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The Global International Waters Assessment for the Pacific Islands: Aspects of Transboundary, Water Shortage, and Coastal Fisheries Issues

Aspects of transboundary, water shortage, and fisheries issues are discussed in the context of the recently completed Global International Waters Assessment (GIWA) for the Pacific Islands. The region encompasses some 30 million km^2 and approximately 12% of the world's ocean space, and features great geographic, demographic and developmental diversity. Global change, especially sea level rise and sea surface temperature increases, is the dominant transboundary concern as it impacts all aspects of life. Water shortage and unsustainable fishing issues are selected for discussion, as they will dominate the region into the foreseeable future, and they are illustrated with examples from Fiji, Kiribati, and Tonga. The environmental impacts are exacerbated by socioeconomic issues such as high population growth rates, urban drift, the breakdown of traditional life styles and the rapid adoption of the cash economy. Policy options that may assist in addressing these issues are proposed.

INTRODUCTION

This report summarizes some of the main concerns and issues identified in a detailed assessment of the Pacific Islands GIWA subregion (Fig. 1) (1). The GIWA methodology used in this assessment is reported elsewhere in this issue of Ambio. The region contains a baffling diversity of island types and corresponding terrestrial, freshwater and marine ecosystems covering some 30 million km^2 of ocean space. There is also great geographic, demographic and developmental diversity. Differences in climate, geological resources, topographical features, soil types, mineral and water availability, extent of coral reefs and diversity of terrestrial, freshwater and marine flora and fauna, are also features of the region.

Although some of the larger island groups have significant mineral, forestry, fisheries, and agricultural land resources, most Pacific Island states and territories and smaller outer

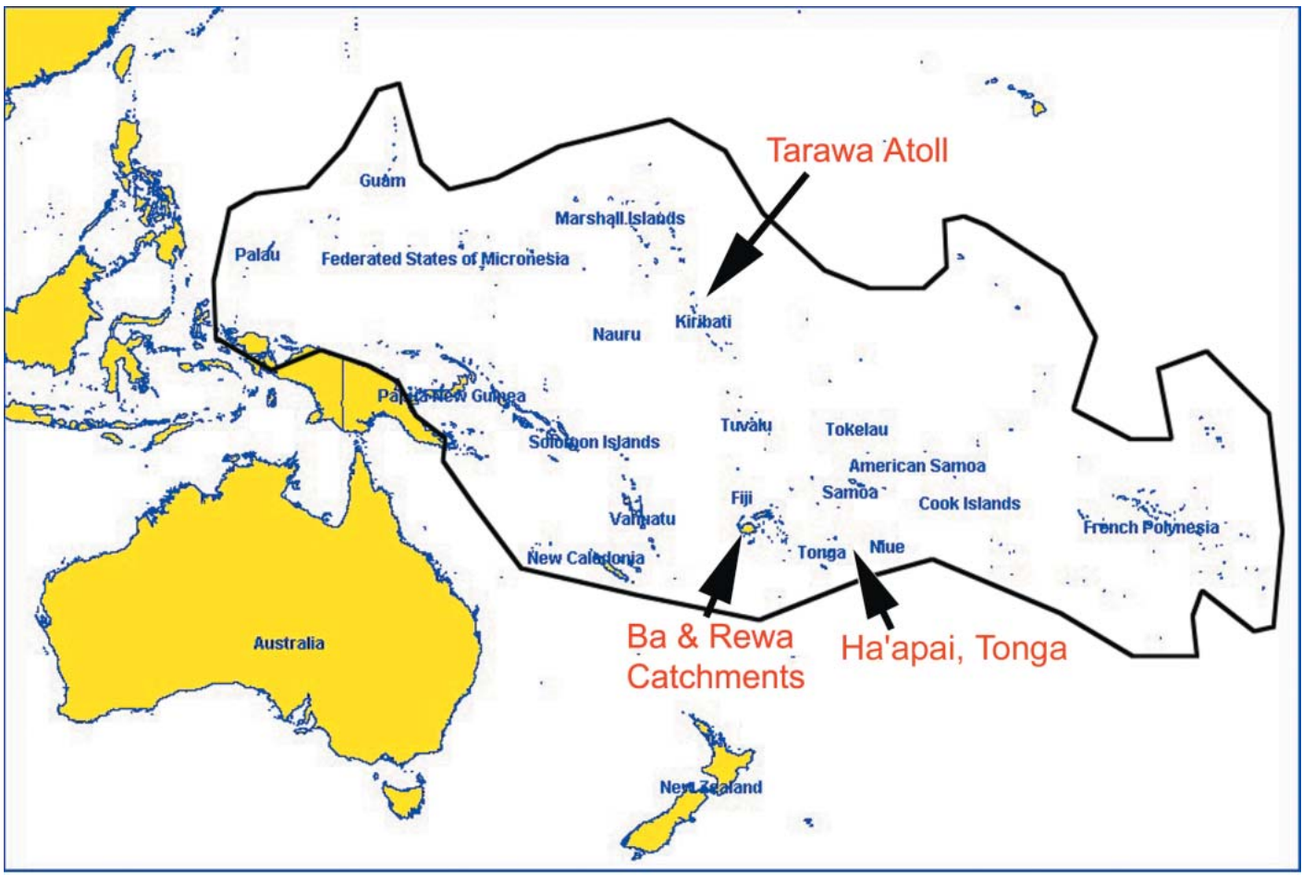

Figure 1. Map showing approximate boundaries of GIWA Subregion 62, Pacific Islands and locations of sites discussed in the text. (© American Digital Cartography, Inc. Corrected by SOPAC on a scale of 1:1 000 000. Digital maps for MapInfo).

islands and isolated rural communities do not. The options for modern economic development are thus extremely limited. Consequently, most island countries, territories and local communities will, for the foreseeable future, have to depend on the sustainable use of their local resources as a basis for their survival and development.

