa has a total land area of approximately 15 km^2 and consists of three main urban centres—Betio, Bairiki and Bikenibeu (Eritai 2003). Population growth has been exceptional, increasing from just 3013 in 1931 to 40 311 in 2005. The population density of South Tarawa is on average 2600 people per km^2 (Moglia *et al.* 2008) but population densities are high as 15 000 people per km^2 (White *et al.* 2008). Such concentration exists on a ribbon of atolls linked by causeway some 35 km in length and at its widest point 300 m in breadth (ADB 2008).

South Tarawa's development challenges are particularly formidable. They include severe overcrowding; a growing share of housing in informal and unplanned settlements; pressure on urban water reserves; high levels of lagoon pollution, as a result of increased solid waste and continuing use of the lagoon for human waste; failing water and sanitation systems; and conflict over land. In short there are both social and biophysical vulnerabilities, which are, of course, intimately linked (Cocklin & Keen 2000). These vulnerabilities are compounded by governance and

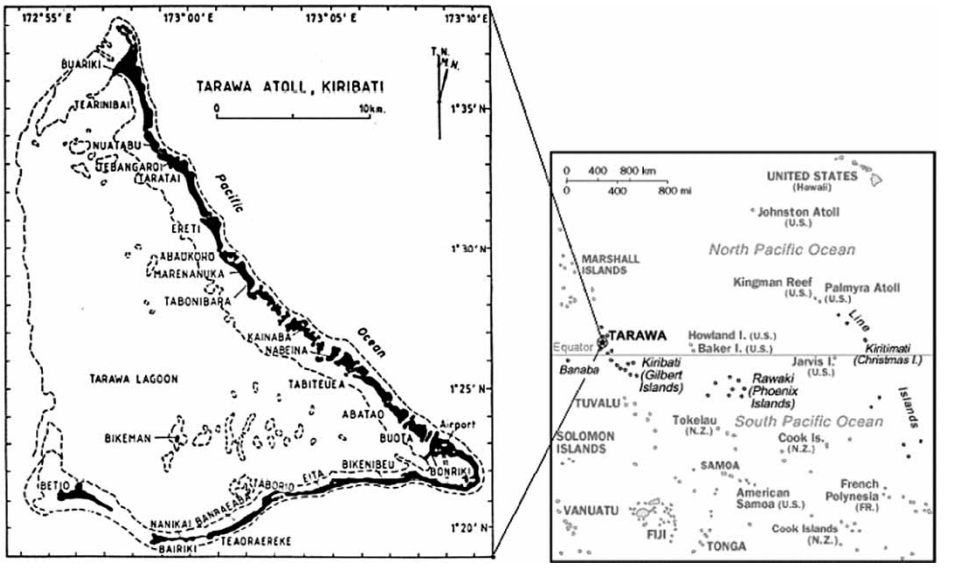

FIGURE 1. Map of Tarawa Atoll, with inset map of larger Kiribati region.
Source: adapted from Moglia *et al.* (2008).

customary systems which have inadequately responded to changing patterns of development (Carden 2003; Jones & Lea 2007). Many initiatives in planning and governance are dependent on external financial aid and expertise. This often results in ephemeral projects with limited uptake.

Several authors have noted a gradual decline in quality of life as a result of ecosystem degradation and limited opportunities for economic development and social opportunity (Connell & Lea 1998; Jones & Lea 2007, p. 481; Storey 2006). Consequently, Nadkarni (2008) has noted that Kiribati faces enormous challenges from both socio-economic as well as environmental vulnerability, with very few resources to address these. It is also evident that the capacity of both social and environmental systems to adapt to change is under great pressure. When combined with climate change scenarios Kiribati is facing somewhat of a 'perfect storm' of multiple and simultaneous threats to its liveability and very survival.

Freshwater resources

Arguably it is in the use and management of freshwater where the greatest vulnerabilities and challenges to sustainability lie. Availability of freshwater in Kiribati is dependent on rainfall which recharges freshwater lenses (White *et al.* 2007b, pp. 1523–4). Kiribati experiences slightly higher rainfall on average in the months from December to May than in the normally drier months from June to November (Burgess 1987). There are two major systems which largely influence the climate in Kiribati—the Intertropical Convergence Zone (ITCZ) and the South Pacific Convergence Zone (SPCZ). The ITCZ influences rainfall in the northern islands while the SPCZ influences rainfall in the southern islands (Government of Kiribati 1999). Typically, during El Niño episodes, the ITCZ moves closer to the equator and then away during La Niña episodes (Porteus & Thompson 1996).

Recent research has indicated that convergence zones are shifting northward with global warming, resulting in less dependable rainfall in future decades (Sachs *et al.* 2009). By far the greatest short- to medium-term threat from climate change is less predictable rainfall patterns (Kundzewicz *et al.* 2008, p. 5). It is during El Niño episodes when Kiribati generally experiences its highest rainfall, while La Niña episodes result in droughts (Bureau of Meteorology 2010). The spatial and temporal variability of rainfall in Kiribati is very high. For example, average annual rainfall varies from just under 1000 mm in Kiritimati (Christmas Island) to over 3000 mm in Teeraina (Washington). The inter-annual variability is also characterised by minimum and maximum annual rainfalls on Tarawa of about 400 mm and 4300 mm, respectively. Variations in rainfall over shorter periods are even more pronounced. Current climate change projections for Kiribati tend to suggest an increase in average rainfall but greater variability (i.e. more/stronger El Niño/La Niña episodes). Kiribati's freshwater is heavily reliant on rainfall, and thus greatly vulnerable to changed patterns from global climate change (Campbell 2000).

