

Water management in the
developing town: a complex
systems perspective

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Declarations

This work contains no material which has been previously submitted for a Degree or Diploma in a University or other tertiary institution. It has concurrently been submitted on this day to the Australian National University. To the best of my knowledge and beliefs, this thesis contains no material previously published or written by any other person, except where due reference has been made in the text.

The word count of the body of this thesis is 96,720 including all tables and figures, which is in accordance with the Australian National University's 100,000 word limit. Preliminary information, references and appendices are not included in this count.

Part of this thesis has been made publicly available in the form of journal articles and conference articles:

Moglia M, Cook S, Sharma A, Burn S (2010) Assessing decentralised water solutions: towards a framework for adaptive learning, *Water Resources Management* 25(1), pp. 217-238

Moglia M, Perez P, Burn S (2009) Modelling an Urban Water System on the Edge of Chaos, *Environmental Modelling and Software* 25(12), pp. 1528-1538

Moglia M, Burn S, Tjandraatmadja (2009) Vulnerability of Water Services in Pacific Island Countries: combining methodologies and judgment, *Water Science and Technology* 60(6), pp. 1621-1631.

Moglia M, Perez P, Pope S, Burn S (2009) Small Town Water Governance in Developing Countries: the Uncertainty Curse, *MODSIM 09 Conference*, Cairns, Australia, 13-17th July 2009.

Moglia M, Perez P, Burn S (2008a) Water troubles in a Pacific Atoll town, *Water Policy* 10(6), pp 613-637.

Moglia M, Perez P, Burn S (2008b) Urbanization and Water Development in the Pacific Islands, *Development* 51(1), pp. 49-55.

Moglia M, Perez P (2007) Participatory assessment of water developments in an atoll town, in *Adaptive and Integrated Water Management: Coping with Complexity and Uncertainty*, eds. C. Pahl-Wostl and J. Möltgen, pp. 381-403, Springer Verlag, Berlin.

Moglia M, Perez P and Burn S (2007) How complex is water service delivery in a small atoll town?, in 'Pre-proceedings of the 1st International Workshop on Complexity and Organizational Resilience', eds. R Kay and KA Richardson, pp. 105-128, ISCE Publishing, Mansfield, MA.

Moglia, M, Perez, P, Burn, S (2006) Strategic and Adaptive Small Town Water Management, *Enviro 06*, 9-11th May 2006, Melbourne: e6013.

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Abstract

Provision of water services is a critical strategy for addressing worldwide poverty, and this is one of the most pressing challenges of current times and is linked to population growth and climate change. Progress has been slow in achieving even the Millennium Development Goals aimed at improving coverage of adequate water services and professionals are struggling to cope with the diversity and scale of situations. Water services provision is a context-dependent process and many types of situations are very challenging, such as that of small developing towns. This thesis addresses the problems of urban centres in Pacific Island Countries and the aim is to provide formal explanations of difficulties in these locations to support recommendations that recognize local constraints and opportunities to best practice management. This is achieved largely by employing a perspective based on the science of Complex Adaptive Systems. This perspective has been chosen in recognition that water management incorporates complex interactions between social, technical and natural systems. The research is case study based, focusing primarily on Tarawa in the Pacific Island nation of Kiribati. The methodology includes historical review of the case study, and the use of historical review, as well as interviews and observation in the field as well as a cross-cutting email-based Delphi survey. This has generated qualitative and quantitative data to allow for the formulation of scientific models, an Agent Based Model describing the complex interactions involved in water service delivery; and Bayesian Network models describing the factors impacting on the chances of successful management interventions. With improved explanation of the complex situation, this has been used to support the formulation of a strategic and adaptive governance framework; aiming to introduce much needed organisational memory, and a consistent strategic direction set on the basis of the effective stakeholder interaction. By recognising weakness in capacity, it is possible to turn these into strengths by building and utilising local knowledge and commitment.