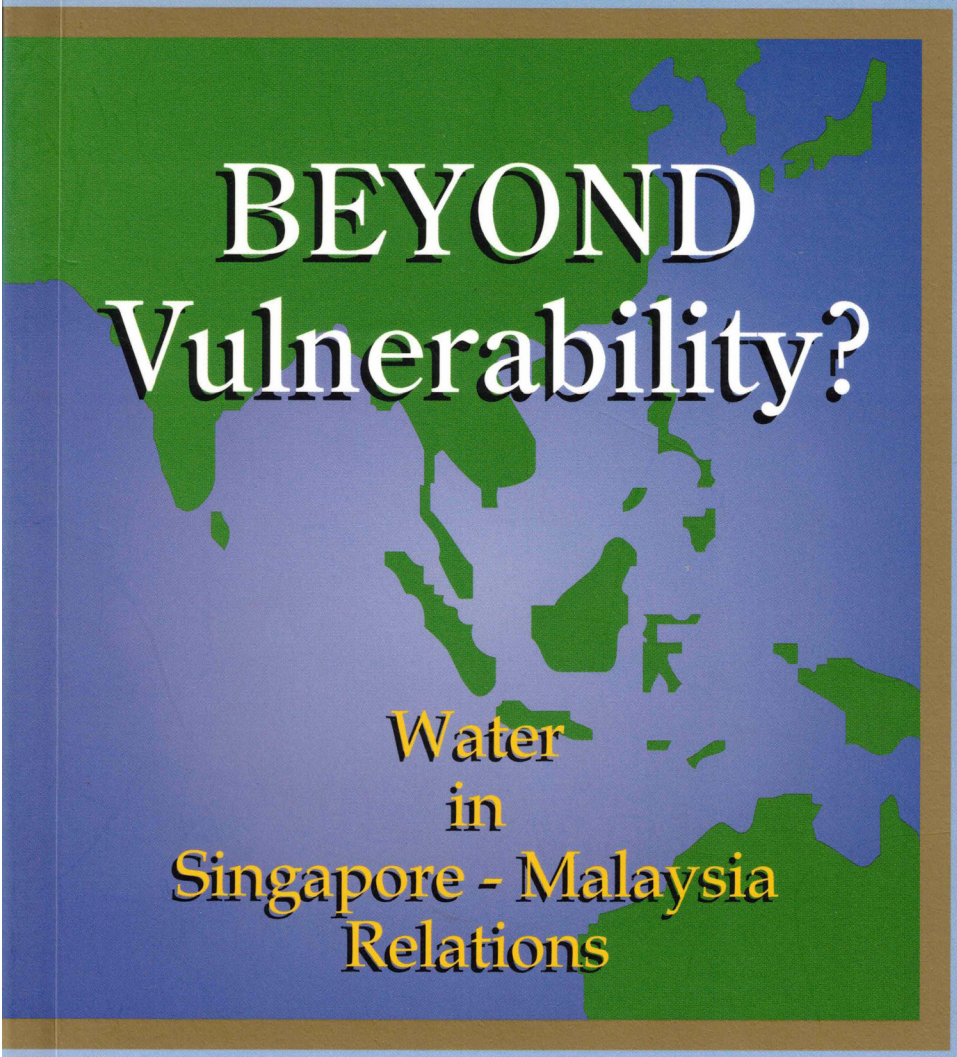


BEYOND Vulnerability?

Water in Singapore - Malaysia Relations

IDSS Monograph No. 3

Kog Yue Choong • Irvin Lim Fang Jau • Joey Long Shi Ruey
Edited by Kwa Chong Guan

IDSS MONOGRAPH NO. 3

BEYOND VULNERABILITY?

WATER IN SINGAPORE-MALAYSIA RELATIONS

KOG YUE CHOONG
IRVIN LIM FANG JAU
JOEY LONG SHI RUEY

Edited by KWA CHONG GUAN

INSTITUTE OF DEFENCE AND STRATEGIC STUDIES

Published by
Institute of Defence and Strategic Studies
Nanyang Technological University
South Spine, S4, Level B4, Nanyang Avenue
Singapore 639798
Telephone: 67906982 Fax: 67932991
E-Mail: wwwidss@ntu.edu.sg
Website: http://www.idss.edu.sg

First published in 2002

Body text set in 11/13 point New Century Schoolbook

Produced by
BOOKSMITH *consultancy*

ISBN 981–04–6768–0

Table of Contents

About the Authors and Editor v

1 Introduction 1
Making the Supply of Water from Johor to Singapore into a Security Issue
Kwa Chong Guan

2 Natural Resource Management & Environmental Security in Southeast Asia 13
A Case Study of Clean Water Supplies to Singapore
Kog Yue Choong

3 Water Spike! 45
Hydropolitik *and Conflict in Singapore-Malaysia Relations*
Irvin Lim Fang Jau

4 On the Threshold of Self-Sufficiency 99
Toward the Desecuritisation of the Water Issue in Singapore-Malaysia Relations
Joey Long Shi Ruey

Select Bibliography 137

About the Authors and Editor

KWA CHONG GUAN

Kwa Chong Guan is Head of External Programmes at the Institute of Defence and Strategic Studies. He was with the old Department of Strategic Studies at the SAFTI Military Institute prior to joining the IDSS, the establishment of which he helped plan. Kwa started his career in the Ministry of Foreign Affairs and has served in the Ministries of Defence, Community Development and Information & the Arts. At the latter two Ministries, he was assigned to restructure and redevelop the old Oral History Department and the National Museum. He also helped plan the Singapore Philatelic Museum and served as its founding Chairman. He continues to serve as an advisor and consultant to various heritage bodies. Kwa has also served in various National Service command and staff appointments up to Division assignments in the Singapore Armed Forces.

KOG YUE CHOONG

Professor Kog Yue Choong is the President of East West Engineering Consultants, the Immediate Past President of the Association of Consulting Engineers Singapore, and an Adjunct Professor at the Faculty of Engineering of the National University of Singapore. He was also a member of the Design Advisory Committee of the Urban Redevelopment Authority, Singapore. He and his firm have undertaken various development projects in Singapore, Myanmar, the Maldives, China and Vietnam and winning prestigious awards such as the Architectural Heritage Award from the Urban Redevelopment Authority, Singapore. He has published extensively in international refereed journals and conferences. He has also been a guest speaker in conferences and a judge in various competitions.

IRVIN LIM FANG JAU

Irvin Lim Fang Jau is the OUB Gold Medal Winner for the graduating class

of the 2000/2001 MSc (Strategic Studies) Programme at the Institute of Defence and Strategic Studies, Nanyang Technological University, Singapore. He also has an MBA from Leicester University, U.K. and was the University Medalist in the Arts (1994) for his BA (First Class Honours) in Communication Studies at Murdoch University, Perth, Western Australia. He has published some work on communications theory and creative writing.

JOEY LONG SHI RUEY

Joey Long Shi Ruey attended the National University of Singapore where he majored in history and mathematics. He received his BA (Hons) in History in 1996. He subsequently pursued his postgraduate studies at the History Department of the National Institute of Education, Nanyang Technological University, where he received an MA in History in 1998. Prior to joining the Institute of Defence and Strategic Studies, Nanyang Technological University, as an Associate Research Fellow, he was working as an archive officer at the National Archives of Singapore. Besides being interested in the relationship between water and interstate conflict, Long is also fascinated with the involvement of the United States in Southeast Asia in the immediate post-World War II period and in military history, particularly the relationship between society and conflict.

1

Introduction

Making the Supply of Water from Johor to Singapore into a Security Issue

"I said that I thought that in middle of confrontation and with our deep involvement in Malaysia and its future it was most surprising that we had not even been given time to express view or to discuss full implications of so drastic a step [of separating Singapore from Malaysia]. I said, for instance, that I presumed that now Lee would have full autonomy in foreign policy. The Tunku confirmed this. I said that one could easily envisage possibility of Singapore Government pursuing foreign policy which might put us in most embarrassing position. For instance, what would happen if they decided to disassociate themselves from confrontation? The Tunku said that if Singapore's foreign policy was prejudicial to Malaysia's interests they could always bring pressure to bear on them by threatening to turn off the water in Johore. With this startling proposal of how to co-ordinate foreign policy we turned to question of Borneo."

British High Commissioner in
Kuala Lumpur, Anthony Head[1]

The English traveller and explorer Carveth Wells re-visited Singapore in 1939 after an absence of 23 years. Wells had worked as a civil engineer on the survey of the Malayan east coast railway line between 1913 and 1918, after which he left for America where he became a travel writer and led scientific expeditions to Lapland and Uganda. Staying again at the Raffles Hotel, Wells reminisced that the large earthenware jar in the bathroom from which he scooped water to bathe had been replaced "by an ugly galvanized iron tub underneath a brass tap… Fresh water was drawn for each bath and the tub was turned upside down afterwards. Running water was new to me in Singapore, and when I learned that the water in those taps was as pure as any drinking water in the world, I realized that the city had changed indeed… twenty years ago it wasn't safe to drink the water or eat a salad… Nowadays, with first-class drinking water brought from a mountain in the Johore jungle forty miles away, and every kind of modern sanitation, Singapore is so healthy that even rats average only three fleas a piece…"[2] Wells was referring to the clean water Singapore had been drawing from the Gunong Pulai waterworks from 1929 onwards, which was piped directly by gravity to the service reservoir on top of Fort Canning Hill, from where it was distributed to the city.[3]

Today, 73 years later, Singapore continues to draw potable water from the Gunong Pulai waterworks and its reservoir, the "Sultan Ibrahim Reservoir", named in honour of the then Sultan of the State and Territory of Johor. Singapore today also receives water from three other waterworks in Johor that draws water from the Skudai, Tebrau and Johor Rivers.[4] In total, Singapore currently receives about half of its daily consumption of water, some 520,000 cubic metres, from Johor. For some 35 years, from 1929 to 9

1 Anthony Head in a confidential telegram no. 1344 from Kuala Lumpur to Commonwealth Relations Office on 9 August 1965, quoted from a copy deposited in the Australian Archives

2 Carveth Wells, North of Singapore (London: Jarrolds Publications Ltd, 1940), p. 119. Wells' memoir of his earlier sojourn in Malaya was recorded in his 1925 popular book, Six Years in the Malay Jungle.

3 Gunong Pulai was selected from three other schemes—the Pelapah scheme, the Lenggiu scheme and the Skudai River scheme—because it would not need pumps to bring the water to Singapore and was hence the most economical. See the report on "Singapore Water" by the Consulting Engineers Messrs. Sir Alexander Binnie, Son & Deacon attached as Appendix F to the 1922 Administrative Report of the Singapore Municipality.

August 1965, this supply of water from Johor to Singapore had not been an issue. The Skudai waterworks was officially opened by His Highness Sultan Ismail ibni al-Marhum Sultan Ibrahim on 3 April 1965. Three years earlier, in 1962, and before that, in 1961, agreements were drawn up allowing Singapore to draw water from Johor up to the years 2011 and 2061 respectively.

Supply of water from Johor to Singapore became a political and security issue when Singapore left the Federation of Malaysia. Recently opened archival records about Singapore's separation reveal that on 9 August 1965, the day Singapore separated from Malaysia, then Malaysian Prime Minister Tunku Abdul Rahman responded to a question by Anthony Head, the British High Commissioner in Kuala Lumpur, about how Malaysia intended to conduct its relations with Singapore. Head quotes the Tunku stating "that if Singapore's foreign policy was prejudicial to Malaysia's interest, they [Malaysia] could always bring pressure to bear on them [Singapore] by threatening to turn off the water in Johore." Head commented to Arthur Bottomley, the Secretary of State for Commonwealth Relations that this was a "startling proposal of how to co-ordinate foreign policy."[5] This revelation of the Tunku's views on water in Malaysia's relations with Singapore, some 35 years after they were stated, confirms in hindsight Singapore's perceptions of its vulnerability that drives its defence and foreign relations policies.[6] The

4 These three waterworks were developed by the City Council, successor to the Singapore Municipality in 1951, when Singapore was granted city status. The river intake, filtration plants and pipeline from Tebrau to Singapore was completed by 1953. Demand for water, however, outstripped the initial output of 41,000 cubic metres and extensions had to be planned. The City Council started drawing water from the Skudai and Johor Rivers after concluding new agreements in 1961 and 1962 with the Government of the State of Johor. Developments of the Skudai and Johor Rivers schemes were undertaken by the successor to the City Council, the Public Utilities Board, between 1963 and 1967. See Public Utilities Board, Yesterday & Today: The Story of Public Electricity, Water and Gas Supplies in Singapore (Singapore: Public Utilities Board, 1985), pp. 34–33, 39.

5 A copy of Head's confidential telegram is in the Australian archive. This statement by the Tunku has been cited by Lee Kuan Yew in Volume One of his memoirs, The Singapore Story (Singapore: Times Editions, 1998), p. 663, and Prime Minister Goh Chok Tong in his address to Parliament on 5 April 2002 on the issue of Malaysian supply of water to Singapore, excerpted in the Straits Times on 6 Apr 2002, p. H9.

6 For a view of how this deep sense of vulnerability drives Singapore's foreign policy, see Michael Leifer, Singapore's Foreign Policy: Coping with Vulnerability (London: Routledge, 2000).

logic of this vulnerability dictates that any Malaysian action to cut its water supply to Singapore would be casus belli for war.[7]

However, it would appear that anticipating this prospect of Malaysia turning off the tap on the water mains to Singapore did not emerge as a driving issue in the early build-up of the Singapore Armed Forces (SAF). The initial imperative for the build-up of the SAF was a more immediate fear that forces and factions within the Malay body politic might forcibly deploy the Malaysian Armed Forces to take over Singapore. Unstable ethnic relations in Malaysia, culminating in the May 1969 racial riots, which spilled over into Singapore, further confirmed the need for an SAF to secure Singapore.[8] Balancing the complex economic and security interdependence of the two territories and insisting on Kuala Lumpur's acknowledgement of its sovereign status provided for in the Separation Agreement preoccupied the initial phase of Singapore-Malaysia relations.[9] The supply of water from Johor to Singapore provided for in the 1961 and 1962 Water Agreements, which was incorporated into the Separation Agreement, appeared sufficiently reassuring and did not appear to be an issue.

The 1961 and 1962 Water Agreements provided for a review in 25 years of the rates each country pays for the water: Singapore pays Johor 3 sen per 1,000 gallons of raw water that it draws and Johor pays Singapore 50 sen per 1,000 gallons of treated water it buys back from Singapore. However it would appear that Johor was sufficiently satisfied with the prices and chose not to review them in 1986 and 1987 respectively. A year later, Mr Lee

7 See, for example, Tim Huxley's elaboration of this argument in "Singapore and Malaysia: A Precarious Balance?" in Pacific Review Vol. 3 No. 3 (1991), p. 210 and his Defending the Lion City: The Armed Forces of Singapore (St Leonards, NSW: Allen & Unwin, 2000), pp. 58–63.

8 Recounted by Lee Kuan Yew in Volume Two of his memoirs, From Third World to First: The Singapore Story 1965–2000 (Singapore: The Straits Times Press and Times Media Pte Ltd, 2000), chapter 2

9 Lau Teik Soon, "Malaysia-Singapore Relations: Crisis of Adjustment, 1965–1968" in Journal of Southeast Asian History Vol. 10 No. 1 (1969), pp. 155–176.

Kuan Yew signed with his Malaysian counterpart, Datuk Seri Dr Mahathir Mohamad a Memorandum of Understanding allowing Singapore to draw more water from Johor than provided for in the 1961 and 1962 Agreements. This 1988 Memorandum was ratified in a 1990 agreement, which also allowed Singapore to dam Sungei Linggui to provide for the additional water Singapore would be drawing from Johor. The 1988 Memorandum of Understanding and agreement signed 29 months later has been hailed as the high water level of Singapore's relations with Malaysia under Prime Minister Mahathir.

Johor's supply of water to Singapore, however, was caught in a complex of issues that emerged in the 1990s to bedevil Singapore-Malaysia relations.[10] These included:

- a dispute over the sovereignty of Pedra Branca, a rock outcrop in the eastern approach to Singapore on which a lighthouse has stood since 1849, and been maintained by the port authorities of Singapore since that date;
- the rental Malaysia pays Singapore for the Royal Malaysian Navy's 72-hectare base, KD Malaya, at Woodlands;
- airspace arrangements for planes from the Singapore air force to fly over Malaysian airspace; and
- the relocation of the Malayan Railway station from Tanjong Pagar to Upper Bukit Timah and the related relocation of the Customs, Immigration and Quarantine (CIQ) stations.

10 Perhaps not coincidentally, these issues emerged when both Singapore and Malaysia were entering a new phase of development to externalise their economies. In Singapore, Lee Kuan Yew had stepped down as Prime Minister and was succeeded by Goh Chok Tong while in Malaysia, Mahathir was leading his country into a new "Vision 2020" and a New Development Policy.

More recent issues include the right of Malaysian workers from Peninsular Malaysia to withdraw their compulsory savings in the Central Provident Fund (CPF) when they returned home upon completion of their work contracts in Singapore and closure of the section of the Singapore stock market, the Central Limit Order Book (CLOB), which traded in Malaysian shares after the 1997 financial crisis.[11] Within this wider complex of Singapore-Malaysia relations, Singapore's drawing of clean water from Johor became a publicly debated security and political issue.[12]

11 These issues are examined by inter alia, N. Ganesan in his "Malaysia-Singapore Relations: Some Recent Developments" in Asian Affairs: An American Review Vol. 25 No. 1 (1998), pp. 21–36; Andrew Tan, Problems and Issues in Malaysia-Singapore Relations, Working Paper No. 314 (Canberra: Australian National University Strategic & Defence Studies Centre, 1997); Bilveer Singh, The Vulnerability of Small States Revisited: A Study of Singapore's Post-Cold War Foreign Policy (Yogyakarta: Gadjah Mada University Press, 1999), pp. 188ff.

12 Contrary to the conventional wisdom of the dominant group in strategic studies and international relations who believe that the security and foreign relations of a nation state is about conflicting national interests as formulated by the governments of these nation states, "securitisation" as an alternative way of thinking about security inquires into why and how an issue, rather than another, is identified and elevated by whom (not only the government, but also political parties and groups, NGO advocacy groups, or the media) into an existential threat to the security of the state. Securitisation is about group identities and how they are shaped by what issues they choose to perceive as existential threats to their survival. This focus on what issues become securitised by whom and for what reasons is largely associated with scholars at the Copenhagen Peace Research Institute, especially Ole Wæver; see Barry Buzan, Ole Wæver and Jaap de Wilde, Security: A New Framework for Analysis (Boulder and London: Lynne Rienner, 1998). William Tow has attempted to draw out the implications of securitisation as an alternative security model for ASEAN in his "Alternative Security Models: Implications for ASEAN," in A. Tan and J. D. K. Boutin, eds., Non-traditional Security Issues in Southeast Asia (Singapore: Select Publishing for Institute of Defence and Strategic Studies, 2001), pp. 257–285. Securitisation of the water issue in Singapore-Malaysia relations therefore inquires into which groups and institutions in Malaysia and Singapore, referring not only to the government, but including others such as the media, political factions and parties, are elevating the water issue into a security threat and for what rationale.

However, underlying the issue of whether the Singapore Armed Forces will cross into Johor to secure the waterworks Singapore that draws water from should Malaysia threaten them[13] is a logic of conflict avoidance. While acknowledging that this dispute over the supply of water to Singapore could lead to armed conflict, retired Malaysian Army Field Commander Lt-Gen Zaini Mohamed Said warned that military conflict must be avoided, as it will only hurt both countries.[14] Malaysian leaders from Prime Minister Mahathir to Johor Mentri Besar Datuk Abdul Ghani Othman have on various occasions expressed confidence that the dispute can be resolved amicably and that Malaysia will abide by its legal commitments to supply water to Singapore. It is a confidence Prime Minister Goh has reciprocated.

It is within this logic of preventing a Singapore-Malaysia conflict over the supply of water to Singapore that three essays the Institute of Defence and Strategic Studies (IDSS) has accumulated over the past year has been written. None of these three essays published in this monograph were commissioned by the IDSS; all were drafted for different IDSS functions.

13 The link between insecurity and environmental issues, among others, scarcity of water and energy resources, atmospheric pollution or the maritime environment, which could lead to conflict between nation states, is complex. Most analysts have sought a causal link; see, for example, Thomas F. Homer-Dixon, Jeffrey H. Boutwell and George W. Rathjens, "Environmental Scarcity and Violent Conflict" in Scientific American Vol. 268 No. 2 (Feb 1993), summarising the results of a two-year Project on Environmental Change and Acute Conflict at the University of Toronto; also Thomas F. Homer Dixon, Environment, Scarcity and Violence (Princeton, NJ: Princeton University Press, 1999). However, this causal link from environmental scarcity to threats to national security to conflict has been challenged; see, for example, Marc A. Levy, "Is the Environment a National Security Issue?" in International Security Vol. 20 No. 2 (1995), pp. 35–62 and exchange with Homer-Dixon, "Correspondence: Environment and Security" in International Security Vol. 20 No. 3 (1995/96), pp. 189–198. Others see environmental issues as a variable that may engender different types of conflict; see, for example, the essays in Alan Dupont, ed., The Environment and Security: What are the Linkages?, Canberra Paper on Strategy & Defence No. 125 (Canberra: Australian National University Strategic & Defence Studies Centre, 1998), particularly Lorraine Elliot, "What is Environmental Security: A Conceptual Overview" and Peter H. Gleick, "Water and Conflict".

14 Mingguan Malaysia, 3 Feb 2002, commentary, and picked up in Straits Times, 4 Feb 2002

15 The papers from this project have been edited by Andrew T. H. Tan and J. D. Kenneth Boutin, Non-traditional Security Issues in Southeast Asia (Singapore: Select Publishing for Institute of Defence and Strategic Studies, 2001).

Prof Kog Yue Choong's essay on "Natural Resource Management and Environmental Security in Southeast Asia: A Case Study of Clean Water Supplies to Singapore" was drafted in response to an invitation from IDSS to participate in a project sponsored by the Ford Foundation[15] to research non-traditional security issues in Southeast Asia. An earlier version of Prof Kog's paper was circulated as IDSS Working Paper No.15. Mr Irvin Lim Fang Jau's essay, entitled "Water Spike! Hydropolitik and Conflict in Singapore-Malaysia Relations", was produced as part of research he undertook when he was a participant in the IDSS's Master's programme in Strategic Studies in 2000–2001. Mr Joey Long Shi Ruey's essay is a spin-off from research he conducted as an Associate Research Fellow at the IDSS. The essay published here is a revised and expanded version which appeared in Contemporary Southeast Asia Volume 23 No. 3 (Singapore: Institute of Southeast Asian Studies, Dec 2001).

Despite their different beginnings, all three essays share a common preoccupation of how, within the context of the water issue becoming a security issue in Singapore-Malaysia relations within the last decades, the issue can now be "desecuritised".[16] A common assumption underlying all three essays is that technology will be the factor to decide whether this water issue can indeed be "desecuritised". Where these essays differ is their evaluation of the significance of the technology enabling Singapore to develop

16 For just as the water issue, or sovereignty of Pedra Branca or trading in Malaysian shares has been politicised and securitised into an existential threat, so too can it be "desecuritised" and resolved as an issue, for example, legalising the issue of sovereignty over Pedra Branca by referring it to the International Court of Justice. Unfortunately, the three papers compiled here assumes that responsibility for "desecuritising" the water issue rests with the governments of Malaysia and Singapore and do not inquire into how other parties that have contributed to securitising the water issue can be persuaded that it may be in their interest to desecuritise the water issue.

alternative supplies of water through recycling water, desalination and more effective harvesting of the natural hydrological cycle. By disseminating this range of perspectives on the issue of Johor's supply of water to Singapore, the Institute of Defence and Strategic Studies hopes to contribute to clarifying the public debate on the issue.

For Kog, it is the technology of better water resource management by both Johor and Singapore that could pre-empt conflict from erupting between Malaysia and Singapore. Kog accepts the traditional link that increasing Singapore and Malaysian demand for water as a consequence of industrialisation and urbanisation coupled with depleting supplies of water as a consequence of pollution and the deforestation-denudation syndrome could spark a conflict, as has happened in other parts of the world. The solution for Kog is better management of the industrial, agricultural and urban pollution that drains into Johor's rivers. However, Kog recognises that managing environmental problems is a national issue for Malaysia over which Singapore has no influence. Singapore's options are therefore to better manage its growing demand for water while developing new technologies for alternative supplies of water which could be costly and reduce Singapore's economic competitiveness. Underlying Kog's essay is the belief that it is ultimately sustainable development of Johor's water resources to meet both Malaysia's and Singapore's water needs that has to be the preferred win-win option.

Lim, however, views the water issue through the lens of mainstream strategic studies realism. For Lim, it is the "technology" of military deterrence developed by the SAF that provides a measure of credible insurance against a cut of supply of water from Johor to Singapore. The narrative underlying Lim's essay is the SAF's development of a deterrent military strategy in response to the existential threat that Malaysia may renege on the 1961 and 1962 Water Agreements despite assurances from Prime Minister Mahathir and other Malaysian leaders to the contrary. Lim cautions that Singapore's development of alternative water supplies, while promising, has not de-

linked Singapore's water supplies and energy needs from its security needs. This continuing link between Singapore's water and security needs creates a tension that drives Lim's narrative: at what point of time is Singapore justified in deploying the SAF in defence of its water needs? Ultimately, Lim recognises that deployment of the SAF into Johor in defence of Singapore's water supplies will be realisation of a doomsday scenario that no one wants.

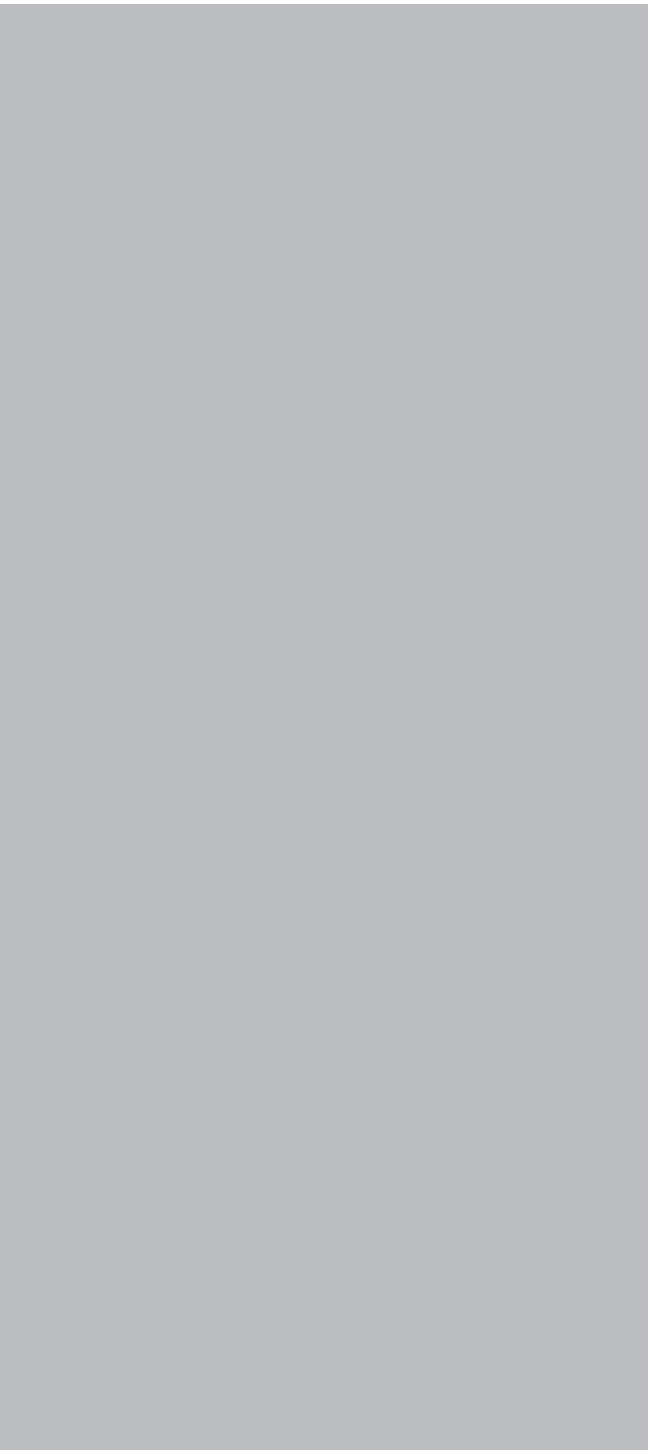
In contrast to Lim, Long takes a more liberal view of the water issue. He argues that technology making possible Singapore's increased water reserves from optimising water yield from the hydrological cycle, coupled with effective conservation measures and search for alternative supplies of water, has enhanced the Republic's water security. Long believes that a premature termination of water supplies from Johor will not jeopardise Singapore's survivability, and will not be sufficient to trigger war between the two countries. Long's view is that the water issue can be desecuritised into a pecuniary issue of whether it will be cheaper for Singapore to desalinate and recycle water than buy treated or raw water from Johor; and for the latter to decide whether it will be cheaper to process its own water or continue to buy treated water from Singapore's waterworks in its territory.

Unstated in all three essays is the assumption that political will and rationality to avoid conflict over the water issue prevails within the national leadership of Singapore and Malaysia. All three essays conclude for different reasons that Singapore and Malaysia need not, and should not, go to war over the issue of Singapore's need for water from Johor. This editor joins Prof Kog, Messrs Lim and Long in hoping that they are right. For the alternative is imponderable.

2

Natural Resource Management & Evironmental Security in Southeast Asia

A Case Study of Clean Water Supplies to Singapore



KOG YUE CHOONG

INTRODUCTION

An environmental crisis is emerging in Southeast Asia. Decades of rapid industrialisation and urbanisation without effective environmental management programmes have led to environmental degradation only partially reflected in the pollution of air, water and land resources and the destruction of natural resources which beset Southeast Asian countries. Soil erosion, flooding, salinisation and toxification of soils challenge most Southeast Asian countries struggling to manage their water resources.

Environmental studies have shown that cities and affluent countries have ecological footprints that are many times the size of the territories that they occupy. It would require resources from an area many times the size of Singapore to produce the food, water, energy and other resources needed to sustain its people and economy. Movement of pollutive industries from richer to poorer countries in the region is another trans-boundary environmental problem. However, the ownership and management of the environment and its resources remains strictly a national concern. The pressure is on Southeast Asian countries to start adopting and enforcing some common environmental standards towards trans-boundary environment problems which could otherwise become a potential source of tension and conflict between nations in the region.

Trans-boundary pollution caused by forest fires in Indonesia has been one source of irritation to its neighbours. These forest fires emit more greenhouse gases than the whole of European industry. The pollution has affected the health and economies, especially the tourism industry, of not only Indonesia but also of Malaysia and Singapore. The "haze" joins other traditional environmental concerns shared by these three countries around the Strait of Malacca, in particular, marine pollution arising from the growth of sea traffic along the Strait, one of the busiest sea lanes in the world.

More effective trans-boundary management of the environment, especially the need for trading and sharing of resources among nation-states in the region, will grow rather than decrease over time. With diminishing supplies of such resources and contestation over them for even domestic needs, tensions are likely to grow not only within countries, but also at the regional level. On a bilateral basis, the question of trade or the sharing of

resources such as water is a source of tension between countries, for example, Malaysia and Singapore and, potentially, Indonesia. Singapore's sourcing of water in Johor has been a source of irritation for Malaysia and its political leadership. Given the rising needs for water in Johor, Singapore's increasing demand for water is likely to be resented among Malaysians especially if their government fails to adequately manage their water resources. This will be accentuated when there are water shortages in Johor while Singapore continues to draw its water from Johor rivers. Income differences between Malaysia and Singapore accentuates this dispute over the trading of water. Poor bilateral relations, or domestic problems in Malaysia, especially when there are water shortages and rationing during periodic droughts, escalates Singapore's demand for water into a crisis.

This paper proposes to consider cases of shared natural resources and other environmental issues in the region that have the potential to threaten regional stability and security. Water supplies to Singapore will be the case study for this paper. This paper will argue that the supply of Johor water to Singapore will have to be considered in the wider context of the management of water resources as well as the inadequacy of infrastructure to provide clean water for the needs of both Johor and Singapore.

In the wider context, the issue is that globally only 1% of the world's supply of water is available for human use. Of the remaining 99%, 97% of the world's water is seawater and 2% is locked up in the polar ice caps and underground reservoirs. Mankind already uses more than half of this amount and is projected to need three times the amount of fresh water that is currently available by 2025. As a comparison, from 1940 to 1990, withdrawals of fresh water from rivers, lakes, reservoirs, underground aquifers and other sources increased by more than a factor of four.[1]

1 Igor Shiklomanov, "World Freshwater Resources" in Peter H. Gleick, ed., Water in Crisis: A Guide to the World's Fresh Water Resources (New York: Oxford University Press 1993)

IMPENDING WATER SHORTAGES

Water literally gives life not only to organisms but to ecosystems as well. The survival of humans and their ecosystems depend on water, as does the production of economic goods and services to maintain social systems. Because water is critical to human survival, the fate of nations often depends on a country's access to water. The World Bank has estimated that globally, one billion people have poor access to clean water and the number will rise to 2.5 billion, about one person in three, by the year 2025 unless governments begin spending more on their water supply systems. Supplying water to people is estimated to be a $700 billion a year industry. That is 40% of the size of the oil sector and one-third larger than the global pharmaceutical sector.[2]

In Asia, where water has always been regarded as an abundant resource, per capita availability declined by 40 to 60% between 1955 and 1990.[3] The looming water crisis is the most severe environmental problem in many parts of Asia today. Asia has the lowest per capita availability of fresh water in the world, with Central and parts of Southeast Asia already well above the threshold of "high water-stress" conditions, which occurs when the ratio of use to availability exceed 40%. Indeed, some countries in Central Asia are already using 90% of their available freshwater resources. In South Asia, use of available freshwater resources will soon reach 50% while the northern portions of China and Mongolia have reached 25%. Many other parts of Asia will suffer the same fate during the next 25 years. China and India, which will have populations of 1.5 and 1.4 billion respectively by 2025, will encounter serious water shortages within the first quarter of this new century. Currently, it is estimated that Asian industries use about 10% of the region's fresh water.[4] Consequently, acute water shortage will limit

2 Shawn Tully, "Water, Water Everywhere" in Fortune Vol. 141 No. 10 (15 May 2000), pp. 69–78

3 David Spurgeon, Water: A Looming Crisis, International Rice Research Institute, available online at: http://www.cgiar.org/IRRI/Looming.html

4 World Meteorological Organisation (WMO), Comprehensive Assessment of the Freshwater Resources of the World, (Geneva: World Meteorological Organisation, 1997)

economic growth and industrial expansion. [5]

Farming in Asia is the largest consumer of water, using more than 80% of fresh water drawn from streams, rivers, reservoirs and underground lakes.[6] Irrigated rice, in particular, is a heavy consumer of water. It consumes 7,650 m^3/ha as compared to wheat, which consumes only 4,000 m^3/ha.[7] This is partly because farmers in developing countries continue to waste water with diffuse irrigation methods.[8] A major fear is that water shortages will affect China's food self-sufficiency. If China is forced to turn to the global grain market to meet shortfalls in its food output, world grain prices will rise. This will in turn aggravate social and political instability in many Third World countries.