Important socioeconomic issues in the subregion include high population growth rates, urban drift, breakdown of traditional lifestyles, a strong dependence on aid, and the rapid adoption of the cash economy. Political instability has caused a breakdown in social and environmental ethics in some countries since independence, exemplified by the current situation in the Solomon Islands.

South et al. (1) ranked the major concerns for the Pacific Islands region as follows: global change; freshwater shortage; unsustainable exploitation of fisheries; habitat and community modification; and pollution.

We recognize that global change is strongly linked to the other major concerns, and is influential on all of them. In this review we focus on transboundary effects, and the 2 most important of the concerns: *i)* freshwater shortage; and *ii)* unsustainable exploitation of fisheries, using illustrative examples. Following are suggestions of policies that will be needed to ameliorate or reverse the negative trends identified.

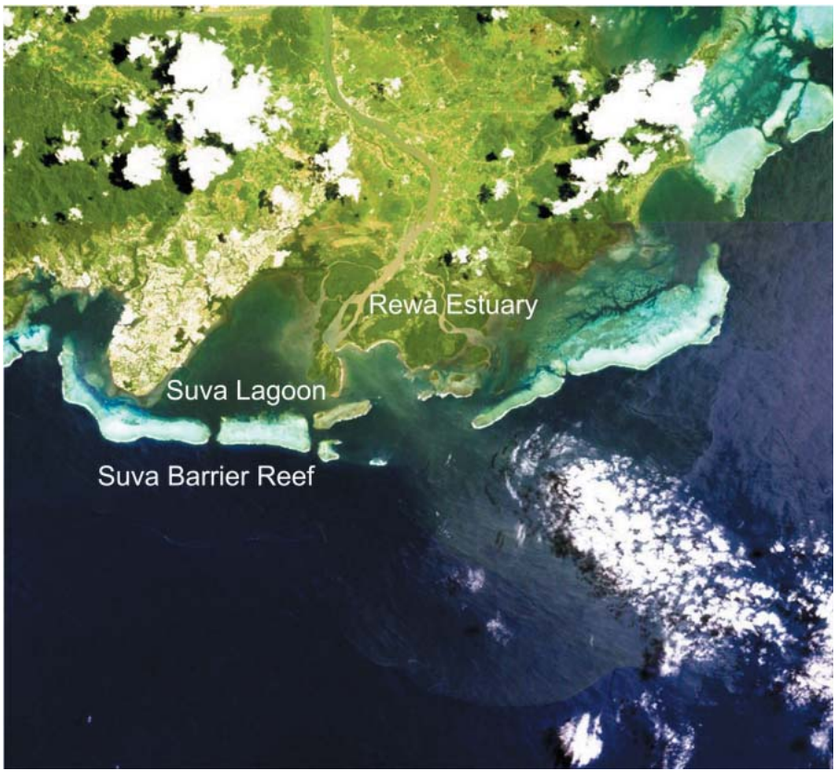

Figure 2. LANDSAT Image of the Rewa River Estuary and Suva Lagoon. 1:50 000 (© SOPAC).

TRANSBOUNDARY ISSUES

The most significant and overriding transboundary effect on the Pacific Islands is climate change, including the related issues of sea level rise and increasing sea surface temperatures which are impacting every aspect of life on the Pacific Islands, and which except for the large islands, are entirely coastal in nature. The island countries are extremely vulnerable to these impacts, and face possible extinction (such as in the low-lying atoll countries), loss of land (all countries) and loss of food security. The effects of climate change and sea level rise are demonstrated by increases in occurrence and severity of El Niño, increases in coral bleaching and consequent disruptions of coral reef communities (2) and, ultimately, the fishery, increases in coastal erosion, and increases in the frequency of catastrophic phenomena such as tropical cyclones.

The boundaries of the subregion are largely adjoining other large oceanic spaces (Fig. 1). Any effects of the Australian continent to the west are buffered by the unpopulated Coral Sea, but to the northwest the subregion is influenced by land-based factors originating from Papua New Guinea, Irian Jaya, and the Philippine Sea. Transboundary effects are minor between the different island states, since they are separated from one another by deep ocean. Within the countries, however, especially the larger archipelagic states, local transboundary effects are very important, as urban impacts, large watershed effects and other anthropogenic disturbances such as mining, forestry, agriculture, and coastal development may impinge on adjacent areas. Some of these localized transboundary issues are discussed in the following sections.

WATER SHORTAGE

Driving forces leading to water shortage include lack of adequate policies on land and water use and their enforcement, natural phenomena and lack of access to technology. Pollution of water supplies is potentially regionwide, due to inadequate treatment of domestic wastewater and inadequate solid waste disposal. Urbanization, population growth and changes in lifestyles are also important driving forces. Changes in the water-table are also widespread, but the most threatened are the atoll countries. Climate change and population growth, are additional driving forces.