Freshwater lenses are particularly vulnerable in Kiribati to saltwater intrusion and pollution permutation. The freshwater zone is bounded by the water table and a transition zone between the freshwater and underlying seawater. The transition zone is created largely by tidal forces causing freshwater to mix with seawater (Wheatcraft & Buddemeier 1981). The thickness of the transition zone fluctuates depending on recharge and the magnitude of groundwater extraction. On small land masses such as Tarawa the freshwater zone thickness is generally about the same thickness as the transition zone (Scott *et al.* 2003). The thickness of lenses also differs depending on the surface area and the permeability of the sediments. On Tarawa, freshwater lenses can be found up to 30 m in depth (Falkland 1992), but in periods of drought have been as shallow as 6 m (White *et al.* 2007b, p. 1524).

The storage of freshwater lenses is dependent largely on three factors: recharge rate, width of the island, and geology (Falkland & Woodroffe 1997). Recharging the lenses is completely reliant on rainfall. In contrast, there are several ways in which freshwater is depleted, including ocean discharge and tidal mixing; vegetation (e.g. coconut trees) tapping into and transpiring directly from the lens; and 'natural' loss through coastal erosion causing an island's surface area to shrink. Studies have shown that coconut and pandanus trees transpire shallow groundwater at rates of approximately 150 L/tree/day (White *et al.* 2002). In Tarawa unregulated groundwater extraction from domestic wells and infiltration gallery pumping schemes also have a large influence on freshwater lens thickness (Moglia *et al.* 2008).

Recognising the need to maintain yield from the major freshwater lenses at sustainable rates, Kiribati has utilised several alternative methods of obtaining freshwater to offset the unregulated use of domestic wells. On islands such as Tarawa, rainwater is harvested for essential needs such as cooking or drinking (East 2008; Scott *et al.* 2003). Water is collected and stored in basins, empty fuel drums and any other sizeable container. Reverse osmosis plants have been installed in the past on Tarawa and Banaba following severe droughts. However, desalination involves significant capital investment and operating costs and requires well-trained personnel to be effective. Given past experience in Kiribati, desalination cannot be viewed as currently viable for public water supplies.

On Tarawa, availability of potable water is a serious constraint to development and a constant threat to health. Inadequate water supply is also an economic brake for business (including tourism), industry, and agriculture. Yet it is pollution rather

than natural scarcity which provides perhaps the greater threat to human health and well-being. Pollution of the groundwater, lagoon and near-shore reef areas as well as over-extraction of freshwater from groundwater sources have been consistent problems in water management. Most pollution is from direct contamination by sewage and rubbish being dumped on the reef or on the edge of the lagoon. High levels of faecal coliforms, in the absence of effective sewerage systems, have been found in many samples of extracted groundwater throughout South Tarawa, and pollutants can and do penetrate freshwater lenses through taro pits and uncovered wells. Health problems resulting from contamination of water resources are very evident. This includes widespread problems of gastric diseases caused by inadequate water supply and sanitation facilities. Statistics show that pneumonia and diarrhoea, both of which have strong links to hygiene and water, are some of the leading causes of illness and death among children in Kiribati (White 2007).

Of climate change, elephants and ants

In recent years there has been an increasing emphasis on the threats facing SIDS from anticipated climate change and associated sea-level rise. Small island developing states, and specifically those located throughout the Pacific, are indeed at very high risk from the potential impacts of sea-level rise and shifts in rainfall patterns. It is estimated that over the past 100 years the Earth's average temperature has increased by 0.6° Celsius, and that global sea levels have risen by about 1–2 mm/year (Metai 2002). Furthermore, climate change models predict that by the year 2050 average temperatures may increase by 0.9°–1.3° Celsius, and that the sea level may rise by 19–58 cm by the end of the twenty-first century (IPCC 2007). The calculated impacts on Tarawa from these predictions in 2050 are estimated to cost between US$8 and US$16 million annually, or approximately 13.2 per cent of Kiribati's current gross domestic product (GDP) (World Bank 2000, 2010).

Climate change poses a number of potential threats to Kiribati, perhaps most especially in the form of water security. This includes a predicted increase in intensity and frequency of tropical storms and droughts (Scott *et al.* 2003). Periodic storm surges could cause up to 55–80 per cent of the land area in North Tarawa and up to 25–54 per cent of South Tarawa to become inundated by 2050 (Campbell 2000). A major impact of this inundation on water resources may arise from erosion causing freshwater lenses to shrink as land sizes are reduced.

