

DELIVERING EDUCATION IN INTEGRATED WATER RESOURCES MANAGEMENT ACROSS THE OCEANIA REGION

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Limited water resources on many islands are highly vulnerable to over-exploitation and pollution, and are affected by climate change and variability. Island physical environments, together with isolation and remoteness, and a range of socio-cultural traditions, all combine to present many challenges to good governance for sustainable water management. This paper outlines the need for an integrated water resources management training programme in the Pacific, and presents an overview of the curriculum. Challenges faced in delivering the programme in a flexible and multi-modal format to students across the vast Oceania region are discussed.

Introduction and background

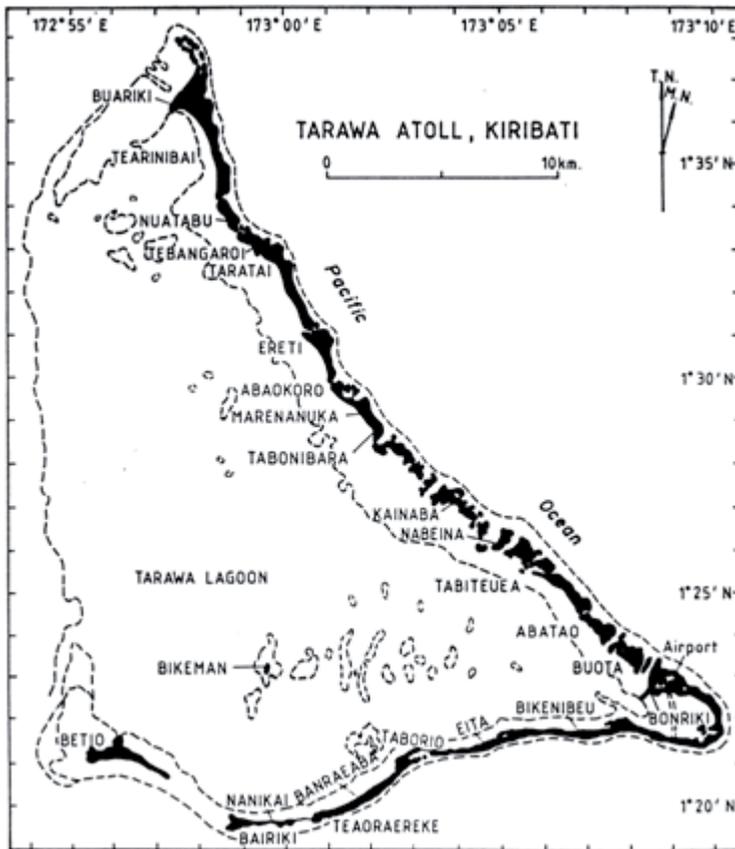
The global community recognised the importance of sustainable water management at the 2002 World Summit on Sustainable Development in Johannesburg, South Africa, complementing the existing Millennium Development Goal to halve by 2015 the proportion of people without dependable access to safe drinking water. The 'Water in Small Island Countries' sessions during the 3rd World Water Forum in Kyoto, Japan in 2003, provided the Pacific Island nations with an opportunity to put forward their priority water issues. Three priority concerns identified were:

- Uniquely fragile water resources due to lack of natural storage and small size of islands, competing land uses, inadequate water resources management in climatic extremes, and vulnerability to anthropogenic hazards such as urban pollution.
- Water service providers are constrained by lack of human and financial resource bases, restricting the availability of experienced staff and investment, leading to poor cost-recovery.
- Highly complex water governance owing to the disconnectedness between traditional community and national administration practices.

The tropical Pacific region is characterised by widely-scattered countries composed of numerous islands that vary considerably in their size, types and hydrologic characteristics. There are large, high volcanic islands such as those in Fiji and Solomon Islands, raised limestone islands like Niue, Nauru and Tongatapu, and tiny, low-lying coral islands on the atolls of Kiribati, Tuvalu and the Marshall Islands.

Small or low-lying islands have very limited water resources because of the small size of stream catchments or underground aquifers. Figure 1 illustrates the special problems of water availability on an atoll. On Tarawa, the main atoll of Kiribati, the small island of Betio in the south-west of the atoll is the main administrative centre and has an extremely high population density – approximately 15000 people/km². Betio's groundwater aquifer is unable to meet water demands, so water must be piped from larger aquifers on Bonriki and Buota islands, which lie more than 30 km away in the south east of the atoll.