The supply of fresh water in a region is limited by the dynamics of the hydrological cycle. When rain falls in Asia it usually arrives in torrents over short periods, usually during a single monsoon that lasts from four to six months. The rest of the year is almost dry. As a result, much of the runoff simply flows into the ocean as waste while eroding uplands, sometimes catastrophically, at the same time. The monsoons, furthermore, are often erratic so that in many countries, floods and seasonal water shortages occur concurrently. This means that the renewable supply is an important constraint to the sustainable use of water within any particular region. Apart from human use, water is also needed to sustain natural ecosystems found in wetlands, rivers and the coastal waters into which they flow.

Pumping water from underground aquifers faster than they can be recharged or diverting so much water from wetlands or rivers that freshwater ecosystems fail are clearly unsustainable practices. Despite this, examples of

5 Asian Development Bank, Asian Environment Outlook 2001 (Asian Development Bank Annual Meeting Seminar "Win-win Policies for a Better Environment", discussion draft), May 2000 (101 pages)
6 World Meteorological Organisation (WMO), Comprehensive Assessment of the Freshwater Resources of the World, (Geneva: World Meteorological Organisation, 1997)
7 David Spurgeon, op. cit., n. 3
8 "China Faces Water Shortage in 10 Years" in The Straits Times, 21 Aug 2000

unsustainable water use can be found in virtually every region. The water table under much of the North China Plain, a region responsible for nearly 40% of China's grain production, had fallen by an average of nearly 1.5 metres over the last five years.[9] The Chinese Academy of Science estimated that economic losses caused by water shortages in cities across the North China Plain ran as high as US$24 billion in 1997 or 3% of the Gross Domestic Product (GDP).[10] Satellite photographs show that the entire north of China is drying out. China's Yellow River ran dry and did not reach the sea for 226 days in 1997. In countries like Bangladesh, salinity and sedimentation are occurring largely as a result of upstream water withdrawal. In India and Pakistan, water tables are falling at rates of two to three metres a year. India is using its underground water reserves twice as fast as they are being replenished. The flow of the Ganges and other important waterways is much reduced compared with only a few years ago.

Aquifers in parts of the Middle East, India and Southeast Asia are also being depleted. Excessive withdrawals from underground aquifers are causing intrusions of seawater into deltas and coastal aquifers in China and Vietnam. In Thailand, the rapid lowering of the water table due to excessive extraction of groundwater has caused the shallow aquifers in Bangkok to become contaminated with seawater. This over-withdrawal of groundwater reserves has also caused land subsidence in cities such as Bangkok and Jakarta. In Bangkok, for instance, land has subsided in some places by 0.5 to 0.6 metres over the last 20 to 25 years, a situation which has aggravated the city's flood problems.[11]

Several additional factors contribute to the potential for regional water shortages by limiting the available supply. Among the most serious is water pollution from a wide variety of industrial, municipal and agricultural sources. Water has contributed most to the Green Revolution, which brought about the growth in rice production in Asia during the past 30 years. But

9 Lester R. Brown and Brian Halweil, "China's Water Shortage Could Shake World Food Security" in World Watch, Jul/Aug 1998

10 "Running Dry" in Far Eastern Economic Review, 3 Feb 2000

11 Economic and Social Commission for Asia and the Pacific (ESCAP), State of the Environment in the Asia-Pacific (Bangkok: ESCAP, 1995)

this expansion has occurred at a cost to the environment. A proportion of the chemicals applied as fertilisers and as pest and weed control pollutes rivers and lakes through runoff and into groundwater from leaching. This uncontrolled flow of sewage and fertiliser runoff is hastening eutrophication in some temperate and tropical lakes and many coastal seas.

A recent investigation by Cambodian and United Nation officials has found traces of arsenic in 9% of drinking water samples collected in 13 of the nation's 24 provinces, prompting concerns that too much pesticide runoff had entered Cambodia's drinking water during recent years.[12] A recent survey of more than 700 mainland rivers in China found that close to half were significantly polluted, with one in ten considered undrinkable. The culprit: industrial waste. Toxins such as DDT are now being detected in fish and other marine life in the South China Sea.[13]

Water pollution thus compounds the existing problems of local and regional water scarcity by removing large volumes of water from the available supply, posing a threat to human health and to the health of aquatic ecosystems in these nations. Although there has been significant progress in controlling water pollution in many developed nations over the past three decades, pollution has continued to rise in most developing nations. One factor is the rapidly growing and industrialising cities of the developing world, where pollution control is still in its infancy and domestic sewage and industrial effluents have left many urban rivers and groundwater sources heavily contaminated. The widening shadow of pollution around major cities has important implications for urban development, exacerbating the already difficult task of extending basic water and sanitation services to the urban poor. Much of the water in Southeast Asia is polluted because of a lack of wastewater disposal, adequate sanitation and proper management of sewage. The problem of pathogenic pollution is quite severe in Southeast Asia, with many of the region's inland water bodies affected by the presence of pathogenic agents. Pathogens generally come from domestic sewage that is discharged untreated into watercourses. 54% of the lakes in

12 "Arsenic in Cambodia's Drink Water" in The Straits Times, 19 Aug 2000
13 "In Tune with Nature" in Asiaweek, 18 Aug 2000

Southeast Asia are found to suffer from eutrophication problems.[14] Many rivers carry enhanced nutrient and pollutant loads as a result of changes in land use, industrialisation and urbanisation. Discharge of mine tailings and development of industrial areas with direct discharge of pollutants into neighbouring river systems have resulted in hot spots of heavy metal pollution throughout the region.

Another factor aggravating water shortages is global warming. 1998 was the hottest year on record with some of the most extreme weather in history. A global panel that studies climate change predicts a 1.5° to 3° Celsius rise in temperature in the 21st century. Global warming could lead to reduced water supplies because of consequential changes to the world climate. A NASA study found that each year of global warming melts Greenland ice equal to 4.5 trillion litres of water, as well as contributing to a 23-cm rise in sea level over the last century.[15] Scientists have predicted that the ice cap stretching from the North Pole will disappear within 50 years. As it stands, the coverage of the Arctic sea ice has already declined by 6% since 1978 and the average thickness of the remaining ice sheet has declined from 3.1 metres in the 1950s to 1.8 metres today, a loss of 42%.[16] The thick ice that has covered the Arctic Ocean at the pole for millennia has turned to water and an ice-free patch of ocean about two kilometres wide has opened at the very top of the world. From Spitsbergen, Norway, to the North Pole, there are now kilometres of unusually thin ice and intermittent open water.[17] Subsequent examination of satellite images revealed a body of water about 15 km long and five km wide near the pole. The remaining ice was also badly fractured. It is known that the average Arctic temperature in winter has risen by about 6°C over the last 30 years and Northern Hemisphere sea ice has been melting at a rate of about 15% per decade.[18] The evidence of global warning is everywhere and its implications extremely worrisome.

14 United Nations Environment Programme (UNEP), Environmental Data Report 1993–1994 (Oxford: UNEP, 1994)
15 "North Pole Melting", Editorial in The Straits Times, 24 Jul 2000
16 ibid.
17 "The Big Polar Meltdown" in The Sunday Times, 20 Aug 2000
18 "Hot and Cold" in The Straits Times, 1 Sep 2000

According to most paleoclimatologists, the last 140 years was one of the most anomalously wet periods in the last 4,000 years.[19] If this is true, then less rainfall and more frequent droughts can be expected once the anomalously wet period ends and the world's freshwater supply situation turns very bleak. There are fears that some of the current freshwater supplies in lakes and reservoirs will be submerged by rising seawater levels. This will in turn reduce the freshwater supply available for human use.

Many believe that water will to be to the 21st century what oil was to the 20th century: the one precious commodity that determines the wealth of nations. As a result, water will replace oil in the 21st century as the major source of geopolitical tension. Some also believe that the way a country handles its water problems could determine the difference between greatness and decline. Those nations that keep their waterworks in superb working order and operate them at the lowest cost will have a competitive edge.[20]

CLEAN WATER SUPPLIES AS REGIONAL AND NATIONAL SECURITY ISSUES

The scarcity of water threatens the environment, the global food supply and the human condition. Resolving this threat may spark violent conflicts within Asia and other regions. Communities upstream of river basins and those downstream find themselves in collision. Where scarcities loom, cities and farms compete for available water. This competition could escalate into conflict and violence. In China, for example, there were recent clashes in Henan province where hundreds of villages were involved in fighting over control of a disputed water catchment area.[21] Recently, northern China experienced the worst drought in decades.[22] This drought dried up rivers and drained reservoirs, forcing more than 100 cities in northern China

19 Mike Davis, "When the Rivers Ran Dry…… The Drought Next Time" in Radical Urban Theory (2000), available online at: http:www.rut.com/mdavis/riversRanDry.html
20 Shawn Tully, op. cit., n. 2
21 "China Faces Water Shortage in 10 Years" in The Straits Times, 21 Aug 2000
22 "China Drought Sparks Riots" in The Straits Times, 22 Jul 2000

to implement strict water rationing. The drought sparked social unrest as farmers protested against water rationing. In some villages, farmers rioted over rationed supplies and higher prices. Thousands of villagers in Shandong clashed with police after officials cut off the water they had been using to irrigate drought-plagued fields. More than 100 people were hurt and a police officer was killed during the mayhem in Anqiu village. The conflict started when government engineers were mobilised to block streams that were leaking water from the nearby Mushan reservoir. Fights broke out after 300 police officers were dispatched to quell the protests of 5,000 villagers.

Disputes over water supplies is also the cause of regional conflicts in various parts of the world. Israel, Jordan, Lebanon and Syria have been warring over their water supplies from the River Jordan and the River Yarmuk. In the 1967 Middle East War, Israel occupied the Golan Heights, enabling them to control the Jordan River and its watershed, pre-empting Syrian and Jordanian plans to cut off the water supply to Israel. The Israelis have been driven to secure a reliable water supply since ancient times, at times through elaborate projects, such as King Hezekiah's secret tunnel to the pool of Siloam in Jerusalem to ensure that the city could survive while it was under siege.[23] Currently, Israel depends on the West Bank for 25% of its supplies.[24] As far as the Israelis are concerned, the return of the West Bank in any peace settlement in the Middle East is thus closely related to the resolution of the water rights of the River Jordan and the use of groundwater from aquifers for the water supply to Israel. In every Middle East war during the past 50 years, both sides have always pursued the destruction of the water supply system and the freshwater sources of their opponent as a strategic target. Therefore, water resources are not only vital for the livelihood of the people but are also crucial for national security in the Middle East. Many believe that if the water issues of the Middle East are not resolved satisfactorily after the resolution of all other issues, the region will remain explosive.[25]

---

23 K. Keller, The Bible as History (New York: Bantam Books, 1980)

24 Robert Engelman and Pamela LeRoy, "Sustaining Water: Population and the Future of Renewable Water Supplies" in Population Action International (Washington, DC, 1993)

25 M. Riyah, "Israel and Arab Water in Historical Perspective" in Farid and Sirriyeh, eds., Israel and Arab Water, (London: The Arab Research Centre, 1985); L. Schmida, "Israel Water Projects and Their Repercussions on the Arab-Israeli Conflict" in Farid and Sirriyeh, eds., Israel and Arab Water

Egypt, Ethiopia and Sudan are among the ten most water-stressed countries in the world. They are some of the countries that the River Nile flows through, making it the major water supply for these countries. Ethiopia and Sudan were the first two countries to confront Egypt over the use of water in the River Nile. In 1991, Egypt objected strongly to an agreement between Sudan and Ethiopia to extract water from the River Nile to meet their water needs, fearing that it would adversely affect the downstream flow into Egypt. Because of the Egyptian objection, as well as other technical and internal political reasons, the plan was not implemented. Nevertheless, with the rapid population growth and the increasing water demand for agriculture, the risk for conflict, including military clashes, among these countries will continue.

India and Bangladesh have been in conflict over water rights to the Ganges since Bangladesh gained independence from Pakistan in 1971. It was only in 1996 that India and Bangladesh signed a 30-year agreement on the allocation of the water resource of the Ganges. There are 114 Indian cities located upstream discharging untreated sewage into the Ganges and, as a result, adversely affecting the water quality downstream in Bangladesh. Understandably, Bangladesh is extremely concerned and this is another of the many unresolved issues between them. The possibility of conflict between India and Bangladesh because of the disagreement on the various problems related to the use of the water resource of the Ganges therefore remains a flash point.

Pakistan's main water supply is from the Rivers Indus, Sutlej, Ravi, Chenab and Jhelum, all of which originate in Kashmir. For many years Pakistan has objected to the Indian plan of building dams upstream, fearing that the downstream flow will be drastically reduced as in the case with the Ganges. Consequently, India's dam building plan has remained an important issue to be resolved diplomatically between the two countries. If this issue is not resolved satisfactorily between them, it will certainly add more fuel to the already strained relationship between the two countries.

From the preceding discussions, it is apparent that water supply has become a security issue in many nations because the supply of clean water determines the survival of that nation. Singapore is no exception. Water

supply is a crucial aspect of Singapore's national security, and is an integral part of its Total Defence Strategy. The memory of how the lack of water was a key factor that hastened the fall of Singapore to the Japanese in World War II continues to serve as a painful reminder of how crucial water supply is to the security of the city-state. When the British blew up the Causeway as they withdrew from the invading Japanese, they inevitably also severed the water mains from Johor.[26] The loss of Singapore's reservoirs to the Japanese finally forced the British besieged in the city to finally surrender. Water supply from Johor continues to be a crucial aspect of Singapore's national security in the post-colonial era after World War II. Senior Minister Lee Kuan Yew recalled impressing on Malaysian Prime Minister Mahathir Mohamad that the Singapore Armed Forces had been built up to ensure that if there was "a random act of madness, like cutting off our water supplies", then Singapore could "go in [to Malaysia] forcibly if need be, to repair damaged pipes and machinery and restore the water flow."

REVIEW OF SINGAPORE WATER SUPPLY AND DEMAND

When Raffles landed in Singapore in 1819, water from inland streams and wells was sufficient to maintain the 150 or so inhabitants on the island. As Singapore grew as a port of call, there was an urgent need for water to be supplied to ships which called at Singapore. A small reservoir was constructed on Fort Canning by 1822 to supply water to ships. However, there were no provisions for water for the population which had grown to more than 50,000 by 1850. The plight of the residents for clean water prompted philanthropist Tan Kim Seng to make a donation of $13,000 in 1857 for the construction of waterworks. This heralded the start of Singapore's piped water supply. Work began on the construction of an earth dam to impound water at the MacRitchie Reservoir, then known as the Thomson Road Reservoir.

Municipal water supplies in Singapore began in 1867 with the completion of the construction of the embankment. Between 1874 and 1878, two pumping stations were built at MacKenzie Road and Mount Emily to

26 I. Simson, Singapore – Too Little, Too Late: The Failure of Malaya's Defence in 1942 (Singapore: Asia Pacific Press, 1970)

improve water pressure and ensure a continued water supply to the city. The MacRitchie dam was enlarged between 1890 and 1894 and again at the turn of the century, moving the dam to its present location and raising it by 1.5 metres. Water was still in short supply with dry spells occurring in 1877, 1885 and 1895. Pearl's Hill Service Reservoir was built between 1903 and 1905, and the Lower Pierce Reservoir was completed by 1912. During World War I, investigations began into new water sources and works on the Seletar Reservoir began after the war.

Meanwhile, the population had risen to more than 400,000 by 1920 and the colonial authorities began looking towards Johor as a possible source of water. The Gunong Pulai Scheme was eventually selected and an agreement was signed in 1924 with the Sultan of Johor for the use of this water. The Gunong Pulai and Pontian Reservoirs, as well as treatment works at Gunong Pulai, were operational by 1932, and steel pipes were laid to carry the water to the Fort Canning Service Reservoir. In 1926, a steam pumping station was built to turn the Woodleigh installation into a pumping system. Between 1937 and 1941, Gunong Pulai's treatment capacity was doubled. A second pipeline was laid to Johor Bahru. A subsidiary reservoir, Pulai I, feeding the Pontian Reservoir was also completed. The Seletar Reservoir was enlarged in 1940 and a pumping station was built there to transfer raw water from this reservoir to the Pierce Reservoir.

After World War II there was a need to find new sources of water for a growing population. The government commissioned a study of the use of groundwater in the late 1940s. White[27] reported that there was a potential supply of three million gallons per day (13,600 cubic metres per day) from wells in the Bedok Valley. However, subsequent studies by the Public Utilities Board (PUB) found that the yield of groundwater from the Old Alluvium in the Bedok Valley was very limited.[28] It has been recognised since then that it is not possible for Singapore to be self sufficient in water supply competitively and that Singapore has to depend on Johor for a substantial part of its water needs.

27 B. White, The Water Resources of Singapore Island: Report on Investigations into the Extent and Water Bearing Capacity of the Alluvial Plain (Singapore, 1952)

28 T. C. Chou, "Groundwater Investigations in Singapore" in Regional Workshop on Water Resource, Environment and National Development, Vol. II, Selected Papers, (Singapore: Science Council of Singapore, 1972)

The state of emergency between 1948 and 1960 also made it difficult to maintain the system because the Gunong Pulai and Pontian Reservoirs were in the heart of the communist territory.[29] Plans to develop the Johor River Scheme were interrupted by the outbreak of World War II and the Malayan Communist insurgency in Malaya from 1948. A new water supply had to be found and the Tebrau River, which was in a safe area and closer to Johor Bahru, was selected. The Sungei Tebrau Scheme, which commenced before the war, was completed in 1953 and a new 1,600-mm pipeline was laid through the Causeway to Singapore.

To provide adequate storage for this increased water supply from Johor, the Murnane Service Reservoir was completed in 1956, followed by the Jalan Eunos Service Reservoir in 1959. The droughts of September 1961 to January 1962 and April 1963 to February 1964 made Singaporeans more aware of the precarious situation of their water supply. In 1961 and 1962, agreements were made with the Johor state government for the supply of water to Singapore. These agreements are still in force. The Skudai River Scheme, operational since August 1964, and the Johor River Scheme, operational since in 1967, have contributed substantially towards relieving water shortages. In 1969 the Seletar Reservoir, renamed the Upper Seletar Reservoir in 1992, was enlarged by more than 35 times[30] and the Woodleigh Waterworks was expanded to cope with the increased volume of water.

The Public Utilities Board (PUB) was constituted by the Public Utilities Ordinance in May 1963 to take over the responsibility of providing water, electricity and piped gas by the former City Council. Most of Singapore's current water supply capacity has been developed by the PUB since independence in 1965. This includes the damming of seven rivers and the creation of Southeast Asia's first stormwater collection system. In 1975, the Upper Pierce Scheme was completed and water from this reservoir was treated at Chestnut Avenue Waterworks. In the same year, the Kranji/Pandan Scheme was completed and water from these two reservoirs was treated at the Choa Chu Kang Waterworks. Between 1976 and 1979, piped water was brought to Pulau Tekong with the construction of an impounding

29 Water Department, Annual Report, 1956
30 Public Utilities Board, Annual Report, 1987

reservoir, a service reservoir, waterworks and a water supply network on the island. Works on the Western Catchments Scheme started in 1977 and was completed in 1981. It involves the damming of four rivers—Murai, Poyan, Sarimbun and Tengah—and converting them into reservoirs. Consequently, the treatment capacity of the Choa Chu Kang Waterworks was also enlarged at the same time. The last surface water source, the Sungei Seletar/Bedok Water Scheme, was completed in 1986. It involved constructing a dam across the mouth of Sungei Seletar to form the Sungei Seletar Reservoir, renamed the Lower Seletar Reservoir in 1992, and converting the Bedok sand quarry site into the Bedok Reservoir and the construction of the Bedok Waterworks. It also involved constructing eight stormwater collection ponds at Yishun, Tampines, Bedok and Yan Kit. The capital expenditure for these projects between 1963 and 1993 amounted to a total of S$1.9 billion (Source: PUB Annual Reports).[31]

The Bedok and Lower Seletar Schemes are good models for Singapore to develop its remaining catchment areas. The scheme collects surface runoff from parts of north-eastern and eastern Singapore, namely the newly urbanised areas of Ang Mo Kio, Bedok, Tampines and Yishun New Towns and the area north-west of Changi International Airport. It then transfers the flow to storage reservoirs in Bedok and Lower Seletar. A unique feature, which sets this scheme apart from earlier ones, is the utilisation of untapped urban runoff from residential areas as its main source of raw water. The design of the scheme required co-ordination within various ministries and organisations including the Housing and Development Board (HDB), the Ministry of the Environment (ENV) and the Planning Department to exclude industries and pollutive land users and to create a drainage system to drain urban runoff into suitable collection points.

Other measures such as the covering of drains and gutters around HDB blocks, the grading of HDB void decks to discharge into the sewage system and the implementation of various pollution control measures on construction sites were implemented so that water in these catchments is not excessively polluted. Only runoff from larger storms is collected, as it tends to have a lower level of pollutants. This is effected through an

31 Public Utilities Board, Annual Report (various years)

32 Lee Mun Fong and Haja Nazarudeen, "Collection of Urban Stormwater for Potable Water Supply in Singapore" in Water Quality International (Jun 1996), pp. 36–40

automatic monitoring system which only collects water when the volume of the runoff is sufficiently large. Since its commissioning in 1986, the scheme has proven itself capable of delivering raw water comparable in quality to raw water obtained from upland reservoirs with a largely forested catchment.[32] Since then, newer urban stormwater pond collection stations have been implemented or are being planned in the northern and north-western parts of Singapore to replace existing stream abstraction stations affected by urbanisation arising from public housing developments. One unique facility is being built under the flyover of an expressway interchange to utilise the land space which otherwise would be of limited use. The PUB is also designing a covered type of stormwater pond at another location, the first of its kind, in order that the land above this functional type of concrete pond can be used for other purposes such as school football fields and basketball courts.[33]

Singapore has also implemented measures to reduce the pollution of its water resources, which was especially acute in the 1960s and 1970s. About half of the 110 million gallons (500,000 cubic metres) of water consumed each day was discharged into open drains.[34] A large number of streams were badly polluted by decayed organic matter and were considered "dead conduits" without any apparent plant or aquatic life.[35] Since then, Singapore has embarked on a comprehensive programme to clean up its rivers and to ensure that all sources of pollution are connected to the sewerage system or are treated before discharging into public water courses. This has been achieved mainly through education and campaigns, extension of the sewerage system, provision of water closets in all homes, phasing out of pig farming and by legislative and administrative control. The latter is effected through the Water Pollution Control and Drainage Act, Trade Effluent Regulations, and the various codes of practice for surface runoff and sewerage to ensure that all new developments comply with the required pollution control standards and the quality of the discharge into water courses.

33 William C. H. Lim and Lim Ngin See, "Urban Stormwater Collection for Potable Use", a Paper presented at the 11th IWSA-ASPAC Regional Conference in Sydney, Australia, 1–5 Nov 1998

34 H. Chen, "Water Pollution and its Control in Singapore" in Journal of the Singapore National Academy of Science Vol. 3 supplement (1973), pp. 100–115

Recycling water has also contributed to saving clean water. In 1966, the Jurong Industrial Water treatment plant was commissioned and began to supply industrial water to Jurong. This water is reclaimed from treated sewerage effluent and, while it is of sufficiently high quality for industrial use, is not potable. Nevertheless, this has helped to ease pressure on potable water supply in Singapore. Industrial water now represents about 2% of all water consumed in Singapore.

Singapore recognised the importance of complementing increasing water supplies with managing water demands very early and has encouraged its population to reduce water consumption by various measures. These measures can be classified as (i) education and persuasion, (ii) fiscal incentives and (iii) legislative and administrative control. Since 1962, the PUB has periodically organised national campaigns to save water. Correct pricing of water has been touted as the best policy to ensure its proper use. Current pricing levels in most countries are far too low to cut down on wastage.[36] On the other hand, high water price could lead to protests and even riots. For instance, Cochabamba, Bolivia's third largest city, decided to raise water rates to pay for an improvement project after privatisation. Waves of protesters attacked soldiers and blocked roads and the city was forced to cancel the project.[37] Moreover, a water rate that is too high may undermine Singapore's economic competitiveness, for example, in attracting wafer plants which require large quantities of water. Since 1973, the PUB has utilised a stepped tariff system for domestic users of water.[38] Non-domestic users are charged a flat rate so as not to discriminate against industries that naturally consume more water.[39]

35 A. Johnson, "A Quarter Century of Freshwater Research in Singapore" in Journal of the Singapore National Academy of Science Vol. 5 (1976), pp. 1–8
36 J. Winpenny, Managing Water as an Economic Resource (London, Routledge, 1994)
37 Shawn Tully, op. cit., n. 2
38 M. Q. Wong, "Evolution of PUB's Tariffs" in PUB Digest No. 14 (1993), pp. 36–41
39 Hansard, Official Report: Parliamentary Debates Singapore, various issues

The Economic Expansion Incentives Act (Chap. 86) was amended in 1984 to allow for a 50% investment allowance for industrial consumers to undertake projects that reduce their consumption of potable water. In 1991, a water conservation tax was levied on water consumption over 20 cubic metres for domestic users and at a flat rate for non-domestic consumers. The tax rates were subsequently raised in following years. In June 1997, the government announced that water tariffs and the conservation tax would be restructured and raised over four annual increments until 1 July 2000 so that all households pay the same rate for water as non-domestic consumers, other than shipping.[40] The Public Utilities (Water Supply) Regulations under the Public Utilities Act and the code of practice for water services allow the PUB to ensure that the water supply systems in operation are of high quality and that leakage of the systems is minimised. They also enable the PUB to require mandatory water conservation measures to be implemented. Despite the implementation of all these measures, Singapore's consumption of water continues to grow at a rate faster than its population growth rate. Nevertheless, demand for water would certainly have been much higher if not for the implementation of these measures.

Singapore has therefore to look beyond its boundaries for new supplies of water. Between 1983 and 1987, the Skudai and Johor River Waterworks were extended. The Skudai and Kota Tinggi Waterworks were extended in 1987 and a 2,000-mm diameter submarine pipeline was laid between the Johor Waterworks and Singapore. The Linggui Reservoir Project commenced in 1988 and was completed in June 1993. A new water agreement was signed with the Johor State Government for the construction of the Linggui Dam. The agreement provides for Johor to supply Singapore with additional treated water in excess of the present entitlement of 250 million gallons of water a day from the Johor River.

In 1987, then Prime Minister Lee Kuan Yew announced that Singapore was looking into the possibility of tapping water from Indonesia.[41] Following this, an agreement "on economic co-operation in the framework of the

40 "Pricier Water from July" in The Straits Times, 27 Feb 1999
41 "Plan to Buy Water from Indonesia" in Business Times, 7–8 Oct 1989

development of the Riau Province" was signed on 28 Aug 1990. Under this agreement, Singapore and Indonesia agree "to co-operate on the sourcing, supply and distribution of water to Singapore". This agreement also includes co-operation over trade, tourism, investment, infra-structural and spatial development, industry, capital and banking.[42] In 1991, a water agreement signed with the Indonesian Government provides for the supply of 1,000 million gallons of water a day from sources in the province of Riau in Indonesia.

Also planned is a project to tap water resources of the Sungei Kampar catchment in West Sumatra.[43] The Sungei Kampar project is described as a project to provide water to the Riau province. This suggests that water for Singapore would have its place as part of a much larger plan to build up the regional economy. The Bintan project marks the beginning of a new era in the development of new water projects. While previously the PUB has managed the construction and development of water resource projects alone, the Bintan scheme will be built and managed by the PUB's subsidiary company, Singapore Utilities International (SUI). Two joint venture companies were created in 1992 for the purpose of developing a supply of water from Bintan and to supply water to Bintan and the neighbouring Riau islands.[44] However, the pace of the progress for these developments has been very slow and it has come to a halt because of the political uncertainty in Indonesia after the financial crisis. At this point in time, there is no certainty that it will proceed in the near future because of the political situation in Indonesia.

Singapore has now reached a point where around half its total land area is harnessed for water resources.[45] Singaporeans consume some 1.2 million cubic metres of water daily. Close to half, or about 680,000 cubic metres, comes from water catchment areas, such as the island's 14 reservoirs

42 Treaties Supplement No. 1, "Agreement between the Government of the Republic of Singapore and the Government of Indonesia on Economic Co-operation in the Framework of the Development of the Riau Province" in Government Gazette, 1990

43 "Singapore and Indonesia Sign Agreements on Sumatra Water, Bintan Development" in The Straits Times, 30 Jan 1993

44 Public Utilities Board, Annual Report, 1992

45 Lim and Lim, op. cit., n. 33

and stormwater collection ponds in HDB new towns. The rest comes from Johor.[46] The total storage capacity for reservoirs in Singapore and in Johor presently is estimated to be 142 x 106 cubic metres and 787.5 x 106 cubic metres respectively.[47] This capacity is enough for about two years supply at current levels of consumption. This means that strategically there is about two years for Singapore to work out a solution to any water supply problem should a water crisis develop. However, if for some reason the water stored in the reservoirs in Johor is no longer available for use by Singaporeans, there is only about four months available for Singapore to sort out the problem with the Malaysian government.

SUPPLY OF CLEAN WATER AS AN ISSUE IN SINGAPORE'S RELATIONS WITH MALAYSIA AND INDONESIA

According to Postel[48], countries with less than 1,000 cubic metres per person per year of water resources can be considered "water-stressed", that is, not sufficient water resources to meet their needs. Such water-stress indexes must be interpreted cautiously. They do not necessarily imply a future shortage of available water, since that depends on actual usage patterns and on the efficiency with which water is used and even reused. Burundi, for example, is potentially a water-stressed country according to the water-stress index, but it uses little water for irrigation at present and so has abundant supplies for other purposes. Moreover, efficient management and modern technology can stretch even scarce water supplies much further. Israel, for example, supports its population, its growing industrial base and intensive irrigation with less than 500 cubic metres per person per year.[49] Table 2.1 shows the water resources of each of the ASEAN countries. Though comparatively well endowed with water resources, only a part of the renewable water

46 "3 Water Plants for Singapore by Year 2001" in The Straits Times, 4 May 1998

47 Adriel Yap Lian Ho, "Water for Singapore: Management of a Resource in a Subregional Economic Zone", an unpublished academic exercise, Department of Geography, National University of Singapore, 1995, p. 138

48 S. Postel, "Water Scarcity Spreading" in L. R. Brown, H. Kane and E. Ayres, eds., Vital Signs: Tends That are Shaping Our Future 1993/1994 (London, World Watch Institute, 1993)

49 Robert Engelman and Pamela LeRoy, "Sustaining Water: Population and the Future of Renewable Water Supplies" in Population Action International, Washington, DC, 1993

resources can be extracted and used, owing to the high variability of stream flow between low water and flood seasons, the inaccessibility of some watercourses and the lack of storage sites on many catchments.[50] Using this criterion, Singapore ranks alongside the Middle Eastern countries to be among the worst eight in Asia and the only country in ASEAN considered water-stressed due to insufficient resources.

Table 2.1 – Water Resources of ASEAN Countries
Sources: World Resources Institute 1998; The Little Data Book*, World Bank 1999; and* Asiaweek 2000

Country Population	Annual internal renewable resources (km^3)	Annual withdrawals (km^3)	Annual per capita internal renewable water resources (m^3)	Annual withdrawals as %-age of water resources	Annual per capita groundwater withdrawal (m^3)	1999 GNP per capita (US$)	(millions)
Cambodia	88.10	0.52	8,195	1	–	300	11.0
Indonesia	2,530.00	16.59	12,251	1	–	1,110	209.4
Laos	270.00	0.99	50,392	0	–	400	5.4
Malaysia	456.00	9.42	21,259	2	–	4,530	23.0
Myanmar	1,082.00	3.96	22,719	0	–	–	48.9
Philippines	323.00	29.50	4,476	9	82.8	1,200	75.8
Singapore	0.60	0.19	172	32	–	32,810	3.9
Thailand	110.00	31.90	1,845	29	15.0	2,740	62.6
Vietnam	376.00	28.90	4,827	8	–	310	80.3

50 Economic and Social Commission for Asia and the Pacific (ESCAP), State of the Environment in the Asia-Pacific (Bangkok: ESCAP, 1995)

Between 1963 and 1999, the population of Singapore increased from 1.8 million to 3.9 million. In the same period, per capita consumption more than doubled from 154 litres per person per day to 327 litres per person per day. Consequently, water consumption increased 4.7 times from 273,912 cubic metres per day to 1,276,000 cubic metres per day. Clearly the increase in water consumption in the past 36 years has outpaced population growth. Factors such as the larger economy and higher standards of living have influenced the increase in Singapore's water consumption. Table 2.2 shows water sales for the period 1960 to 1999. Roughly, sale of water to homes makes up about half of all water consumed and water for industrial and commercial use makes up most of the remaining water sold.