Two examples were chosen to illustrate water shortage issues: the Rewa and Ba Catchments, Viti Levu, Fiji. The Rewa River Catchment (Fig. 2) is located in eastern Viti Levu, and is the largest fluvial system both in Fiji and the tropical South Pacific islands in general (3). The Rewa basin spans 2900 km^2, or approximately 1/3 of the island of Viti Levu. It has a recorded history of major floods, and its major tributary the Wainimala River gives rise to high sediment yields. Much of the suspended load is from bank erosion. The 3.2 cm yr^{-1} accretion rate in Fiji exceeds rates reported from other fluvial systems in the region. The catchment is subject to very high use from agriculture and forestry. It is likely that very little if any of the catchment has been unaffected by humans, and most of the forest areas are of secondary growth. The Ba River catchment (Fig. 3) is located on the northwestern side of Viti Levu, and is the third largest fluvial system in Fiji, draining an area of 937 km^2 (4). A

difference between the Ba and Rewa catchments is that the former is a center of sugar-cane growing. During the 1994 sugar-cane crushing season, dissolved oxygen fell to near zero along at least 7.5 km of river length. Faecal coliform bacterial levels are elevated both during crushing and post-crushing seasons, and the sugar mill causes most of the oxygen sag.

Until mid-1991, no measurements had been made on the amounts and composition of the suspended solids in the Rewa River (5). The average sediment load for the Rewa was estimated at approximately 10^7 tonnes yr^{-1} (6). Morrison (7), Nunn (8), and Hasan (6) also estimated that soil loss in the Rewa catchment was 34-36 tonnes (t) ha^{-1} yr^{-1} and Nunn (8) stated that the losses in the 4 main tributaries of the Rewa stood at: Wainimala (30 t ha^{-1} yr^{-1}), Waidina (69 t ha^{-1} yr^{-1}), Wainibuka (24 t ha^{-1} yr^{-1}) and Waimanu (79 t ha^{-1} yr^{-1}). This has led to the fact that since 1983 the Fiji Government has spent about USD 6 mill. annually on dredging, in order to alleviate the problem of flooding in the Rewa and other rivers (5).

In the Ba river, average flows are affected during the dry months due to changes in the rainfall patterns and average river flows are 10 m^3 s^{-1} in dry seasons and 60 m^3 s^{-1} when wet (4). Rainfall seasonality is more pronounced in the northwest region, which receives only 20% of the annual rainfall total in the dry months (9). This results in rivers in the northwest experiencing very low stream baseflows causing a severe depletion of available water resources (9).

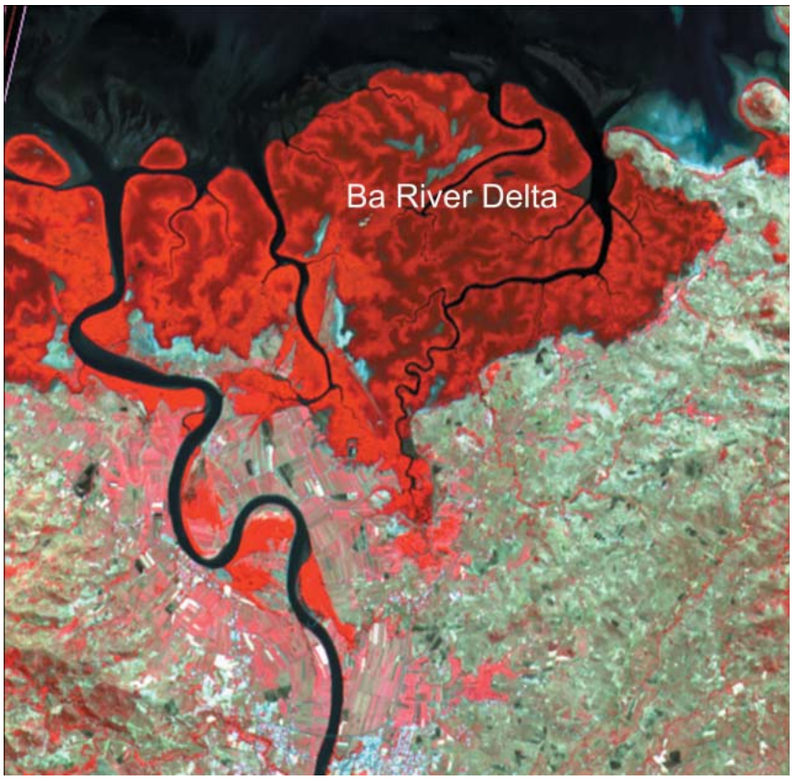

Figure 3. SPOT Image of Ba River Estuary. SPOT Image 4, 6th August 1998. 1:50 000 (© SOPAC).

The immediate causes for erosion were identified as:
- increased logging practices (deforestation and commercial forestry);
- increased agricultural production;
- decreased precipitation inputs;
- industry;
- urbanization (concentration of industries);
- lack of regulations and enforcement;
- cutting of access roads for foresty and agriculture;
- construction of dams.