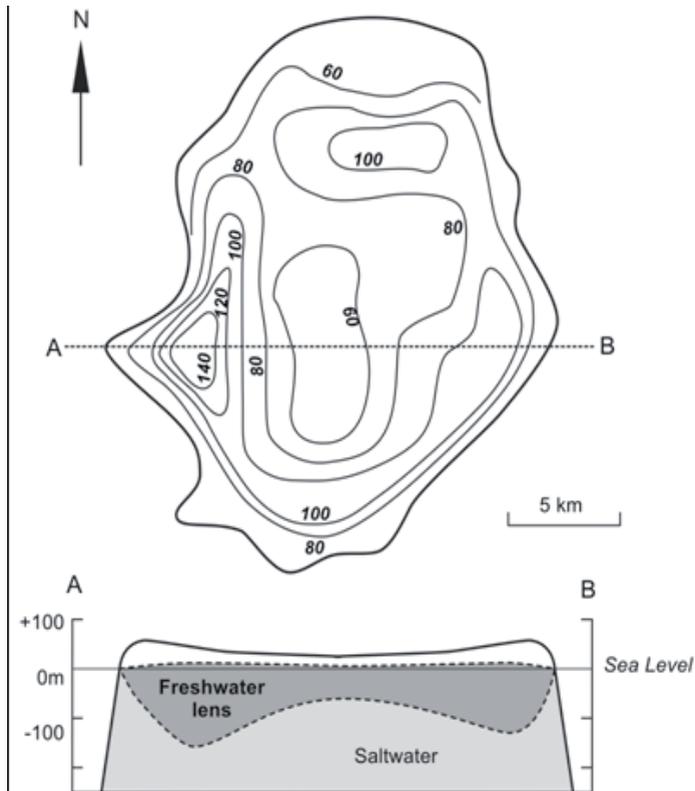
Figure 1: Tarawa Atoll in Kiribati



Source: From White et al. (1996)

Limestone islands, like coral islands on atolls, have no natural surface water systems at all, and their inhabitants are completely dependent upon rainwater harvesting and groundwater. Figure 2 shows the shape and thickness of the groundwater lens on Niue, which is a raised limestone island 259 km² in area. The 'contours' in metres show the thickness of the lens within the limestone bedrock. Although the population on Niue is small, approximately 1800, and the freshwater resources are normally sufficient to meet demands, the porous nature of the bedrock means that the natural aquifer must be carefully protected against pollution by human or agricultural effluent.

Figure 2: Plan view and cross section of Niue island's freshwater lens

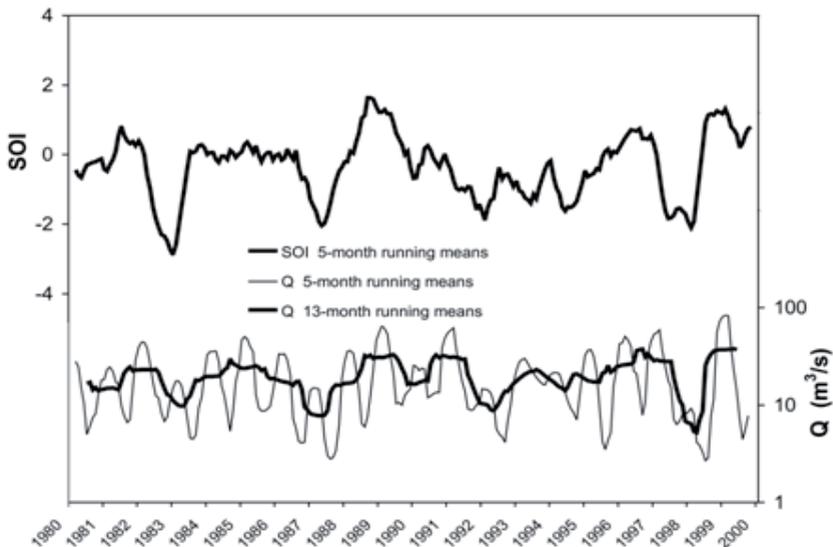


Source: Adapted Jacobson and Hill (1980) and Nunn (1994).

Contrary to popular belief, even high volcanic islands with surface drainage (rivers and streams) are vulnerable to prolonged drought. Figure 3 illustrates the point, showing the behaviour through time of river discharge (flow) in the major Ba River in northern Viti Levu, the largest island in Fiji. This river is typical of most watercourses on volcanic Pacific islands in the sense that it is used for domestic water supply by villages located along the banks of its main channel and numerous tributaries. The river is also utilised by the Fiji Public Works Department as the source of urban water supply in Ba town situated on the river delta. Periods of rain failure and associated minimum flow in the Ba River therefore adversely affect a large population living within this river basin.