Table 2.2 – Water Sales in Singapore, 1960–1999
(in thousand m^3)
Source: Department of Statistics, Singapore

Year	Domestic	Shipping	Commerce/ industry	Government	Total annual consumption
1960	40,786.9	n.a.	21,697.6	36,997.2	99,481.7
1970	71,024.0	2,276.9	35,718.3	43,923.6	152,942.8
1980	113,478.0	3,347.0	75,991.3	23,750.0	216,566.3
1990	177,343.3	2,914.4	113,148.6	29,391.8	322,798.1
1999	234,638.4	1,997.2	175,345.6	27,701.1	439,682.3

Singapore has depended on Johor to meet its shortfalls of water supplies for the last 68 years and is likely to continue to be dependent upon Johor for future increased water demands. On the other hand, Johor also depends largely on a supply of treated water from Singapore. This is the result of the water agreements between Singapore and Malaysia under which Johor sells raw water to Singapore at 3 sen per 1,000 gallons and buys treated water back at 50 sen per 1,000 gallons. It would appear that this arrangement is increasingly unacceptable to Malaysia, judging from the recent Malaysian Cabinet's decision to approve $318 million for the construction of a water treatment plant in Johor. When the plant is completed, Johor will have its own

water supply and be independent of Singapore.[51] It must be recognised that demand for water within Malaysia is also increasing because of population and economic growth. For example, in Selangor and the Federal Territory, water consumption is expected to increase to 3,500 million litres a day in 2003, 4,000 million litres a day in 2010 and 5,000 million litres a day in 2020.[52] At the same time, pollution, mismanagement and urbanisation have reduced the usable water resources in Malaysia.

The situation that Singapore and Malaysia find themselves in over water is not unique. There are several countries sharing water resources with their neighbours. This is because their rivers and groundwater basins transcend national boundaries. Therefore, neighbouring countries of the water resource have a natural 'right' to the resource. Such 'rights' are recognised in international law and form the basis for countries to negotiate should disputes on the use of shared water resource arise. A series of such legal agreements similarly regulates Johor's supply of water to Singapore. Singapore's situation is, however, unique in that the water resources in Malaysia, and hopefully in Indonesia in the near future, are being shared with Singapore even though Singapore does not share river or groundwater basins with its neighbours.

Under the 1961 and 1962 Johor River Water Agreements, which expire in 2011 and 2061 respectively, Singapore pays RM0.03 per 4,500 litres of raw water while Johor buys back some of the processed water at RM0.50 per 4,500 litres.[53] The Singapore government claims that Singapore is subsidising Johor to the tune of RM29 million a year by selling it treated water at a reduced rate. It also noted that Johor is voluntarily buying an average of 37 million gallons of treated water per day from Singapore, more than double the amount of 15 million gallons of water that it has a right to.[54]

---

51 "KL Approves $318m Waterworks for Johor" in The Straits Times, 19 Aug 2000
52 ibid.
53 Brendan Pereira, "Water Talks: Singapore Asking Too Much" in The Straits Times, 31 Aug 1998
54 "S'pore Sells Subsidised Water to Johor" in The Sunday Times, 6 Sep 1998

Singapore officials have been meeting their counterparts in Malaysia to discuss a new 100-year water agreement after 2061. Singapore officials have requested 350 million gallons a day of raw water and 400 million gallons a day of treated water to be supplied by Johor and Pahang to meet its projected demand of 950 million gallons a day for a population of seven million 160 years from now. This request for water beyond 2061 is, however, contingent on Malaysia satisfying its own needs first. The Malaysian officials are prepared to supply Singapore the present volume of 250 million gallons a day and have asked Singapore to source for water elsewhere, perhaps Indonesia, or to build desalination plants to meet its additional water demands. This is because Malaysia cannot commit itself to a quantum in view of the uncertainty of its own situation in 150 years' time. In addition, Johor's and Pahang's resources are earmarked for an inter-state water transfer following the 1998 water crisis in the Klang Valley.

Malaysian officials recognise that water is an emotional issue for both countries. What makes water a particularly emotive issue among the Malaysian states is that some states suffer from chronic water shortages while others enjoy water surpluses. In March 1990, water rationing was imposed in the northern regions of Johor while water flowed from reservoirs in Johor managed by the PUB to Singapore. Critics have pointed out that this implies that the Johor government seemed to put Singaporean needs before those of the state.[55] Malacca faced a water crisis in 1991, with water rationing being imposed throughout the state. Malaysians living in Malacca were incensed that while they had to endure the inconvenience of water rationing, water continued to flow across to Singapore. Eventually, a National Water Council was set up to allow for sharing of water resources between various states.[56] Future water talks between Singapore and Malaysia will only be held closer to the expiry period of the two agreements.[57]

Johor's supply of water to Singapore has become entangled with, and indeed, become a part of the complexities of Singapore-Malaysia relations.

---

55 "Johor MB to Critic: Water Project Not a Disadvantage to Malaysia" in The Straits Times, 10 Apr 1990

56 "States Agree to Set up National Water Council" in The Straits Times, 12 Jun 1992

57 Brendan Pereira, op. cit., n. 53

A Malay Malaysian claimed that most Malay Malaysian's thoughts and perceptions on what Singapore has done to incur Malaysian hatred are:

(i) the support by Singapore newspapers, and therefore the Singapore government, for the Anwar issue;
(ii) the sabotaging of Malaysia's economic situation by short-selling activities through CLOB;
(iii) an unwillingness to lend to Malaysia when it was in dire straits;
(iv) the high interest rates in Singapore banks, including Maybank, during the Asian financial crisis; and
(v) the timing of the CIQ (Customs, Immigration and Quarantine) issue.

Overall, he claimed that it made the Malay Malaysians feel there was a very serious and co-ordinated effort to bring down the Mahathir government and to slow Malaysia's rapid movement towards achieving their Vision 2020.[58] If this is indeed the prevailing sentiment of the average Malay Malaysian, then it will be very difficult for Singapore to continue to rely on Malaysia for a supply of water when the existing water agreement expires in 2061. Even more difficult will be for Singapore to secure from Malaysia an additional 400,000 cubic metres of water per day to meet its eventual demand for a population of seven million.

There has also been some unhappiness expressed in Indonesia over the selling of water to Singapore on the grounds of ecological damage to an identified reservoir area and Singapore's "exploitation" of Indonesia.[59] Singapore is small and, with limited resources, has been remarkably successful because it has relied on the goodwill of its neighbours for water, labour, natural resources and trade. Inevitably, Singapore's success may have led to envy and resentment from certain sectors of the Malaysian and Indonesian populations because of historical reasons. The Growth Triangle represents "a new horizon of ample opportunity to improve the standard of living for (the Indonesian) people".[60] By being an active partner in the Growth Triangle, Singapore can then legitimately stake a claim to the resources of the

58 "A Malaysian's View on Relations with Singapore" in The Sunday Times, 20 Feb 2000
59 "S'pore Signs Water Pact with Indonesia" in The Straits Times, 29 Jun 1991; "Half of Bintan Water for Domestic Consumption" in The Straits Times, 1 Dec 1993
60 "S'pore Signs Water Pact with Indonesia" in The Straits Times, 29 Jun 1991

region. Singapore's present practice of tying water resource agreements to other joint developments in Malaysia and Indonesia is a pragmatic attempt at promoting inter-state interdependence.

Awareness of these criticisms and constraints on its demand for water from Johor has led Singapore to attempt to better manage the water resources it draws from in Johor. However, accepted state practice does not allow Singapore to directly intervene in the management of the catchments in Malaysia and Indonesia in future. The quality of the water is controlled by environmental policies and enforcement practices of the territory in which the water catchments are located. Therefore, pollution control in these catchments becomes an inter-governmental concern, and skilful diplomatic handling of the pollution problem which implicitly recognises the issue of sovereignty over the territory. Failure to manage pollution may make it necessary to close down the treatment plant as was the case at the Skudai Water Treatment Works in 1991 while the problem of pollution is being resolved.

Singapore has been fortunate in that its government has enabled the country to prosper despite the lack of any significant natural resources. Singapore has also been successful in being able to provide a safe and reliable supply of water to its entire population. This is possible only because Singapore's water resources have for many years been supplemented substantially from Johor, as evidenced by the preceding discussion. While Malaysia's supply of water to Singapore is a testimony to good international co-operation and friendship, this relationship has not always been smooth. It must also be pointed out that both the water supply agreements were concluded before Singapore gained full independence, while Singapore was still under British rule. There is a risk that the Malaysian government will decline to continue supplying water to Singapore if this is in conflict with their own interests—even while the relationship with Singapore has been cordial. The same is true for the Indonesian government. This was amply demonstrated in the episode involving the initial Concorde flight from Singapore. The inaugural Singapore Airlines-British Airways Concorde flight from London to Singapore and back on 10 Dec 1977 did not take place even though it was fully booked because Malaysia refused to grant permission for the supersonic jet to fly its skies. The inaugural flight was saved when Indonesia gave permission for the Concorde to re-route over

its air space after an eleventh hour meeting. But this was only for a short while. Indonesia withdrew permission for the Concorde to fly over its skies a week after the Singapore-British joint service commenced. It was only a year later, after numerous talks, that Malaysia and Indonesia gave the green light for the Concorde.[61]

CONCLUSION AND RECOMMENDATIONS

It is clear that despite the implementation of a good water resource management in Singapore it has been and will continue to be difficult for Singapore to be self sufficient in meeting its water needs competitively because of its small size and limited water resources. Even though substantial resources have been invested in Singapore since independence to secure as much of a domestic water supply as possible, Singapore has to continue to rely on Malaysia (and probably Indonesia in the future) to supplement its present water resources and to meet future water needs. This raises serious questions about Singapore's dependency on its neighbours for so vital and strategic a resource. Malaysian and Indonesian water consumption will likely increase because of pressure from population and economic growth. Mismanagement of the water supply system and pollution problems caused by the agricultural sector, industrialisation and urbanisation in the two countries will reduce substantially the surplus water for supply to Singapore. Therefore, there is a compelling need to reduce the level of dependency for the sake of Singapore's security and relationships with her neighbours. Recognising that nations with lower cost of water resources will have a competitive advantage in this century, the options available for Singapore to meet its future water needs are discussed as follows. More than one option may have to be pursued simultaneously to ensure redundancies and safeguard the interests of Singapore due to the strategic importance of water to the security of Singapore.

The first option is to increase the water supply locally by desalination and reclaiming water from treated sewage effluent. The potential for water

61 "Remember when SIA Went Supersonic?" in The Straits Times, 27 Jul 2000

reclamation and reuse in Singapore is great, as 80% to 85% of water supplied by the PUB is discharged into the sewage after use.[62] This means that more than 800,000 cubic metres of municipal waste is available for reclamation each day. With regards to the desalination of seawater, there are various methods currently available and the two universities in Singapore are actively involved in research to help reduce the cost of desalinated water. If Singapore succeeds in pioneering a desalination method to produce potable water at a cost that is comparable to the present treatment costs, it will be able to achieve self sufficiency in water supply and need not rely on neighbouring countries to supplement its water needs. Even if this is not possible, it is strategically important that a few desalination plants be put in operation so that expertise on the operation of these plants can be built up and put to good use whenever the need arises.

Current plans are for Singapore to have three desalination plants by 2011 and these could produce enough to replace the water supplied under Singapore's first water agreement with Malaysia, which expires in 2011.[63] The first such plant will be operational by the year 2005 with a capacity of 136,000 cubic metres (30 million gallons) a day.[64] At the same time, Singapore has been experimenting with the use of water reclaimed from treated sewerage effluent to produce potable water after erecting a S$10 million pilot plant in the Bedok Sewage Treatment Works which has been operational since 2001.

At the same time, the model of the Bedok/Lower Seletar Schemes of collecting surface runoff from urbanised areas should be duplicated in other remaining areas so that the land area harnessed for water resources can be increased further beyond the present level of about 50%. This infrastructure will be developed and operationally ready but will not need to be operated at full capacity if other cheaper sources of water supply are available. In addition, the storage capacity of reservoirs within Singapore should be increased whenever possible to increase the time available to work out a solution in the event of the non-availability of water stored in reservoirs

62 H. E. Tay, G. A. Piggott, Y. S. Bong, A. W. Sharpe and A. J. Killeen, "Infiltration-Inflow Studies of Singapore Sewage Catchments" in Proceedings of the International Conference on Asian Water Technology 94, Singapore, 22–24 Nov 1994, pp. 223–235

63 "3 Water Plants for Singapore by Year 2001" in The Straits Times, 4 May 1998

64 "New Plant Sells Potable Water" in The Straits Times, 3 Jan 2000

in Johor. In this regard, the use of underground space for storing water should be pursued further. Leaks from mains and pipes, which constitutes "Unaccounted-for Water" that has been reduced from 10.6% in 1989 to 6.2% in 1995[65], should be lowered further by the PUB. Ultimately, this going for technology to supplement its water supply is the fallback position for Singapore in its negotiations with Malaysia and Indonesia.

The second option is to further manage water demand in Singapore. While it is inevitable that future water demand will increase because of continued population and economic growth, the rate of increase can continue to be moderated by education and persuasion, fiscal incentives and disincentives, and by administrative and legislative control. Another water management measure that can be implemented is to identify economical usages that are appropriate for the more pollutive surface runoffs that are not being collected by the current storm collection system or treated trade effluent from sewerage treatment works. At worst, this should be a contingency plan to be activated as and when the need arises.

The third option is to resolve as soon as possible the issue of securing more water from Malaysia after 2061. The recent visit to Malaysia by Senior Minister Lee Kuan Yew is an important step in this direction and the response from the Malaysian Government seems to be favourable.[66] Despite the risk of being dependent on Malaysia for part of Singapore's water supply and the occasional hiccup in their relationship, this is still one of the most cost effective sources of water supply. For the last 68 years, this option has worked well for Singapore and Malaysia is also a politically more stable country compared to Indonesia.

65 Ng, et al, "Unaccounted-for Water – Singapore's Experience" in Journal of Water Supply Research and Technology Vol. 46 No. 5 (International Water Association, Oct 1997) pp. 243–251

66 "A Fruitful Four Days for SM Lee in Malaysia" in The Straits Times, 19 Aug 2000; "Daim: We have to Move on" in The Straits Times, 26 Aug 2000

The fourth option is to expedite the installation of a water supply system under the water agreement with Indonesia as and when possible. Strategically, this serves as a backup plan to the water agreements with Malaysia.

The fifth option is for Singapore to explore the feasibility of securing water from water-rich countries in Southeast Asia like Papua New Guinea and Laos. Very large water tankers can be used to transport water back to Singapore just like oil is being transported from the Middle East to other countries. In the twenty first century, water may become a commodity like oil, which can be bought on the international market. If this is a possibility, then it will be advantageous for Singapore to secure necessary agreements with water-rich countries to help establish Singapore as an important water trading hub of the world in the near future.

One key question is how self sufficient Singapore should be for its water supply, and how much water in terms of storage and catchments should it carry to meet emergency needs. From the security viewpoint, Singapore should be as totally self sufficient as possible in a water crisis. Therefore, the water supply system including water catchments to meet Singapore's water needs minus wastage must be in place and operationally ready. However, from the economic competitiveness viewpoint, a 'least cost' water supply system must be relied upon to ensure Singapore's competitiveness. The water supply system in operation must therefore be a balance of the above two considerations. The storage within Singapore of only about four months of the current water consumption is too low and should be increased to the equivalent of one year's supply—this will enable a smooth transition to the totally self sufficient water supply system and the sorting out of any teething problems. Underground storage appears to offer a feasible alternative in achieving this objective. Notwithstanding the above, Singapore must maintain a political environment in Southeast Asia that enables future generations to share in the water resources of her neighbours.

3

Water Spike!

Hydropolitik and Conflict in Singapore-Malaysia Relations

"He [Mahathir] was direct and asked what we were building the SAF [Singapore Armed Forces] for. I replied equally directly that we feared that at some time or other there could be a random act of madness like cutting off our water supplies which they [the Malaysians] had publicly threatened whenever there were differences between us… In [the Separation] agreement, the Malaysian government had guaranteed our water supply. If this was breached, we would go to the UN Security Council. If water shortage became urgent, in an emergency, **we would have to go in, forcibly if need be,** to repair damaged pipes and machinery to restore the water flow. I was putting my cards on the table. He denied that such precipitate action would happen. I said I believed that he would not do this, but we had to be prepared for all contingencies."

Lee Kuan Yew[1]

INTRODUCTION: WATER BLUES – FACT AND FICTION

In the dramatic pulp-fiction tradition of the political thriller genre à la Tom Clancy, Joshua Parapuram's first bold novel, Once in a Blue Moon[2], has given provocative literary expression to Senior Minister Lee Kuan Yew's sombre revelation in his memoirs of a contingency strategy to secure Singapore's water rights through forced entry into the southern state of Malaysia in the event of a cut in vital water supplies to the island state. Cautionary tale and political brinkmanship aside, will Singapore ever really fight a war with Malaysia over water? For some, such a thought may seem almost as improbable as it is imponderable; and talk of it 'irresponsible' even. Surely, the consequences will be too mutually devastating for both sides to contemplate such suicidal action. After all, in an age of global free trade, can alternative water supplies not be sourced from elsewhere should Singapore's northern neighbour decide to turn off the taps for political leverage in the event of a bilateral row? For an answer to that, we might do well to begin with an examination of the larger issue of water as a vital global resource.

Water may be a recyclable resource but it is not an abundant resource. The irony is that though 70% of the world is covered by water, only 3% is covered by fresh water; even then, only 0.3% of it is accessible for human consumption.[3] The global population and industry demand for fresh water makes it a resource that is fast drying up in many parts of the world. Many

1 Lee Kuan Yew, From Third World to First: The Singapore Story 1965–2000 (Singapore: The Straits Times Press and Times Media Pte Ltd, 2000), p. 276 [emphasis is author's]

2 The novel is set some years into the new millennium. In order to secure its water supply, Singapore has gone to war with Malaysia. "Southeast Asia would never be the same again… the first bud of the flowering Singapore story, the unspoken wish, the recurring dream of Singaporeans that one day they could stop being nice to people who did not like them, just because these people controlled their water supply… It was the water. Any other annoyance they could cope with. But not a threat to their water supply." See Joshua Parapuram, Once in a Blue Moon: The Flowering of the Singapore Story (London: Minerva Press, 2000), pp. 15–16. For a political fantasy story-in-reverse, see Douglas Chua, The Missing Page (Singapore: Flame of the Forest, 1999) and Crisis in The Straits: Malaysia Invades Singapore (Singapore: Flame of the Forest, 2001).

3 Sharmipal Kaur, "Every Drop Counts" in The Straits Times, 22 March 2001, p. H6–H7

parts of the world are becoming severely water-stressed.[4] The unprecedented dry spells which hit the U.S., China, Taiwan, central Japan, South Korea, Thailand and India in the early years of the new millennium underscore the gravity and extent of the problem.[5] The global dry spells are aggravated by the pollution of waterways and the over-exploitation of non-renewable underground water resources in many places throughout the world.

Even a tiny littoral state like Singapore has been rated a highly water stressed country given its high domestic consumption and lack of natural water resources and reserves. Malaysia too, despite its seemingly abundant reserves, has also had to face up to the reality that water resources cannot be taken for granted. The severe Kuala Lumpur drought caused by the El Nino weather phenomenon in 1998 caught authorities unprepared and led to six months of water rationing. In early 2002, warning of yet another prolonged dry spell was sounded off by the Malaysian Meteorological Services Department after its 33 monitoring stations nationwide reported a pattern of abnormally low rainfall.[6] The subsequent forest fires in the Klang Valley and in the Riau Province in Sumatra in mid February 2002 were clear symptoms of the unusually dry weather phenomenon sweeping the region. Malaysia's water catchment areas are increasingly vulnerable to unpredictable fluctuations in the seasonal monsoon weather patterns caused by the El Nino effect. As a result, water shortages have become more frequent and threaten to reach national crisis levels.

To ameliorate the situation, nationwide efforts have been underway for sometime now to improve the country's aging network of corroded

4 High water-stress conditions occur when the ratio of use to availability exceed 40%. It is projected that by 2025 mankind will need three times the amount of fresh water that is currently available. See Kog Yue Choong, "Natural Resource Management and Environmental Security in Southeast Asia: A Case Study of Clean Water Supplies to Singapore" in this publication. See also his "Asia's Liquid Assets: The Water Margin" in The Sunday Times, 22 Apr 2001, p. 38.

5 Kim Jih-Un, "Drifting on the Drying Water Pool: China's Water Scarcity and its Political Foreboding" in Asian Perspective Vol. 25 No. 1 (2001), pp. 133–155; see also The Straits Times, 8 Jun 2001, p. 6; 12 Jun 2001, p. 4; 22 Jun 2001, p. A7; 9 Aug 2001, p. A6 and 8 Mar 2002, p. 15.

6 "Water Rationing Looms in Malacca" in The Straits Times, 17 Feb 2002, p. 18; "Widespread Forest Fires Threaten KL Homes" in The Straits Times, 19 Feb 2002, p. A8

7 The Straits Times, 21 Jul 2001, p. A24; 24 Apr 2002, p. A5

water pipes and water treatment plants to reduce wastage through leakage,[7] stop illegal siphoning by water thieves[8] and clean up pollution building up in Malaysia's rivers.[9] In fact, both countries are also working towards reducing pollution into the Strait of Johor. While Singapore is proceeding with its Deep Tunnel Sewerage System project to divert sewage from the three sewage treatment works located in the northern sector of Singapore, Malaysia plans to clean up its rivers in Johor, Sungei Skudai and Sungei Segget.[10] Both countries have also set up a joint monitoring committee to tackle the problem.

As has been well acknowledged, a water crisis, unlike an energy crisis, is life-threatening. The future survival of nations and the fate of communities rest on the ability to access water for livelihood, agriculture and industry. Numerous surveys over the past few years, in particular, have set alarm bells ringing about the coming global water crisis. The prognosis is not good. The supply of water for drinking and other needs is now under threat from river pollution, the destruction of forests and the loss of the world's natural water resources. By 2025, the International Water Management Institute estimates that a third of the world's population will experience severe water shortages with three billion people in 48 countries afflicted.[11] Wars will be increasingly fought over control of water resources. Already there is a well-established trend of conflict over water in human history (see Table 2.1 at the end of this chapter).

---

8 It was recently reported that Johor's privatised water company has lost more than S$12 million to water thieves who have been siphoning water off at housing estates, farms and construction sites. See The Straits Times, 26 May 2001, pp. A34. See also report on "Drought, Illegal Water Pipes Leave Cameron Resort Dry" in The Straits Times, 16 Aug 2001, p. A7.

9 Johor recently announced a S$104 million plan to clean up the Skudai River, which is a major source of drinking water to Johor Baru and Singapore. The river, which runs through the city, has become heavily polluted with human and industrial waste over the years. Owing to pollution, it is no longer tapped for supply of water to surrounding areas, including Singapore. Recently, it was reported that the E-coli (faecal) contamination level has gone up by eight times in the three major rivers in Johor which flow into the Tebrau Strait. The rise in pollution has been attributed to the densely packed squatter colony around the Pasir Gudang area. See The Straits Times, 15 Apr 2001, p. 19 and 11 May 2001, p. A21. See also "Pollution Still on the Rise" in The Straits Times, 23 Apr 2001.

10 "Singapore and Malaysia Committed to Improve Water Quality in the Straits of Johor" in Singapore Environmental News Issue Number 7, Jun 2000

11 Kaur, op. cit, p. 7. See also "Water as a Matter of Life and Death in Mid-East" in The Straits Times, 11 Dec 1999, p. 63.

Recently, in the Middle East, a war was almost started between Israel and Lebanon over the alleged diversion of the Hatsbani River by the latter. The flare-up has subsided for now, after eliciting threats of retaliation by Israel. But it is not likely to go away. Israel is experiencing a major water shortage because of several years of less-than-average rainfall, and Lebanon also faces a serious shortage of water to meet the needs of its local population. Israel also has disputes with all its neighbours over water issues. To be sure, as some have rightly pointed out, "water has always been more incendiary than oil in the parched Middle East."[12]

STILL WATERS RUN DEEP

For those who have been tracking bilateral developments between Singapore and Malaysia, the perennial issue of water is no trifle matter. In recent years following the 1997 Asian financial crisis, water, which has always been a cause of anxiety for Singapore since her separation from Malaysia in 1965, has taken on a more strategically conflicting dimension. This is due in part to the fact that the two water agreements signed in 1961 and 1962 are due to run out by 2011 and 2061 respectively. And up until early September 2001 at least, talks between Malaysia and Singapore appeared to have stalled indefinitely over the conclusion of new water agreements. However, with broad agreements reached over a whole slew of outstanding bilateral issues, it had appeared to some commentators then that a new "deal for the future" had finally been set in motion, following Senior Minister Lee Kuan Yew's visit to Malaysia in early September 2001. But by January 2002, the supposed new deal appeared to unravel, as the Malaysians went "back to the future" by launching a new round of media barrage at Singapore for been exploitative, unreasonable and stalling on negotiations to reach a "fair price" in a new water agreement. The water pressure, ostensibly over polemical pecuniary issues, continues.

12 Abraham Kabinovich, "Mid-East War Almost Starts over Water-pipe" in The Straits Times, 19 Mar 2001, p. 17. See also Paul Williams, "Turkey's H_2O Diplomacy in the Middle East" in Security Dialogue Vol. 32 No. 1 (2001), pp. 27–40; report on "Turkish Men Hit by Water Boycott" in The Straits Times, 17 Aug 2001, p. 5 and Naomi Regan, "From a Distance: Turning the Bloom into Desert" in The Jerusalem Post, 3 May 2001.

Though a political breakthrough could still be reached over the outstanding thorny issues and water, the interminable proclivity for Malaysian leaders to play the water card and the Singapore bogey in order to shore up domestic support and pressure Singapore has heightened the latter's sense of vulnerability for some time now. This has also exacerbated the prickly relations between the two nations previously soured over a host of unresolved bilateral issues.[13] Water, especially when politically exploited as a life-and-death gambit of what I would call hydropolitik, runs like a deep undercurrent through the subterranean caverns of structural tensions between the two neighbouring countries.

Prior to the September 2001 agreement, the urgency in addressing the outstanding water issue as part of a 'package' of other unresolved bilateral issues had been given wide coverage in the local media of both countries. More ominously in the background to this discourse is the question of whether Singapore will actually embark upon pre-emptive military action to secure her water supplies if Malaysia ups the ante by threatening to or actually cut off water supplies. This has been a doomsday scenario that has long figured in the minds of strategic analysts and scenario planners. It has now also cropped up for serious contemplation in the minds of the general population on both sides of the Causeway. The doomsday scenario as deterrent strategy has been figuratively purveyed by popular publications such as Volume Two of Senior Minister Lee's memoirs and country-specific military strategy expositions like Tim Huxley's Defending the Lion City.[14] To be sure, political fantasy novels, like Parapuram's Once in a Blue Moon, have similar potential to fuel the popular imagination and ignite polemical debate.

13 Besides the issue of water supply, relations between Malaysia and Singapore have also been strained over issues like the relocation of Malaysia's Customs, Immigration and Quarantine (CIQ) stations on Malayan Railway Land in Singapore, Malaysia's unilateral Causeway re-building plans and Malaysian's right to withdraw from the Central Provident Fund (CPF). The Central Limit Order Book (CLOB) issue was only resolved after an extended period of class-action negotiations by the affected investors, mostly Singaporean. For an insightful Malaysian perspective into the testy Singapore-Malaysia relationship, see M. Bakri Musa, "That Pesky Neighbour" in The Malay Dilemma Revisited: Race Dynamics in Modern Malaysia (Malaysia: Merantau Publisher, 1999) pp. 229–246.

14 Tim Huxley, Defending the Lion City: The Armed Forces of Singapore (St Leonard, NSW: Allen & Unwin, 2000)

NOT QUITE WATER UNDER THE BRIDGE

The Singapore and Malaysia hydro-link goes back to the turn of the 20th century when the island began importing water from the south Malaysian state of Johor to meet its rapidly growing population and economic needs. That dependency continues till today. Singapore currently draws water from Johor under two agreements: a 1961 contract gives Singapore rights to extract 86 million gallons of water per day (mgd; equivalent to 400,000 cubic metres) from the Pontian and Gunung Pulai Reservoirs, as well as the Tebrau and Skudai Rivers; and under a 1962 agreement, Singapore can draw up to 250 mgd (1.15 million cubic metres) from the Johor River. While the 1962 agreement runs until the year 2061, the 1961 deal expires in 2011, and this has become the focus of current Singaporean concerns over securing her future water supplies.[15] The tentative agreement reached between Senior Minister Lee and Prime Minister Mahathir on water in September 2001 had, until early 2002, looked to have provided some renewed assurance that Malaysia would continue to provide water to Singapore to meet its domestic and industrial needs—at least for the short to medium term. In return, Singapore had offered to pay 15 times more for the water than it currently pays.[16] The initially promising skeletal agreement, if successfully fleshed out and followed through, has the potential to make water less of a contentious issue in bilateral relations over the longer term by putting relations on a more even keel. But does the broad agreement mean that water would soon be 'under the bridge' insofar as Singapore's vulnerability is concerned? Not quite, I would argue, so long as the prospect of water scarcity and dependency (even if partial) are still the order of the day; 'done deal' or not.

Singapore's daily water consumption is about 300 million gallons (1.4 million cubic metres) of fresh water. This comes up to about 500 million cubic metres in one year. Such figures are somewhat alarming, considering the year-on-year increase in water consumption in Singapore. A closer look

15 Azra Moiz, "Singapore – Running out of Water" (1 Nov 1995), available online at: http://worldwaterconservation.com/Singapore.html. See also Andrew Tan, "Problems and Issues in Malaysia-Singapore Relations" in Working Paper No. 314 (Canberra: ANU, December 1997), pp. 16–18

16 The price of the water to Singapore under the current agreement is also being reviewed from 45–60 sen over the present 3 sen. When the 2011 agreement expires, the Malaysian

at Singapore's water resources shows just how much of a premium the island places on water. With no rivers or lakes to tap for fresh water, Singapore's only indigenous source of water is rainfall collected in its 14 reservoirs. This has never been sufficient to slake the domestic thirst, so Singapore has had to turn to neighbouring Malaysia to make up for the shortfall.[17] It gets about half its water from its own reservoirs and catchment areas while the rest is bought from Johor.[18] Though Johor is relatively comfortable with this arrangement for now, Singapore's rising demand for water may even potentially exceed the supply available from Malaysia in the future, given the latter's growing domestic demand from an increasing population as well as its industrial and agricultural development. Furthermore, whether the Johor state authorities will allow Singapore to draw more than the total 336 mgd (1.55 million cubic metres) permitted under the 1961 and 1962 agreements remains a contentious issue. Even though it had appeared that the issue had been broadly addressed and agreed upon in principle by Senior Minister Lee and Prime Minister Mahathir following the meeting in early September 2001, after several earlier rounds of talks on the matter.[19] The details have still to be worked out by officials on both sides before the two countries finally ink any deal.

Singapore's sensitivity to the dangers of water shortage is also historically informed by the Japanese siege and conquest of the island during World War II. And during the tumultuous years of separation and independence from Malaysia, Tunku Abdul Rahman, the then Prime Minister of Malaysia, had told the British High Commissioner in Malaya the very same day of Singapore's independence on 9 August 1965: "If Singapore's foreign policy is prejudicial to Malaysia's interests, we could always bring pressure to bear on them by threatening to turn off the water in Johore."[20] Ever mindful of its strategic vulnerability, the island republic has, over

---

Prime Minister is prepared to offer 100 mgd from 2011 to 2061 at a price of 60 sen per 1,000 gallons, with adjustments for inflation every 5 years. See Ng Boon Yian, "A Deal for the Future" in Today, 5 Sep 2001, p. 1 and Irene Ng, "Tough Talks, Then Progress on KL Pact'" in The Straits Times, 5 Sep 2001, p. 1

17 Azra Moiz, "Singapore – Running out of Water"

18 Sharmipal Kaur, "Every Drop Counts" in The Straits Times, 22 Mar 2001, p. H7

19 Malaysia had assured Singapore of water supply beyond 2061. Beyond 2061, Malaysia would provide 350 mgd (1.633 million cubic metres) at a price of 60 sen per thousand gallons a day (to be reviewed every five years). Singapore now spends 3 sen per thousand gallons daily. See Today, 5 Sep 2001, p. 1.

20 Cited in "Extracts of PM Goh's Speech" in The Straits Times, 6 Apr 2002, p. H9

the past decade, been seeking to sign new legally binding conditions and guarantees with Malaysia before the present agreements expire in 2011 and 2061 respectively. However, negotiations have been fraught with deep political difficulties; as the new Malaysian brakes on the early September 2001 'breakthrough' had again shown.[21]

Time and again, some Malaysian politicians and segments of their constituents have suggested ending water agreements with Singapore whenever there were diplomatic rows over political issues. Threats to "cut off water" resurfaced in early 1997 in an acerbic row with Malaysia over Senior Minister Lee Kuan Yew's remarks on crimes in Johor.[22] The bilateral dispute saw calls by Malaysians to cut Singapore's water supplies as well as threats to freeze bilateral relations amongst other retaliatory measures. The ensuing 1997 Asian financial crisis only made matters worse, as more tensions arose between the two countries when they adopted divergent economic policies to deal with the new economic reality and domestic political challenges; the latter particularly in the case of Malaysia. A series of rows thereafter sent bilateral relations into a steep descent. They included the publication of Senior Minister Lee's first memoirs in 1998, followed by disputes over the

21 Analysts have noted that the change to a tougher stance taken by the Malaysian government highlights that "the political dynamics underlying the deal have changed since September", in that the agreement was reached a week before the September 11 terrorist attacks in the U.S. At the time, Dr Mahathir was under challenge from fundamentalist Islamic opposition and needed the pact to bolster his stature by claiming he had won a breakthrough deal with Singapore. But the events of September 11 discredited Malaysia's Islamic Party, leaving the Prime Minister in a stronger position that enabled him to press Singapore for more concessions. See John Burton, "Malaysia Puts the Screw on Singapore Over Water" in Financial Times, 6 Mar 2002.

22 In an affidavit dated 27 Jan 1997, Senior Minister Lee Kuan Yew mentioned Johor as a state notorious for crimes like shootings, muggings and car-jackings. The remarks were made in an affidavit in a defamation suit against Workers' Party member Tang Liang Hong who had taken political refuge in Johor and failed to return to Singapore to answer defamation charges levelled against him. When the confidential affidavit was inadvertently leaked to the Malaysian media later in March 1997, a barrage of criticisms ensued, threatening to seriously upset bilateral relations. Mr Lee later apologised twice and expunged the controversial statement from his affidavit. The Malaysian government accepted the apology, but the grudge continued to play out in the Malaysian media for the months to follow. See Barry Porter, "Move to Water Down Island's Vulnerability" in South China Morning Post, 11 Jun 1997.

CIQ, CPF and CLOB. Malaysian calls to terminate Singapore's water supplies reached new levels of audibility and acrimony. However, such familiar sabre-rattling did not translate into unilateral punitive action insofar as water was concerned. Otherwise, the consequences would have been potentially catastrophic for both countries.