The effects of sea-level rise on small coral islands threaten freshwater lenses through potential inundation of coastal zones leading to saltwater intrusion, as well as possible shrinking of the overall lens size. Kundzewicz *et al.* (2008, pp. 4–5) have estimated that the thickness of small island's freshwater lenses will decline from 25 to 10 m from just a 0.1 m sea-level rise. However, in studies of the Bonriki freshwater lens (South Tarawa), Alam and Falkland (1997) concluded that sea-level rise causing saltwater intrusion was not necessarily a major factor contributing to the vulnerability of the freshwater lenses (see also Falkland 2003; Scott *et al.* 2003). Risks from climate change were more likely to be from less predictable rainfall variations which in turn would exacerbate potable supplies in the face of increasing extraction and the impact of pollution (Campbell 2000).

Consequently, declining levels of water security are the complex amalgam of sea-level rise, less predictable rainfall, over-extraction and contamination.

Figure 2 depicts the direct impacts which climate change is expected to have on Tarawa's freshwater resources. The three major factors identified are mean rainfall, drought frequency and magnitude, and coastal effects. The diagram recognises that mean rainfall has a chance of *increasing* as per current climate change predictions, which would improve water resources. Such data reflect the uncertainty of climate change impacts. Indeed, little is known on the impact on precipitation from present climate change simulation models (Kundzewicz *et al.* 2008, p. 7).

There is a broad consensus that the threats of climate change are very real for small islands. These include changing and unpredictable precipitation patterns, intensification of extreme weather events (including cyclones), increasing air and ocean temperatures affecting fish stocks, greater likelihood of tidal surges, new health risks from malaria and dengue fever, and sea-level rise (Barnett 2001; Mimura *et al.* 2007). The impacts are difficult to estimate, of course, but will certainly include adverse changes to business and tourist investment, agricultural systems, economic prospects and living standards. In the case of Kiribati, the United Nations Framework Convention on Climate Change (UNFCC) has estimated that impacts equivalent to 18 per cent of its GDP will be felt by 2050 (UNFCC 2008). Recently, leaders at the 40th Pacific Islands Forum meeting in Cairns called for a significant increase in climate change aid and the prioritisation of climate change assistance in national development policy (PIFS 2009). This followed from resolutions made in Mauritius (United Nations 2005) regarding threats to the very existence of a number of SIDS, and the need for international support for both mitigation and adaptation initiatives (SPREP 2008).

Consequently, recent framing of environmental threat has significantly shifted towards Pacific Island nations been largely at the mercy of others; a sustainable future essentially out of their control. This is illustrated well in the following quote from a former Kiribati President, Teburoro Tito: 'It's like little ants making a home on a leaf floating on a pond. And the elephants go to drink and roughhouse in the water. The problem isn't the ants' behaviour. It's a problem of how to convince the elephants to be more gentle' (Kristof 1997).

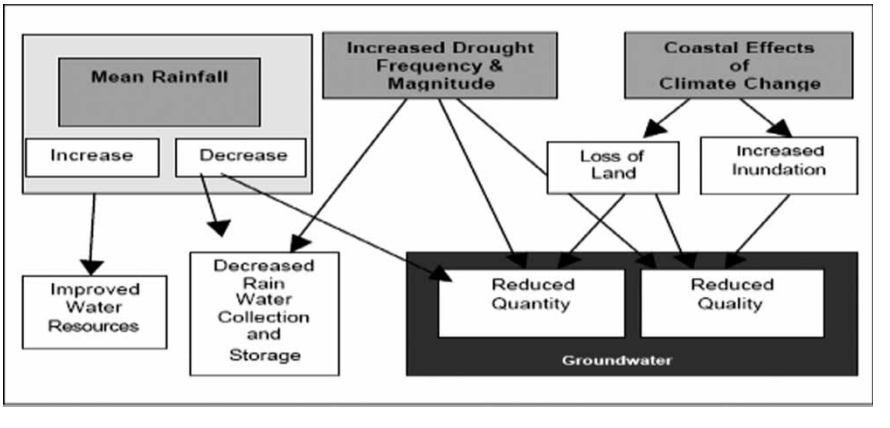

FIGURE 2. Likely impact of climate change on the water resources of Tarawa.
Source: World Bank (2000).

Human impacts and the future of SIDS: the elephant within the room?

The threats facing fresh groundwater sources on Tarawa from human activity arguably pose an equally great menace to sustainability, health and liveability for the atoll's escalating population (Nadkarni 2008). Water quality is threatened by over-usage and contamination through pollution. While providing breeding grounds for mosquitoes, rats and flies, waste build up in South Tarawa also creates a serious hazard to freshwater lenses (Rokoua & Kirata 2002). The most important risk concerning freshwater lens contamination is the depth from the surface to the watertable. This depth on atolls is often less than 2 m. While this makes the process of extraction relatively easy and economic, it also represents a serious hazard as the surface soil is very permeable and allows for easy contamination (White *et al.* 2007b). Once a lens is polluted a long period of time is required before it can recover to a potable condition (Rokoua & Kirata 2002).