The hydrograph in Figure 3, plotted over a 20-year period from 1980 to 2000, is drawn above a graph of fluctuations in the Southern Oscillation Index (SOI) for the same period. Prolonged low values of the SOI indicate El Niño episodes. El Niños normally cause significant reductions in precipitation across a broad area of the south west Pacific. Well below average rainfall may continue for many months, up to periods of a year or more. The patterns in the two graphs demonstrate how times of lowest average water flow in the Ba River correspond with the strong El Niño phases of 1983, 1987 and 1998.

Figure 3: The behaviour of river discharge (Q) in the Ba River on Viti Levu, Fiji



Source: From Terry (2005).

Projections of future climate change in the Pacific also mean that surface and groundwater supplies could be affected by variations in rainfall, higher surface temperatures (leading to an increase in evapotranspiration) and sea level rise (Bettencourt *et al.* 2002). At the same time, there are competing activities in watersheds. Water is needed for a wide range of sectors: urban and rural water supplies, commercial forestry, industry, tourism developments and subsistence agriculture. These all combine to present many problems to good water governance at different scales.

Building capacity for Pacific IWRM Training – the Water Virtual Learning Centre

For the above-mentioned reasons, sustainable water resources management is not being fully achieved in many Pacific Islands. In light of this, the Pacific states are showing greater commitment to the long-term goal of enhancing national capacities that will promote the development and implementation of sustainable water management at local, regional, sub-regional and basin levels, and contribute to strategic planning in the ‘Water for Life Decade’ (2006-2015). One of the agreed main targets is to improve water governance using integrated water resources management (IWRM).

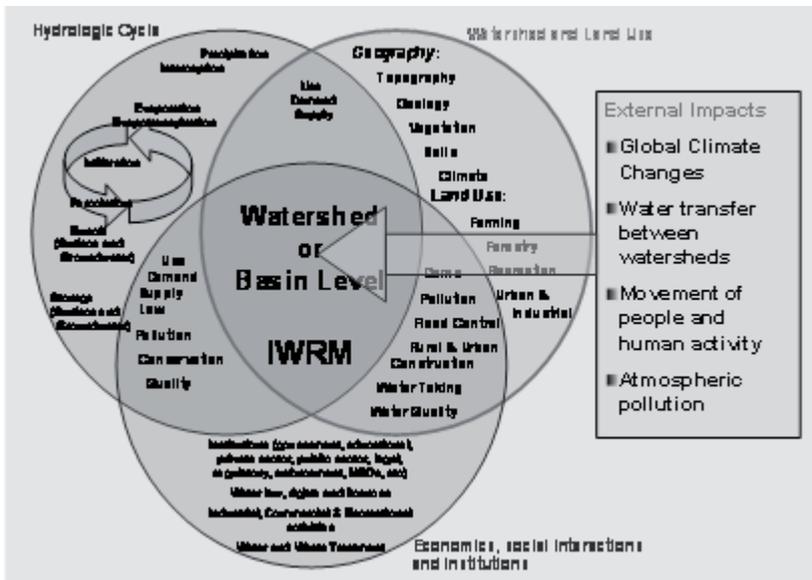
The first step in this process has been the establishment of a regional training centre for the Pacific Islands by the United Nations University - International Network on Water, Environment and Health (UNU-INWEH). This was achieved in partnership with the University of the South Pacific (USP) which is the main provider of tertiary education to 12 island nations (Cook Islands, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu and Vanuatu). For this project, the USP set up the ‘Water Virtual Learning Centre’ (WVLC) in 2005 on the university campus in Suva, Fiji. The objective of the WVLC is to provide adult training in IWRM to assist managers, scientists and policy makers, to build more sustainable water resource management practices in the Pacific Islands. Two other WVLCs have also been established with UNU-INWEH support, one at the Asian Institute of Technology in Bangkok, Thailand, and one at the University of Ghana in West Africa, where similar IWRM training is being trialled.

The second step is delivery of a core curriculum on IWRM that offers opportunities for continuing education and upgrading skills. The WVLC is flexible in terms of delivery mechanisms and procedures, so as to accommodate the widely-varying schedules, work requirements, technology access and professional backgrounds of the IWRM programme participants.