In May 1998, Singapore's statement over the guarantee on the quality of water from Malaysia created another stir amongst Kuala Lumpur officials. Singapore's National Development Minister Lim Hng Kiang had said that treated water sold by Malaysia must be accompanied by certain guarantees to ensure that its quality was as good as that which Singaporeans were already consuming. He added that the Republic would buy treated water from Malaysia only when it was certain that safeguards had been put in place.[23]

Malaysian government officials retorted that Singapore had until then never raised with Kuala Lumpur the question of a Malaysian guarantee to safeguard the supply of treated water to the Republic. They criticised Minister Lim's statement as tantamount to questioning Malaysia's ability to treat water satisfactorily. As one Malaysian official reportedly put it: "Are they trying to say that we are not able to produce water for them when we are able to provide water for a 20 million population?"[24] Malaysian politicians had also stepped up periodic calls for the water pacts to be dissolved, and for Johor not to rely on Singapore for treated water. Malaysia has since followed up with plans to build the $S315-million Semanggar water treatment plant located near Kota Tinggi in Johor to replace the southernmost Malaysian state's reliance on Singapore's water treatment facilities.[25] Johor has also cut down its purchase of treated water from Singapore since 1995 and had announced publicly several times its decision to stop buying treated water from Singapore altogether when its own plant is ready by 2003.[26]

23 The Straits Times, 4 May 1998
24 The Star, 8 May 1998
25 The Straits Times, 19 Aug 2000
26 The New Straits Times, 21 Dec 2000; Agence France Presse, 22 Sep 2000; The Straits Times, 1 Feb 2002, p. A30

In another apparent tit-for-tat, Malaysia has sought to impose its own conditions on any new water supply agreements with Singapore. In July 1998, Malaysia announced that it had agreed in principle to supply water to Singapore but with conditions imposed. As Datuk Seri Dr Mahathir Mohamad ambiguously put it then: "We couldn't reach an agreement on the details. In principle we have reached agreement… Even between states in Malaysia, it is difficult to resolve the problem of supplying water from one state to another."[27]

Although Dr Mahathir had denied that there was any relation between the Singapore Central Provident Fund (CPF) issue and the water supply issue at that time, it was perhaps telling that just one week before the issue was raised, the Malaysian cabinet had urged Singapore to allow Peninsular Malaysians who had stopped working in the Republic or had been retrenched to withdraw their CPF savings.[28] Such strident calls came at a time when Malaysia was reeling badly from the full impact of the 1997 Asian financial crisis.

Another major problem in the ongoing discussions by Singapore to secure a new 100-year water deal with the Malaysians is the dispute over the reneging of agreements. On 7 June 1999, fresh tensions erupted between Singapore and Malaysia over a proposed long-term water supply agreement. Singapore accused its neighbour of reneging on previous deals reached previously between Singapore's Prime Minister Goh Chok Tong and his Malaysian counterpart Dr Mahathir Mohamad under the Framework of Wider Cooperation, and for leaking details from confidential negotiations to the media in order to distort the picture against Singapore. As the Singapore spokesman complained, the Malaysians "have insisted on starting

27 Ruben Sario, "Malaysia's Conditions for Water Supply" in The Star, 8 Jul 1998

28 ibid.
It was reported that these workers had savings totalling some RM1 billion in the CPF. The CPF Board allows Malaysians from Sabah and Sarawak to withdraw their savings when they end their contract in Singapore. However, in the case of Malaysians from the peninsula, the CPF Board only allows them full withdrawal of their savings when they reach the age of 55.

the negotiations from scratch and made many new demands."[29] The spat stemmed from disagreements over future volumes of raw water supply and pricing. The Malaysians had earlier accused Singapore of profiteering in the resale of water and refused to commit huge volumes of raw water in the next deal, arguing that they have to look after their own needs first. Singapore had consistently refuted the profiteering charges, asserting that it sells water at below treatment cost with substantial subsidies to Johor as stipulated in the original agreements.[30] Singapore also rejected the suggestion that Singapore's request for 750 million gallons (3.4 million cubic metres) of water a day by 2161, compared to around 336 million gallons (1.55 million cubic metres) at present, was excessive. Citing Taipei and Bangkok as models, Singapore argued that its requirements were "based on projections of our population growth and economic requirements and our estimated per capita water consumption in the year 2061… In any case, we have always told Malaysia that our request for water beyond 2061 is contingent on Malaysia satisfying its own needs first." Singapore has also voiced its interest in obtaining future water supplies from Pahang, another Malaysian state, which has indicated

29 Agence France Presse, 22 Sep 2000; see also Ivan Gan, "Again, Testy Neighbours' Ties Hit a Snag" in Asia Times, 28 Jul 1999

30 Singapore's government has robustly countered Malaysia's charges as follows:
Johor buys treated water at a discounted rate. Singapore is subsidising Johor to the tune of RM29 million a year by selling it treated water at a reduced rate. It cost Singapore RM2.40 to treat 1,000 gallons. But Johor buys the water from Singapore for only RM0.50, which is the price stated in the treaties. Johor then sells the water to its own people at an average price of RM3.95. Singapore is thus effectively subsidising the Johor government RM1.90 per thousand gallons. This enables the Johor government to earn some RM29 million of extra profits per year, at recent exchange rates. Singapore consumers paid more for their water because they did not enjoy this subsidy. Singapore's higher water tariffs were to encourage conservation and help pay for costly desalination plants. Johor is voluntarily buying more than double the amount of water that it has a right to. Singapore is required to sell Johor only 15 million gallons of water a day. If the price is unreasonable, Johor is not obliged to buy treated water from Singapore. But Johor buys an average of 37 million gallons of treated water per day from Singapore. Responding to suggestions that Singapore was profiting by selling the water commercially, the Singapore authorities argue that this was entirely within Singapore's rights. Singapore has pointed out, however, that most of the treated water was sold back to Johor or consumed domestically. Water sold to ships calling at Singapore made up less than one per cent of the total demand and attracted the highest tariffs so as not to encourage this demand.
See "Singapore Sells Subsidised Water to Johor" in The Straits Times, 6 Sep 1998.

its willingness to secure a lucrative water deal.[31] Even if it is economically viable and mutually desirable, it is clear that any inroads into such water deals with the other Malaysian states beyond Johor is unlikely to be free of political obstacles, and will ultimately require the imprimatur of the Federal Government in Kuala Lumpur.

Singapore's chronic dependence on Malaysia's water has also opened its economy for further exposure to the vicissitudes of hydropolitik. Now that Malaysia is rapidly emerging as a competitor in semi-conductor production—one of the world's most water-intensive industries—there is, according to some analysts, potentially greater economic impetus to tinker with Singapore's water supply. With Malaysia set to become a serious competitor for wafer manufacturing, its faucet control puts Singapore at a major disadvantage. In negotiations for the new water contracts, Malaysia has insisted that Singapore buy treated water, which is more expensive. Any increase in Singapore's water costs will ultimately drive up the cost of wafer production.[32] As it currently stands, Singapore and Malaysia are still negotiating the final ratio of raw to treated water after 2061.[33]

Singapore's vulnerability was again highlighted from an unexpected angle in late November 2000 when former Indonesian President Abdurrahman Wahid charged that Singapore was profit-minded,

31 "Fresh Singapore-Malaysia Row Erupts over Water Supply" in Agence France-Presse, 8 Jun 1999; "Pahang Wants KL to Handle its Water Pact with Singapore" in The Straits Times, 30 Apr 2002, p. A7.

32 Chip production is currently one of Singapore's most dynamic growth industries, despite several years of decline. In 1999, the semi-conductor sector grew more than 20%, leading the electronics industry, which represents more than half of the country's manufacturing. Manufacturing itself encompasses 25% of GDP. One of the largest chip companies operating in Singapore, Chartered Semiconductor Manufacturing, increased its sales to $694.3 million, a 64% gain from the previous year. See analysis report "Singapore Seeks to Break Reliance on Malaysian Water" at Stratfor.com, 14 Mar 2000; see also The Straits Times, 15 May 2001, p. S12.

33 Prime Minister Mahathir had offered Singapore 100 mgd a day of raw water and 250 mgd of filtered or treated water which will be a joint venture between Johor and the Public Utilities Board. Singapore is asking for 150 mgd of raw water and 200 mgd of filtered water. See The Straits Times, 5 Sep 2001, p. 1.

manipulative and underestimated the Malays. Speaking to a closed-door audience at the Indonesian embassy in Singapore, he revealed that after conferring with Dr Mahathir at an ASEAN Heads of Government Meeting, he had suggested that Indonesia and Malaysia jointly withhold water supply to the island republic, so as to teach it a lesson.[34] His remarks were subsequently watered down following the launch of a lucrative and long-term gas deal between Singapore and Indonesia on 15 January 2001.[35] But they have nevertheless left a deep mark in the Singaporean psyche. The ex-Indonesian leader's unexpected outburst coupled with perennial problems with Malaysia over water has no doubt stiffened resolve amongst Singapore's security managers to break out of the hydropolitik cycle that has plagued Singapore's relations with its northern neighbour; which has also shown similar potential for political entanglement with her neighbour to the south. The latter is all the more perplexing for Singaporean authorities given that the island state has been seriously exploring the possibility of sourcing alternative water supplies from the Indonesian Riau islands since the early 1990s.

34 Specifically on the issue of water, President Wahid's comments are pertinent in providing an insight into the logic of hydropolitik: "Now, let me turn to water. I met PM Mahathir this morning during breakfast, I asked why he did not control the water supply to Singapore. Singapore only pays 3 cents for 1,000 gallons of water and they resell it for $20. So, we have been manipulated by Singapore. If we withhold the water supply, Singapore won't have any more water. Don't be afraid. Our interests should come first. The interests of other people should come second." For a transcript of his speech given on 25 Nov 2000, see The Straits Times, 27 Nov 2000, p. A8.

35 Following his attack on Singapore, President Wahid attended the ceremony held in Singapore on 15 January 2001 to mark the first delivery of gas from the West Natuna gas field; it was a deal which Singapore had earlier signed with the Habibie government in January 1999. Worth US$8 billion in revenue to Indonesia, the deal was for West Natuna to supply gas to the island state over the next 22 years. Another deal to buy almost US$7 billion of natural gas from Sumatra over 20 years is still being worked out. The gas deals will eventually form part of a pan-regional gas pipe-line for Southeast Asia (ASEAN PowerGrid) that has been endorsed by ASEAN members. See The Straits Times, 14 Mar 2001, p. 11; 15 Feb 2001, p. S13; 16 Jan 2001, p. H4.

SEEKING A WAY OUT OF THE WHIRLPOOL

Given that hydropolitik continues to be the sword of Damocles that hangs over relations between Singapore and Malaysia, the search for alternatives has become all the more urgent. In recent years, the momentum has been gathering speed as the end of the first water agreement beckons in 2011.

The Singapore government announced a series of initiatives to make the Republic less dependent on Malaysia for water on 10 June 1997. Consistent with the water management policy of the past decades, Singapore has incrementally raised and re-structured water tariffs to encourage Singaporeans to treat water as a precious and strategic resource, and make water conservation a way of life. Singapore's Public Utilities Board (PUB) believes the answer to long-term water conservation lies with changing behaviour patterns and not just with monetary disincentives. To impress upon the public the necessity of conservation, the PUB has been spearheading annual "Save Water" campaigns. Working closely with the Economic Development Board (EDB), the PUB has also encouraged industrial users to conserve and recycle water through legislation and economic incentives. However, water conservation alone will not ensure that future water supplies meet rising demand. Building more reservoirs is also not feasible in land-scarce Singapore and damming the sea between islands would not provide a big enough catchment area for rainfall.[36]

To overcome the natural constraints, Singapore's Public Utilities Board and the Ministry of Trade and Industry (MTI), which oversees the PUB, has been actively exploring innovative options for other sources of water supply. Three main ideas and projects have focused the minds and efforts of Singapore's water managers. They are the build-up of domestic water catchment and advanced treatment capacity, the importation of water from Indonesia and the desalination of seawater.

36 Moiz, op. cit., n. 15

Building Up Domestic Water Catchment and Advanced Treatment Capacity

Singapore has introduced strict pollution control measures and successfully turned half of the island's total land area into catchment areas for the collection of stormwater. All Housing and Development Board (HDB) New Towns have been constructed with a complex stormwater collection system. The stormwater collection scheme comprises collection ponds, pumping stations and connecting pipelines to collect rainwater that would otherwise be lost. Non-traditional water treatment technology like recycling sewage for industrial use is also undergoing trials.[37] In fact, Singapore's fledgling wafer fabrication industry has been targeted to receive recycled sewage water, called NEWater, by the end of 2002. NEWater is ultra-purified treated sewage water that is reportedly even purer and of a higher grade than drinking water. The two NEWater plants to be built at the Bedok and Kranji water reclamation plants would eventually supply reclaimed water to the Tampines-Pasir Ris and Woodlands wafer fabrication plants. With a combined capacity to treat up to 10–14 million gallons (45,000–65,000 cubic metres) or about 18–25 Olympic-sized swimming pools of water daily, this new additional water source for industrial use will potentially free up more of Singapore's freshwater supplies for drinking.[38] By 2010, 55 mgd (257,000 cubic metres) of fresh water is targeted to be made available for drinking, thanks to NEWater. Towards that end, the country's four semi-conductor parks, which will eventually consume 15% of Singapore's water supply, have been earmarked for the NEWater resource. Some earlier media reports had raised some initial concerns that NEWater might be too pure for semi-conductor plants, as the slightest difference in water, even a lack of certain

37 Kaur, op. cit., n. 3

38 The PUB and the Environment Ministry began operating an advanced water treatment plant in Bedok in May 2000 which can treat 10,000 cubic metres of water a day. See The Straits Times, 17 Jul 2001.

trace chemicals and minerals, could throw off a plant's processes.[39] But in a significant seal of confidence highlighting its long-term potential, the PUB has since managed to sign a deal with all seven wafer fabrication plants in Singapore to switch from potable water to NEWater.[40]

Importation of Water from Indonesia

Tapping Indonesia as a future water source would be a natural extension of Singapore's tradition of relying on its neighbours. In 1991, Singapore signed a memorandum of understanding with Indonesia to jointly develop water resources in the Riau province and Sumatra. The agreement, when actualised, would allow Singapore to potentially draw up to 1,000 mgd (4.5 million cubic metres) of water from Bintan island in the Riau archipelago and from Sungei Kampar in Sumatra. Again, the devil is in the details. While the potential supply is huge, the high cost of the infrastructure to transport the water to Singapore has been reported to be prohibitive. On a cubic metre basis, it was assessed that transportation costs of Indonesian water to Singapore could increase the current cost of water by five to eight times.[41] At the turn of this century, water from Indonesia has not yet begun to flow due, in part, to the continued occupation of water catchment areas in Pulau Bintan by local squatters.[42]

---

39 With the semiconductor industry and their shareholders initially uncertain over the suitability of using NEWater, not to mention the image issue over the use of recycled sewage water, the switch to NEWater apparently took some convincing. As Sunny Chan, vice-president of Tech Semiconductor put it: "But if I use this new water, if it fouls up my plant, it will create more burdens for my shareholders." See Mahlon Meyer, "Nor Any Drop to Drink" in Newsweek, 16 Jul 2001, p. 17.

40 Irene Ng, "Wafer-Fab Plants Opt for Recycled Water" in The Straits Times, 31 Aug 2001. See also Sharmilpal Kaur, "Water Supplier has Burning Ambition" in The Straits Times, 19 Sep 2001, p. H6.

41 Moiz, op. cit., n. 15

42 "Singapore, Indonesia Sign Pact to Develop Water Resources in Bintan" in Singapore Bulletin, Apr 1992, p. 13; Narayanan Ganesan, "Malaysia-Singapore Relations: Some Recent Developments" in Asian Affairs: An American Review Vol. 25 No. 1, (Spring 1998), p. 26; cited in Huxley, op. cit. (2000), pp. 51-52.

Question marks over the quality of the fresh water and the potential escalation in cost remain. Nevertheless, the possibility of drawing water from Indonesia is still held out by the Singapore authorities. Negotiations and feasibility studies are still currently underway to determine the minimum quantity of water to be drawn and to settle on a price acceptable to both sides.[43] Riau province officials have been talking to several Indonesian companies about supplying affordable water to Singapore and are hopeful of putting forward a proposal to Singapore by 2002, although such plans still remain at a preliminary stage with no definite timetable.[44]

Desalination

In addition to the above measures, the Singapore government announced initiatives to start developing desalination plants back in 1997. A Singapore government spokesman explained that: "To prepare for all eventualities, we need to start building desalination plants."[45] To date, the PUB has called for pre-qualification tenders for a 20-year contract to build a desalination plant that will produce 30 million gallons (136,000 cubic metres) a day. The private sector will own, build and operate the proposed plant by 2005. A novel hybrid method of desalination, combining distillation and reverse osmosis, has been assessed to be the most cost effective. This tender represents a real opportunity for the building of a dual plant that can marry power (natural gas) and water. Also known as "co-generation", it is a process that combines the production of power and water. In fact, co-generation has been a main technical feature of the water-scarce Middle East as early as the 1970s.[46] The cost of desalinating water has come down to the extent that it could soon be cheaper for Singapore to desalinate seawater than import fresh water. Four years ago, the cost was US$1.80 per cubic metre. The cost is about US$0.70 now. In a few years, when Singapore becomes a major user, it could go down to as low as US$0.50 per cubic metre.[47] Given the timely

43 The Straits Times, 19 Apr 2001, p. H3; 25 May 2001, p. 8.
44 Robert Go, "Indonesia Gears Up to Supply Water to Singapore" in The Straits Times, 6 Nov 2001, p. H9
45 Porter, op. cit., n. 22; see also The Straits Times, 19 Sep 2001, p. S10
46 In 1995, it was reported that a joint PUB/MTI team had visited desalination plants in Saudi Arabia, the United Arab Emirates and Malta to examine the feasibility of desalination; see Moiz, op. cit., n. 15
47 The Straits Times, 15 Mar 2001, p. H2

confluence of maturing hydro-technologies with declining economic cost and pressing strategic need, Singapore, it is said, is poised to be an important centre for the desalination industry in the years to come. In the meantime, it is assessed that factors like final cost effectiveness, extensive land use, high energy consumption and poor seawater quality will pose no small challenges to be overcome before desalination can take off in a big way for Singapore.

Besides the above measures taken so far, other developments in the field of freshwater resource 'marketing', water treatment and water prospecting also offer promising new alternatives for Singapore.

Another Possible Source of Blue Gold?

Canada, the world's second largest country with between 9% and 20% of the globe's fresh water, is presently exploring the possibility of exporting its potentially lucrative "blue gold".[48] Far-flung but not entirely far-fetched, watershed developments in such non-traditional hydro resources may yet hold out the possibility of Singapore acquiring such alternative long-range supplies of fresh water in the future. This is especially important if the need becomes pressing and water importation proves to be technically viable and the costs not too prohibitive over the long run.

Ultrasounding Seawater

Singapore's Environmental Technological Institute (ETI) and an American oil company have reportedly teamed up to bring a new form of seawater processing to Singapore. The new method crystallises salts when seawater is passed through ultrasound waves twice. This new efficient method, it is reported, cuts out the need for desalination where large amounts of

48 The Straits Times, 20 May 2001, p. 8

energy are used to remove salt from seawater. It could even slash the cost of producing drinking water by about 90% from the current S$1.20 used to process a cubic metre of saltwater using different methods to about 10 cents.[49]

Underground Water Prospects

In another exciting development, civil and environmental engineering researchers in Singapore recently announced that an underground reservoir with potentially 35,000 swimming pools (70 million cubic metres) of fresh water could be a viable and substantial source of water to help meet Singapore's long-term needs. This underground reservoir sits below 25 square kilometres of reclaimed land in Changi. It was inadvertently created by land reclamation in the area over the years, which have resulted in rock and sand formation—called aquifers—that can store water underground. The reclaimed land acts like a natural reservoir by collecting and filtering rainfall in small hollows within the sand mass. The challenge remains to extract water from the aquifers safely without disruption to land in the surrounding areas. Although the findings are still preliminary, more research will be conducted to confirm the technical feasibility of extracting the underground water and using it, as well as the tapping of potential aquifers in other reclaimed areas throughout the country.[50]

Singapore is therefore closely tracking and carefully accessing emergent hydro-technologies and developments for future applications. There is even the radical possibility, however remote for now, that nuclear power plants may someday be able to provide safe and abundant energy necessary for full-scale desalination to meet Singapore's long-term water needs, sans hydropolitik.[51] But for now at least, it has been targeted that by 2010, 15%

49 Sharmilpal Kaur, "Ultrasound may Make Waves in Sea-Water Processing" in The Straits Times, 11 Sep 2001, p. H3

50 Natalie Soh, "Underground Water Found" in The Straits Times, 30 Apr 2002, p. 3

51 Kenneth Mak, "Create an Independent Water Supply for Singapore" in The Straits Times, Forum page, 7 Feb 2002, p. 17; Peter Hardstone, "Nuclear Power for Desalination Not the Answer" in The Straits Times, Forum page, 8 Feb 2002, p. 23

of all water in Singapore will come from alternative sources like desalination and the recycling of sewage water into NEWater. For Singapore, water, energy and security will then become intricately linked together. As has been well said, "If you have power, you can create water. If you have water you can create security… The 20th century was driven by oil, and in the 21st century, water will be the most important resource."[52]

On that last point, Singapore's annual domestic water consumption has grown at an average of about 3%; notwithstanding a low fertility rate with a declining trend in indigenous population growth. It is not certain that this consumption demand will necessarily taper off or stabilise substantially in tandem with a slowing population growth. If Singapore's initial official request to Malaysia for 750 million gallons (3.4 million cubic metres) of water a day beyond 2061, compared with about 336 million gallons (1.55 million cubic metres) at present (with justifications for doing so based on projections of population growth, economic requirements and estimated per capita water consumption in the year 2061), provides an accurate indication, then the long-term demand for water is set to grow considerably; not dwindle or stabilise.

For now at least, domestic supplies may be sufficient to meet household requirements, but they will become hard pressed to meet the needs of the industrial sector over the long term.[53] With parallel increases in domestic energy consumption as a result of steady economic growth resulting in a larger population base aspiring towards an ever higher standard of living, the pressures on securing reliable alternative and non-traditional water sources can be expected to increase in the future. This situation will be potentially compounded if a new agreement is not reached when the 1961 water agreement water contract with Malaysia expires in 2011. Even though this agreement supplies 86 mgd of raw water compared to the 1962 agreement of 250 mgd, it is still a substantial amount; notwithstanding

52 Leon Awerbuch, Technical-Programmes Chairman for the International Desalination Authority, cited in The Straits Times, 21 Mar 2001

53 Water consumption by the manufacturing sector has been growing at an average annual rate of 7.3% over the past decade. See Stephan Helgesen, "Singapore – Water Conservation & Recycling Systems", available online at: http://www.tradeport.org/ts/countries/singapore/isa/isar0022.html

that Singapore should be able to provide up to 85 mgd of water from both desalination and NEWater by 2010 to cover the 1961 agreement. But it is not exactly a foregone conclusion that the multi-pronged domestic measures taken so far will ensure that Singapore be sufficiently comfortable for the moment or even beyond 2011. The problem may still be exacerbated if the latest Malaysian offer of 100 mgd (from 2011 to 2061) under a new water agreement is not satisfactorily followed through.

It can, however, be conceded that hydropolitik pressures can be reduced somewhat and endured for a longer period of time (up to four months, according to some estimates) if contingencies and alternative measures taken so far by Singapore's water managers are able to deliver on their promises, and there is no severe drought on the horizon.[54] Nevertheless, one should be mindful, when trumpeting the hydro-technology alternatives and strategies being put in place, that the measure touted so far seek principally to cover the first (1961) agreement of 86 mgd, which expires in 2011. There is still the all-important 1962 agreement (expiring in 2061) which supplies the much more substantial 250 mgd that remains to be addressed in the longer term; although political will is certainly not lacking on the part of Singapore's authorities to overcome the challenge. While it is one thing to note that Singapore's water managers have been judiciously putting in place measures to improve Singapore's self-sufficiency—with more plans to follow—it is quite another to suggest that because of those incipient measures, water will soon be discoursed in simply pecuniary terms and non-securitised ways.

There remains lurking in the background to the contemporary discourse over the potential of a water conflict, the spectre of a sudden unilateral abrogation of all the water agreements in the event of extreme bilateral political tensions. Even if such action is highly unlikely, given the

54 The possibility of a drought cannot be written off in a region that has seen extreme variations in weather patterns over the past decade. The forest fires and resultant haze have become almost perennial problems in the Southeast Asian neighbourhood. Further to the north of the Asia-Pacific, Taiwan's hi-tech sector was threatened by water shortage in early 2002, as the island faced its most serious drought in 20 years. The Taiwanese Government undertook emergency measures like diverting water for farm use to the city in order to keep critical economic infrastructure like industrial parks running. It was reportedly even considering taking the unprecedented step of importing water from the mainland by boat, even though Taiwan has resolutely rejected the long-standing offer by the mainland to sell water to the island. See The Straits Times, 1 Mar 2002, p. A4; 3 Mar 2002, p. 16; 25 Apr 2002, pg. A2; 8 May 2002, p. A2.

mitigating atmospherics, particularly as such action goes against the self-interested calculus of economic rationalism and spirit of mutually beneficial co-operation, it cannot be entirely discounted. Caught in such a predicament, water remains a 'securitised' issue of concern for Singapore's long-term national survival, and seeking a definitive way out of the whirlpool remains an on-going struggle that is not yet over.

AT THE SHARP END OF THE WATER'S EDGE

For the indefinite future at least, the security dilemma posed by the opening question remains salient. Will Singapore go to war with Malaysia over water? Or posed somewhat differently: Can Singapore afford not to initiate forward defensive action as soon as warning indicators alert that Malaysia is taking serious action to turn off the taps? The answer to the latter question would seem to be a calculated yes, if one were to look at the steady progress made in building up indigenous water supplies to absorb the shock of a sudden cut in supply.

Domestic water supplies, judiciously built up through some of the measures mentioned above, and water rationing should be able to provide at least a short buffer period for diplomatic solutions before water becomes too critical an issue of national survival. Such a sanguine reading has also been somewhat alluded to by Tim Huxley in his latest book.[55] Huxley, a long-time observer of Singapore's military developments, argues that over the years, Singapore has rapidly built up the absorptive capacity to cushion a first blow before launching retaliatory action thereafter.

In other words, the argument is that the SAF no longer needs to rely solely on a pre-emptive operational strategy. The huge investments in protective building technology and Total Defence strategy over the years would have no doubt enhanced Singapore's national resilience across the spectrum from critical infrastructure to social psychology. Furthermore, it stands to reason that by delaying the military option in the face of hostile action enforcing a water siege on the island, Singapore may then be able to gain wider international support, which a pre-emptive strategy might not have worked as well in mustering. Jus ad bellum—just cause for going

55 Huxley, op. cit., n. 14

to war—would then seem to favour the victim of threats and aggression or the defensive side. However, the cautionary note is that the perceived need to hold back military action to gain international support need not be an overriding consideration when a state's very survival and existence is perceived to be gravely at stake.

Any decision to deploy the SAF will largely hinge on strategic imperatives like whether sufficient alternatives are readily available or reliable as well as whether the loss in water supply is assessed to be so vital and protracted as to cast the entire nation irretrievably into dire straits. As is already well-established under international humanitarian law, which applies to armed conflicts—in particular the 1977 Protocol of the Geneva Conventions—it is illegal to starve civilians as a method of going to war. Such a threat or act of siege alone should be sufficient grounds for casus belli with jus ad bellum. Of course, on the other hand, the benefits of holding back long enough for diplomatic action to resolve the dispute or rally up international support would seem to be a prudent and logical one. In any case, it is in neither Singapore's or Malaysia's interest to seek military solutions to bilateral problems. Other more established conflict resolution mechanisms and pacific norms of preventive diplomacy should come into play first.

Huxley had rightly observed that the SAF's raison d'être is deterrence and should deterrence fail and the SAF is forced into action by strategic necessity, it would be a regional "doomsday machine"[56] that will be disastrous for all parties involved in the conflict. And up till now at least, Singapore has demonstrated its credible resolve and its "neighbours understand only too well that any direct interference with its vital interests (such as its water supplies or its sea lanes) would court military response. Singapore is not the Israel of Southeast Asia, but it has sent strong signals since the later 1960s that it is willing, in extremis, to risk assuming that status,"[57] especially in the event that it is cornered with unambiguous acts of aggression to its vital national interests and survival. Singapore is, assuredly, not Israel and has no desire to be corralled into the latter's unenviable predicament. Nevertheless, its resolve and capability to defend its interests should not be underestimated either.

---

56 Tim Huxley, "Singapore and Malaysia: A Precarious Balance?" in Pacific Review Vol. 4 No. 3 (1991)

57 ibid., p. 249

Given the grave stakes and stark strategic choices, it is not unreasonable to assume or wish, as some have, that Singapore may someday be able to eliminate water as one of Malaysia's most valuable bargaining chips. This should then give the city-state greater leverage in negotiating sensitive border agreements concerning immigration and air space. Non-traditional sources as well as the innovative desalination technology outlined above may yet enable Singapore to tap alternative water supplies, stealing Malaysia's long-time trump card.[58] From the broad-based measures highlighted earlier above, it is clear that Singapore is seriously seeking alternatives to avoid the costly view that armies are the only way to solve water conflicts. The provision of reliable and alternative water supplies makes for more policy options and flexibility of action, delaying or diminishing the reliance on purely military responses. To be sure, this is a positive and stabilising development that can mitigate any bilateral rows over water. In fact, this realisation has been articulated by Singapore's Prime Minister Goh Chok Tong's recent remarks in Parliament that Singapore is taking a hard look at a "new approach" which seeks to reduce dependence on Malaysian water. As he had put it:

> "I think it is high time we explore a different approach to water supply from Malaysia. I do not want our relations with Malaysia to be always strained by this issue. It is not healthy to be always locked in dispute. It is unwise to allow this one issue to sour bilateral relations at all levels and on all fronts. It prevents us from co-operating in strategic areas of mutual benefit… It may be better for bilateral relations if we start to move a little away from our reliance on Malaysia for water. This is doable if we have to."[59]

Meanwhile, as Singapore's new approach to water finds its level, it is equally clear that much work and uncertainty still lies ahead for the island republic in the area of securing adequate vital water (and food) supplies for the medium term. Until Singapore is able to build-up truly robust absorptive and sustainable capacities—such as greater self-reliance and secured alternatives in vital water supplies—the military option, however

58 Stratfor.com, 14 Mar 2000

59 Tan Tarn How, "Water: Singapore to Rely Less on KL" in The Straits Times, 6 Apr 2002, p. 1; "Extracts of PM Goh's Speech" in The Straits Times, 6 Apr 2002, p. H9; Chua Lee Hoong, "Greater Self-Reliance in Water is the Way to Go" in The Straits Times, 10 Apr 2002, p. 17

unthinkable and undesirable, remains a last resort in the event of a water siege on the Lion City. Therefore, for all intents and purposes, Singapore's deterrence strategy, premised on a Forward Defence Doctrine, encompasses not just defence of the homeland, but also extends beyond its borders towards the defence of its vital lifelines like water resources and the sea lines of communications.

The prevailing belief amongst Singapore's security managers is that having a credible deterrence force can be a strong stabilising equation in damming the vacillating currents of hydropolitik. As Singapore's Senior Minister Lee Kuan Yew had stated: "A credible defence capability helps lower the risk of rash political acts. Whenever they were displeased with us Malaysian leaders regularly uttered threats in the press to cut off our water supply."[60] Recently, he expressed guarded optimism on the issue when he said: "I don't think that Malaysia would so easily turn off the tap… No rational government would want to take a step that would lead to intervention by the UN Security Council, and then action by us to protect our interest and self-defence. It's not something you do without consequences."[61]

In the extreme event that the island republic is forced to take the drastic step of securing its water supply, the strategic military option for a small state appear transparent enough, as many defence analysts have pointed out. In proposing his "third" theory of conventional deterrence, Mearsheimer had argued that while deterrence incorporates assessments of weapons type and balance of force ratio, it is also the direct function of specific military strategies.[62] In particular, he identifies three types of deterrence strategies: Attrition, Blitzkrieg and Limited Aims strategies. It is with the Blitzkrieg and also Limited Aims strategies that Singapore's conventional military strategy vis-a-vis Malaysia has to be assessed. To some extent, Huxley's analysis would appear to confirm Mearsheimer's work on conventional deterrence, if the much touted SAF's strategy of blitzkrieg (deep-strategic penetration) with limited political aims—like securing vital water supplies—is indeed held to be true. To be sure, strategic logic and survival imperatives dictate that any small and overexposed island nation like Singapore can ill afford to fight a

60 Lee, op. cit., p. 46
61 Irene Ng, "A Deal is a Deal, Let's Move On" in The Straits Times, 6 Sep 2001, p. 1
62 John Mearsheimer, Conventional Deterrence (Ithaca & London: Cornell University Press, 1983), p. 28

defensive war of attrition, especially when low intensity conflict, terrorism and "phoney war" strategies of asymmetric engagement are factored into the equation.

Therefore, one should not be too hasty in reading too much into Huxley's suggestion that "Singapore now envisages the possibility of absorbing an enemy's first strike before using the SAF to strike back hard and decisively"[63] as the adoption of a new doctrinal strategy. And in the context of this paper, one should not overestimate the sustainability of water measures still in the process of being put in place by Singapore, and thereby underestimate the latent dangers of a water conflict. Prudent intellectual pause is necessary if one is to avoid prematurely buying wholesale into the triumphalist promise of hydro-technology and rhetoric of self-sustainability. Furthermore, any blatant act of aggression like (the explicit threat of) "turning off the taps" will ipso facto be accompanied by military posturing. This will invariably escalate tensions and elicit defensive action.