Lifuka Island, Ha'apai Group, Tonga (Figs 4, 5) was chosen as an example to demonstrate pollution of freshwater supplies. Lifuka is a flat, coral island dependent on ground and rainwater for water supply to the population of approximately 3500 people dispersed among 2 villages. The main source of income for the villagers is from agriculture, and from remittances from overseas. Appropriate technology in the form of composting toilets has been recently introduced, following the realization that flush toilets exacerbate pollution problems given that the water lens is approximately 2 m below the surface.

The water supply to the village of Pangai-Hihifo on Lifuka island is vulnerable to pollution (10). A UNESCO and SOPAC funded applied research project on groundwater pollution was conducted in the late 1990s. This project demonstrated the close linkages between sanitation systems and groundwater pollution of wells, through a series of experiments at a school using tracers including a dye (10). The technical component of the project was designed to measure travel times and decay rates of faecal indicators between potential sources of pollution, such as sanitation facilities and water supply sources such as wells (11). Over the period of testing, the pollution levels appeared to be gradually increasing. It was assumed that the high concentration of pit latrines and septic tanks in the village area were contributing

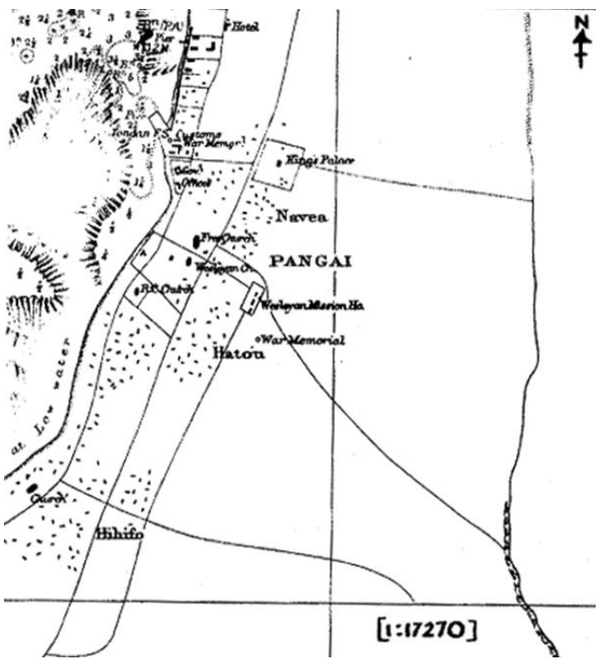

Figure 4. Map of Pangai-Hihifo, Lifuka Island, Tonga (Courtesy of Admiralty Chart 473: UK).

to the pollution. A density of at least 300 toilets km^{-2} indicated widespread contamination of the aquifer (10).

Changes in watertable were analyzed based on the example of the Bonriki Freshwater lens, South Tarawa, Kiribati (Figs 6, 7). There is a strong database on this site, which has been intensively studied by a number of agencies, although many of these studies are contained in limited distribution consulting reports. About 35 km in length, the atoll is not more than 1230 m wide. Bonriki is located at the southeastern corner of Tarawa atoll (Fig. 7), with a population of 35 000. Rainfall is highly variable on a year-by-year basis. Recent figures are available in Kaly et al. (12).

This rainfall variation means that periods of drought are not uncommon. It was noted that a single coconut tree consumes approximately 150 L day^{-1}. The effect of vegetation recharge is such that 80% tree cover would reduce recharge to 35% (13). Extended low rainfall periods occurred in 1998 and the early part of 1999, particularly in South Tarawa. This resulted in dramatic increases in salinity in domestic wells, the death of some trees, dieback in others, rainwater tanks running dry and an increasing demand on potable, reticulated water (14).

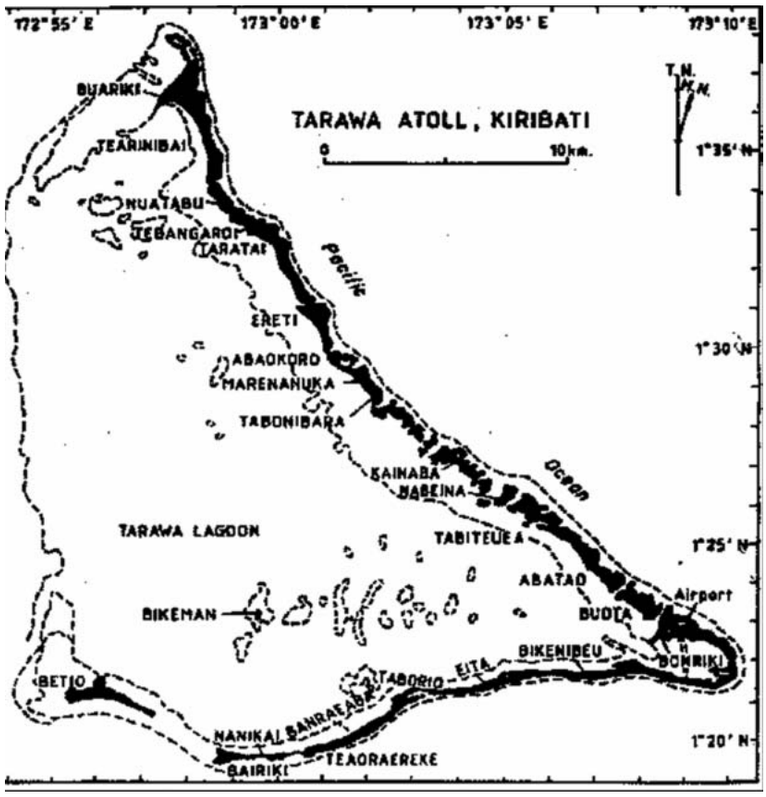

Figure 6. Map of Tarawa Atoll, Kiribati.