IWRM curriculum for the Pacific Islands

Although IWRM is a relatively new 'brand' in the Pacific Islands, the concepts and approaches it embodies are not new (Figure 4), namely that there is a need to take holistic, participatory and cross-sectoral approaches to water resources management. This is necessary to ensure that socio-cultural, technical, economic and environmental factors in the development and management of water resources are properly considered, and that traditional practices in the Pacific Islands are acknowledged and utilised (Carpenter and Jones 2004). The problem of land pressures, choosing whether to use limited available land for a plantation, a water reserve, a school or recreation area, must be appreciated at the household, village and community levels. Furthermore, competing activities in watersheds have to be tackled together if the water resources within them are to be managed adequately. In particular, every community must understand that activities on the land have an impact on freshwater quality and storage.

Figure 4. Elements of Integrated Water Resources Management



Examples of participatory catchment management initiatives include the UNESCO-supported “Catchment and Communities” project in eight catchments in Vanuatu and the “River Care” project on Viti Levu in Fiji. Both projects involve local communities monitoring their own impact upon water resources as well as commercial activities in the catchments, and both demonstrate an ‘island adaptation’ of IWRM concepts to the needs and realities of the Pacific Islands (Carpenter and Jones *ibid*).

A curriculum to be taught through the three WVLCs in Fiji, Thailand and Ghana was developed by an advisory group of the UNU-INWEH in Canada, and was offered for the first time in 2007 in Fiji. Directed at new and practising professionals in the water, environment or health sectors, it provides the core knowledge-base for IWRM and consists of ten courses, totalling 250 learning hours over a period of 15 – 18 months. United Nations University certificates are given for each successfully completed course, and a Diploma in IWRM from the UNU will be awarded in 2008 for the satisfactory completion of the entire programme. The diploma also serves as a foundation to higher degrees, such as Masters level in Environmental Studies or Science.

The ten courses comprising the IWRM curriculum have been specifically designed to be easily modified and updated, and use non-proprietary standards for formatting and presenting materials. The contents of each course relate back to the basic principles of IWRM. The courses are as follows:

1. *An Introduction to Integrated Water Resources Management*: A broad examination of critical concepts and knowledge needs related to IWRM, including essential human and institutional capacities.
2. *Water Transfer*: The natural components and processes of the hydrologic cycle, temporal variance, global and regional processes and impacts of anthropogenic alterations on the water cycle.
3. *The Terrestrial Ecosystem and The Impacts of Land Use Changes*: Changes and impacts that occur as a result of land use change and development.
4. *The Aquatic Ecosystem*: Concepts, processes, analytical approaches and procedures that relate to our understanding of the structure and function of the aquatic ecosystem.
5. *Aquatic Ecosystem Health and Impact Assessment*: Aspects of anthropogenic impact and change to the physical, chemical, biological and ecological components of the aquatic environment.

6. *Water Use*: The many human uses of water, both consumptive and non-consumptive, and their implications for the hydrologic cycle, ambient water quality and both ecosystem and human health.
7. *Wastewater*: The discharge of wastewater to natural and artificial catchments, potential impacts, methods of treatment and mitigation, the urban water cycle and methods to evaluate and choose appropriate technologies.
8. *Governance and Community Based Approaches*: Legislative, regulatory, legal, jurisdictional, community and individual responsibilities of IWRM. Gender issues, the requirements and benefits of capacity building, public education and community involvement.
9. *Organisational Infrastructure and Management*: Building and maintaining water management infrastructure, various public and private-sector organisational models. Auditing, reporting and long-range planning.
10. *Applying Integrated Water Resources Management*: Customised case studies, practical illustrations of the concepts and procedures of IWRM, and investigative techniques for students to assess their own IWRM needs.

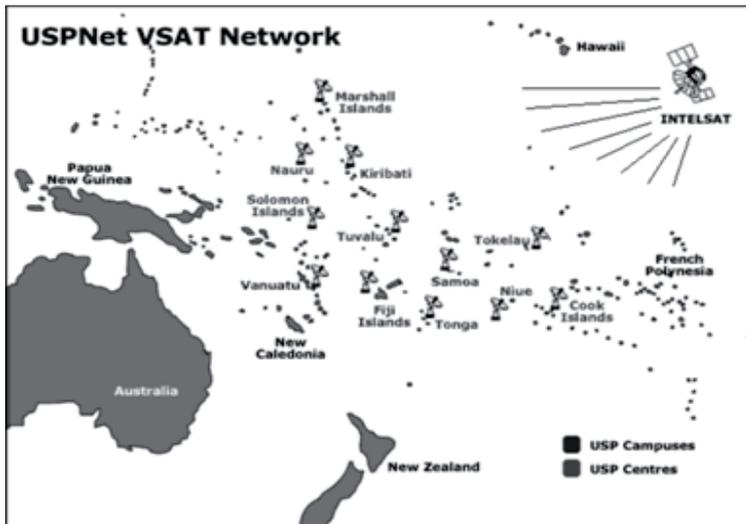
A special feature is that the courses are ‘customised’ to the requirements of the Pacific Island nations by introducing significant local and regional materials and data. Essentially, customisation means using appropriate island case studies and examples, based on research carried out in the region, to make the core programme relevant to the special needs of the Pacific. In other words, an appropriate ‘Island Style’ of IWRM is developed whilst maintaining the content of the core curriculum. The academic staff are responsible for customising the courses in their area of expertise, for example hydrology, development economics, water management and governance. After this, courses are delivered to participants through the Water Virtual Learning Centre at USP in Fiji.