Given Singapore's lack of strategic depth, open economy, and large disparity in physical size and close proximity with Malaysia, holding back in the event of a clear and present threat to its lifelines in the event of a conflict would likely pose less room for subsequent operational manoeuvre. This problem is further compounded when one considers the prescient observation made by the late Michael Leifer. He had warned in his last book that the strategic balance between Singapore and Malaysia would fundamentally alter if the latter bought land-to-land attack missiles by "putting the island-state at strategic risk and so obliging Singapore to contemplate a matching capability that could reach Kuala Lumpur."[64]

This scenario has now come to pass with Malaysia's recent acquisition of the Multiple Launch Rocket Systems (MLRS) and long-range artillery guns.[65] Malaysia has also recently announced plans to boost its armour

63 Huxley, op. cit., p. 249

64 Michael Leifer, Singapore's Foreign Policy: Coping with Vulnerability (London: Routledge, 2000), p. 155

65 Malaysia is boosting its firepower with the S$463 million procurement of 18 Brazilian-made Astros II MLRS (90 km) and 22 155-mm G-5 artillery guns (39 km range) from South Africa. As to be expected, Malaysia's Deputy Defence Minister Datuk Shafie Apdal has sought to downplay the quantum leap in offensive capabilities provided by these weapon purchases by rationalising that "other countries should not be unduly worried as this exercise is part of an ongoing process to establish a credible deterrent power, not for aggression." See The Straits Times, 28 Nov 2000, p. A15.

with new Main Battle Tanks from Poland, beefing up air defences with the deployment of anti-air missile systems together with the purchase of new fighters and helicopters in the pipeline. Up to three submarines are also on order to build up new maritime capabilities.[66] On its part, Singapore has also been progressively modernising its armed forces with new frigates, fighter aircraft and attack helicopters on the cards. Against the background of the recent arms purchases, the call by a Malaysian Member of Parliament for the Malaysian government to break off ties with Singapore altogether for equipping itself with the best defence weaponry in the region is most telling, and may be representative of calcifying threat perceptions amongst some quarters in Malaysia:

> "We should break off ties with Singapore to ensure the security of the country… Singapore is a small country. We should show them how much stronger we are… Singapore has acquired four to five submarines and we still seem unworried."[67]

With the heightened dangers of a security dilemma posed by new offensive capabilities on both sides, there is growing evidence of an arms-racing dynamic (even if routinely denied by Singapore and Malaysia officials).[68] For obvious reasons, the active balancing of power between the two states is both a material and ideational pursuit that is not readily admitted, but increasingly palpable in their strategic calculations and security motivations. For that matter, one therefore cannot be sure, despite Huxley's suggestion, that because Singapore can now possibly afford to wait out a hostile first strike, it necessarily follows that it will, especially when its very survival is at stake.

The short reaction posed by time and space factors, coupled with the possible dire consequences for delaying action may be too perilous for a small island nation to contemplate. All the more, this makes a "take the first hit" strategy a nice second thought, that is highly unlikely to forestall more decisive military options in the event of a rapidly closing strategic window of opportunity and increasing window of vulnerability. The reading of Singapore's rapid build-up in absorptive capacity would therefore be more measured.

66 The Straits Times, 30 Oct 2000, p. 25; 12 Feb 2001, p. A10; 28 Apr 2001, p. A7; 30 Apr 2001, p. A7; 8 May 2001, p. A10

67 The Straits Times, 18 Nov 2000, p. A27

In line with its Total Defence concept, Singapore's increasingly robust absorptive capacity can better protect the lives of its citizenry and strengthen domestic population morale, while military operations are being conducted. It also makes Singapore more resilient in the event it is caught by strategic surprise. Therefore, having a robust absorptive capacity need not foreclose a more punitive and pre-emptive military option to secure the flow of vital water supplies in the event of political blackmail. On the issue of blackmail, it is important to remember that an overt act like turning off the taps is only one form of hydropolitik. In an age of shadowy terrors and stateless threats where war is the extension of terrorism by any means, more surreptitious modus operandi by way of water sabotage also represent insidious forms of hydropolitik that are much harder to deter, detect, counteract and attribute. The propensity of states to sponsor, arm and plan proxy terrorism as a form of coercive diplomacy also cannot be ignored.

Parenthetically, recent media revelations of a terrorist plot to poison Rome's water supply with cyanide-based chemicals and reports of the Abu Sayyaf group's plans to poison the Basilan water supply underscore the new reality and credibility of such malevolent threats.[69] In respect of which, Prime Minister Goh Chok Tong had in early April 2002 reminded the Singaporean public of a polemical argument made across the Causeway that had caused some disquiet on the island republic. The argument made was that not only did Malaysia have the ability to use water as a "strategic weapon" to disrupt the water supply to Singapore in order to counter Singapore's military advantage over Malaysia, it also reserved the right of self-defence to pollute

68 Contrary to earlier analysis by regional observers like Amitav Acharya, it is now clear that an 'action-reaction' phenomenon has come to characterise the military relations between Singapore and Malaysia, largely masked by a lack of defence transparency in procurement and policy. See Jane's Defence Weekly, 24 Jan 2001, p. 26; Amitav Acharya, An Arms Race in Southeast Asia? Prospects for Control (Singapore: Institute of Southeast Asian Studies, 1994); Andrew Tan, "Singapore's Defence Policy in the New Millennium" in Working Paper No. 322 (Canberra: ANU, July 1998), pp. 12–15. See also "KL Says New Weapons Not Meant to Target Singapore" in The Straits Times, 7 Apr 2002.

69 Italian authorities arrested five Moroccans with a map of the Rome water system in Feb 2002. See The Straits Times, 2 Feb 2002, p. 22; 26 Feb 2002, p. 11. See also "Bandits Reportedly Planning to Poison Isabela Water Supply" in AFP Report, 10 Oct 2001, also available online at: http://www.inq7.net/brk/2001/oct/10/brkpol_4-1.htm

the water supply with either chemical or biological agents in the event of conflict.[70]

Ironically, such a view could precipitate political miscalculation, invite strategic error and does not augur well for promoting stable normal bilateral relations between two equally sovereign neighbouring states who have many interests in common and more to gain from mutual friendly co-operation. This is all the more so, given that Singapore's deterrence strategy is based precisely on the apposite logic that it reserves the right to do whatever is necessary, within international law, for national survival and self-defence. For Singapore, the water "issue goes beyond money", as Prime Minister Goh had put it.[71] The island republic remains acutely sensitive and deeply concerned about the importance of preserving the integrity of the internationally binding agreements on water supply with its neighbour, which should be honoured and safeguarded, and not be wilfully or unilaterally tampered with.

Perhaps, it is also necessary to add that one would be overstating the issue to assume that a water dispute between Singapore and Malaysia would form the sole reason why the two countries may go to war. In the end, a water dispute may not be the direct source of conflict even though it may be the triggering reason or excuse given for initiating hostile action. Water disputes are often the symptoms of more intractable structural tensions. Understood in such a context, water as a pressure point for political posturing may often be little more than a convenient means of brinkmanship, bargaining and bluster. But as a potent weapon of war it remains an invaluable strategic resource for achieving grander strategic ends or hidden agendas.

70 "Use Water as Weapon in Singapore Ties: KL Article" in The Straits Times, 9 Oct 2001, p. H5; 6 Apr 2002, p. H9

71 "Extracts of PM Goh's Speech" in The Straits Times, 6 Apr 2002, p. H9

CONCLUSION: SHAKY BRIDGE OVER TROUBLED WATERS

Returning to my earlier point in the introduction, some may still contend that the whole issue of a fight over water is but a red herring and may not hold water. After all, in an age of complex interdependence, the overwhelming economic and social cost of conflict is so painful as to be an effective deterrent in itself. In fact, notwithstanding intensifying economic competition on many fronts, strong trade ties continue to characterise the bilateral relations of the two squabbling neighbours, with much room for mutually beneficial co-operation. Malaysia was Singapore's No. 1 trading partner in 2000. While Singapore remains Malaysia's main trading partner and one of it biggest investors; six million of the 12.7 million tourist arrivals in the country in 2001 were Singaporean.[72]

Although Prime Minister Mahathir considers the extant water deal to be "unfair", he has acknowledged that Malaysia is bound by the 1963 pact to supply water to Singapore at three sen for every 1,000 gallons and cannot simply alter the water pact without Singapore's agreement.[73] He has also assured Senior Minister Lee Kuan Yew that such a precipitate action like cutting off Singapore's water supplies would not happen[74] even if, from time

72 Singapore's trade with Malaysia surged 37% to $S82.6 billion in 2000. Malaysia had overtaken the U.S. as Singapore's top trading partner. See The Straits Times, 23 Feb 2001, p. S12; 4 Aug 2001, p S11; 9 May 2002, p. A8.

73 Prime Minister Mahathir reportedly lamented that it was Malaysia's own fault for signing the 1963 agreement which, he argued, was against his country's interest: "The agreement was made during the time of the British era and we are bound for 100 years. It ends only in 2061… Unfortunately our people were not so smart because we signed in 1963 when Singapore was still part of Malaysia." The grudging tension over water pricing is symptomatic of deeper Malaysian misgivings in other areas of economic and political competition between the two neighbouring states. This is palpable in Dr Mahathir's candid remark over the recent Malaysian success in attracting two major shipping lines away from Singapore to Tanjung Pelapas in Johor: "There are many ways to skin a cat, and to skin Singapore, there are also many ways." See Leslie Lau, "Water Deal 'Unfair' but KL Can't Act Alone" in The Straits Times, 4 May 2002, p. 3; see also "Critical Singaporean Responses to PM Mahathir's Comments" in The Straits Times, Forum page, 8 May 2002, p. 18.

74 Lee, op. cit., p. 276

to time, the former is not averse to playing the water card.[75] This point was publicly reiterated by the Malaysian Prime Minister when he was recently asked whether the broad agreement he had reached with Senior Minister Lee on 4 September 2001 would be a permanent deal: "We will not cut off water for as long as Singapore needs water."[76] Indeed, one could well be tempted to argue that there was, up till that point in time at least, a new realism for the two countries to move on by genuinely resolving thorny issues like water. By all appearances, it was a new realism aimed at pragmatically forging closer bilateral co-operation as a bulwark against the looming threat of prolonged regional economic difficulties and domestic political uncertainties.

Such win-win concessions in the name of closer co-operation must, assuredly, be welcomed by many on both sides of the Causeway. But the challenge as always lies in the details of follow-through implementation. Prime Minister Goh too had previously struck a conciliatory and cautionary tone when he averred in 1997 during the height of a diplomatic row with Malaysia that "there is a Malay saying that water cannot be separated even by a knife. That's the nature of our relationship with Malaysia. Our interests are very closely intertwined and we certainly share some common future because if one country is badly hit, the other country will be affected."[77] And up until the recent 5 April 2002 announcement of Singapore's "new approach" towards reducing water dependency from Malaysia, Prime Minister Goh had maintained the position that Singapore should not go for full self-reliance on water, despite the mounting strategic pressures and domestic calls to do so. He had reasoned then that:

75 On 4 Aug 1998, Prime Minister Mahathir gave a rousing speech to a 5,000-strong crowd of politicians, public servants and supporters in Johor Bahru, where he worked up the crowd to call for the cutting of Singapore's water supplies. Speaking about the CIQ dispute with Singapore, he had strongly remarked: "Our officers are asked to leave Singapore even while we supply them with water." Mahathir's reference to Singapore's water supply was not lost on the crowd who began chanting in unison: "Potong! Potong! Potong! (Cut! Cut! Cut!)" See WSWS Analysis, 19 Aug 1998. He went on the add: "We don't have a large military to attack others. We have tried to be good neighbours. But don't take us for granted." See The Straits Times, 6 Aug 1998.

76 Irene Ng and Brendan Pereira, "Thorny Issues that Go Back Many Years" in The Straits Times, 5 Sep 2001, p. A10

77 The Straits Times, 12 Apr 1997

> "I don't think it's wise for us to work for complete self-reliance. Firstly, Dr Mahathir promised me that Malaysia would always give Singapore water, enough for our consumption. I take him at his word. Secondly, Malaysian water is cheaper than other means of water for the foreseeable future. Thirdly, for good reasons, I believe in interdependency with our neighbours. If we are completely independent of Malaysia, in terms of water, vegetables, other essentials that we buy from Malaysia and there's no economic interaction, I think that will spell more trouble between two neighbours. So I believe in interlocking our relationships and water is a symbol of this interlocking relationship between the two countries. Say if Malaysia continues to sell us water, not to meet our entire needs but to meet part of our needs, well, it is a sign to say that 'We are going to be interdependent forever, therefore, we must find a way to co-exist happily.'"[78]

Finding a way to "co-exist happily" remains a challenge, and there are little illusions that removing the water issue from bilateral relations would end the interminable disputes between the two close neighbours, given their "shared and broken history" and the different ways in which they organised their politics.[79] Nevertheless some optimism in the ultimate success of co-operative economic ventures in "bridging the Causeway gap"[80] may well be justified at one level, if the positive economic figures and anodyne official rhetoric about interdependency from both sides are to be taken at face value. In any case, political pronouncements of official policy on both sides have generally tended to focus rhetorically on co-operation and highlighting the mutually dire costs of conflict by playing down the risks following the public airing of disputes, albeit not to roil the waters uncontrollably. As a retired Malaysia military general had confidently put it in contending that there was a "zero possibility" of war between Malaysia and Singapore: "Whatever the excuse, it should not reach the level of resorting to violence. All matters

78 The Straits Times, 26 Jan 2001

79 Tan Tarn How, op. cit.
As PM Goh had put it emphatically: "I do not want to leave Singaporeans with the impression that if we remove this issue of water from bilateral relations, or if we wrap up the bilateral package, then there will be no more disputes between Singapore and Malaysia forever."

80 Lee Kim Chew, "Bridging the Causeway Gap" in The Sunday Times, 1 Oct 2000, p. 53

can be discussed, including the issue of water… Malaysia will not use water as a weapon, that is inhumane and not a smart thing to do."[81]

On a recent goodwill visit to Singapore, Malaysia's Barisan Nasional Youth Chief Datuk Hishammuddin Tun Hussein also ruled out any unilateral action to change the shape, form or content of the two extant water agreements that could impact negatively on Singapore.[82] Such views augur well for easing bilateral relations and go some way in ameliorating Singaporean anxieties. Some may even hope that someday the water issue may yet be one that unites and not divide the two countries. But if the past and the present is any indication of the future, that day is still a long way off. Much will hinge on the success of Singapore's quest for alternative water supplies. Meanwhile, there are no guarantees in realpolitik,[83] and less so in hydropolitik when a push comes to a shove and the taps are turned off. Words and deeds do not always match seamlessly in the complex realm of domestic and foreign policies where competing personalities, agendas, perceptions and interests prevail. Even if the economics are sound, the twist and turns of politics, with inevitable changes of the ruling guards on both

81 Wan Hamidi Hamid, "Malaysia-Singapore War: A Zero Possibility" in The Straits Times, 16 Oct 2000, p. 27. See also Mingguan Malaysia Columnist Awang Sulung's view that only insane Singaporean leaders would wage war against Malaysia, just as only insane Malaysian politicians would turn the taps off on Singapore. He wrote: "Let us all pray that our countries will not fall into the hands of such insane leaders", as reported by Joceline Tan, "Veteran Journalists Praise Bilateral Pact" in The Straits Times, 10 Sep 2001, p. A10. However, another retired general, Lt-Gen Zaini Mohamad had warned in an article to Mingguan Malaysia, 3 Feb 2002, that unless the water issue was resolved properly, it had the potential to ignite a military conflict between Singapore and Malaysia. He added that such a scenario had to be avoided because it would ultimately hurt both countries. See The Straits Times, 4 Feb 2002. Responding to queries over the upsurge in the Malaysian media barrage against Singapore in early 2002, Malaysian International Trade and Industry Minister Rafidah Aziz had brushed aside business community concerns by averring: "Let the politicians settle the political differences. All your apprehension is unfounded. Forget what is ruffling us. Sometimes we fight. Business must go on." See The Straits Times, 17 Apr 2002, p. 1.

82 Brendan Pereira, "Malaysia Won't Take Unilateral Action to Change Water Deal" in The Straits Times, 3 Mar 2002, p. 1

83 For example, barely a week after the Malaysian Barisan Nasional Youth delegation visit to Singapore in early March 2002 in which both sides had declared the visit as important in improving bilateral ties, UMNO politicians and the Malaysian media suddenly chose to take special public umbrage at an off-the-cuff remark made in jest by a Singaporean junior minister during the visit to vent anger at Singapore.

sides and new domestic agendas over time, can sometimes end up telling a different story. Furthermore, sudden changes in elite dispositions, policy volte-face, strong-arm tactics and strategic miscalculation can also pull the plank out from a still shaky relationship, as was seen in 1998 when the Malaysians unilaterally and without warning barred Singapore's air force from overflights into Malaysian airspace. Andrew Tan's cogent analysis of the numerous troubling episodes—in particular the Herzog and Pedra Branca bilateral disputes—that continue to tar contemporary Singapore-Malaysia relations "lend credence to the view that armed conflict between the two states cannot in fact be ruled out."[84]

New friction points like the Malaysian media's critical coverage of Singapore's tudung issue, land reclamation and even vegetable import issues from February to May 2002 continue to spring up interminably and sharply underscore the embedded primat der innenpolitik[85] pattern of bilateral linkage politics and emergent pattern of megaphone diplomacy via media barrage. In fact, regional political commentators have long described the perennial attempt by Malaysia to put Singapore in its place as the manifestation of an abang-adik (big brother-small brother) syndrome that comes with a heavy historical baggage ever since the latter's separation and independence from the former. It is clear that for the two neighbouring states with complexly intertwined history and destiny, domestic politics often extends beyond—not stop—at the water's edge. In the end, as the late

84 Andrew Tan, "Intra-ASEAN Tensions" in Discussion Paper 84 (London: The Royal Institute of International Affairs, 2000), p. 25. An astute student of human history will note that when stripped of all fanciful theoretical garb, the naked causes of wars remain essentially the same: "honour, interests and fear", à la the Peloponnesian Wars.

85 One component of this statecraft is polity management, a collection of tricks and tactics designed to protect and promote the state elite's objectives and interests. An important assumption is that external affairs will be part of those tricks and tactics. This is the logic of primat der innenpolitik—the formation and execution of foreign policy to deal with internal domestic problems. The term primat der innenpolitik was coined by German scholars to explain German foreign policy before 1945 and the causes of World War One. Although the interpretation comes in different versions, their common argument is that the aggression of German foreign policy is primarily a product of domestic political, social and economic tensions. See also Rozli Ali, "The Media's Not a Diplomat" in The New Straits Times, 8 Apr 2002.

Michael Leifer had observed in addressing Singapore's strategic dilemma of having to constantly cope with uncertainty and vulnerability, Singapore presents a "soft and easy target" for Malaysian politicians to attack and to play the nationalist card. "It arouses a strong feeling" and "niggling differences" will continue to persist between the two countries as "basically, there is a lack of trust as well."[86] In fact, the latest round of hydropolitik over the pricing of extant and future water agreements in January 2002[87] just barely five months after the apparently "water-tight" deal between Senior Minister Lee and Prime Minister Mahathir, shows the persistence of complex leaks in the bilateral relationship that have yet to be plugged.

In drawing a costly lesson from Singapore's troubled business venture into the Suzhou Industrial Park (SIP) project with China, Senior Minister Lee Kuan Yew had observed that "Singaporeans take for granted the sanctity of contracts. When we sign an agreement, it is a full and final undertaking. Any disagreement as to the meaning of the written document is interpreted by the courts or an arbitrator."[88] The candid remark captures in essence the perennial dilemma of Singapore when dealing with less than likeminded partners who may find "new reason" to unilaterally renege on deals or

86 Michael Leifer, cited in The Straits Times, 7 Jan 2000. As an example of the issue of trust: KL recently eased foreign property ownership rules to help revitalise its real estate market. However, some property analysts have reportedly said that the relaxed rules alone were unlikely to entice Singaporean property investors to return to the Malaysian market. Some pointed out that "the Malaysian government's track record for changing rules without warning and even making laws retroactive as 'a major turn-off'." See The Straits Times, 4 May 2001, p. S14.

87 "Settle Singapore-KL Water Issue Quickly" in The New Straits Times, 23 Jan 2002; Han Fook Kwang, "It's a Watertight Agreement, Please" in The Straits Times, 16 Feb 2002, p. H11

88 Lee op. cit., p. 723
In the context of the latest tentative "deal" with Malaysia, Senior Minister Lee had alluded to the bleak possibility with customary candour: "Suppose for instance—heaven forbid in 2004—we don't have an UMNO-led coalition. Then we've got a new partner to negotiate with. That's more problematic…". See The Star and The Sun reports cited in Today, 7 Sep 2001, p. 15. Given the uncertainty that the future holds, Mr Lee concedes, not unreasonably, that "we might be dealing with a government which may not deliver, or will not deliver." See The Straits Times, 6 Sep 2001, p. 1.

89 Compiled by Peter Gleick, (September 2000 Version), Pacific Institute for Studies in Development, Environment and Security, available online at: http://www.worldwater.org/conflictIntro.htm

renovate written agreements. In the event of an intractable dispute, such as over Singapore's vital water supplies, rocks of risk continue to spike above the bilateral waves, as they have on occasion, and the present danger, even if submerged for now, remains clear.

Table 2.1 – Water Conflict Chronology[89]

Year / parties involved	:	**1503** / Florence and Pisa warring states
Basis / nature of conflict	:	Military tool / Violent
Description	:	Leonardo da Vinci and Machiavelli planned to divert the Arno River away from Pisa during a conflict between Pisa and Florence.
Year / parties involved	:	**1642** / China – Ming Dynasty
Basis / nature of conflict	:	Military tool / Violent
Description	:	The Huang He's dikes had been breached for military purposes. In 1642, "toward the end of the Ming dynasty (1368–1644), General Gao Mingheng used the tactic near Kaifeng in an attempt to suppress a peasant uprising."
Year / parties involved	:	**1863** / The United States Civil War
Basis / nature of conflict	:	Military tool / Violent
Description	:	General U. S. Grant, during the Civil War campaign against Vicksburg, cut levees in the battle against the Confederates.
Year / parties involved	:	**1898** / Egypt, France and Britain
Basis / nature of conflict	:	Military and political tool and control of water resources / Military manoeuvres
Description	:	Military conflict nearly ensued between Britain and France in 1898 when a French expedition attempted to gain control of the headwaters of the White Nile. While the parties eventually negotiated a settlement of the dispute, the incident had been characterised as having "dramatized Egypt's vulnerable dependence on the Nile, and fixed the attitude of Egyptian policy-makers ever since."

Year / parties involved	:	**1924** / Owens Valley, Los Angeles, California
Basis / nature of conflict	:	Political tool, control of water resources, terrorism and development dispute / Violent
Description	:	The Los Angeles Valley aqueduct/pipeline suffers repeated bombings in an effort to prevent diversions of water from the Owens Valley to Los Angeles.

Year / parties involved	:	**1935** / California, Arizona
Basis / nature of conflict	:	Political tool and development dispute / Military manoeuvres
Description	:	Arizona calls out the National Guard and militia units to the border with California to protect the construction of Parker Dam and diversions from the Colorado River; dispute eventually settled in court.

Year / parties involved	:	**1938** / China and Japan
Basis / nature of conflict	:	Military tool and military target / Violent
Description	:	Chiang Kai-shek ordered the destruction of flood-control dikes of the Huayuankou section of the Huang He (Yellow) River to flood areas threatened by the Japanese army. West of Kaifeng, dikes were destroyed with dynamite, spilling water across the flat plain. The flood destroyed part of the invading army and its heavy equipment was mired in thick mud, though Wuhan, the headquarters of the Nationalist government, was taken in October. The waters flooded an area variously estimated as between 3,000 and 50,000 square kilometres, and killed Chinese estimated in numbers between "tens of thousands" and "one million".

Year / parties involved	:	**1940–1945** / multiple parties
Basis / nature of conflict	:	Military target / Violent
Description	:	Hydroelectric dams routinely bombed as strategic targets during World War II.

Year / parties involved	:	**1943** / Great Britain and Germany
Basis / nature of conflict	:	Military target / Violent
Description	:	British Royal Air Force bombed dams on the Mohne, Sorpe and Eder Rivers in Germany (16 and 17 May). The Mohne Dam breech killed 1,200 and destroyed all downstream dams for 50 km.

Year / parties involved	:	**1944** / Germany, Italy, Britain and U.S.A.
Basis / nature of conflict	:	Military tool / Violent
Description	:	German forces used waters from the Isoletta Dam (Liri River) in January and February to successfully destroy British assault forces crossing the Garigliano River (downstream of the Liri River). The German Army then dammed the Rapido River, flooding a valley occupied by the American Army.

Year / parties involved	:	**1944** / Germany, Italy, Britain and U.S.A.
Basis / nature of conflict	:	Military tool / Violent
Description	:	The German Army flooded the Pontine Marches by destroying drainage pumps to contain the Anzio beachhead established by the Allied landings in 1944. Over 40 square miles of land were flooded. A 30-mile stretch of landing beaches was rendered unusable for amphibious support forces.

Year / parties involved	:	**1944** / Germany and Allied forces
Basis / nature of conflict	:	Military tool / Violent
Description	:	Germans flooded the Ay River in France (in July), creating a lake two metres deep and several kilometres wide, slowing an advance to Saint Lo, a German communications centre in Normandy.

Year / parties involved	:	**1944** / Germany and Allied forces
Basis / nature of conflict	:	Military tool / Violent
Description	:	Germans flooded the Ill River Valley during the Battle of the Bulge (winter 1944–45), creating a lake 16 kilometres long, 3–6 kilometres wide, and 1–2 meters deep, greatly delaying the American Army's advance toward the Rhine.

Year / parties involved	:	**1947** onwards / Bangladesh and India
Basis / nature of conflict	:	Development disputes and control of water resources / Non-violent
Description	:	A partition divides the Ganges River between Bangladesh and India. Construction of the Farakka barrage by India, beginning in 1962, increased tension. Short-term agreements settled dispute in 1977–82, 1982–84 and 1985–88, and 30-year treaty is signed in 1996.

Year / parties involved	:	**1947–1960s** / India and Pakistan
Basis / nature of conflict	:	Development disputes, control of water resources and political tool / Non-violent
Description	:	A partition had left the Indus Basin divided between India and Pakistan. Disputes over irrigation water ensued, during which India stemmed the flow of water into irrigation canals in Pakistan; the Indus Waters Agreement was reached in 1960, after 12 years of World Bank-led negotiations.

Year / parties involved	:	**1948** / Arabs and Israelis
Basis / nature of conflict	:	Military tool / Violent
Description	:	Arab forces cut off West Jerusalem's water supply in the first Arab-Israeli war.

Year / parties involved	:	**1950s** / Korea, U.S.A. and others
Basis / nature of conflict	:	Military target / Violent
Description	:	Centralised dams on the Yalu River serving North Korea and China were attacked during Korean War.

Year / parties involved	:	**1951** / Korea and the United Nations
Basis / nature of conflict	:	Military tool and military target / Violent
Description	:	North Korea released flood waves from the Hwachon Dam, damaging floating bridges operated by UN troops in the Pukhan Valley. U.S. Navy planes were then sent to destroy spillway crest gates.

Year / parties involved	:	**1951** / Israel, Jordan and Syria
Basis / nature of conflict	:	Political tool, military tool and development disputes / Violent
Description	:	Jordan made public its plans to irrigate the Jordan Valley by tapping the Yarmouk River. Israel responded by commencing drainage of the Huleh swamps located in the demilitarised zone between Israel and Syria. Border skirmishes ensued between Israel and Syria.

Year / parties involved	:	**1953** / Israel, Jordan and Syria
Basis / nature of conflict	:	Development dispute, military target and political tool / Violent
Description	:	Israel began construction of its National Water Carrier to transfer water from the north of the Sea of Galilee out of the Jordan Basin to the Negev Desert for irrigation. Syrian military actions along the border and international disapproval lead Israel to move its intake to the Sea of Galilee.

Year / parties involved	:	**1958** / Egypt and Sudan
Basis / nature of conflict	:	Military tool, political tool and control of water resources / Violent
Description	:	Egypt sent an unsuccessful military expedition into disputed territory amidst pending negotiations over the Nile waters, Sudanese general elections and an Egyptian vote on Sudan-Egypt unification. The Nile Water Treaty was signed when a pro-Egyptian government was elected to power in Sudan.

Year / parties involved	:	**1960s** / North Vietnam and U.S.A.
Basis / nature of conflict	:	Military target / Violent
Description	:	Irrigation water supply systems in North Vietnam were bombed during the Vietnam War. 661 sections of dikes were damaged or destroyed.

Year / parties involved	:	**1962–1967** / Brazil and Paraguay
Basis / nature of conflict	:	Military tool, political tool and control of water resources / Military manoeuvres
Description	:	Negotiations between Brazil and Paraguay over the development of the Paraná River were interrupted by a unilateral show of military force by Brazil in 1962, which invaded the area and claimed control over the Guaira Falls site. Military forces were withdrawn in 1967 following an agreement for a joint commission to examine development in the region.

Year / parties involved	:	**1963–1964** / Ethiopia and Somalia
Basis / nature of conflict	:	Development dispute, military tool and political tool / Violent
Description	:	The creation of boundaries in 1948 left Somali nomads under Ethiopian rule. Border skirmishes occurred over disputed territory in the Ogaden Desert where critical water and oil resources were located. A ceasefire was negotiated only after several hundred were killed.

Year / parties involved	:	**1965–1966** / Israel and Syria
Basis / nature of conflict	:	Military tool, political tool, control of water resources and development dispute / Violent
Description	:	Fire was exchanged over an "all-Arab" plan to divert the Jordan River headwaters and presumably pre-empt the Israeli National Water Carrier. Syria halts construction of its diversion in July 1966.

Year / parties involved	:	**1966–1972** / Vietnam and U.S.A.
Basis / nature of conflict	:	Military tool / Violent
Description	:	The U.S. tried cloud-seeding in Indochina to stop the flow of materiel along the Ho Chi Minh Trail.

Year / parties involved	:	**1967** / Israel and Syria
Basis / nature of conflict	:	Military target and tool / Violent
Description	:	Israel destroyed Arab diversion works on the Jordan River headwaters. During the Arab-Israeli War, Israel occupied the Golan Heights, with the Banias tributary to the Jordan River. Israel also occupied the West Bank.

Year / parties involved	:	**1969** / Israel and Jordan
Basis / nature of conflict	:	Military target and tool / Violent
Description	:	Israel, suspicious that Jordan was over-diverting the Yarmouk, led two raids to destroy the newly-built East Ghor Canal. Secret negotiations, mediated by the U.S., led to an agreement in 1970.

Year / parties involved	:	**1970s** / Argentina, Brazil and Paraguay
Basis / nature of conflict	:	Political goal and development dispute / Non-violent
Description	:	Brazil and Paraguay announced plans to construct a dam at Itaipu on the Paraná River, causing Argentina concern about downstream environmental repercussions and the efficacy of their own planned dam project downstream. Argentina demanded to be consulted during the planning of Itaipu but Brazil refused. An agreement was reached in 1979 that provided for the construction of both Brazil and Paraguay's dam at Itaipu, and Argentina's Yacyreta dam.

Year / parties involved	:	**1974** / Iraq and Syria
Basis / nature of conflict	:	Military target, military tool, political tool and development dispute / Military manoeuvres
Description	:	Iraq threatened to bomb the al-Thawra Dam in Syria and massed troops along the border, alleging that the dam had reduced the flow of Euphrates River water to Iraq.

Year / parties involved	:	**1975** / Iraq and Syria
Basis / nature of conflict	:	Development dispute, military tool and political tool / Military manoeuvres
Description	:	As upstream dams were filled during a low-flow year on the Euphrates, Iraqis claimed that the flow reaching its territory was "intolerable" and asked the Arab League to intervene. The Syrians claimed they were receiving less than half the river's normal flow and pulled out of an Arab League technical committee formed to mediate the conflict. In May, Syria closed its airspace to Iraqi flights and both Syria and Iraq reportedly transferred troops to their mutual border. Saudi Arabia successfully mediated the conflict.

Year / parties involved	:	**1975** / Angola and South Africa
Basis / nature of conflict	:	Military goal / Violent
Description	:	South African troops moved into Angola to occupy and defend the Ruacana hydropower complex, including the Gové Dam on the Kunene River. The goal was to take possession of and defend the water resources of south-western Africa and Namibia.

Year / parties involved	:	**1978** onwards / Egypt and Ethiopia
Basis / nature of conflict	:	Development dispute and political tool / Non-violent
Description	:	Long standing tensions over the Nile, especially the Blue Nile, originated in Ethiopia. Ethiopia's proposed construction of dams on the headwaters of the Blue Nile led Egypt to repeatedly declare the vital importance of water. "The only matter that could take Egypt to war again is water" (Anwar Sadat, 1979). "The next war in our region will be over the waters of the Nile, not politics" (Boutrous Ghali, 1988).

Year / parties involved	:	**1981** / Iran and Iraq
Basis / nature of conflict	:	Military target and tool / Violent
Description	:	Iran claimed to have bombed a hydroelectric facility in Kurdistan, thereby blacking out large portions of Iraq, during the Iran-Iraq War.

Year / parties involved	:	**1980–1988** / Iran and Iraq
Basis / nature of conflict	:	Military tool / Violent
Description	:	Iran diverted water to flood Iraqi defence positions.

Year / parties involved	:	**1988** / Angola, South Africa and Cuba
Basis / nature of conflict	:	Military goal and military target / Violent
Description	:	Cuban and Angolan forces launched an attack on the Calueque Dam via land and then air. Considerable damage was inflicted on the dam wall and power supply to the dam was cut. The water pipeline to Owamboland was cut and destroyed.

Year / parties involved	:	**1982** / Israel, Lebanon and Syria
Basis / nature of conflict	:	Military tool / Violent
Description	:	Israel cut off the water supply of Beirut during a siege.

Year / parties involved	:	**1986** / North Korea and South Korea
Basis / nature of conflict	:	Military tool / Non-violent
Description	:	North Korea's announcement of its plans to build the Kumgansan hydroelectric dam on a tributary of the Han River upstream of Seoul raised concerns in South Korea that the dam could be used as a tool for ecological destruction or war.

Year / parties involved	:	**1986** / Lesotho and South Africa
Basis / nature of conflict	:	Military goal and control of water resources / Violent
Description	:	South Africa supported a coup in Lesotho over support for the ANC and anti-apartheid, and water. The new government in Lesotho then quickly signed the Lesotho Highlands water agreement.

Year / parties involved	:	**1990** / South Africa
Basis / nature of conflict	:	Development dispute and control of water resources / Non-violent
Description	:	Pro-apartheid council cut off water to the Wesselton township of 50,000 blacks following protests over miserable sanitation and living conditions.