Common sources of contamination frequently found on Tarawa include swamp taro pits excavated into the watertable, pit latrines, septic tanks or leachate from solid waste sitting on the surface (Metai 2002; White *et al.* 2004). Faecal and other waste creates a serious hazard as rainfall washes it through the porous soil to the watertable where contamination of the groundwater occurs. Use of groundwater from wells often results in outbreaks of gastroenteritis and other diseases. As human and animal populations continue to increase, without improved waste management the amount of untreated waste generated will also increase. Conventional sewerage systems are difficult to construct because of the amount of water needed to make them effective. Even though South Tarawa has introduced saltwater flushing systems at the main urban centres of Betio, Bairiki and Bikenibeu, other sanitation methods including traditional defecation at the beach or in the bush and pit toilets are still the most frequent. Most human and solid waste continues to be dumped in open spaces and along waterfronts, and water catchments have been gradually overrun with housing in the absence of effective land-use planning and regulation (Jones & Lea 2007).

Infrastructure upgrading projects in past years have simply been unable to cope with increased demand and population growth, and have not been maintained. On Tarawa, when water is contaminated people continue to use it, mainly because of the unaffordability or lack of access to alternative sources. This has led to groundwater in some areas of South Tarawa (Betio, Bairiki, Teaoraereke and Bikenibeu) becoming unsuitable for human consumption primarily as a result of contamination. While some gains were made in sanitation and solid waste management in the late 1990s and early 2000s, these programmes have had somewhat of an ephemeral impact on environmental conditions, policy and public attitudes (ADB 2008; Government of Kiribati 2003).

Added to population growth, Kiribati is becoming more reliant on imported food to meet dietary needs (Thomas 2003). The packaging of this imported food creates further pressures on solid waste management and storage of both hazardous and non-hazardous waste (Sikabongo & Storey 2003). With an extremely limited infrastructure (including landfill sites) to deal with 'new' waste, most of it is simply discarded in open areas or dumped into the lagoon or sea. While there have been some advances in recent years in solid waste management, including a recycling enterprise for many materials and the construction of two large waste disposal pits at Nanikaai and Bikenibeu, these strategies have failed to adequately meet

accelerating impact. Solid waste pollution remains a major problem and threat to human liveability.

Apart from inadequate waste management practices, the informal and unplanned character of urbanisation is having a significant impact on water resources. As noted, South Tarawa has been experiencing rapid urbanisation for a number of years. The lack of available land for housing has led to unplanned settlements that have spilled onto water reserves. thereby creating further contamination through human and animal waste (Rokoua & Kirata 2002). Tarawa has many pull factors such as employment and education opportunities and greater access to goods and services. To extend these benefits to outer islands and rural areas would be very expensive. In the mid-1980s, a resettlement project was introduced in an attempt to curb urban growth in South Tarawa. The project relocated around 1500 people to two islands, Teeraina and Tabuaeran, in the Line Islands group. The project was later abandoned, however, when the government decided to reserve those islands for future tourism development (Rokoua & Kirata 2002). More recently, an ADB-funded initiative has sought to develop Kiritimati Island in the Line Islands as an alternative economic and demographic centre, though that also appears to have been forsaken (Paul Jones, pers. comm. 2009).

This continues a broad policy and planning failure to recognise and act on problems emerging from inward migration to and urbanisation of South Tarawa, despite clear evidence of the problems emerging from the accelerating concentration of people and activities. In short, there has been evident and continued failure to develop sustained multi-sector partnerships around actual and emerging impacts of urbanisation and environmental degradation (Jones & Lea 2007). With this situation, former President Tito's analogy of the ants building a home on a leaf in a pond can be viewed differently. The actions of the ants themselves are just as critical to the future sustainability of SIDS into the twenty-first century.

Can policy adapt, and in time?

The challenges and responses outlined above take place in a context of weak environmental management, in part driven by a lack of data but also ephemeral commitment to environmental issues. Falkland (2002) outlines several general factors which often constrain sustainable water management in the Pacific region and which are highly relevant to Kiribati. These include: fragmentation in the water sector; inadequate water resources legislation; failures in policy and planning; insufficient human resources; insufficient hydrological data available for analysis and planning; conflicts relating to the use of water resources or water supply systems on customary land; inadequate design and implementation of management projects; and insufficient community education, awareness and participation. In a number of areas these parallel failures in developing effective and coordinated responses to problems emerging from urbanisation. Jones and Lea (2007) have documented the difficulties in progressing urban management reform in the late 1990s, especially when change required confronting existing behaviours, land-use patterns and land-tenure status. A reluctance of families and communities to pay has also provided great constraints to the necessary extension of services and the development of much-needed infrastructure. A number of initial gains made in the 1990s under the South Tarawa Urban Management Plan (STUMP) have subsequently been rapidly lost.

A common management strategy aimed at protecting groundwater from contamination has been the declaration of water reserves; areas that are declared groundwater protection zones in which limited development and habitation is allowed. However, these zones often create friction with local communities, and especially with traditional landowners who retain strong cultural ties with and responsibilities for the natural environment. One specific example of such a case is the Bonriki Island reserve on Tarawa. Declared a water reserve in the 1970s, land use in this area has been restricted which consequently has upset traditional landowners and resulted in less local acceptance of the policy. This illustrates a common problem in Kiribati, where the establishment of water reserves comes into conflict with local needs and attitudes (White *et al.* 1999). It is also not uncommon for local communities to ignore private land boundaries declared by public institutions because of the relation of such decision making to colonial imposition (Crennan 1998). This attitude leads to many strategies, such as zoning plans, going largely ignored because they are not supported or understood by the wider community (Jones 2003).