The main domestic water sources are groundwater, rainwater, and desalination; supply is managed by the government. Freshwater use cap^{-1} day^{-1} for the Bonriki population of 35 000 is 50 L. The freshwater lenses on the islands of Tarawa atoll are up to 30 m thick and the current total pumping capacity of the Bonriki freshwater lens is approximately 1000 m^3 day^{-1} (15); Bonriki supplies about 75% of the public water for the people of South Tarawa. A reduction of 25% in rainfall causes a 64% reduction in the freshwater lens thickness if pumping rates are maintained. The main concern is saline intrusion. If more water is pumped than is entering, the lens will suffer saline intrusion. Increased tree cover is leading to saline intrusion because more people want to increase coconut production and therefore increase water use.

Due to the overuse of the public water system, water supply to consumers has been restricted. The reason for restrictions was essentially that the supply from the combined galleries at Bonriki and Buota were unable to keep up with the

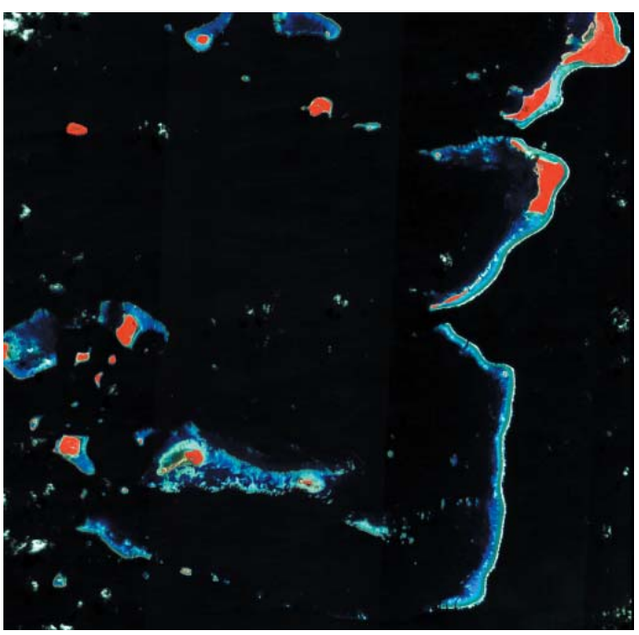

Figure 5. SPOT Image 4, 6th August 1998, 1:50 000 Lifuka Island, Ha'apai Group, Tonga. © (SOPAC).

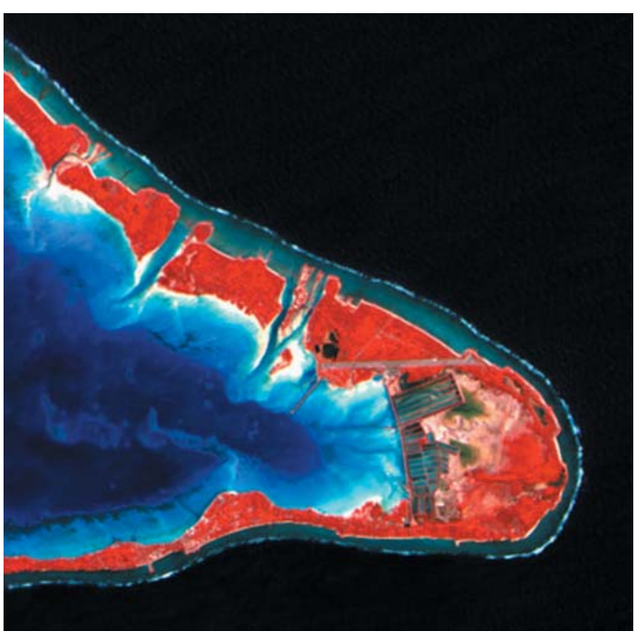

Figure 7. SPOT Image 4 of southeastern part of Tarawa Atoll (location of Bonriki), Kiribati. 1:50 000. (© SOPAC).

demand. The reticulated water supply was intermittent due to illegal connections, reticulation leakages, increasing demand, and water wastage (15).

The high population growth rate on urban South Tarawa, due to both births and inward migration of outer islanders, as well as the lack of common use of rainwater tanks, all place demands on the water supply system which exceed the system design specifications (16).

Coconut harvesting for copra export accounts for approximately 62% of exports (17). Coconuts, and other crops such as breadfruit, pandanus, pawpaw, bananas, and swamp taro are direct users of groundwater and (as mentioned above) a coconut tree can consume up to 150 L of water a day, which is as much as a household of 5 people (18).

The immediate causes for reductions in water table in Tarawa were identified as:
- Lack of enforcement of regulations.
- Infrastructure provision, i.e. expansion of distribution systems, increased household demand cap^{-1}.
- Urbanization (increased demand due to the increasing number of consumers).
- Decreased precipitation due to climatic changes.

Driving forces were:
- Governance (enforcement capacity).
- Legal-property rights (water and land ownership).
- Knowledge.
- Access to technology.
- Lifestyles.
- Urbanization trends.
- Natural phenomena (El Niño).
- Anthropogenic changes due to climatic systems (global warming).