Year / parties involved	:	**1990** / Iraq, Syria and Turkey
Basis / nature of conflict	:	Development dispute, military tool and political tool / Non-violent
Description	:	The flow of the Euphrates was interrupted for a month as Turkey finished construction of the Ataturk Dam, part of the Grand Anatolia Project. Syria and Iraq protested that Turkey now had a weapon of war. In mid 1990 Turkish president Turgut Ozal threatened to restrict water flow to Syria to force it to withdraw support for Kurdish rebels operating in southern Turkey.

Year / parties involved	:	**1991**–present / Karnataka and Tamil Nadu (India)
Basis / nature of conflict	:	Development dispute and control of water resources / Violent
Description	:	Violence erupted when Karnataka rejected an Interim Order handed down by the Cauvery Waters Tribunal, empanelled by the Indian Supreme Court. The Tribunal was established in 1990 to settle two decades of dispute between Karnataka and Tamil Nadu over irrigation rights to the Cauvery River.

Year / parties involved	:	**1991** / Iraq, Kuwait and U.S.A.
Basis / nature of conflict	:	Military target / Violent
Description	:	During the Gulf War, Iraq destroyed much of Kuwait's desalination capacity during its retreat.

Year / parties involved	:	**1991** / Iraq, Turkey and the United Nations
Basis / nature of conflict	:	Military tool / Violent
Description	:	Discussions were held at the United Nations about using the Ataturk Dam in Turkey to cut off flows of the Euphrates to Iraq.

Year / parties involved	:	**1991** / Iraq, Kuwait and U.S.A.
Basis / nature of conflict	:	Military target / Violent
Description	:	Baghdad's modern water supply and sanitation system were intentionally targeted by the Allied coalition.

Year / parties involved	:	**1992** / Czechoslovakia and Hungary
Basis / nature of conflict	:	Political tool and development dispute / Military manoeuvres
Description	:	Hungary abrogated a 1977 treaty with Czechoslovakia concerning construction of the Gabcikovo/Nagymaros project based on environmental concerns. Slovakia continued construction unilaterally, completed the dam, and diverted the Danube into a canal inside the Slovakian Republic. Massive public protest and movement of military to the border ensued and issue was taken up to the International Court of Justice.

Year / parties involved	:	**1992** / Bosnia and the Bosnian Serbs
Basis / nature of conflict	:	Military tool / Violent
Description	:	The Serbian siege of Sarajevo, Bosnia and Herzegovina included a cut-off of all electrical power and water feeding the city from the surrounding mountains. The lack of power cut the two main pumping stations inside the city despite pledges from Serbian nationalist leaders to United Nations officials that they would not use their control of Sarajevo's utilities as a weapon. Bosnian Serbs took control of water valves regulating flow from wells that provided more than 80% of water to Sarajevo. The reduced water flow to city was used to 'smoke out' Bosnians.

Year / parties involved	:	**1993**–present / Iraq
Basis / nature of conflict	:	Military tool / Non-violent
Description	:	To quell opposition to his government, Saddam Hussein reportedly poisoned and drained the water supplies of southern Shiite Muslims, the Ma'dan. The European Parliament and UN Human Rights Commission deplored the use of water as weapon in the region.

Year / parties involved	:	**1993** / Yugoslavia
Basis / nature of conflict	:	Military target and tool / Violent
Description	:	The Peruca Dam was intentionally destroyed during the war.

Year / parties involved	:	**1995** / Ecuador and Peru
Basis / nature of conflict	:	Military and political tool / Violent
Description	:	Armed skirmishes arose in part because of disagreement over the control of the headwaters of the Cenepa River. Wolf argued that this was primarily a border dispute simply coinciding with the location of a water resource.

Year / parties involved	:	**1997 / Singapore and Malaysia**
Basis / nature of conflict	:	**Political tool / Non-violent**
Description	:	**Malaysia supplies about half of Singapore's water. In 1997, it threatened to cut off that supply in retribution for criticisms by Singapore of policies in Malaysia.**

Year / parties involved	:	**1998** / Tajikistan
Basis / nature of conflict	:	Terrorism and political tool / Potentially violent
Description	:	On 6 November, a guerrilla commander threatened to blow up a dam on the Kairakkhum Channel if political demands were not met. Col. Makhmud Khudoberdyev made the threat, reported by the ITAR-Tass News Agency.

Year / parties involved	:	**1999** / Lusaka, Zambia
Basis / nature of conflict	:	Terrorism and political tool / Violent
Description	:	A bomb blast destroyed the main water pipeline, cutting off water from the city of Lusaka, population 3 million.

Year / parties involved	:	**1999** / Yugoslavia
Basis / nature of conflict	:	Military target / Violent
Description	:	Belgrade reported that NATO planes had targeted a hydroelectric plant during the Kosovo campaign.

Year / parties involved	:	**1999** / Bangladesh
Basis / nature of conflict	:	Development dispute and political tool / Violent
Description	:	50 people were hurt during strikes called to protest power and water shortages. The protest over the deterioration of public services and law and order was led by former Prime Minister Begum Khaleda Zia.

Year / parties involved	:	**1999** / Yugoslavia
Basis / nature of conflict	:	Military target / Violent
Description	:	NATO targeted utilities and shut down water supplies in Belgrade. NATO bombed bridges on the Danube, disrupting navigation.

Year / parties involved	:	**1999** / Yugoslavia
Basis / nature of conflict	:	Political tool / Violent
Description	:	Yugoslavia refused to clear war debris on the Danube (downed bridges) unless financial aid for reconstruction was provided. European countries on the Danube feared flooding due to winter ice dams would result. Diplomats decried environmental blackmail.

Year / parties involved	:	**1999** / Kosovo
Basis / nature of conflict	:	Political tool / Violent
Description	:	Serbian engineers shut down water system in Pristina prior to its occupation by NATO.

Year / parties involved	:	**1999** / Angola
Basis / nature of conflict	:	Terrorism and political tool / Violent
Description	:	100 bodies were found in four drinking water wells in central Angola.

Year / parties involved	:	**1999** / Puerto Rico and U.S.A.
Basis / nature of conflict	:	Political tool / Non-violent
Description	:	Protesters blocked water intake to Roosevelt Roads Navy Base in opposition to U.S. military presence and its Navy's use of the Blanco River, following chronic water shortages in neighbouring towns.

Year / parties involved	:	**1999** / East Timor
Basis / nature of conflict	:	Military tool, political tool and terrorism / Violent
Description	:	Militia opposing East Timor independence killed pro-independence supporters and threw bodies into a water well.

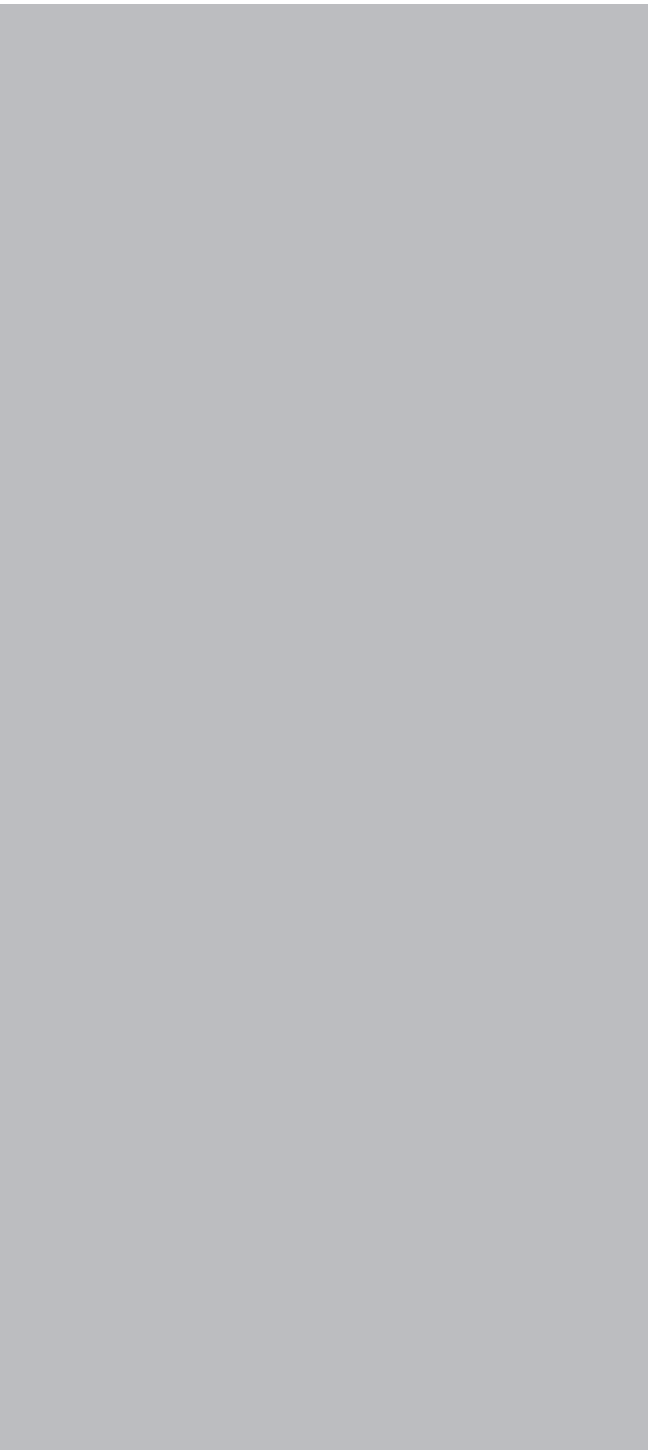
Year / parties involved	:	**1999** / Kosovo
Basis / nature of conflict	:	Terrorism and political tool / Violent
Description	:	Water supplies in wells were contaminated by Serbs disposing of bodies of Kosovar Albanians in local wells.

Year / parties involved	:	**1999–2000** / Namibia, Botswana and Zambia
Basis / nature of conflict	:	Military goal / Non-violent
Description	:	Dispute over border and access to water on Sedudu/Kasikili Island in the Zambezi/Chobe River was presented to the International Court of Justice

4

On the Threshold of Self-Sufficiency

Toward the Desecuritisation of the Water Issue in Singapore-Malaysia Relations



JOEY LONG SHI RUEY

INTRODUCTION

Johor's supply of water to Singapore has dominated a significant portion of the discourse on the likely causes of armed conflict between neighbours Singapore and Malaysia. It stems from two water agreements, signed by both governments in 1961 and 1962 which guaranteed, among other provisions, Singapore's right to obtain fresh water from Johor for a period of fifty and ninety-nine years respectively. Ruminating on the possibility of war between the two countries, some commentators and analysts have suggested that should Kuala Lumpur unilaterally and prematurely abrogate the two water agreements, Singapore, which is ostensibly highly dependent on Malaysian water for its survival, would have no qualms about launching a retaliatory military strike to regain its access to the water reserves in the southern Malaysian state. For academics and observers, the water issue is a grave security problem as disputes over water supply, if inappropriately handled, may boil over and ignite armed hostilities between Singapore and Malaysia.[1]

While scholars assert that any Malaysian attempt to tamper with Johor's water supply to Singapore constitutes a threat to the national security of the resource-poor city-state and may spark military retaliation, the particular claims of such a hypothetical contention has actually not been tested empirically. To be more specific, the prediction that a water war may ensue is predicated on obtaining answers to a more important and

1 Tim Huxley, Defending the Lion City: The Armed Forces of Singapore (St Leonards, NSW: Allen & Unwin, 2000), pp. 58-63; idem, "Singapore and Malaysia: A Precarious Balance?" in Pacific Review Vol. 4 No. 3 (1991), p. 210; Andrew Tan, "Intra-ASEAN Tensions" in Discussion Paper 84 (London: Royal Institute of International Affairs, 2000); idem, "Problems and Issues in Malaysia-Singapore Relations" in Working Paper No. 314 (Canberra: Strategic and Defence Studies Centre, Australian National University, 1997); Alan Dupont, "The Environment and Security in Pacific Asia" in Adelphi Papers 319 (London: International Institute for Strategic Studies, 1998), pp. 67–69; Paul J. Smith and Lt. Col. Charles H. Gross, Water and Conflict in Asia (Honolulu, Hawaii: Asia-Pacific Center for Security Studies, 2000), pp. 2–3. Lee Kuan Yew also addressed this topic in his memoirs, From Third World to First: The Singapore Story 1965–2000 (Singapore: The Straits Times Press and Times Media Pte Ltd, 2000), pp. 258, 276 and 287–288. The potential for armed conflict between the two countries over water has also stimulated the interest of a novelist; see Joseph Parapuram, Once in a Blue Moon (London: Minerva Press, 2000). For details about the water agreements, see "Singapore's Vital Water Links with Johor" in The Straits Times, 20 July 1988.

fundamental question: Is Singapore so critically dependent on Malaysia for its water needs that it will risk war to preserve its right of access to the water reservoirs in Johor? The underlying premise to the analysts' prediction of armed reprisal, after all, is that Singapore is seriously lacking in water self-sufficiency and must invade Johor to secure the water needs of its citizenry and industries. How much water reserves does Singapore possess and can those reserves as well as the city-state's water catchment facilities sufficiently meet its domestic wants? Currently lacking are quantitative or qualitative studies that closely examine Singapore's ability to provide for its own water needs. Consequently, speculations about the possibility of a war over water between Singapore and Malaysia, while eloquently crafted, continue to be mere speculations.

This essay is thus an attempt to plug the lacuna in the literature and provide a more empirically verifiable analysis of the Singapore-Malaysia water issue. Its focus is primarily on the ability of Singapore to mobilise sufficient volumes of water to meet the industrial and domestic needs of its citizens. The frequently cited allusion to the volume of water Singapore buys from Malaysia, which has been described in general terms as amounting to about half of the total volume consumed daily in Singapore, as a gauge of the city-state's dependence is not particularly useful. Only by providing a systematic description and analyses of Singapore's efforts to enhance and conserve its own water stocks and reserves can one better ascertain the condition of the city-state's water supply and its long-term demand as well as the degree of its dependence on Malaysia for water. Only then can one better determine whether Singapore will be sufficiently motivated to launch a blitzkrieg in the event that Malaysia prematurely terminates the water links, to secure its legal right of access to the potable liquid resource across the Strait of Johor.

In that regard, the main empirical finding of this essay is this: The contention that water disputes between Singapore and Malaysia may spiral toward war has been exaggerated. The study argues that Singapore has built up sufficient water reserves and it is unlikely that the city-state will launch a military offensive across the Causeway to secure the supplementary water supplies in Johor should Malaysia deprive Singapore of access to those reservoirs and waterworks in the southern Malaysian state. Singapore's unrelenting efforts to obtain the maximum water yield from the hydrological cycle, its government's aggressive selling and implementation of water

conservation campaigns and programmes to check demand, as well as the sourcing of supplementary water supplies from desalination and wastewater recycling have augmented its water reserves to such an extent that it will be relatively immune to any attempts by Malaysia to unilaterally cut the water links. This suggests that the water issue between Singapore and Malaysia can be regarded as an insubstantial contributory factor that may trigger armed conflict between the two neighbours.

The findings of this study have policy implications. The conclusions propose that the continued casting of the water issue as a security problem by policymakers, domestic groups and analysts of Singapore-Malaysia relations may be inappropriate, if not counterproductive. The discourses of danger, survival, national interest and threat may ineluctably reproduce more insecurity, especially when the probable policy reactions to a securitised water issue—"hydropolitics" as it has been typecast in sexier political scientific parlance or funkier still, "hydropolitique"—prioritises military counteraction. More fruitful debates about the future of the Singapore-Malaysia water link may develop if scholars and pundits begin to view the issue as desecuritised.[2]

What thus follows is an attempt to explore the routinely accepted "security-ness" of the water issue. The first section presents the academic debates about the topic. Given that Singapore is posited in the published scholarship as dependent on Malaysia for water and thus may employ military measures to safeguard its leased reservoirs and waterworks in Johor, the second section empirically reviews the state of Singapore's domestic water reserves and its programmes to augment its water stocks. Furnished with a relatively more accurate reading of Singapore's water condition, the third section presents arguments against the backdrop of a few scenarios to suggest that scholars should begin to regard the water issue as desecuritised. Finally, the essay concludes by highlighting the policy implications of its findings.

2 The concepts of securitisation and desecuritisation build on the analytical framework advanced in Barry Buzan, Ole Wæver and Jaap de Wilde, Security: A New Framework for Analysis (London: Lynne Rienner, 1998) and Ole Wæver, "Securitization and Desecuritization" in Ronnie Lipschutz, ed., On Security (New York: Columbia University Press, 1995), pp. 46–86.

THE WATER ISSUE AS A SECURITY PROBLEM

Since Singapore separated from Malaysia in August 1965, relations between the two countries have been marked by periods of tension and normalcy. Acrimonious disputes over economic matters like the Common Market, personal antagonisms and political competition between rival politicians from the People's Action Party (PAP), United Malays National Organisation (UMNO) and the Malayan Chinese Association (MCA), as well as heightened tensions and clashes over communal questions like Malay hegemony in Malaysia during the twenty-three months between 1963 and 1965 when Singapore was part of Malaysia not only resulted eventually in the separation of the former from the latter but also left both sides with a lingering bitter aftertaste of failed hopes, uncorrected wrongs and personal antipathy. It is against this rancorous historical background that scholars examining political tensions among member states of the Association of Southeast Asian Nations (ASEAN) in general and bilateral frictions between Singapore and Malaysia in particular have accentuated, inter alia, the water issue as a flashpoint of potential armed violence between the two countries.[3]

3 For further discussion of the history of the merger and separation between Singapore and Malaysia, see Albert Lau, A Moment of Anguish: Singapore in Malaysia and the Politics of Disengagement (Singapore: Times Academic Press, 1998); Mohamed Noordin Sopiee, From Malayan Union to Singapore Separation: Political Unification in the Malaysia Region 1945–65 (Kuala Lumpur: Penerbit Universiti Malaya, 1974); Nancy McHenry Fletcher, The Separation of Singapore from Malaysia (Ithaca: Cornell University Southeast Asia Program, 1969); R. S. Milne, "Singapore's Exit from Malaysia; The Consequences of Ambiguity" in Asian Survey Vol. 6 No. 3 (March 1966), pp. 175–184. For analyses that include more contemporary bilateral security policy issues, besides the works of Tim Huxley and Andrew Tan, see also Chin Kin Wah, "The Management of Interdependence and Change Within a Special Relationship" in Azizah Kassim and Lau Teik Soon, eds., Malaysia and Singapore: Problems and Prospects (Singapore: Singapore Institute of International Affairs, 1992), pp. 230–248; N. Ganesan, "Bilateral Tensions in Post-Cold War ASEAN" in Pacific Strategic Papers (Singapore: Institute of Southeast Asian Studies, 1999); idem, "Malaysia-Singapore Relations: Some Recent Developments" in Asian Affairs, An American Review Vol. 25 No. 1 (Spring 1998), pp. 21–36; idem, "Factors Affecting Singapore's Foreign Policy Towards Malaysia" in Australian Journal of International Affairs Vol. 45 No. 2 (Nov 1991), pp. 182–195; Lee Poh Ping, "Malaysia-Singapore Relations: A Malaysian Perspective" in Azizah Kassim and Lau Teik Soon, eds., Malaysia and Singapore: Problems and Prospects (Singapore: Singapore Institute of International Affairs, 1992), pp. 219–229. See also the seminal work by Michael Leifer, Singapore's Foreign Policy: Coping with Vulnerability (London: Routledge, 2000).

These scholars' assertions are based on the fundamental premise that Singapore critically lacks sufficient domestic sources of water stocks and is greatly dependent on Malaysia for its water needs. They point to Singapore's continued importation of water from Malaysia, which routinely averages about half of the total volume of water consumed in the city-state, as indicative of that dependence. Parenthetically, this water supply is provided for under the rubric of two water agreements, brokered by the British and signed by Singaporean and Malaysian officials on 1 September 1961 and 29 September 1962 respectively. The two compacts expire respectively in 2011 and 2061. Despite the hostile circumstances under which Singapore separated from Malaysia in 1965, both sides had explicitly stated that they would honour the contracts, a pledge that was unequivocally stipulated in the Independence of Singapore Agreement 1965 detailing that both sovereign states would "abide by the terms and conditions" of the two pacts.[4] Yet, analysts have astutely noted that Malaysian politicians have periodically attempted to take advantage of this important asymmetry in Singapore-Malaysia relations—marked by the fact that Singapore is ostensibly dependent on Malaysia on water, while the latter is not—to impose their policy or domestic agendas on the city-state.

N. Ganesan has noted that the possible use of water as a foreign policy instrument was plainly articulated by Malaysian Prime Minister (from 1957 to 1970) Tunku Abdul Rahman on 9 August 1965—the day Singapore left Malaysia. The latter had bluntly told British High Commissioner Anthony Head in Kuala Lumpur "that if Singapore's foreign policy was prejudicial to Malaysia's interests they [the Malaysians] could always bring pressure to bear on them by threatening to turn off the water in Johore."[5] The words, spoken in the tense and embittered environment of 1965, might have been overlooked as a mere verbal and private swipe at Singapore had it not been for the fact that since 1965, Malaysian elites have actually harangued domestic crowds about the prospect of playing the water card to convey Malaysian displeasure with specific diplomatic, economic, social or political stances taken by the city-state, thereby seeking to influence the Singapore government's policies.

4 Independence of Singapore Agreement 1965–"B" A Bill intituled, available online at: <http://agcvldb4.agc.gov.sg/ (Mar 2002)

5 Quoted in N. Ganesan, "Bilateral Tensions in Post-Cold War ASEAN", p. 37. For a Malaysian newspaper editorial's spin on the Tunku's remarks, see "Realism in Diplomacy" in The New Straits Times, 7 Apr 2002.

In a series of academic works, security analysts like Tim Huxley and Andrew Tan have highlighted instances where the water card was, indeed, dealt by Malaysian elites in attempts to further their policy objectives or protest against perceived slights. These included confrontations in 1986 and 1998 where Malaysian calls for the review of the water links with Singapore were made. The November 1986 episode occurred in the context of Israeli President Chaim Herzog's visit to Singapore, which sparked off angry protests from anti-Zionist Malaysian activists. Lustily rousing agitated Muslim crowds in Johor in their heavy criticism of the city-state's irreverent attitude toward the religious and political sensitivities of its predominantly Muslim neighbour, verbal attacks launched by the youth wing of the ruling UMNO and by agitators from opposition parties filled the air with corybantic calls for Kuala Lumpur to prematurely terminate the water supply to Singapore. Although nothing untoward ultimately occurred, the oral tirades threatened to boil over when crowds apparently moved to forcibly occupy the Singapore-run waterworks in Johor and disrupt the water supply.[6]

The second confrontation occurred in August 1998. This time, it was stirred up by Malaysian Prime Minister Mahathir Mohamad whose country was then caught up in the Asian financial crisis. His stinging criticism at a political rally in Johor Bahru of Singapore's decision to relocate Malaysia's railway station and its Customs, Immigration and Quarantine (CIQ) outpost from its original site in the south of the city-state to Woodlands invariably roused the rally attendees to call for Malaysia to terminate the water links. The water ties were undoubtedly being used as a leverage in an attempt to induce the Singapore government to modify its policies and for domestic political purposes.[7]

---

6 Tim Huxley, "Singapore and Malaysia: A Precarious Balance?", p. 210; Shanti Nair, Islam in Malaysian Foreign Policy (London: Routledge, 1997), pp. 225–230; Andrew Tan, "Problems and Issues in Malaysia-Singapore Relations", p. 17

7 Ven Sreenivasan, "Don't Take Our Goodness for Granted, Mahathir Tells S'pore" in Business Times, 5 Aug 1998; Eddie Toh, "Suspend Fresh Ties with S'pore, Urges Umno Youth Chief" in Business Times, 4 Aug 1998; Michael Leifer, Singapore's Foreign Policy, pp. 149–153. For other examples, see Alan Dupont, "The Environment and Security in Pacific Asia" in Adelphi Papers 319 (London: International Institute for Strategic Studies, 1998), pp. 68–69.

Huxley's and Tan's interest in the chronology of Malaysia's repeated play of the water card stemmed from their endeavours to identify possible provocations that might lead to cross-border conflict between Singapore and Malaysia. As regards the water issue, their discourse of danger and threat was cast in terms of the survivability of Singapore. In other words, if Malaysia prematurely abrogated the water agreements and cut off the water supply, Singapore's survival would be threatened. That conclusion was derived from their forecast of the city-state's short- and long-term water needs, where they maintained that Singapore would remain water-stressed and would continue to rely on Malaysia for water indefinitely. They calculated that a disruption in the water supply would badly affect Singapore's economic development as well as standard of living, erode belief in the national purpose and perhaps even threaten the long-term viability of Singapore's existence as a sovereign state. The adverse effects of any water disruption and the fact that Malaysia was contractually bound to honour the water agreements thus led Huxley and Tan to speculate that Singapore would retaliate militarily should Kuala Lumpur take steps to prematurely terminate the water supply.

Andrew Tan has argued that "[w]hile Malaysia might be expected to have some measure of political influence over Singapore owing to the latter's dependence on Malaysia for its water supply, the safeguarding of these water sources in Johore is concomitantly a primary national security interest of Singapore, and could prompt it to take military action if necessary to secure the supply in a crisis." Like Tan, Tim Huxley identified the water reserves in Johor as Singapore's security interest, which invariably necessitated the adoption of military measures to safeguard or repossess: "Singapore's neighbours understand only too well that any direct interference with its vital interests (such as its water supply…) would court a military response. Singapore is not the 'Israel of Southeast Asia', but it has sent strong signals since the late 1960s that it is willing, in extremis, to risk assuming that status."[8]

8 Tim Huxley, "Singapore and Malaysia: A Precarious Balance?", pp. 204–205 and 210; Andrew Tan, "Problems and Issues in Malaysia-Singapore Relations", pp. 6–7 and 17–18. Notably, Huxley has sketched a war scenario involving Singapore's military attempt to secure control over the water extraction and treatment plants in Johor in his Defending the Lion City, pp. 58–63. The Malaysian counter-offensive has been examined by Muhammad Fuad Mat Noor, "Konflik Malaysia & Singapura: Analisis Kritikal Kekuatan Angkatan Tentera dan Keupayaan Dalam Konflik" in Perajurit (12 November 2000), pp. 3–9.

It must have seemed that Huxley and Tan were right in their prognostications if one were to take at face value the forewarning issued in 1978 by Lee Kuan Yew, then Singapore's Prime Minister, to then Deputy Prime Minister Mahathir about the grave consequences if Malaysia, in "a random act of madness", cut off the water supply: "If water shortage became urgent, in an emergency, we would have to go in, forcibly if need be, to repair damaged pipes and machinery and restore the water flow." Lee's stern admonition, which was revealed in his 2000 memoirs, would be revisited below, but for now let us return to Huxley and Tan.[9]

Based on the logic of Huxley's and Tan's arguments, it could be argued that the water stock in Johor is not a security interest to Singapore in and of itself but is one because it has been referenced to the city-state's water insufficiency and survivability. Yet, despite making those references, the question of sufficiency itself has actually not been empirically scrutinised by the scholars. By highlighting Singapore's importation of water from Malaysia and extrapolating that transaction as indicative of dependence misses other motivations that may be at play. For instance, in 2001, Singapore's Prime Minister Goh Chok Tong had explicitly spelt out three fundamental reasons for Singapore's continued purchase of water from Malaysia. The first was availability: "Firstly, Dr Mahathir promised me [Goh] that Malaysia would always give Singapore water, enough for our consumption." The second was cost: "Secondly, Malaysian water is cheaper than other means of water for the foreseeable future." And the third involved creating interdependence, with all its attendant political benefits: "Thirdly, for good reasons, I believe in interdependency with our neighbours. If we are completely independent of Malaysia, in terms of water, vegetables, other essentials that we buy from Malaysia and there's no economic interaction, I think that will spell more trouble between the two neighbours." "So I believe," he continued, "in interlocking our relationships and water is a symbol of this interlocking relationship between the two countries. Say if Malaysia continues to sell us water, not to meet our entire needs but to meet part of our needs, well, it is

9 Shahrum Sayuth, "Singapore was Ready to Go to War" in The New Straits Times, 8 Apr 2002; "Ex-Mentri Besar Recalls 'War Threat'" in The Straits Times, 9 Apr 2002; Lee Kuan Yew, From Third World to First, p. 276

a sign to say that 'We are going to be interdependent forever, therefore, we must find a way to co-exist happily.'"[10]

To the extent that Singapore's motivations for importing water from Malaysia stem from availability, cost and the promotion of interdependence, it begs the question about the state of Singapore's water assets and actual dependence on Malaysia for water. Surprisingly, very little systematic work has been done on those subjects despite the continued proliferation of writings that essentially sustain the orthodoxy. What thus follows is an examination of Singapore's water assets and the strategies the Singapore government has implemented to enhance the country's domestic water reserves. The findings will go a long way toward establishing whether the water issue in Singapore-Malaysia relations can be properly categorised the security problem that Huxley and Tan have characterised it.

SCRUTINISING SINGAPORE'S WATER ASSETS

A number of sources provide the valuable data to scrutinise Singapore's water assets and policies. Overlooked by the existing scholarship, these sources include openly available works like the annual reports published by the Public Utilities Board (PUB), Singapore's statutory board charged to manage the country's water resources, statements put out by the PUB in the press, noteworthy articles published in the press itself about water, and other documented published or unpublished studies.[11] By piecing together all the bits of information that have been derived from the open record, this paper brings into sharper focus the three broad strategies that the Singapore government has pursued in its quest to augment the city-state's water reserves. It tracks the PUB's efforts to harvest and store the abundant stormwater that falls on the wet and humid island annually; its endeavours to conserve the use of water; and its ventures to procure water from alternative sources, to draw a picture of Singapore's robust water programme. The findings will furnish the empirical base to debate Huxley's and Tan's contentions about the probability of conflict between Singapore and Malaysia over water.

---

10 Quoted in Irene Ng, "Unwise to Work for Full Self-reliance on Water" in The Straits Times, 26 Jan 2001

11 For a history of the PUB, see PUB, Yesterday and Today: The Story of Public Electricity, Water and Gas Supplies in Singapore (Singapore: Public Utilities Board, 1985).

Harvesting and Storing Stormwater

Singapore receives an average annual rainfall of approximately 2,400 millimetres. This is well above the global average, which stands at 1,050 millimetres according to one report.[12] Singapore is consequently and comparatively not short of fresh water in terms of its availability from the hydrological cycle. The challenge for the city-state since achieving independence in 1965, however, is in capturing and storing as much of this abundant rainfall as possible for use by its populace and industries. Given the competing demands placed by residential and economic developments on the available real estate in Singapore, the amount of land that has been reserved to catch water is limited indeed. Even so, Singapore has done much to collect and store rather than allow the rainwater to flow wastefully to the sea.

One of the schemes rolled out by the PUB to increase the water stocks was reservoir construction. In the aftermath of Singapore's separation from Malaysia in August 1965, the PUB embarked on a number of building projects to construct new reservoirs as well as expand the storage capacities of existing ones. Money was first poured in to increase the holding capacity of the Seletar Reservoir in 1969, the reservoir being one among three (the others being the MacRitchie and Peirce Reservoirs) that the PUB managed on the island following separation. Their total storage capacity was 31.1 million cubic metres. By 1986, the number of reservoirs in Singapore had increased from three to fourteen. In tandem with this numerical expansion in reservoirs, the total storage capability of Singapore's reservoirs saw a significant fivefold increase in volume, from 31.1 to 142.0 million cubic metres.[13]

---

12 Compare Singapore's mean annual rainfall at Meteorological Service Facts & Figures, available online at: <http://www.mot.gov.sg/key_nav/main5.htm> (Apr 2002), with the estimation of the global average by the Global Precipitation Climatology Project, which is cited in Fundamentals of Physical Geography, available online at: <http://www.geog.ouc.bc.ca/physgeog/contents/8g.html> (Mar 2002).

13 PUB, Yesterday and Today, pp. 8–15, 32–33 and 39–42. Numerical figures for the holding capacity of Singapore's reservoirs can be found in Adriel Yap Lian Ho, "Water for Singapore: Management of a Resource in a Subregional Economic Zone", B. A. (Hons) academic exercise, National University of Singapore, 1994/95, p. 25.