The creation of an environment unit and then the Ministry of Environment (MOE) in the 1990s, and the subsequent passing of the *Environment Act* in 1999, has paved the way for more environmental policy to emerge. Still, progress has been uneven. The 'latest' *State of the environment report* remains the 1994 document (Wilson 1994). Through the South Pacific Regional Environmental Programme (SPREP), a National Environmental Management Strategy (NEMS) was later developed, although its priorities 'were not much reflected in the policies of government' (Government of Kiribati 2008). Neither was there much public participation and debate in environmental policy formulation. Ongoing weaknesses, which continue to hobble policy development, are weak policy coordination and a broad reluctance to trade limited opportunities for economic growth with efforts at conservation. Nevertheless, Kiribati's report to the United Nations Framework on Climate Change identified public awareness (through increased education and publicity) as a major strategy for combating the effects of climate change (Government of Kiribati 2008). But clearly policy development and implementation remain a problem in environmental management and this will have implications for any policy initiatives for mitigation and future adaptation to climate change.

Of all the strategies focusing on mitigating or adapting to the environmental impacts of change there are very few which focus solely on the problems derived from urbanisation or waste management and pollution. The most notable of these was the ADB funded Sanitation, Public Health and Environment (SAPHE) project (ADB 2000). Beginning in 1999, the US$10.2 million project had an overall objective to improve the health and well-being of the people of South Tarawa through improvements to the water supply, sanitation services, solid waste disposal and environmental conservation (Rokoua & Kirata 2002). The project aimed to provide significant environmental and social benefits for the people of South Tarawa through such measures as repairing sewage outfalls, installing an incinerator for hospital wastes and promoting recycling, reuse, composting of solid wastes and improved water conservation (ADB 2007). However, shortly after the project's completion follow-up studies showed that the advancements made were already in disrepair due to poor design (for example, the solid waste containment structures at Nanikaai and Bikenibeu); lack of maintenance; and too few skilled

workers to operate and implement equipment and manage new processes. Other notable strategies include the *Special Fund (Waste Materials Recovery) Act 2004*, also known as the 'Bottle Bill', which allows consumers to claim refunds for recycling waste (Container Recycling Institute 2009); promoting the use of recyclable 'green' bags; and waste reduction/minimisation programmes promoted by international donors. As discussed earlier in this paper, there have also been resettlement plans to combat urbanisation in South Tarawa; however, these have not successfully countered population concentration and have suffered from weak ongoing commitment.

In recent years, there has been an attempt through aid support to mainstream climate change into national sustainable development planning and budgetary processes (White *et al.* 2007a). One of the more important attempts to do this has been through the Kiribati Adaptation Program (KAP). Beginning in 2003 the current tranche (KAP II; 2006–10) is currently in its final stages. KAP II has a fund of US$6.58m derived from the World Bank, the Global Environmental Fund (GEF), and bi-lateral assistance through AusAID and NZAID. It is focused on changing the way planning and implementation takes place so that climate change risks are mainstreamed into policy and planning across government (World Bank 2010).

Though World Bank reports indicate eventual uptake of core principles, the broader experiences of the KAP are instructive. Until recently, evaluations reported that the programme was 'unsatisfactory' and initial expectations of developing showcase community-based projects have by and large been scrapped. In many respects problems with the programme mirror those outlined by Jones and Lea (2007) with regard to the demise of action on urban planning, namely a lack of human and financial resources; dependence on international consultants which was largely resented by I-Kiribati; a lack of political support in creating a Strategic National Policy and Risk Assessment Office for overall coordination and leadership as it would potentially compete with establishment offices; and, after an initial period of community-based support and activity, an ebbing away of this in the absence of on-the-ground benefits for I-Kiribati (World Bank 2010). Indeed, many activities of the KAP II appear to have retreated ('re-focussed' in World Bank reports) into institutional strengthening, with some activity in coastal zone management and water security (World Bank 2010). Overall, given the severe and well-publicised environmental threats facing Kiribati, including its own stance at international forums (see also Connell 2003 on Tuvalu), it is perhaps surprising that policies and programmes focused on climate change appear to have hit somewhat of an institutional and implementation brick wall.

The above experiences raise questions regarding the efficacy of externally driven environmental policy. Kiribati's lack of resources has meant that the country has long relied on international aid and donor agencies to assist with the development of environmental policy (Carden 2003). As such activities tend to exist only for the lifetime of external resourcing (Barnett 2005, p. 214), this results in short-term donor-focused agendas with less efficiency overall (White *et al.* 2008). Indeed, Gupta (2009) has questioned what can be achieved from aid-driven climate change adaptation in separation from development policy more generally. Instead, recent calls have been for better identification and support given to those most directly affected by change and who can benefit most from enhanced social and ecosystem

resilience (Worldwatch Institute 2009). In order to achieve sustainability within these programmes, strong community–state networks have been identified as critical for public education as well as pathing the way for acceptance of necessary infrastructure development and land-use planning. To effectively achieve sufficient community awareness, longer term programmes are needed in order to allow enough time to build trust and realise behavioural change. Yet, to date, sustained community involvement in development programmes focusing on water and sanitation, specifically in the planning, design and management of such programmes, has been minimal (Carden 2003; White *et al.* 2008).