Another important element of the programme is Course #10, which is a module based in Fiji. The aim of this module is to reinforce the basic principles already learnt through 2 – 3 weeks of fieldwork on IWRM practice. The objective is to bring all participants together at the WVLC in order to visit a range of selected sites that are relevant as case studies for water resources issues: drainage basin management, water harvesting, and water treatment and storage. In this way, IWRM is applied in a ‘hands-on’ way to find solutions to real water-based problems and to evaluate a range of resource development options on islands.

IWRM course delivery by distance and flexible learning

The vast geographical distances across Oceania make it difficult for all students to come to study at one of the three major campuses of the University of the South Pacific in Fiji, Vanuatu and Samoa. In response to this difficulty, USP has been a pioneer in 'Distance and Flexible Learning' (DFL) since the 1970s. The IWRM course is therefore offered through DFL, providing multi-modal course delivery to participants across the Pacific Islands, who would otherwise not be able to study face-to-face. To support multi-modal course delivery, DFL students are provided with printed materials and CDs. In addition, students have access to online learning at their regional USP campuses through 'USPNet' (Figure 5).

Figure 5. The 'USPNet' Regional Telecommunications Network



USPNet is a state-of-the-art satellite communications network, owned and operated by USP. It provides the opportunity to participate in audio tutorials, communicate by email with a lecturer or another student, access the Internet, watch live video broadcasts of classes, and take part in video conferences (and tutoring) with other course participants. Video conferencing allows the presentation of PowerPoint slides, the use of overhead camera for transparencies and other visual material, and video playback. Via USPNet, IWRM course participants are therefore able to interact with other students, lecturers or support staff, no matter where they are located.

As of mid-2007, the first enrolment of students have participated in a face-to-face introduction to the IWRM programme at the WVLC (or alternative venue), enjoyed regular email updates and study advice from the Programme Assistant and course lecturers, and benefited from new materials being made available on a weekly basis for download on the WVLC website to augment the core programme written to CD. Since the participants are mostly senior professionals, many have previous exposure to DFL-type delivery of education. The result is that they have adapted quickly to the multi-modal learning environment, and of their own accord have established a 'virtual peer-group' network for mutual encouragement and support. This augurs well for the success of individual student performance and for the IWRM programme as a whole.

Conclusions

Across the developing island nations of the tropical Pacific, there is a wide diversity of water resources characteristics. The region has scattered countries composed of numerous islands that vary considerably in their size, physical geography, and hydrology, including high volcanic islands, emerged limestone islands and coral atolls. Limited water resources are under threat from overexploitation by growing human populations and are vulnerable to climatic extremes. Island environments, remoteness and socio-cultural traditions all combine to present challenges to good governance for sustainable water management.

In this context, Integrated Water Resources Management (IWRM) is a relatively new concept in the region, but has been recognised by the University of the South Pacific, which established the Water Virtual Learning Centre in 2005 for advanced training in IWRM, through partnership with the United Nations University—International Network on Water, Environment and Health. A curriculum in IWRM was offered for the first time in 2007 through CD-ROM and distance and flexible learning (DFL), using an advanced satellite communications network and access to online learning through the internet. The programme ensures that socio-cultural, economic and environmental features of different islands are considered holistically in the management of water resources. There is a special focus on course customisation for regional needs, and to acknowledge traditional practices carried out in the past, so that these are included, where appropriate, in IWRM training. The 'Island Style' IWRM curriculum will enhance the capacity of Pacific nations to implement sustainable water strategies at local, basin, island and regional scales. This will assist overall in the sustainable development of Pacific Island communities.

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