Despite the proliferation of reservoirs and the reservation of close to half of Singapore's total land area for water catchment purposes, the water authorities continued to explore other means of collecting rainwater. While forested nature reserves predominantly formed the water catchment areas in Singapore, urban areas also eventually became catchment grounds for the PUB as well. A groundbreaking auxiliary project, undertaken in conjunction with the building of the Sungei Seletar and Bedok Reservoirs in the eastern and north-eastern part of the island during the mid 1980s, demonstrated the feasibility of harvesting water from built-up districts. That undertaking involved the PUB constructing a complex network of stormwater collection depots (basically huge and deep ponds) and water drainage systems across adjacent residential estates and other built-up areas to collect and channel storm run-offs to the impounding reservoirs. The stormwater collection network effectively enabled the PUB to optimise water yield from the eastern quarter of Singapore. Given the success of that endeavour, the PUB proceeded, after the completion of the Sungei Seletar and Bedok Reservoir development in 1986 to construct more of these stormwater networks in other wards. In 1999, Lim Hng Kiang, the National Development Minister, announced the PUB's intention to build eight more of such ponds in addition to the existing eight that were already constructed in the eastern part of Singapore. With the completion of these additional ponds, the collection capacity of the stormwater scheme alone would amount to 50,000 cubic metres daily.[14]

Besides the stormwater collection pond project, the PUB had also invested its resources into exploring the feasibility of obtaining non-potable water from "marginal catchment areas" like the areas surrounding the Punggol River in the northeast of Singapore and the Singapore River in the south. Ostensibly, water obtained from these areas would not be procured for drinking but would be used for other purposes. Such additional sources of, albeit undrinkable, water would help to ease the demand on Singapore's potable water stocks. To bring both potable and non-potable water to

14 Lee Hsien Loong, "Bedok Waterworks' Opening Ceremony", 16 Oct 1986, National Archives of Singapore; Lim Hng Kiang, "Groundbreaking Ceremony of BKE/SLE Water Catchment Pond", 5 Aug 1996, National Archives of Singapore; "Eight More Storm-water Ponds to be Built" in The Straits Times, 28 Jan 1999

consumers, the PUB reportedly intends to introduce a "dual reticulation system", basically a dual-pipe arrangement to independently channel both types of water to the user. As Lee Ek Tieng, then Chairman of the PUB, commented: "The availability of such supply in future for non-potable uses in new developments, through a dual reticulation system, will help to conserve the use of potable water."[15]

In addition to marginal catchment areas in the northeast and south, another potential source of water that researchers have been investigating reside in aquifers—water-bearing formations of rock or soil—in Singapore. Together with professionals from Stanford University and the PUB, researchers from the School of Civil and Environmental Engineering at the Nanyang Technological University have been examining the potential of the aquifers to store and supply fresh water. Such soil or rock formations notably stretch across Singapore's reclaimed land. Indeed, researchers have found that there is much potential for groundwater to be removed from the aquifers in the reclaimed land. As Tay Joo Hwa, a member of the exploration team, pointed out: "Singapore's land reclamation programme has produced large subsurface environments, or aquifers, that are ideal for water storage and water reclamation." Elaborating, Stephen Tay, another member of the team, said: "These aquifers have highly permeable and porous sand that can hold large volumes of water economically, with minimal disruption to land use. As an added benefit, the sand acts as a natural filter, further purifying the water passing through." Preliminary feasibility studies conducted on a 25-square kilometre plot of reclaimed land in the south-eastern part of Singapore indicated that the area alone has the potential to yield significant quantities of fresh water. According to a report, "preliminary findings show that the Changi aquifer already holds a substantial amount of fresh water from rainfall infiltration and could potentially store more than 70 million m^3 of water." Theoretically, therefore, there is a vast quantity of fresh water in the Changi aquifer to augment Singapore's water reserves. Should the experts eventually succeed in developing and putting into place the technical

15 "PUB Seeks More Non-potable Water" in The Straits Times, 12 Nov 1997

apparatuses to draw and make the fresh water available in sufficient volumes to consumers, Singapore would be able to add another water source to its existing pool of water resources.[16]

In sum, considering all of Singapore's water catchment projects, the potential for the city-state to increase its water yield from the hydrological cycle is only limited by space constraints. So long as Singapore continues to be situated near the equator in the tropical climate zone and so long as the processes that make up the hydrological cycle—evaporation, transpiration and precipitation—continue to function normally in that part of the world and are not thwarted by some unforeseen grand cosmic event, the rainfall that descends on the city-state is not a finite entity. Singapore's stormwater collection depots, reservoirs and water catchment reserves are currently reportedly capable of collecting, on average, approximately 680,000 cubic metres of rainwater daily, a figure which incidentally represents a significant 57% of the 1.25 million cubic metres of water consumed daily in the city-state.[17] That statistic is not fixed indefinitely, of course. If one were to give room for the remarkable capacity of human ingenuity to find new ways or improve the existing methods of harvesting the frequent downpours over Singapore, additional volumes of water can be added to the daily collection. It should also be noted that domestic water demand is unlikely to escalate but more likely abate within the next fifty years as Singapore's population growth slows. In other words, while Singapore presently continues to import water from Johor to make up for the shortfall in daily collection capacities, the water from Malaysia will potentially comprise proportionately less and less of the total consumed by Singaporeans, given the demographic trends in the city-state and given further technical improvements in the expansion of its water collection facilities.[18]

16 Quotes and details in "Watershed Discovery: Clean Water in Reclaimed Land" in NTUNEWS No. 44 (Apr – Jun 2002), Nanyang Technological University, p. 9; see also Natalie Soh, "Underground Water Found" in The Straits Times, 30 Apr 2002

17 PUB, Annual Report, 1999 (Singapore: PUB, n.d.), p. 13; Chan Yoon Kum, "We will not Go Thirsty" in The Straits Times, 4 Apr 1997

18 Singapore's demographic developments will be further explored later.

Water Conservation Programme

Conservation is the other programme that the PUB has aggressively pursued to protect and stretch the use of Singapore's water stocks. The chief aims of the water conservation programme are to curb growing consumption rates and to instil a sense of prudence into each consumer regarding the use of water. The recipe for conservation in Singapore comprises four fundamental ingredients:

- public education to cultivate frugality in water use;
- incentive-based and pricing mechanisms to encourage water conservation;
- regulation as well as legislative measures to check growing demand; and
- consistent improvements in the infrastructure of the water distribution network to minimise wastage through leaks and the like.

One important component of the PUB's conservation programme is public education. Since 1981, the PUB has energetically launched information campaigns to bring to public awareness the concept of water as a strategic resource that should be protected and wisely used. To drum in the water conservation message into the general consciousness, officials from the PUB's conservation department regularly organise public seminars and put up message boards advocating conservation in locations like shopping malls and government offices. The PUB has also printed and handed out large numbers of pamphlets in local and foreign languages to domestic consumers and foreign workers, emphasising and reiterating the point that water be used prudently.[19]

Efforts to shape water consumption behaviour have also been systematically introduced into the educational system, with the impressionable young as the target audience. In Singapore's schools, studies related to water have been conducted under the national education curriculum, a programme designed "to develop national cohesion, the instinct for survival and confidence in our future." Referring to Singapore's water situation, Lee Hsien Loong, the Deputy Prime Minister, stated in

19 PUB, Annual Report, 1999 (Singapore: PUB, n.d.), pp. 14–15; PUB, Annual Report, 1981 (Singapore: PUB, n.d.), p. 2; "Waterworks Visit Among 'Save Water' Activities" in The Straits Times, 12 Jun 1997

his 1997 speech inaugurating the national education programme that "our young must understand Singapore's unique challenges, constraints and vulnerabilities, which make us different from other countries… We will always be small, we will always worry about our water supply, we will always have to work harder and do better than other countries. That is the hand which geography and history have dealt us." To this end of showing concern for Singapore's water supply, the PUB, in collaboration with the Education Ministry, has arranged for visits by schoolchildren to waterworks and has facilitated discussions on conservation. Such excursions and dialogues undoubtedly contribute to the nurturing of prudent habits among the young as regards to the use of water.[20]

Alongside public education that is targeted at the general public and schools, the PUB has also marked out industries for its education activities. Research showed that the volume of water consumed by firms, industrial plants and factories comprised about 40% of the total water consumed in 1999. Successful reductions in water use in this sector will certainly redound to the general good of controlling water demand. Consequently, PUB officers actively collaborate with their counterparts in the Economic Development Board, the lead governmental agency in attracting foreign investment to Singapore, to identify and steer thirsty industries toward reductions in water consumption. The nature of the PUB's work with such industries involves a number of details, both informational and practical. First, the PUB promotes and shows the firms that alternatives such as recycled or non-potable water can be used just as effectively as potable water to accomplish specific tasks within the organisation. The water authority also encourages water-intensive companies to install water conservation devices like low-flow or self-closing delayed action taps in their factories or plant sites. In addition, the PUB moves water-squandering manufacturing factories to commission full-time regulators to monitor their water use. Feedback to cut back on unnecessary and excessive water use can thus be obtained and acted upon, or glitches in the water distribution network contributing to sudden changes in water

20 Quotes from a speech by BG Lee Hsien Loong, Deputy Prime Minister, at the launch of National Education on 17 May 1997 at TCS TV Theatre, available online at: <http://www1.moe.edu.sg/speeches/1997/170597.htm> (Apr 2002); "Beginning of the Longest Water Rationing" (23 Apr 1963), available online at: <http://www1.moe.edu.sg/ne/sgstory/waterration.html> (Apr 2002); "National Education Programme – Educating the Young" in PUB News (March 1998), p. 4

consumption patterns quickly isolated and rectified. In so doing, the PUB not only aids firms in lowering their water bills, but it also protects Singapore's water reserves from wastage.[21]

The second key element in the PUB's water conservation policy is the establishment of incentive-based and pricing mechanisms to encourage water conservation. Notably, the PUB has implemented policies making available financial rewards to thirsty industries and large-scale consumers that make conscious efforts to conserve water. The conservation incentives have seen not a few takers. According to a newspaper report in 1990, for instance, a firm was not only directly rewarded with tax rebates for its decision to replace with seawater the large amounts of potable water it had previously used as coolant but it was also able to save some S$3 million in its annual water bills.[22]

Incentives aside, a "user-pays" pricing system also helps to promote conservation. The adoption of a charging scheme that advances an incremental approach to the pricing of water reveals the PUB's keen advocacy of the notion that monetary costs do provide the impetus for consumers to be less nonchalant about using water beyond what is required to satisfy basic needs. Rather than viewing water as a social good, the Singapore government has rightly treated it as a valued scarce commodity. It is instructive to note that one important cause of the water stress afflicting particular regions in the world is government water subsidies. Peter Gleick, director of the Pacific Institute for Studies in Development in Oakland, California, has noted: "We underpay for water almost everywhere. That's one of the biggest problems with water world-wide." Subsidies, which maintain water prices at artificially low rates, do not promote thrift but wastage since consumers face no financial constraints in their usage of water. Alongside subsidies, water authorities that charge flat rather than per unit rates also inadvertently encourage wastage

21 Kog Yue Choong, "Natural Resource Management and Environmental Security in Southeast Asia: A Case Study of Clean Water Supplies to Singapore" in this volume; Evangeline Gamboa, "PUB and EDB Team up to Cut Water Use" in The Straits Times, 22 Jun 1983; "PUB Checks to Weed out Water Wasters" in The Straits Times, 24 Mar 1990

22 "Seawater Helps to Save a Cool $3m" in The Straits Times, 4 Apr 1990

since no incentives or disincentives are in place to regulate consumption behaviour.[23]

In Singapore, consumers are not only charged the basic tariffs, they also have to pay a conservation tax as well as a waterborne fee, the latter levied for the treatment of wastewater. Incidentally, the conservation tax was introduced in 1997 and has gradually increased from zero to 30% in the moderate consumption rate category (one to 40 cubic metres monthly) and from zero to 45% for users in the high consumption group (beyond forty cubic metres monthly) between 1997 and 2000. The effectiveness of the pricing tools—progressive levels of tariff rates and accompanying taxes—to discourage wastage have been further enhanced by the fact that all domestic and industrial water use in Singapore are metered. Meters provide detailed measurements upon which tariff rates and the additional taxes may be accurately calculated and the consumer billed.[24]

To illustrate, under the PUB's 2002 charging system, a household that consumes one to 40 cubic metres of water in a month pays the standard tariff rate of 117 cents for every cubic metre of water used, an additional 30% conservation tax and a waterborne fee at the going rate of 30 cents per cubic metre. On the other hand, households consuming more than 40 cubic metres of water monthly will be charged tariff rates of 140 cents per cubic metre. They will also have to pay an additional 45% conservation tax as well as a waterborne fee of 30 cents per cubic metre. Industrial users, meanwhile, pay a flat rate of 117 cents per cubic metre, a 30% conservation tax and a waterborne fee of 60 cents per cubic metre. All in all, the "user-pays" mechanism acts as an instrumentality of conservation, literally demonstrating to paying consumers the value of water. Yet, in evolving toward the progressive water pricing system, it must be noted that the government has been particularly mindful of the potential financial impact it may have on low-income families in Singapore. Consequently, in conjunction with the introduction of steeper water charges, monetary rebates have been

23 Gleick quoted in G. Pascal Zachary, "International Water Pressure: Nations Scramble to Defuse Fights Over Supplies" in The Wall Street Journal, 4 Dec 1997; see also Bjørn Lomborg, The Skeptical Environmentalist: Measuring the Real State of the World (Cambridge: Cambridge University Press, 2001), pp. 155–156; "A Soluble Problem" in The Economist, 23 Mar 2000.

24 Leong Ching Ching, "Water Price to Double by 2000" in The Straits Times, 11 Jun 1997

periodically distributed to the financially challenged. Such inducements ensure that societal burdens will be equally distributed.[25]

The third aspect of the conservation effort in Singapore has to do with regulation and legislation. Incentives to encourage conservation notwithstanding, the PUB's focus on large-scale consumers has also come in the form of regulation—specifically the deliberate control of the number of water-intensive industries allowed to base its operations in Singapore. By stemming the proliferation of thirsty corporations, the water authority can thus avert drastic changes to water consumption levels in the city-state. Singapore's legal infrastructure also underpins the water conservation endeavour. In particular, the Public Utilities Act empowers relevant government officials to take action against those found deliberately wasting water or against those who illegally divert water from the main transmission and distribution network for personal use. The costs of breaking the law include sanctions such as imprisonment and fines. Such costs create deterrents to illicit activities that may adversely affect Singapore's water stocks.[26]

Apart from its preventive features, the law has also facilitated water conservation by mandating the installation of water-saving appliances in Singapore. In 1996, the Singapore Parliament amended the Public Utilities (Water Supply) Regulations of the Public Utilities Act, obligating all newly-constructed or renovated residential, commercial and industrial buildings be fitted with low capacity flushing cisterns. Compared to the water closets then in use, tests demonstrated that the low capacity flushing cisterns could significantly reduce water consumption by half. Accordingly, the Singapore government has made it mandatory for the low capacity cisterns to be installed in the lavatories of all new building projects while requiring

25 Ven Sreenivasan, "Companies Spared Brunt of Water Tariff Hikes: Self-sufficiency in Water Possible, but Costly: BG Lee" in Business Times, 11 Jun 1997; Leong Ching Ching, "Water Price to Double by 2000" in The Straits Times, 11 Jun 1997; Tan Hsueh Yun, "How Water Price Hikes Affect 3 Families" in The Straits Times, 12 Jun 1997; Tariffs for Water, available online at: <http://www.pub.gov.sg/ ws_ tariffs. html> (Apr 2002)

26 Evangeline Gamboa, "PUB and EDB Team up to Cut Water Use" in The Straits Times, 22 Jun 1983; "PUB Checks to Weed out Water Wasters" in The Straits Times, 24 Mar 1990

building renovators to use such cisterns if they intend to replace old water closets with new ones.[27]

Conservation in Singapore has also benefited from constant improvements in the water distribution system and the PUB's watchful maintenance of the existing water network. By keeping the distribution network in good working order, the PUB has managed to reduce the volume of "unaccounted-for" water, identified as the component forming the difference between the total amount of water produced and the total amount of water sold in the system. Unaccounted-for water includes water lost through water pipe leaks and unauthorised draw-offs. Defective meters may also fail to bridge the difference between the volume of water sold by the PUB to a consumer and the volume that was actually used by the latter. During the early 1980s, unaccounted-for water comprised 11% of the PUB's total water output, indicating that thousands of cubic metres of water were being lost or wasted.[28]

The PUB, therefore, embarked on a number of schemes to fight leaks, improve the reliability of meters and deter illegal draw-offs. Commencing in March 1983, the PUB launched a comprehensive pipe replacement programme. Across Singapore, cast-iron and galvanised iron water pipes, which were prone to corrosion, were dug up. In their place, the PUB laid more durable copper, stainless steel and ductile iron pipes, internally layered with cement mortar. The results achieved were remarkable: reported water leakages declined considerably from 18,058 cubic metres in 1985 to 4,373 in 1996. In any case, most of that water seeped from the old galvanised iron pipes rather than the post-1983 replacements. As for the endeavours to enhance meter accuracy, the PUB also has a replacement programme in place. The meters of small consumers are replaced every eight years

27 "Public Utilities Act 2001", available online at: <http://statutes.agc.gov.sg/> (Apr 2002); Yeo Cheow Tong, Minister for Trade & Industry, "Launch of the National Save Water Campaign", 24 Jun 1995, National Archives of Singapore; "Cisterns that Use Only Half the Water of Existing Ones" in The Straits Times, 23 Mar 1997

28 Ramahad Singh, "Controlling Unaccounted-for Water in Singapore" in Towards Efficient Water Use in Urban Areas in Asia and the Pacific (New York: United Nations, 1998), pp. 48–50

while those of industries are changed every two years. This ensures that high standards of accuracy are maintained in meter readings. Finally, as discussed above, fines and the prospect of imprisonment act as deterrents against unauthorised draw-offs.[29]

In sum, when the overall water consumption patterns and freshwater management efforts in Singapore are examined, it is clear that the impact of the PUB conservation programme has been significant. For instance, from 1989 to 1996, the percentage of unaccounted-for water declined from 10.6% to 5.9% of the total water output. Between 1997 and 1999, although Singapore's population had increased by some 160,000, the conservation measures helped to retard domestic water consumption rates. In fact, those years saw a drop in annual water consumption by an average of 0.2%.[30] With the slowing down of consumption rates and the minimisation of water wastage, it would appear that individual consumers and industries were putting the limited water supplies in Singapore into the best use. Indeed, the conservation programme has increased the efficiency of water use and stretched the ability of the city-state's reserves to provide for domestic consumption.

Procuring Water from Alternative Sources

New and improved water purification and filtration technologies, in addition to the availability of water elsewhere abroad, have opened up new avenues for Singapore to augment its domestic water reserves. The steady proliferation of alternatives to water from Malaysia has been made possible, first, by advancements in desalination and recycling technology and, second, by the opportunities afforded by the Indonesian government to Singapore to explore the extraction of fresh water from the Riau province.

Desalination is one technology that Singapore will be exploiting to obtain alternative sources of water. Over the last two decades, progress in

29 ibid., pp. 52–59

30 ibid.; PUB Press Release: Public Utilities Annual Report 1999, 29 Jun 2000, pp. 1–2 and note that domestic water consumption was growing at an annual rate of 3.2% between 1994 and 1996.

desalination technology has made the process of desalting seawater for fresh water an increasingly affordable and cost-effective option to relieve water stress. Previously, desalination processes relying on evaporation methods as the chief means of separating briny compounds from seawater typically consume relatively large amounts of energy in their operations. The new methods of desalination like reverse osmosis, however, where seawater is forced to pass through filter membranes which remove bacteria and simple inorganic ions and comes out as potable water, use less energy to produce each cubic metre of fresh water. Juxtaposed to old methods, desalination plants using techniques like reverse osmosis thus have the potential to markedly increase freshwater production per energy use. As technological advancements make desalination cheaper and less energy demanding, the sea is becoming more and more an alluring and viable source of freshwater supplies.[31]

Since the late 1990s, the proliferation of new desalination methods and their availability on the market have spurred the PUB to accelerate its efforts to exploit water desalination in Singapore. Once considered prohibitive, the cost of desalting seawater has also become more affordable. In 2001, the cost of processing one cubic metre of seawater using existing methods, for instance, was estimated to be about S$1.20. One report suggested that experiments utilising ultrasound waves to process the same volume of seawater could bring the cost down to about ten Singapore cents.[32]

The PUB's foray into desalination, however, would involve commercial developers and operators. The PUB was evidently cognisant of the fact that as desalination technology developed and became more complex, technical experts rather than government bureaucrats could best master the informational requirements and technical expertise needed to exploit the latest desalination gadgets to obtain a certain volume of water at the cheapest rate. Competition would also keep prices competitive and encourage innovation. Consequently, Singapore's water authority publicised

31 Bjørn Lomborg, The Skeptical Environmentalist, pp. 149–158; Chua Lee Hoong, "Greater Self-reliance in Water is the Way to Go" in The Straits Times, 10 Apr 2002; Tan Hsueh Yun, "Desalinated Water will Get Back a Pinch of Salt" in The Straits Times, 12 Nov 1997

32 Sharmilpal Kaur, "Cheaper to Desalinate Seawater than to Import it" in The Straits Times, 15 Mar 2001; idem, "Ultrasound may Make Waves in Seawater Processing" in The Straits Times, 11 Sep 2001

its intention in 1999 to buy desalinated water from commercial sellers rather than build desalination plants on its own. This announcement was followed by the PUB's release of tender documents to a number of bidders in December 2001. Private enterprise would compete for contracts to build desalination plants as part of the so-called Build-Own-Operate (BOO) arrangement. In other words, once commissioned, a water treatment firm would build the desalination plant, run it and sell desalinated water to the PUB. As regards the type of desalination process to be used, the PUB stipulated that it would give the bidders for the BOO project free rein to choose from the variety of available desalination methods, which might include multi-effect distillation, multi-stage flash distillation, reverse osmosis processes and/or hybrid systems. Ultimately, what mattered for the PUB was that the desalination technology, capable of churning out about 140,000 cubic metres of fresh water daily, would be operational by 2005. This is in keeping with the PUB's aim to further diversify Singapore's water resources by increasing the volume of desalinated water available for domestic use to 400,000 cubic metres daily by 2010/2011.[33]

Like desalination, advanced recycling techniques have also boosted the ability of Singapore to diversify its water sources. Developments in new filter and membrane technologies allow users of such recycling tools to competently treat wastewater for reuse. The cost of recycling has also become relatively affordable. One estimate put the cost at slightly over one Singapore dollar per cubic metre. In 2000, the PUB began operating a prototype water recycling plant in Bedok with an initial output capacity of 10,000 cubic metres of recycled water, or what the PUB terms NEWater, per day. By the end of 2002, the PUB will have completed the construction of another reclamation plant in Bedok and another NEWater factory in

33 Lilian Ang, "S'pore may Tap the Sea as Source of Water: Cheow Tong" in Business Times, 12 Mar 1995; idem, "Invest in Water Desalination Plants, says MP" in Business Times, 4 Jun 1997; PUB, Annual Report, 1997 (Singapore: PUB, n.d.), pp. 11–12; Ven Sreenivasan, "Self-Sufficiency in Water Possible, but Costly: BG Lee" in Business Times, 11 Jun 1997; Tan Hsueh Yun, "Singapore's First Desalination Plant to be Ready in 2003" in The Straits Times, 11 Jun 1997; PUB, Annual Report, 1999 (Singapore: PUB, n.d.), p. 3; "3 Water Plants for S'pore by Year 2011" in The Straits Times, 4 May 1998; Sharmilpal Kaur, "30m Gallons a Day to Drink" in The Straits Times, 22 Mar 2001; Ronnie Lim, "Desalination Plan to Proceed" in Business Times, 7 Nov 2001; Liang Hwee Ting, "Desalinated Water from Singapore Taps in 2005" in The Straits Times, 1 Dec 2001; Teh Hooi Ling, "PUB Issues Desalination Project Tender Documents" in Business Times, 1 Dec 2001

Kranji. Each will have the capacity to produce about 22,730 cubic metres of NEWater daily. Stringent and complex filtration processes ensure that the NEWater that is produced surpasses the World Health Organization's benchmark constituting safe drinking water. The recycling plant first extracts wastewater and forces it through the small pores of thousands of tubes to separate semi-microscopic matter from the water. The filtrated water is then pushed through semi-permeable membranes with tinier microscopic pores to remove whatever vestiges of organic and inorganic matter that still reside in the water. The water is finally put under intense ultraviolet light to kill any still-living viruses left behind.[34]

Since water-recycling technology became available in 2000, wafer-fabrication factories, which typically buy relatively large quantities of high-grade water from the PUB, have switched to NEWater. Encouraged, the PUB intends to construct more of such plants to meet domestic industrial water needs. One article indicated that the PUB has "plans to increase this [output of recycled water] to between 182,000 and 205,000 cubic metres." More generally, plans are afoot to exploit NEWater to satisfy approximately 15% to 20% of Singapore's daily water needs by 2010. Going by the current consumption rate of 1.25 million cubic metres daily, this would work out to between 180,000 and 250,000 cubic metres daily. Indeed, recycled water has every potential to significantly augment Singapore's total water reserves. According to Minister for Environment Lim Swee Say, NEWater has a "multiplication effect" on Singapore's domestic reserves: "If we increase the supply of fresh water by 20% and at the same time reclaim 30% of the used water, we will be able to increase our total water capacity by as much as 70%!" He added: "This combination of 'adding' to and 'multiplying' of our water capacity is a highly promising and effective approach in sustaining adequate

34 Quality Living Environment, available online at: <http://www.env.gov.sg/sgp2012/quality_water.htm> (May 2002); Sharmilpal Kaur, "In the Pipeline – More Recycled Water Plants" in The Straits Times, 20 Jan 2001; Irene Ng, "Wafer-fab Plants Opt for Recycled Water" in The Straits Times, 31 Aug 2001. Besides the PUB-run NEWater plants, another waterworks operated by a government-linked company, SembCorp Engineering, has also been offering high-grade recycled water for sale since early 2000. The plant is reportedly capable of producing about 30,000 cubic metres of high-grade water daily. The water is priced at S$1.45 per cubic metre. See "What it Should have Been" in The Straits Times, 7 Sep 1999; Joanne Lee, "Cheaper Water for Jurong Island" in The Straits Times, 3 Sep 1999; "Industrial Water: SembCorp Eng to Process" in The Straits Times, 9 Mar 1999.

water supply for the long term." Given that NEWater is also potable, the possibility that Singaporeans may one day consume recycled water cannot be ruled out. While that option exists, only the psychological barriers to the prospect of consuming treated wastewater remain to be overcome.[35]

Besides being able to generate potable water, water-recycling technology is also producing lower grades of non-potable water for industrial use in Singapore. The city-state's Environment Ministry reportedly operates a plant that is capable of producing about 125,000 cubic metres of such low-grade water in the western part of the island. Unlike those that are used in producing NEWater, the equipment employed in producing the lower grade of recycled water at the Jurong Industrial Water Works is more concerned with removing the large and fine solids as well as the odour rather than the microscopic matter from the wastewater. The entire recycling process takes about four hours to complete. According to a manager of a waterworks in Singapore, the non-potable water, more commonly known as industrial water, "is clean enough for just about everything except drinking." Consequently, industrial water is mainly used for purposes such as cooling, washing and processing. Priced at about 38 Singapore cents per cubic metre according to a 1999 report, its major users include those in the textile, steel and paper trades. Chemical plants, shipyards and refineries also use the non-potable water for similar purposes. On the whole, Singapore recycled and sold about 70,000 cubic metres of low-grade water daily to industries in 2002. Given its relatively low price, the potential for a greater take-up rate for industrial water is high. At any rate, the Jurong Industrial Water Works is currently capable of producing an additional 55,000 cubic metres daily to meet any further orders. It is estimated that if industries switch over and use all the 125,000 cubic metres of industrial water that is presently available, this will set aside enough fresh water for more than 190,000 households in Singapore daily.[36]

---

35 "Water: Add and Multiply" in Streats, 26 May 2001; Sharmilpal Kaur, "In the Pipeline – More Recycled Water Plants" in The Straits Times, 20 Jan 2001; idem, "20% of Sewage Water can be Recycled" in The Straits Times, 30 Jan 2001; idem, "Add, Multiply to Meet Water Needs" in The Straits Times, 26 May 2001; Irene Ng, "Wafer-fab Plant Opt for Recycled Water" in The Straits Times, 31 Aug 2001

36 Quality Living Environment, available online at: <http://www.env.gov.sg/sgp2012/quality_water. htm> (May 2002); Dominic Nathan, "Industrial Water Supply to be Doubled" in The Straits Times, 3 Apr 1999; "Using Recycled Water" in The Straits Times, 30 Jul 1997

In addition to wastewater recycling and seawater desalination, Singapore's other alternative source of fresh water can potentially come from Indonesia. Officials from the water authorities of both countries signed an agreement in June 1991 to develop water resources in Indonesia's Riau province and the Kampar River in Sumatra. Under the terms of the agreement, Indonesia would be prepared to sell Singapore up to 4,546,100 cubic metres of water daily for 100 years. Yet, while the potential supply of fresh water is admittedly considerable, construction of the project's infrastructure of dams, impoundments, and pipelines to channel the water to Singapore is likely to be very costly (estimated, in fact, to be approximately S$1.5 billion). The high cost of the project explains, in part, why policymakers have been so deliberative about commencing construction work. In November 2001, however, the prospect of Indonesia supplying water to Singapore regained some momentum. According to media reports, Indonesian Ambassador Dr Johan Syahperi revealed that Riau province officials had been broaching the subject with a number of corporations and consultants "about supplying water affordably to Singapore." With this renewed impetus to finally bring into fruition the plans outlined in the 1991 accord, Syahperi stated that Indonesia would probably be able to present a concrete proposal to Singapore by 2002. This suggests that an earlier Straits Times report published in 2000, which indicated that water from Indonesia to Singapore "could come through as early as 2005", might not be far-fetched. [37]

37 Adriel Yap Lian Ho, "Water for Singapore", p. 26; "Singapore Team Finds Water Potential in Riau" in The Straits Times, 10 Apr 1990; Paul Jacob, "S'pore Signs Water Pact with Indonesia" in The Straits Times, 29 Jun 1991; Yeoh En-lai and Liang Hwee Ting, "Massive Water Project is Floated" in The Straits Times, 2 Jul 2000; Yeoh En-Lai, "Riau in Sumatra Keen to Fill S'pore's Water Needs" in The Straits Times, 2 Jul 2000; Robert Go, "Indonesia Gears up to Supply Water to S'pore" in The Straits Times, 6 Nov 2001

WATER AS A LIKELY PROXIMATE CAUSE OF ARMED CONFLICT?

What is the likelihood that Singapore and Malaysia will become the first pair of states since Lagash and Umma, two Mesopotamian city-states that fought each other over water in 2500 BC, to engage in a water war?[38] In particular, how would the above findings on Singapore's water situation and institutional policies affect the prospect for armed conflict between Singapore and Malaysia if the latter unilaterally abrogates the water agreements? Speculative answers to questions about whether water will be a proximate cause of outright warfare are invariably laden with uncertainties. But reasoned deductions and predictions can help to inform policy discourse and facilitate decision-making. Accordingly, the arguments that follow are attempts to unravel Singapore's likely response to Malaysia's play of the water card.

The ensuing analyses leverage on a number of developments and markers. The first has to do with Singapore's daily water consumption rate, which appears to be reaching a steady state of between 1.2 and perhaps 1.3 million cubic metres. At present, some 4.1 million people in Singapore and a significant number of industries use about 1.25 million cubic metres of water daily. Water demands are unlikely to escalate dramatically. Demographic developments, for one, are likely to ease the demand for more water. In Singapore, the total fertility rate has fallen below the replacement level of 2.15 children per woman. The fertility rate was 1.77 in 1995 but has declined to 1.42 in 2001. Demographer Saw Swee Hock has pointed out that if Singapore's birth rate continues to hover at 1.77 children per woman, the city-state's resident population (citizens and permanent residents) will peak at 3.3 to 3.5 million between 2025 and 2030 and decline subsequently. Given that the fertility rate has fallen dramatically from 1.77 to 1.42, it appears that the upper limits of the demographic plateau will have to be adjusted downwards and that it will be reached sooner rather than later.

38 Since the Lagash-Umma conflict, studies indicate that no other war has erupted over water. See Sandra L. Postel and Aaron T. Wolf, "Dehydrating Conflict" in Foreign Policy (Sep/Oct 2001), p. 60.

Thus, assuming that there will not be a spectacular flood of immigrants to Singapore and that the number of foreigners remains at the current level of approximately 750,000, the population of the city-state will not climb above 4.3 million for the next two to three decades. This suggests that the population's demands on Singapore's water reserves will be constrained for the foreseeable future.[39]

Another factor besides demographic change that will restrain a rapid upsurge in water consumption is Singapore's conservation effort. The conservation measures, as discussed above, have made an impact in arresting high growth in consumption rates, minimising waste and dampening demand. To be sure, volumes more (like water lost to leaks or inefficient household and industrial water consumption habits) can still be conserved or put to better use. As the PUB further improves its already efficient water management practices and continues to cultivate prudence in water use among Singaporeans, while the latter become more adept in water conservation practices, Singapore's water consumption rate looks to be evening out.

Besides factoring Singapore's water consumption patterns, the following investigation of the city-state's likely response to Malaysia's use of the water link as political leverage also takes its cue from the pronouncements of Singapore's policymakers. Revisiting Lee Kuan Yew's narrative in From Third World to First, it was disclosed that Senior Minister Lee had stated to Prime Minister Mahathir: "If water shortage became urgent, in an emergency, we would have to go in, forcibly if need be, to repair damaged pipes and machinery and restore the water flow."[40] That assertion was made in a 1978 meeting. As the Senior Minister developed and brought the narrative in his memoirs to current concerns and the future of Singapore-Malaysia relations,

---

39 Water Supply, available online at: <http://www.pub.gov.sg/ws_overview.htm> (Apr 2002); speech by Prime Minister Goh Chok Tong during the Parliamentary Debate on the President's Address on Friday, 5 Apr 2002, available online at: <http://www.gov.sg/singov/announce/050402pm.htm> (Apr 2002); "More Babies Wanted as Birth Rate Dives" in The Straits Times, 6 Apr 2002; Saw Swee Hock, The Population of Singapore (Singapore: Institute of Southeast Asian Studies, 1999); "5 Million People? Not Likely" in The Straits Times, 20 Oct 1999; "S'pore is Short of 200,000 Babies" in The Straits Times, 20 Oct 1999

40 Lee Kuan Yew, From Third World to First, p. 276

however, his subsequent pronouncements reflect less a preoccupation with the possibility of armed conflict with Malaysia over water than with a glowing assessment of Singapore's ability to overcome a water crisis. Recalling how Tunku Abdul Rahman "did not expect us [Singapore] to succeed" and had attempted to use water as one of "three levers [the other two being the Malaysian military and economy] to impose his will on Singapore", Mr Lee's riposte is instructive: "As for water, we have alternatives – our own reservoirs provide about 40% of our domestic consumption, and with modern technology for desalination, reverse osmosis and recycling of used water, we can manage."[41]

In this connection, while Singapore's Prime Minister Goh Chok Tong had aired his views in the local media in 2001 about the benefits of maintaining the water ties with Malaysia, he also candidly asserted that if water was used as leverage, Singapore had recourse to alternative water sources. As he pointed out to the interviewer: "Well, it [water in the context of Singapore-Malaysia relations] can be used as a leverage which is why we need to have alternative sources of water which can be put in place very quickly." As to the availability of these "alternative sources", the Prime Minister revealed: "we have been exploring reverse osmosis."[42] The allusion to Singapore weaning itself off Malaysian water was put in more emphatic terms in the Prime Minister's speech to the Singapore Parliament in April 2002, following another downturn in interstate relations which predictably saw Malaysia's continued supply of water to Singapore being put under the spotlight again. Stating that "it is high time we explore a different approach to water supply from Malaysia", Mr Goh made it known that Singapore intended to rely less on Malaysia for water. "This is doable if we have to do it," he declared. He accentuated that Singapore has recourse to and is in the process of generating alternatives. With desalination and recycling technologies making such rapid advances that the production of desalinated and recycled water have become increasingly affordable, the Prime Minister disclosed that Singapore's search for alternatives to water from Malaysia was well underway: "We have already called a tender for a 30 mgd [million gallons per day] desalination plant. We have been operating a plant to produce NEWater (reclaimed water) using membrane technology for two

41 ibid., p. 288

42 Irene Ng, "Unwise to Work for Full Self-Reliance on Water" in The Straits Times, 26 Jan 2001

years now. And we intend to build more such NEWater plants. The cost of these alternative sources of water is not all that prohibitive either." Mr Goh admitted as much that the proliferation of these alternative water sources would give Singapore more options to exercise should a water-related crisis develop between Singapore and Malaysia.[43]

Taken together, the Prime Minister's and the Senior Minister's pronouncements indicate that alternatives to water from Malaysia are being generated in Singapore. To what extent, however, are these alternatives, together with the entire water reserves impounded in Singapore's reservoirs, adequate to make up for any water shortfall in Singapore should Malaysia prematurely cut the water links? The answer to that question is important as it raises the prospect of water being a proximate cause of conflict between the two neighbouring states. Indeed, Mr Lee, in particular, has alluded to expressions like "[i]f water shortage became urgent" and "emergency" to suggest the grave conditions under which Singapore may be forced to take extreme measures to ensure Singapore's survivability should Malaysia use water as a strategic weapon against the city-state. Correspondingly, such references to urgency strongly indicate that whether or not Singapore will resort to armed force to restore the water flow from Johor to the city-state—a supply which is guaranteed by the two water agreements signed in 1961 and 1962—will be largely dependent on whether the termination will seriously undermine Singapore's existence. Deductively, if Singapore's survival is not in jeopardy, it may use means other than armed force to rationally rectify the situation, given that a war will be extremely costly in political or economic terms. At any rate, the theoretical literature on the relationship between water and war suggest that if states in a water-scarce region have access to alternative sources of water and are able to rely on the alternatives to achieve a measure of water self-sufficiency, there will be less likelihood that water-related conflicts between states in that region will erupt.[44]

---

43 Speech by Prime Minister Goh Chok Tong during the Parliamentary Debate on the President's Address on Friday, 5 Apr 2002, available online at: <http://www.gov.sg/singov/announce/050402pm.htm> (Apr 2002)

44 Peter Gleick, "Water and Conflict" in International Security Vol. 18 No. 1 (Summer 1993), pp. 79–112; idem, "Water Scarcity and Conflict" in The Environment and Security: What are the Linkages?, Canberra Papers on Strategy and Defence No. 125, edited by Alan Dupont (Canberra: Strategic and Defence Studies Centre, Australian National University, 1998), pp. 35–44; Bjørn Lomborg, The Skeptical Environmentalist, pp. 149–158

With the pointers above providing some analytical orientation and direction in addition to the details garnered previously about Singapore's water situation providing the empirical base to buttress subsequent arguments, what follows is an attempt to examine the city-state's likely response to Malaysia prematurely terminating the water ties. The ensuing study sets its analyses in two contexts: the first assumes that all the desalination and recycling plants that the Singapore government had previously announced its intention to erect would be operational while the second would be one in which the desalination and recycling projects are in their assorted phases of construction. For the sake of furthering discussion, both scenarios also assume that Singapore has yet to gain access to water from Indonesia. Positing the presence or absence of alternative sources of water would contribute to the simulation of conditions under which Singapore might experience different levels of water stress. The different set of circumstances would, in turn, allow one to gauge whether Singapore would be capable of coping without water from Malaysia or whether the city-state might be compelled to resort to extreme measures to alleviate its condition of water stress.