Conclusions

There is little doubt that Kiribati faces very real and alarming threats as a result of climate change and associated sea-level rise. With Kiribati's reliance on foreign aid the issue of climate change will likely be an important basis for financial assistance in future years. While this extra economic gain may be beneficial, there remain serious threats to sustainability from human impacts at the local level. Forging an alliance of efforts that simultaneously address the impacts of climate change, solid waste, pollution, and degradation will be critical in addressing the future vulnerability and survival of the nation and its citizens. Any future strategy for the sustainability of Kiribati must involve the mainstreaming of climate change agendas into meeting existing economic and social development needs. In short, climate change adaptation should intensify efforts towards sustainable and inclusive development (Barnett 2005). Effective adaptation may not be that unrecognisable from 'good' development.

Tension between a lack of available resources and demands for development means that SIDS such as Kiribati face careful balancing acts between 'development' initiatives and environmental impacts (see also Storey & Murray 2001). 'Development' has clearly left much of Tarawa, and specifically its freshwater resources, extremely vulnerable to a number of both natural and human-impact hazards. Implementing strategies which strengthen both social and biophysical resilience is fundamental. These are political challenges if nothing else. To date, efforts to promote sustainable development which run counter to freedom of movement and consumerism have proved very difficult and not politically very popular in Kiribati. Most sustainability strategies developed for Tarawa have been poorly implemented and lack resource and other commitments. While climate change initiatives and debates have moved increasingly to centre stage, future sustainability (and indeed adaptation) requires continued commitment to these broader development challenges.

That there are real threats to SIDS posed by predicted climate change and sea-level rise is not disputed, but even in small island states the 'brown agenda' issues of pollution, sewerage and solid waste management cannot afford to be left outside of the concerns of governments, development agencies and donors. Indeed, developing environmental policy inclusive of both 'internal' and 'external' threats is essential if Kiribati is to mitigate and adapt to the impacts of climate change. A sick body is ill-suited to fight new disease. A more consistent and holistic focus, which includes community stakeholders, will more likely achieve sustainable outcomes than one that looks towards the horizons, and ignores the very real dangers which lie within.

Acknowledgements

The authors wish to thank Ian White for his very valuable observations on an earlier draft and the insightful comments of two anonymous referees. The usual disclaimer, though, applies. The statements and opinions in this article are solely the authors and do not necessarily reflect the views of the Foundation for Development Cooperation (FDC).

Correspondence: Donovan Storey, School of Geography, Planning & Environmental Management, University of Queensland, QLD 4072, Australia. E-mail: d.storey@uq.edu.au

REFERENCES

ADB (2000) *SAPHE living conditions report*, Asian Development Bank, South Tarawa, Kiribati.

ADB (2007) *Kiribati fact sheet*, Asian Development Bank, Madaluyong City

ADB (2008) *A tale of two CDs: capacity development and community development in the waste, water, and sanitation sector in Kiribati*, Asian Development Bank, Madaluyong City.

ADB (2009) *Strengthening Pacific fragile states: the Marshall Islands experience*, Asian Development Bank, Madaluyong City.

Alam, K. & Falkland, A. (1997) *Vulnerability to climate change of the Bonriki freshwater lens, Tarawa*. Report No HWR97/11, ECOWISE Environmental, ACTEW Corporation prepared for Ministry of Environment and Social Development, Republic of Kiribati, April 1997.

Barker, H.M. (2008) *Vulnerable island nations at mercy of world's polluters*, Pacific Islands Report, available from: http://archives.pireport.org/archive/2008/November/11-05-com.htm (accessed 12 December 2009).

Barnett, J. (2001) 'Adapting to climate change in Pacific Island countries: the problem of uncertainty', *World Development* 29, pp. 977–93.

Barnett, J. (2005) 'Titanic states? Impacts and responses to climate change in the Pacific Islands', *Journal of International Affairs* 59, pp. 203–19.

Barnett, J. & Adger, W.N. (2003) Climate dangers and atoll countries', *Climate Change* 61, pp. 321–37.

Bureau of Meteorology (2010) 'El Niño and La Niña: important ocean phenomena', fact sheet of the South Pacific Sea Level and Climate Monitoring Project, available from: http://www.bom.gov.au/pacificsealevel/pdf/Elnino_and_La_Nina.pdf (accessed 30 January 2010).

Burgess, S.M. (1987) *The climate and weather of Western Kiribati*, Report No. 188, New Zealand Meteorological Service, Wellington, New Zealand.

Campbell, J. (2000) *Climate change vulnerability and adaptation assessment for Kiribati: Technical summary and synthesis*. Report prepared for the World Bank by the Centre for International Global Change Institute, Waikato University, Hamilton, New Zealand.

Carden, Y.H. (2003) Solid waste-level rise on atoll nation states: a less publicised environmental issue in the Republic of Kiribati', *Australasian Journal of Environmental Management* 10, pp. 35–45.