Policy Issues: Freshwater Shortage

Within Fiji a variety of recent initiatives is indicative of how important water policy issues are being addressed. There is a National Code of Logging Practice, and there is a move towards sustainable forest management. In a broader context, Fiji is currently developing a national Land Use Policy, which is intersectoral in nature. In recognition of catchment management problems, the Fiji Government is now putting more resources into land-use issues and there is a section devoted to Land and Water Usage. Fiji convened its first intersectoral, high level National Water Committee during 2002.

In the case study on Fiji, policy options focus on governance, and while the government is moving towards the realization that there is a need for integrated water resources management, there is little evidence of the implementation of such an approach in practice. For policies to work, there is a need to identify the key stakeholders and to involve them in policy development, like for example, the landowning units "*mataqali*", own the land and the activities that they undertake such as logging, agricultural cultivation and other land-based activities are of their own choice.

In the case studies for Rewa and Ba river catchments, the traditional landowners have every right to the access to their land and so policies will have to be made with their input. Policies will need to be developed and promoted by government and built into National Development Plans. Those that favor the development of integrated water management strategies could have some socio-economic impacts, and these would have to be anticipated and dealt with. For example, sustainable forestry or agriculture policies could create some reductions in employment opportunities in those sectors and so alternative employment or opportunities would need to be developed to counteract these losses.

Unless appropriate policies are put in place and implemented, the continued degradation of catchments and disruption of water supplies to rapidly growing populations will have long-term negative effects. A common theme that was seen throughout the Pacific was the need for capacity building, and for awareness-raising at all levels of society, on matters relating to proper wastewater treatment and sewage-disposal practices.

Relevant policies would include;
- All stakeholders to be involved in the development and implementation of integrated water management.
- Implement existing policies on sustainable forestry and sustainable land management in water catchments.
- Training and awareness-raising on the importance of integrated water management should be a priority of government, the private sector and NGOs.
- The socioeconomic impacts of integrated management policies should be examined, and alternative scenarios developed to re-deploy those whose employment is lost through the implementation of these policies.

In July 2002, 18 Pacific Island countries formally endorsed the Pacific Regional Action Plan on Sustainable Water Management, 12 countries at ministerial level. This Action Plan (19) identified specific actions to address priority issues and constraints to achieving sustainable water management. These are (Adapted from Pacific Regional Action Plan (19):
- Apply best management practices to minimize impacts from activities such as logging, cultivation and mining (Key Message 3: Action # 3: Point 4).
- Implement strategies to improve the management of water resources, and surface and groundwater catchments (watersheds) for the benefit of all sectors including local communities, development interests and the environment (Key Message 3).
- Identify water pollution sources and undertake preventive and corrective steps, including financial penalties for environmental and water degradation (Key Message 3: Action # 3: Point 6).
- Conduct environmental impact assessments as an integral part of planning for development projects to ensure environmental values and objectives are properly considered (Key Message 3: Action # 3: Point 7).
- Develop catchment management plans for the rational allocation, use and protection of water resources. This may include the establishment of catchment management, protection, and buffer zones (Key Message 3: Action # 3: Point 3).

The Pacific island countries need to be aware that they are polluting their own water resources and are putting their own citizens at risk of contracting waterborne diseases such as cholera and diarrhoea. The Pacific Wastewater Policy Statement and the Pacific Wastewater Framework for Action (20), are the 2 regional policy and action documents agreed by 15 countries in the Pacific. These provide a structure to regional and national interventions on wastewater management and include the following:

– Governments will develop national wastewater and sanitation policies and regulations that are consistent with international and national laws, regulations, technical standards, and obligations (Guiding Principle 1: Policy 1.2).
– Governments will develop and implement appropriate wastewater and associated regulatory frameworks, compliance and enforcement requirements that benefit the specific cultures, customs, economies and environment of the people of the Pacific (Guiding Principle 1: Policy 1.3).
– Governments and regional organizations, the private sector and NGOs will actively cooperate to ensure that wastewater management policies and plans are integrated into the national development policies and plans and other cross-sectoral initiatives (Guiding Principle 1: Policy 1.7).
– Governments will ensure that wastewater technologies and related infrastructure are appropriate to meet national and local priorities and needs, within the constraints of available finance and other resources, while recognizing the need for protection of human health and the environment (Guiding Principle 2: Policy 2.2).
– Governments, service providers and NGOs will ensure that rural and urban communities will be given opportunities for active participation in the choice, development and implementation of wastewater and sanitation projects and on-going operation and maintenance of its facilities (Guiding Principle 4: Policy 4.4).
– Planning of wastewater facilities will ensure acceptable access for all, with special regard to women, the disadvantaged, the disabled and those in rural and remote communities (Guiding Principle 4: Policy 4.5).
– Service providers will take into account traditional knowledge and practices complemented by new approaches to wastewater management (Guiding Principle 4: Policy 4.6).

With respect to water lens issues in Kiribati, governance and awareness were the main policy options and the fact that water problems faced by the islanders are due to the absence of water legislation and enforcement capacity to safeguard the use of the freshwater lens. Human factors such as population density, land use and sanitation methods have a large impact on the availability of water, the microbiological and chemical quality of water supplies and impacts on the freshwater resource.