Cocklin, C. & Keen, M. (2000) Urbanization in the Pacific: environmental change, vulnerability and human security', *Environmental Conservation* 27, pp. 392–403.

Connell, J. (2003) Losing ground? Tuvalu, the greenhouse effect and the garbage can', *Asia Pacific Viewpoint* 44, pp. 89–107.

Connell, J. & Lea, J.P. (1998) *Island towns: managing urbanization in Micronesia*, Center for Pacific Islands Studies, University of Hawaii, Honolulu.

Container Recycling Institute (2009) *Worldwide bottle bills: Kiribati*, available from: http://www.bottlebill.org/legislation/world/kiribati.htm (accessed 13 December 2009).

CRENNAN, L. (1998) *Water resource conflicts in Tarawa*. Environment and development in coastal regions and in small islands. UNESCO, Paris.

EAST, A. (2008) 'A future in the past: urban agroforestry systems in future planned urban settlements in Kiribati, a Pacific case study', PhD thesis, Queensland University of Technology, Brisbane, Australia.

ERITAI, R. (2003) 'Impact of urbanisation on the growth patterns of housing in South Tarawa, Kiribati', MPhil thesis, University of the South Pacific, Suva, Fiji.

FALKLAND, A. (1992) *Review of Tarawa freshwater lenses*, Republic of Kiribati. Hydrology and Water Resources Branch, ACT Electricity and Water, Rep 92/682, Canberra, Australia (unpublished report).

FALKLAND, A. (2002) *From vision to action towards sustainable water management in the Pacific*, Theme 1 Overview Report, Water Resource Management, Pacific Regional Consultation on Water in Small Island Countries, Sigatoka, Fiji.

FALKLAND, A. (2003) *Promotion of effective water management policies and practices*, Kiribati Water Resources Assessment Report, Asian Development Bank, Manila.

FALKLAND, A. & WOODROFFE, C. (1997) 'Geology and hydrogeology of Tarawa and Christmas Island, Kiribati', in Vacher, H.L. & Quinn, T.M. (eds) *Geology and hydrogeology of carbonate islands*, Developments in Sedimentology series, Elsevier, Amsterdam, pp. 577–610.

GHINA, F. (2003) 'Sustainable development in small island developing states: the case of the Maldives', *Environment, Development, Sustainability* 5, pp. 139–65.

GOVERNMENT OF KIRIBATI (1999) *Initial communication under the United Nations Framework Convention on Climate Change*, Tarawa, Kiribati.

GOVERNMENT OF KIRIBATI (2003) *National Development Strategies 2004–2007: enhancing growth and ensuring equitable distribution*, Tarawa, Kiribati.

GOVERNMENT OF KIRIBATI (2008) 'Kiribati SoER process and policy impacts', presentation at the UNEP Regional Workshop to Review GEO-IEA Training Manual, Chiang Mai, 8–11 September.

GUPTA, J. (2009) 'Climate change and development (cooperation), in Salih, M.A.M (ed.) *Climate change and sustainable development*, Edward Elgar, Cheltenham, pp. 94–108.

HOOD, M. (2008) 'Tropical island states' desperate plea: we are drowning', *Canberra Times* 11 December.

IPCC (2007) *IPCC fourth assessment report: climate change 2007*, available from: http://www.ipcc.ch/publications_and_data/publications_and_data_reports.htm (accessed 12 November 2009).

JONES, P. (2003) 'Managing urban development in the Pacific: key themes and issues', UN ESCAP Regional Workshop on Pacific Urban Development, Nadi, Fiji.

JONES, P. & LEA, J.P. (2007) 'What has happened to urban reform in the Island Pacific? Some lessons from Kiribati and Samoa', *Pacific Affairs* 80, pp. 473–91.

KRISTOF, N. (1997) 'In Pacific, growing fear of paradise engulfed', *The New York Times* 2 March.

KUNDZEWICZ, Z.W., MATA, L.J., ARNELL, N.W., DÖLL, P., JIMENEZ, B., MILLER, K., OKI, T., SEN, Z. & SHIKLOMANOV, I. (2008) 'The implications of projected climate change for freshwater resources and their management', *Hydrological Sciences—Journal—des Sciences Hydrologiques* 53, pp. 3–10.

KURUPPU, N. (2007) *Mental preparation for climate adaptation: the role of cognition and culture in enhancing adaptive capacity of water management in Kiribati*, available from: http://www.ymparisto.fi/download.asp?contentid=74580&lan=en (accessed 2 December 2009).

METAI, E. (2002) 'Vulnerability of freshwater lens on Tarawa—the role of hydrological monitoring in determining sustainable yield', paper prepared for the Pacific Regional Consultation on Water in Small Island Countries, Ministry of Works and Energy, Republic of Kiribati, Sigatoka, Fiji.

MIMURA, N., NURSE, L., MCLEAN, R.F., AGARD, J., BRIGUGLIO, L., LEFALE, P., PAYET, R. & SEM, G. (2007) 'Small islands', in Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. & Hanson, C.E. (eds) *Climate change 2007: impacts, adaptation and vulnerability*, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, pp. 687–716.