At present, there are no policies in place to reduce water use, or to recycle water, and with increasing awareness of global changes occurring — these atolls being at the forefront of this plight — this has led to more funding being made available for training and preparedness initiatives. As is the case in most rural communities in the Pacific, raw water quality is the most important, because, in most cases, water treatment is not affordable.

The SOPAC (19) Action Plan identified specific actions to address priority issues and constraints to achieving sustainable water management. They provide a structure to future regional and national interventions on wastewater management.

UNSUSTAINABLE FISHERIES

A comprehensive review of coastal fisheries in the Pacific Islands was provided by Dalzell et al. (21). They concluded that about 80% of coastal fisheries production is from subsistence fishing. The problems they identified are typical for most Pacific Island countries. Here we used the example of Fiji, reported in South et al. (1).

Fish is the primary source of protein for Fijians (22), and consumption in Fiji is estimated at ca. 55 kg cap^{-1} yr^{-1} (23). The unsustainable exploitation of fisheries resources is increasingly becoming a negative feature of fisheries development in the Pacific Islands, where there is now a characteristic boom and bust pattern. This feature is the result of factors such as the need to maximize income and involvement in fisheries activities. There is increased effort by fishers to fish rapidly declining resources with undesirable consequences. In addition, destructive fishing methods are frequently used as people attempt to meet their own commitments. Ultimately, the fish population is changed due to the modification of their ecosystems (24).

Coastal communities that have relied on their coastal fisheries resources for centuries are finding their catches dwindling and increasingly the catch is for people other than themselves. Market forces are providing incentives to fish more using newer and more efficient fishing equipment. This is evidenced in major urban centers such as Suva, Lautoka, and Labasa and surrounding areas, where mullets and other reef fishes are depleted.

The Fiji Fisheries Division Annual Reports (23, 25) highlighted a decrease in catch per unit effort as well as a steady decline of fish sales at municipal markets (11% in 1996 compared to 40% in 1981), in particular the central division. There is a high demand for fish in urban areas due to large numbers of indigenous Fijians migrating in search of employment and better opportunity (26). Such demand often forces the fish price up (27), providing incentives to increase fishing effort (28). A study of the Great Astrolabe Reef indicated that there is indeed a great deal of fishing pressure on easily accessible fringing reefs, as indicated by the declining number of giant clams and trochus. The situation is similar throughout Fiji as shown in the Fisheries Division's annual reports, with most sedentary species being threatened.

Overexploitation of fisheries resources is also attributed to the use of destructive fishing methods, such as explosives, modern poisons (cyanide, bleach, pesticides), physically destructive practices (fish drives, manual breaking of corals) traditional poisons (plant and animal compounds that stun or kill fish), and other methods that lead to the overharvesting of one or more species (29). Gillnets are blamed for the overexploitation of fisheries resources in many parts of Fiji (30). The availability of dynamite to fishers in Votua, Ba, worsens the situation, coupled with the fallacy that dynamite fishing is less destructive than gillnets (31). Newer industries such as the ornamental and aquarium trades being undertaken along the Coral Coast, are enticing some fishers to earn 'quick cash' (32).

Enforcement is an essential element of fisheries management, which is inadequately executed in Fiji. Surveys and monitoring are vital to complement fisheries management measures (31). It is unfortunate that some surveys and monitoring methods require certain scientific knowledge and are not cheap; they are often beyond the capacity and capability of countries such as Fiji.

Marine Protected Areas (MPAs), which involve co-management between government and indigenous resource owners, are being used as a fisheries resource management strategy. In a situation where the science is unable to provide all of the information required for the management of

fisheries and the marine environment in general, MPAs have been established as a useful precautionary approach to reduce fishing effort in an area and therefore allow for the recovery of the fisheries.

MPAs require that people protect their resources over long periods, even permanently. This together with the size of the areas involved has made the concept difficult to implement in the Pacific Islands where the people rely on their resources for their sustenance.

Technological change has been clearly evident within the inshore fisheries. With the desire for more catch, people invest in more efficient fishing gear that allowed them to access areas where they seldom ventured in the past (22). Outboard motors and motorized vessels allowed fishers to travel far, over reduced times, while ice and storage facilities allowed the keeping of catch for longer periods. Furthermore, the use of underwater breathing apparatus has made fishing so efficient that it threatens the survival of the fisheries stock (IOI-South Pacific, unpubl. data). The use of technology has made fishers more efficient. Dynamite and underwater breathing apparatus have allowed fishers to harvest even the best stock.

With the emphasis of government policy on rural development and decentralization, infrastructure development has been rigorously pursued. New roads, jetties, airstrips and processing facilities have been provided in rural areas and outer islands. These new developments have not only stimulated the intensive utilization of fisheries resources, they have also introduced people in outer areas into the market economy and consumerism.

Licenses are put in place to control the entry into the fisheries. Unfortunately, licensing has not been as effective as it was hoped. The number and condition of licenses offered has not been scientifically based and is offered to all those who ask and pay for these. This is a particularly serious problem in the inshore fisheries where there is little knowledge of the stocks (33).

Policy Issues: Fisheries

Most of the problems relating to unsustainable exploitation of fisheries in Fiji relate to lack of capacity to enforce regulations, the licensing system, inadequate fisheries data (especially for the subsistence fishery) and a lack of awareness among stakeholders and consumers of the consequences of over-exploitation. For Fiji it was agreed that over-population was not a driving force, rather that the economy, government policies, lack of data and awareness were the most critical issues.