Moglia, M., Perez, P. & Burn, S. (2008) 'Water troubles in a Pacific atoll town', *Water Policy* 10, pp. 613–37.
Nadkarni, D. (2008) 'Social disaster before rising seas? Kiribati braces for the many challenges', *Islands Business* November.
Pacific Islands Forum Secretariat (PIFS) (2009) Final communiqué of Fortieth Pacific Islands Forum, Cairns, 5–6 August.
Porteus, A.S. & Thompson, C.S. (1996) *The climate and weather of Rawaki and Northern Line Islands of Eastern Kiribati*, NIWA Science and Technology, series 42. The National Institute of Water and Atmospheric Research, New Zealand.
Rokoua, T. & Kirata, T. (2002) *Kiribati national report to the World Summit on Sustainable Development*, UN Department of Economic and Social Affairs (UNDESA), Division for Sustainable Development, Tarawa.
Sachs, J.P., Sachse, D., Smittenberg, R.H., Zhaohui, Zhang, Battisti, D.S. & Stjepko, G. (2009) 'Southward movement of the Pacific intertropical convergence zone AD 1400–1850', *Nature Geoscience* 2, pp. 519–25.
Scott, D., Overmars, M., Falkland, A. & Carpenter, C. (2003) *Pacific dialog on water and climate*, Synthesis Report, SOPAC, Suva, Fiji.
Sikabongo, F. & Storey, D. (2003) 'Development implications of hazardous waste in urban environments: a problem that cannot be buried', *International Journal of Environment and Pollution* 19, pp. 101–22.
SPREP (2008) 'Climate change, variability and sea level change', available at: http://www.sprep.org/topic/climate.htm (accessed 3 July 2009).
Storey, D. (2006) 'Urbanisation in the Pacific', State, Society and Governance in Melanesia, Targeted research papers for AusAID, Australian National University, Canberra.
Storey, D. & Murray, W.E. (2001) 'Dilemmas of development in Oceania: the political-economy of the Tongan agro-export sector', *Geographical Journal* 167, pp. 291–304.
Thomas, F. (2003) 'Kiribati: some aspects of human ecology, forty years later', *Atoll Research Bulletin* No. 501.
UNFCC (2008) 'Vulnerability and adaptation to climate change in small island developing states', background paper for the expert meeting on Adaptation for Small Island Developing States, Jamaica, 5–7 February.
United Nations (2005) *Report of the International Meeting to Review the Implementation of the Programme of Action for the Sustainable Development of Small Island Development States*, Port Louis, Mauritius, 10–14 January.
Wheatcraft, S.W. & Buddemeier, R.W. (1981) 'Atoll island hydrology', *Ground Water* 19, pp. 311–20.
White, I. (2007) *Coordination of the water and sanitation sector: background to the Kiribati National Water and Sanitation Coordination Committee*, Australian National University, Canberra.
White, I. Falkland, A , Etuati, B , Metai, E & Metutera, T (2002) 'Recharge of fresh groundwater lenses: field study, Tarawa Atoll, Kiribati', in Gladwell, J.S. (ed.) *Hydrology and water resources management in the humid tropics: proceedings of the Second International Colloquium, 22–26 March 1999, Panama*, IHP-V, Technical Documents in Hydrology, No. 52, UNESCO, Paris, pp. 299–322.
White, I., Falkland, A., Metutera, T., Katatia, M., Abete-Reema, T., Overmars, M., Perez, P. & Dray, A. (2008) 'Safe water for people in low, small island Pacific nations: the rural–urban dilemma', *Society for International Development* 51, pp. 282–7.
White, I., Falkland, A., Metutera, T., Metai, E., Overmars, M., Perez, P. & Dray, A. (2007a) 'Climatic and human influences on groundwater in low atolls', *Vadose Zone Journal* 6, pp. 581–90.
White, I., Falkland, A., Perez, P., Dray, A., Metutera, T., Metai, E. & Overmars, M. (2007b) 'Challenges in freshwater management in low coral atolls', *Journal of Cleaner Production* 15, pp. 1522–8.
White, I., Falkland, A., Perez, P., Dray, A. & Overmars, M. (2004) 'Sustainable development of water resources in small island nations of the Pacific', in *Proceedings of the 2nd Asia Pacific Association of Hydrology and Water Resources conference, 5–8 July 2004*, Singapore, pp. 345–56.

WHITE, I., FALKLAND, A. & SCOTT, D. (1999) *Droughts in small coral islands: case study, South Tarawa, Kiribati*, International Hydrological Programme, Paris.

WILSON, C. (1994) *Kiribati state of the environment report 1994*, South Pacific Regional Environment Program, Apia, Samoa.

WORLD BANK (2000) *Cities, seas and storms: managing change in Pacific Island economies*, Volume IV: *Adapting to climate change*, World Bank, Washington, DC.

WORLD BANK (2010) *Reducing the risk of disasters and climate variability in the Pacific Islands: Republic of Kiribati country assessment*, World Bank, Washington, DC, available from: http://siteresources.worldbank.org/INTPACIFICISLANDS/Resources/KIRIBATI_ASSESSMENT.pdf (accessed 8 January 2010).

WORLDWATCH INSTITUTE (2009) *State of the world 2009: into a warming world*, Worldwatch Institute, Washington, DC.