Recent community-level studies have greatly enhanced awareness of the value of self-regulation of the inshore fishery: many villages in Fiji are now requesting assistance on how to increase their capabilities in this area. Regulation is hampered, however, by the lack of data on most stocks fished in the subsistence sector, and hence lack of any regulation of the fishery. There are 410 gazetted fishing areas (*qoliqoli*) in Fiji, and all of these could self-regulate, given the necessary know-how and capacity. The Fiji Fisheries Division is unable to meet the demand for assistance because of a shortage of staff, so this is being carried by the University of the South Pacific and NGOs. Community-regulated fisheries would enable resources owners to use appropriate social pressures for compliance, but at the moment there is no legal recognition of traditional "law", and this needs to be changed. Furthermore, government priorities in the fishery are driven much more by economics than by conservation or sustainable ethics.

The fisheries licensing system needs to be reviewed and improved so that more sustainable and integrated management of stocks can be carried out. This would have to go hand in hand with the development of a much improved scientific basis for the fishery, focusing on stock estimates that would allow the implementation of realistic size and catch limits on subsistence fisheries. At the same time, there is a need for much greater feedback between government and the stakeholders.

Illegal fishing such as the use of explosives, poisons, and illegal nets is a significant problem in Fiji, and is poorly enforced because of the lack of human resources and funds in the Fisheries Division.

Aquaculture has serious implications in Fiji and elsewhere in the region. In Fiji, it is largely unregulated and there is no government legislation in place, although the government is bound by various agreements and conventions to which it is signatory, such as CITES. The industry is almost entirely involved with introduced species, such as *Tilapia*, 2 species of prawns, grass carp, pearl oysters, seaweeds (*Kappaphycus*) and, most recently, goatfish. Policies need to be put in place for the prevention of alien introductions. The seaweed *Kappaphycus* has now "escaped" from some of the many seaweed farms in Fiji, and is occurring as an invasive species on coral reefs in Vanua Levu, and Viti Levu. The same species has become a serious nuisance seaweed in Hawaii, and is heading in that direction in Fiji. It was agreed that there should be more attention paid to the potential of local species as aquaculture candidates.

Policies need to be considered in Fiji (as in other Pacific Islands) in the following areas:

- Promotion of community-based marine resources management of the fisheries with cooperation between the resource owners, custodians, the government, NGOs and the fishing industry; the focus would be on sustainable development of marine resources and integrated coastal management.
- Changes to the current licensing system to improve feedback between government and all the stakeholders and to encourage and promote sustainable fishing using both scientific and customary practices.
- Development of appropriate research policies to enhance the gathering of data on inshore stocks, these to be used in the development of size and catch limits for the subsistence fishery.
- Identification and utilization of better resource-use methods that are appropriate and cost effective.
- Development of legislation and regulations for the aquaculture and mariculture industries.
- Recognition and formulation of local by-laws that would allow greater monitoring and enforcement of fishery regulations at the community level.

CONCLUSION

Given the enormous size of the subregion, it is extremely difficult to make assessments that apply to the entire region. Further, some of the GIWA methodology did not lend itself to the specific issues relating to the Pacific Islands, and the issue of sea surface temperature rise for example was omitted from the methodology; this emerged as one of the most important transboundary issues for the region (1). The overriding transboundary issues relating to global change will affect the region well into the future, and national or regional mitigation strategies will have only local effects.

In many ways, the Pacific Islands region is unique compared with other tropical island regions of the world, although the concerns and issues we describe here are common to other small island developing states, but on a different scale. What is most apparent is the extreme vulnerability of Pacific Island fragile (and often pristine) ecosystems to global change, their overwhelming reliance on their limited natural resources, and their lack of capacity to put in place the policies needed to allow them to utilize these resources in a sustainable way now and in the future.

For the present and into the immediate and long-term future, water supply will be a growing problem in the region, and will be exacerbated by climate change and many of the socioeconomic trends identified here, including high population growth, urban drift and pollution. Governments need to consider changes in policy and actions as proposed by the SOPAC (19) Action Plan. These are issues that can be impacted by proper policy and implementation, regardless of external factors. Policies may be politically difficult, but will need to be enforced and regulated if the universal need for clean water is to be met now and in the future.

In the fishery, the problems identified for Fiji apply to a greater or lesser extent in most of the Pacific Island nations, and on a global scale among other small island developing states. Much of the evidence points to the fact that current trends are unsustainable, that there is a serious lack of scientific information on many subsistence fishery stocks, that there is a loss of traditional knowledge, that regulations cannot be enforced because of lack of capacity, and that there is a lack of knowledge or awareness on the part of the subsistence fishers. The fact that most Pacific Islanders rely on fish as their main source of protein means that pressures on the coastal fisheries will continue to influence the fishery into the indefinite future. There are, however, encouraging signs that policies on the establishment of MPAs and co-management strategies may lead to greater possibilities of sustainability, but there continues to be a development mind-set in government and the private sector that encourages increasingly unsustainable exploitation for short-term gain. Some of the same driving forces relating to water also apply to the fishery, such as population growth and urban drift. The implementation of far-sighted policies in the coastal fishery, and their proper enforcement, would provide appropriate conservation measures and hope for sustainable fisheries into the future.

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