Singapore with Access to Alternative Sources of Water

This scenario sees Singapore operating a number of desalination and recycling plants, equipped to supplement the water supply provided by its domestic reservoirs and from across the Causeway. Based on current estimations, Singapore's domestic reservoirs, catchment areas and urban water catchment ponds would still be able to collectively provide at least 680,000 cubic metres of water daily. Assuming that Singapore continued to purchase water from Malaysia and would only operate the desalination and recycling plants to provide emergency alternatives, slightly more than 500,000 cubic metres of water would continue to be extracted from water catchment areas and rivers in Johor and pumped across the Causeway to supplement consumption in Singapore (presumed to be between 1.2 and 1.3 million cubic metres) on a daily basis. According to published reports, by 2010, Singapore's desalination programme would reportedly be able to supply some 400,000 cubic metres of fresh water to the state daily. Its recycling plants would also be capable of producing some 250,000 cubic metres of NEWater daily. Should Singapore

be adept at extracting groundwater from the Changi aquifer, a significant volume of fresh water would further be made available for consumption. Industries would also still have the option of buying non-potable water from the Jurong Industrial Water Works for their manufacturing and other plant operations. Thus, even should Singapore's joint venture with Indonesia to extract the water resources in the Riau province fail to materialise, the city-state would still possess a sizeable volume of water stocks to satisfy its domestic water requirements.

Accordingly, should Malaysia attempt to use water as a strategic weapon and disrupt the water flow from across the Causeway to Singapore, it is hard to conceive of the city-state launching a retaliatory military strike to restore the status quo ante. Singapore, in fact, would be relatively unaffected by a water cut-off since alternatives could replace the water from Malaysia. Given that Singapore would not face chronic water shortages that might undermine its survivability, it would be judicious to expect the city-state's leaders to react to the water crisis more as a test of will and legality, to be confronted in the diplomatic arena rather than the battlefield. Any military action would make little sense, given that Singapore's domestic water reserves, supplemented by the availability of volumes of desalted and recycled water, would, in themselves, be more than sufficient to meet the city-state's daily water use. War would also be counterproductive since Singapore as well as Malaysia would stand to lose much if their economies and social fabric were devastated by armed conflict. A Singaporean military offensive, which would certainly entail high material and human costs, to regain access to the fresh water in Malaysia that could be sufficiently generated domestically would indeed be unjustifiably outlandish.

Military restraint certainly does not mean that Singapore would remain indifferent to Malaysia's violation of the 1961 and 1962 water agreements. What is most likely to develop would be a diplomatic offensive launched by Singapore to isolate and censure Kuala Lumpur for breaching the terms of the two accords. As Mr Lee Kuan Yew asserted, "If this [water agreement] was breached, we would go to the UN Security Council."[45] As a matter of principle and in utilising a non-military instrument to punish Malaysia, Singapore would doubtlessly mount a vigorous regional and

45 Lee Kuan Yew, From Third World to First, p. 276

international diplomatic campaign to garner regional and international support for the censure of Kuala Lumpur for the premature termination of water supply to the city-state. It seems very unlikely that Malaysia would not have to pay a diplomatic price should it play the water card against Singapore.

Singapore with Access to Limited Sources of Alternative Water Resources

Arguably, Singapore's survivability would also not be jeopardised should Malaysia prematurely terminate the water links before all of the city-state's projected numbers of desalination and recycling plants become operational. The direct upshot of a sudden termination of the water supply from Malaysia, however, would be an increased drain on the city-state's water reserves. Still, the heightened water stress could be managed. The total storage capacity of Singapore's impounding reservoirs stand at approximately 140 million cubic metres. At a consumption rate of 1.2 million cubic metres per day, Singapore's water reserves, without refill, could theoretically sustain domestic demand for approximately 117 days. With 2,400 mm of rainfall falling on Singapore annually and the PUB indicating that it could collect an average of 680,000 cubic metres of rainwater daily, sufficient volumes of water could be harvested and stored away in Singapore's impounding reservoirs to satisfy domestic water needs for at least 280 days at a consumption rate of 1.2 million cubic metres daily. Singapore could, moreover, mobilise its three wastewater recycling plants, capable of collectively churning out about 55,000 cubic metres of water daily, and call upon the waterworks producing lower-grade industrial water to relieve the stress on domestic water reserves. Finally, if the Singapore government imposes water rationing, bring in adequate quantities of bottled water and seriously explore the possibility of purchasing water, transported via supertankers, from commercial sellers in countries like Canada, Singapore's water needs could perhaps be met indefinitely.[46]

46 The feasibility of buying water from a firm in Canada was explored by Choo Bee Yian and G. Chandradas, "Water by Tanker" in The Straits Times, 28 Aug 1998.

Of course, Singapore in this scenario would be relatively intolerant of any sudden and unjustifiably high increases in the water consumption rate and vulnerable to a severe drought. Water rationing might also be disruptive and the procurement of bottled water would incur relatively higher monetary costs for Singapore's inhabitants. Nonetheless, such troubles would admittedly be bearable, momentary and surmountable. Waging a war to relieve the transitory inconveniences would be unwarranted, especially when the political, economic and social costs to be incurred in an armed struggle would be excessively costlier than if diplomatic measures were mobilised to confront Malaysia. For instance, while households in Singapore might have to allot a larger percentage of their incomes to pay for the use of more expensive alternatives like bottled water, that prospect would seem relatively insignificant when compared to the price of war. War costs would also seem to be far too expensive when Singapore could focus on accelerating its existing desalination and wastewater recycling programmes to relieve water stress. Here, the counsel of an analyst is both illuminating and helpful: "Why go to war over water? For the price of one week's fighting, you could build five desalination plants. No loss of life, no international pressure, and a reliable supply you don't have to defend in hostile territory."[47]

Intrinsically, it would be expected that the Singapore government would speed up the construction of sufficient numbers of desalination and NEWater factories and bring them into action as speedily as possible to free the city-state from over-dependence on the finite volumes of fresh water that could be derived from precipitation and the existing recycling plants. While the first large-scale desalination plant capable of producing about 140,000 cubic metres of potable water would be completed around 2005, an accelerated construction programme would make it possible for Singapore to roll out sufficient numbers of operational desalination plants to completely ameliorate water stress.[48] It is estimated that should non-stop construction work take place in twenty-four shifts over seven days in a week, it might

47 Bjørn Lomborg, The Skeptical Environmentalist, p. 157
48 Sharmilpal Kaur, "30m Gallons a Day to Drink, From the Sea" in The Straits Times, 22 Mar 2001

be possible for a large-scale desalination plant generating 186,000 cubic metres of water daily to be made operational within three years.[49] With the simultaneous construction of and eventual operation of two or three such desalination factories, Singapore would be able to achieve a comfortable measure of potable water self-sufficiency.

Whereas during the first three decades of its existence as a sovereign state Singapore would have been hard-pressed to cope satisfactorily with a water crisis, it is better able, especially since the late 1990s when its demographic expansion has gradually slowed, to accelerate the completion of its various projects-in-progress like the procuring of alternative water supplies via desalination or wastewater recycling in addition to exploiting other sources obtainable in the open market to compensate for any water shortfall. Its comprehensive water strategy and diversification of water sources have better enabled Singapore to manage its relations with Malaysia during a water crisis. By reducing its water vulnerabilities, therefore, Singapore would be expected to deal with a premature termination of the Malaysian water links less as a security issue than a problem that could be resolved without resorting to military measures. Comparatively, Malaysia would suffer graver diplomatic retribution should the international community be ranged against it for violating the water agreements. Faced with intense diplomatic pressure, Kuala Lumpur might be compelled to restore the status quo ante at substantial cost to its regional and international standing.

Arguably then, the likelihood of the water issue becoming a proximate cause of war between the two sovereign states has lost much of its credibility in light of what has been outlined about the robustness of Singapore's water schemes and the viability of its reserves to satisfy domestic water needs. The cumulative effects of Singapore's reservoir construction endeavours, the improvement of its water catchment capabilities, the implementation of effective water conservation policies, its decision to embark on the building of desalination and recycling plants (which incidentally has afforded it the ability to hasten their construction in the event of a water crisis), and the levelling off of its population expansion, have effectively diminished the city-state's water vulnerability. As former president of the International Desalination Association Leon Awerbuch had astutely observed: "Usually, armies are the way to solve water conflicts… But Singapore is finding

49 Interview with Mr Alfred Wong, Civil Engineer, UTRACO Pte Ltd, 10 Apr 2001

alternatives." [50] While Singapore might have previously restricted itself to a military option to safeguard its water security, it has now created for itself more political and diplomatic room to manoeuvre and this, in turn, will further enhance its survivability as a sovereign state.

CONCLUSION AND POLICY CONSIDERATIONS

Singapore's efforts in reducing its dependence on Malaysia for water, in diversifying its sources of supply and in enhancing its water self-sufficiency are collectively inducting an opportunity, if not, an imperative, for moving discourse about the Singapore-Malaysia water issue away from one which problematises it as an interstate security problem. Indeed, while the scenarios explored previously might have been of those of worst-case varieties, they surely undermine arguments that would continue to posit the water issue as a likely proximate cause of armed conflict between Singapore and Malaysia. As Singapore continues to add new sources of water supplies to its already formidable inventory of domestic reserves, there is little reason to perpetuate the securitisation of the water issue in terms of threats and survival.

On the contrary, with greater understanding that it is possible for Singapore to remain impervious to any Malaysian attempt to use the Johor water supply as a means of brinkmanship and blackmail, and that an objective foreign threat to Singapore's water supply no longer exists, it is time to regard the water issue in Singapore-Malaysia relations as desecuritised. Rather than continuing to treat a Malaysian threat to cut off the water supply as necessitating a military response, such an action can instead be handled as a contractual matter in an international court of law and opinion. The desecuritisation of the water issue widens policy options, makes negotiation possible, contributes to the reduction in the perception of threat and may better bring about a diplomatic resolution of difficulties involving the water issue between Singapore and Malaysia.

Desecuritisation is also likely to shift future debates of the water issue in Singapore-Malaysia relations from security to pecuniary considerations. While Singapore may be capable of achieving a measure of self-sufficiency, it has signalled that it will like to continue to purchase raw water from

50 Mahlon Meyer, "'Nor Any Drop to Drink: Singapore Tries Innovating its Way to Clean Water" in Newsweek, 16 Jul 2001

Johor—but in smaller volumes than previously and at a price both sides will find reasonable and fair. Singapore has also coupled its price offer with a "package" of deals that includes, inter alia, the offer of alternative plots of real estate to Malaysia in exchange for a strip of Malaysian railway land in Tanjong Pagar, Singapore, all amounting to some 1.5 billion ringgit (US$395 million). Malaysia, on the other hand, stands to profit from continuing the sale of water to Singapore at a higher negotiated fee and from securing all the concessions it had gained under a preliminary agreement reached between Senior Minister Lee Kuan Yew and Prime Minister Mahathir Mohamad in September 2001. The trajectory of both governments' rhetoric and actions thus indicates the willingness of both sides to continue the water links. It seems reasonable to suggest that pecuniary considerations will preoccupy policymakers of both states as the water ties prevail. It remains for both to serve up a new deal that will continue to reap mutual benefits for the inhabitants of both countries in the spirit of "prosper thy neighbour".[51]

Alongside the expected shift of the water issue from a security to a pecuniary consideration, a desecuritised water relationship between Singapore and Malaysia can also provide the impetus for putting an end to an enemy-producing security discourse. Indeed, it is imperative that both neighbours consciously endeavour to change discourses emphasising threat-military defence sequences to one of disagreement-negotiation in their bilateral relations. This will keep doors open for both to engage each other and facilitate the resolution of disputes. There are signs that the Singapore government, on its part, would like to contribute to this process of downplaying the discourses of threat and danger. Alluding to public reports that referred to the possibility of armed conflict between Singapore and Malaysia over water and how "Malaysia should take full advantage of water as a strategic weapon to counter Singapore's military advantage over

51 Kamal Ahmad, "Does S'pore Appreciate Malaysia's Neighbourliness?" in The Straits Times, 24 Feb 1998; Irene Ng, "Tough Talks, then Progress on KL Pact" in The Straits Times, 5 Sep 2001; idem, "Now up to Officials to Flesh out Details of the Pact" in The Straits Times, 6 Sep 2001; Ng Boon Yian, "Pact Politics" in Today, 6 Sep 2001; "PM: Not much Progress in Talks with S'pore" in The Star, 22 Jan 2002; Ramlan Said, "Discussion with Singapore Stalled Due to Water Issue" in The New Straits Times, 22 Jan 2002; Cheah Chor Sooi, "Malaysia just as Eager to Solve Bilateral Issues" in The New Straits Times, 29 Jan 2002; Tan Siok Choo, "It's a Question of Fair Price" in The New Straits Times, 29 Jan 2002; Zainal Aznam Yusof, "Pay Market Rates for Water" in The New Straits Times, 8 Feb 2002; "Singapore Studying New Malaysian Proposals in Water Price Row" in Agence France Presse, 12 Mar 2002

Malaysia", Singapore's Prime Minister Goh Chok Tong grimly pointed out in April 2002 that such a discourse only "breeds mistrust and suspicion, and does not make for a productive relationship." "We want to have good, stable relations with Malaysia for the long term and for mutual benefit. We shall play our part to achieve this," Prime Minister Goh asserted, following his declaration that Singapore intends to rely less on Malaysia for water by turning to alternatives like desalinated and recycled water.[52]

The Singapore government's actions may yet eventually remove the water issue from the list of perceived grievances that political and activist groups in Malaysia continually and, perhaps cathartically, harp on to further their domestic agendas.[53] Once such groups realise that the water issue no longer commands much of the sense of security drama of yesteryears, and those specifically in Johor begin to pay higher water tariffs for treated water produced domestically, a new sense that interdependence and co-operation ultimately benefit the inhabitants of both countries may dawn. Indeed, while Singapore has paid three Malaysian cents for every 4.5461 cubic metres of raw water it buys from Johor, it has also sold purified water back to Johor at 50 Malaysian cents for the same volume, a price that is significantly lower than what the Johor government will have to pay if it treated the raw water itself. This represents a significant subsidy, especially when one compares the selling price of Singapore's treated water to the price charged by SAJ Holdings Sdn Bhd, the Malaysian corporation entrusted to supply water to Johor, for the same volume of treated water. An article in the Malaysian media in March 2002 revealed that the "token price" fixed by SAJ Holdings for its supply of treated water to Malacca was 66 Malaysian cents for one cubic metre (or approximately 300 Malaysian cents for every 4.5461 cubic metres). The price charged ostensibly enabled the company merely "to break even." Thus, while SAJ Holdings has found that it is able to balance the books only by selling treated water at the rate of 300 Malaysian cents for every 4.5461 cubic metres, the Johor government's intention to cease importing treated water from Singapore—even at the subsidised rate—and turn to domestic suppliers like SAJ Holdings from 2003 will invariably have a considerable

52 Speech by Prime Minister Goh Chok Tong during the Parliamentary Debate on the President's Address on Friday, 5 Apr 2002, available online at: <http://www.gov.sg/singov/announce/050402pm.htm> (Apr 2002); Tan Tarn How, "Water: S'pore to Rely Less on KL" in The Straits Times, 6 Apr 2002

53 Chua Lee Hoong, "No Polite Lunch in Bilateral Competition" in The Straits Times, 1 May 2002

financial impact on consumers in Johor. In fact, in January 2001, Johor had begun to raise its domestic water tariffs "by up to 40%" to cover higher domestic operating costs of supplying water to its constituents.[54]

Intrinsically, the recognition that ultimately both countries have benefited from their close water relations—a win-win situation in every sense of the phrase—may eventually bring with it the conscious appreciation that it may be in the interest of all affected groups to begin to embrace the desecuritisation of the water issue and co-operate. One avenue had been broached during the September 2001 talks between Mr Lee and Dr Mahathir: the institution of a partnership on water issues. Such an association can advance technical co-operation on matters such as water treatment and management between the water authorities of the two countries. Mutual pecuniary and social benefits can be gained if co-operation eventually leads to more economical water treatment methods, better efficiency in water use and the protection of water sources.[55]

All told, the conscious pursuit of collaboration, the realisation that both Singapore and Malaysia can profit from that partnership and the cessation of speech acts that conflate the water relations with references to danger, threat and war will, in the end, enhance bilateral relations and bring mutual benefits. In seeking to further promote co-operation, it may thus no longer be productive to frame future debates about the Singapore-Malaysia water issue in security terms. Against all the past rhetoric that water may be a proximate cause of armed conflict between Singapore and Malaysia, there is a critical need to accentuate not only the idea that a war over water is unlikely, especially when one appreciates that there are less costly alternatives, but the view that sustaining the water relationship on win-win terms ultimately benefits the two neighbouring states. If these notions can be accepted and each eventually becomes the other's co-operative partner, both Singapore and Malaysia will be far better off in their quests to provide their inhabitants with access to fresh water.

---

54 Reme Ahmad, "Tariff Hike may Double Water Rates in Kuala Lumpur" in The Straits Times, 16 Feb 2001; Sim Bak Heng and A. Hafiz Yatim, "Johor's SAJ Supplies Water Daily to Malacca at Cost" in The New Straits Times, 22 Mar 2002

55 Irene Ng, "Tough Talks, then Progress on KL Pact" in The Straits Times, 5 Sep 2001; idem, "Now up to Officials to Flesh out Details of the Pact" in The Straits Times, 6 Sep 2001

Select Bibliography*

Acharya, Amitav, An Arms Race in Southeast Asia? Prospects for Control (Singapore: Institute of Southeast Asian Studies, 1994)

Ang, Lilian, "S'pore May Tap the Sea as Source of Water: Cheow Tong" in Business Times, 12 Mar 1995

"Beginning of the Longest Water Rationing", 23 Apr 1963, available online at: www1.moe.edu.sg/ne/sgstory/waterration.html (Apr 2002)

Bilveer Singh, The Vulnerability of Small States Revisited: A Study of Singapore's Post-Cold War Foreign Policy (Yogyakarta: Gadjah Mada University Press, 1999)

Binnie, Alexander, "Report on Singapore Water" in Administrative Report of the Singapore Municipality, Appendix F, (Singapore: Government Printing Office, 1922)

Brown, Lester R. and Halweil, Brian, "China's Water Shortage Could Shake World Food Security" in World Watch, Jul/Aug 1998

Burton, John, "Malaysia Puts the Screw on Singapore Over Water" in Financial Times, 6 Mar 2002

Business Times, "Invest in Water Desalination Plants, says MP", 4 Jun 1997

———, "Plan to Buy Water from Indonesia", 7–8 Oct 1989

Buzan, Barry, Ole Wæver and Jaap de Wilde, Security: A New Framework for Analysis (Boulder and London: Lynne Rienner, 1998)

* Compiled by Ms Chong Yee Ming, Librarian, Institute of Defence and Strategic Studies

Chan, Yoon Kum, "We will Not Go Thirsty" in The Straits Times, 4 Apr 1997

Cheah, Chor Sooi, "Malaysia just as Eager to Solve Bilateral Issues" in The New Straits Times, 29 Jan 2002

Chen, H. "Water Pollution and its Control in Singapore" in Journal of the Singapore National Academy of Science Vol. 3 (Supplement), 1973

Chin, Kin Wah, "The Management of Interdependence and Change Within a Special Relationship" in Azizah Kassim and Lau Teik Soon, eds., Malaysia and Singapore: Problems and Prospects (Singapore: Singapore Institute of International Affairs, 1992)

Choo, Bee Yian and G. Chandradas, "Water by Tanker" in The Straits Times, 28 Aug 1998

Chou, T. C., "Groundwater Investigations in Singapore" in Regional Workshop on Water Resource, Environment and National Development, Vol. II, Selected Papers, (Singapore: Science Council of Singapore, 1972)

Chua, Douglas, The Missing Page (Singapore: Flame of the Forest, 1999)

———, Crisis in The Straits: Malaysia Invades Singapore, (Singapore: Flame of the Forest, 2001)

Chua, Lee Hoong, "Greater Self-reliance in Water is the Way to Go" in The Straits Times, 10 Apr 2002

———, "No Polite Lunch in Bilateral Competition" in The Straits Times, 1 May 2002

Davis, Mike, "When the Rivers Ran Dry… The Drought Next Time" in Radical Urban Theory, available online at: http://www.rut.com/mdavis/riversRanDry.html (May 2002)

Dupont, Alan, ed., The Environment and Security: What are the Linkages?, Canberra Papers on Strategy and Defence No. 125 (Canberra: Strategic and Defence Studies Centre, Australian National University, 1998)

———, The Environment and Security in Pacific Asia, Adelphi Papers 319 (London: International Institute for Strategic Studies, 1998)

Economic and Social Commission for Asia and the Pacific (ESCAP), State of the Environment in Asia and the Pacific (Bangkok: Asian Development Bank, 1995)

Engelman, Robert and Pamela LeRoy, Sustaining Water: Population and the Future of Renewable Water Supplies (Washington, DC: Population Action International, 1993)

Far Eastern Economic Review, "Running Dry", 3 Feb 2000

Fletcher, Nancy McHenry, The Separation of Singapore from Malaysia, Data Paper No. 73 (Ithaca: Southeast Asia Program, Cornell University, 1969)

Fundamentals of Physical Geography, available online at: http://www.geog.ouc.bc.ca/physgeog/contents/8g.html (Mar 2002)

Gamboa, Evangeline, "PUB and EDB Team up to Cut Water Use" in The Straits Times, 22 Jun 1983

Gan, Ivan, "Again, Testy Neighbors' Ties Hit a Snag" in Asia Times, 28 Jul 1999

Ganesan, N., Bilateral Tensions in Post-Cold War ASEAN, Pacific Strategic Papers 9 (Singapore: Institute of Southeast Asian Studies, 1999)

———, "Malaysia-Singapore Relations: Some Recent Developments" in Asian Affairs: An American Review Vol. 25 No. 1 (Spring 1998)

———, "Factors Affecting Singapore's Foreign Policy Towards Malaysia" in Australian Journal of International Affairs Vol. 45 No. 2 (Nov 1991)

Gleick, Peter H., "Water and Conflict" in International Security Vol. 18 No. 1 (Summer 1993)

———, Water Conflict Chronology – Introduction; available online at: http://www.worldwater.org/conflictIntro.htm (May 2002)

———, ed., Water in Crisis: A Guide to the World's Fresh Water Resources (New York: Oxford University Press, 1993)

Go, Robert, "Indonesia Gears up to Supply Water to S'pore" in The Straits Times, 6 Nov 2001

Goh, Chok Tong, Prime Minister, Parliamentary Debate on the President's Address on Friday, 5 April 2002, available online at: http://app.internet.gov.sg/data/sprinter/pr/archives/2002040501.htm (May 2002)

Han, Fook Kwang, "It's a Watertight Agreement, Please" in The Straits Times, 16 Feb 2002

Hardstone, Peter, "Nuclear Power for Desalination Not the Answer" in The Straits Times, 8 Feb 2002

Harpajan Singh and Zulfakarin Mergawati, "Look Elsewhere for Extra Water, Singapore Told" in The Star, 5 Jun 1999

Homer-Dixon, Thomas F., Environment, Scarcity and Violence (Princeton, NJ: Princeton University Press, 1999)

Homer-Dixon, Thomas F., Jeffrey H. Boutwell and George W. Rathjens, "Environmental Scarcity and Violent Conflict" in Scientific American Vol. 268 No. 2 (Feb 1993)

Huxley, Tim, "Singapore and Malaysia: A Precarious Balance" in Pacific Review Vol. 4 No. 3 (1991)

———, Defending the Lion City: The Armed Forces of Singapore (St Leonards, NSW: Allen & Unwin, 2000)

Independence of Singapore Agreement 1965, available online at: http://agcvldb4.agc.gov.sg/ (May 2002)

Jacob, Paul, "S'pore Signs Water Pact with Indonesia" in The Straits Times, 29 Jun 1991

Johnson, A., "A Quarter Century of Freshwater Research in Singapore" in Journal of the Singapore National Academy of Science Vol. 5, 1976

Kabinovich, Abraham, "Mid-East War Almost Starts Over Water-pipe" in The Straits Times, 19 Mar 2001

Kamal Ahmad, "Does S'pore Appreciate Malaysia's Neighbourliness?" in The Straits Times, 24 Feb 1998

Keller, K., The Bible as History (New York: Bantam Books, 1980)

Kim, Jih-Un, "Drifting on the Drying Water Pool: China's Water Scarcity and its Political Foreboding" in Asian Perspective Vol. 25 No. 1 (2001)

———, "Asia's Liquid Assets: The Water Margin" in The Sunday Times, 22 Apr 2001

Lau, Albert, A Moment of Anguish: Singapore in Malaysia and the Politics of Disengagement (Singapore: Times Academic Press, 1998)

Lau, Teik Soon, "Malaysia-Singapore Relations: Crisis of Adjustment, 1965–1968" in Journal of Southeast Asian History Vol. 10 No. 1 (1969), pp. 155–176

Lee, Hsien Loong, "Bedok Waterworks' Opening Ceremony" 16 Oct 1986, National Archives of Singapore

———, Deputy Prime Minister, at the Launch of National Education on Saturday 17 May 1997 at TCS TV Theatre, available online at: http://www1.moe.edu.sg/speeches/1997/170597.htm (Apr 2002)

Lee, Joanne, "Cheaper Water for Jurong Island" in The Straits Times, 3 Sep 1999

Lee, Kim Chew, "Bridging the Causeway Gap" in The Sunday Times, 1 Oct 2000

Lee, Kuan Yew, The Singapore Story: Memoirs of Lee Kuan Yew (Singapore: The Straits Times Press and Times Editions, 1998)

———, From Third World to First: The Singapore Story 1965–2000 (Singapore: The Straits Times Press and Times Media Pte Ltd, 2000)

Lee, Mun Fong and Haja Nazarudeen, "Collection of Urban Stormwater for Potable Water Supply in Singapore" in Water Quality International (WQI), Jun 1996

Lee, Poh Ping, "Malaysia-Singapore Relations: A Malaysian Perspective" in Azizah Kassim and Lau Teik Soon, eds., Malaysia and Singapore: Problems and Prospects, (Singapore: Singapore Institute of International Affairs, 1992)

Leifer, Michael, Singapore's Foreign Policy: Coping With Vulnerability (London: Routledge, 2000)

Leong, Ching Ching, "Water Price to Double by 2000" in The Straits Times, 11 Jun 1997

Levy, Marc A., "Is the Environment a National Security Issue?" in International Security Vol. 20 No. 2 (1995)

———, "Correspondence: Environment and Security" in International Security Vol. 20 No. 3 (1995–96)

Liang, Hwee Ting, "Desalinated Water from Singapore Taps in 2005" in The Straits Times, 1 Dec 2001

Lim, Hng Kiang, "Groundbreaking Ceremony of BKE/SLE Water Catchment Pond", 5 Aug 1996, National Archives of Singapore

Lim, Ronnie, "Desalination Plan to Proceed" in Business Times, 7 Nov 2001

Lomborg, Bjørn, The Skeptical Environmentalist: Measuring the Real State of the World (Cambridge: Cambridge University Press, 2001)

M. Bakri Musa, The Malay Dilemma Revisited: Race Dynamics in Modern Malaysia (Malaysia: Merantau Publisher, 1999)

Mak, Kenneth, "Create an Independent Water Supply for Singapore" in The Straits Times, 7 Feb 2002

Malik Tahir, "A Malaysian's View on Relations with Singapore" in The Sunday Times, 20 Feb 2000

Mearsheimer, John, Conventional Deterrence (Ithaca and London: Cornell University Press, 1983)

Meyer, Mahlon, "Nor Any Drop to Drink: Singapore Tries Innovating its Way to Clean Water" in Newsweek, 16 Jul 2001

Milne, R. S., "Singapore's Exit from Malaysia: The Consequences of Ambiguity" in Asian Survey Vol. 6 No. 3 (Mar 1966)

Ministry of the Environment, "Singapore and Malaysia Committed to Improve Water Quality in the Straits of Johor" in Singapore Environmental News, Issue No. 7, Jun 2000

Mohamed Noordin Sopiee, From Malayan Union to Singapore Separation: Political Unification in the Malaysia Region 1945–65 (Kuala Lumpur: Penerbit Universiti Malaya, 1974)

Muhammad Fuad Mat Noor, "Konflik Malaysia & Singapura: Analisis Kritikal Kekuatan Angkatan Tentera dan Keupayaan Dalam Konflik" in Perajurit (12 Nov 2000)

Moiz, Azra, "Singapore – Running out of Water", available online at: http://worldwaterconservation.com/Singapore.html (May 2002)

Nanyang Technological University, "Watershed Discovery: Clean Water in Reclaimed Land" in NTUNEWS No. 44 (Apr–Jun 2002)

Nathan, Dominic, "Industrial Water Supply to be Doubled" in The Straits Times, 3 Apr 1999

Ng, et al., "Unaccounted-for Water: Singapore's Experience" in Journal of Water Supply Research and Technology Vol. 46 No. 5 (Oct 1997)

Ng, Boon Yian, "A Deal for the Future" in Today, 5 Sep 2001

———, "Pact Politics" in Today, 6 Sep 2001

Ng, Irene, "A Fruitful Four Days for SM Lee in Malaysia" in The Straits Times, 19 Aug 2000

———, "Unwise to Work for Full Self-reliance on Water" in The Straits Times, 26 Jan 2001

———, "Wafer-fab Plants Opt for Recycled Water" in The Straits Times, 31 Aug 2001

———, "Tough Talks, Then Progress on KL Pact" in The Straits Times, 5 Sep 2001

———, "A Deal is a Deal, Let's Move On" in The Straits Times, 6 Sep 2001

Ng, Irene and Brendan Pereira, "Thorny Issues that Go Back Many Years" in The Straits Times, 5 Sep 2001

Parapuram, Joseph, Once in a Blue Moon (London: Minerva Press, 2000)

Pereira, Brendan, "Water Talks: Singapore Asking Too Much" in The Straits Times, 31 Aug 1998

———, "Malaysia Won't Take Unilateral Action to Change Water Deal" in The Straits Times, 3 Mar 2002

Porter, Barry, "Move to Water Down Island's Vulnerability" in South China Morning Post, 11 Jun 1997

Postel, S., "Water Scarcity Spreading" in L. R. Brown, H. Kane and E. Ayres, eds., Vital Signs: Trends That are Shaping Our Future 1993/1994 (London: World Watch Institute, 1993)

Postel, Sandra L. and Aaron T. Wolf, "Dehydrating Conflict" in Foreign Policy (Sep/Oct 2001)

Public Utilities Act, available online at: http://statutes.agc.gov.sg/ (Apr 2002)

Public Utilities Board, "National Education Programme – Educating the Young" in PUB News (Mar 1998)

———, Singapore Water Supply (Singapore: Public Relations Division, Public Utilities Board, 1997)

———, Tariffs for Water, available online at: http://www.pub.gov.sg/ ws_ tariffs (Apr 2002)

———, Yesterday & Today: The Story of Public Electricity, Water and Gas Supplies in Singapore (Singapore: Times Books International for the Public Utilities Board, c1985)

Quality Living Environment (Draft Singapore Green Plan 2012), available online at: http://www.env.gov.sg/sgp2012/quality_ water.htm (May 2002)

Ramahad Singh, "Controlling Unaccounted-for Water in Singapore" in Towards Efficient Water Use in Urban Areas in Asia and the Pacific (New York: United Nations, 1998)

Ramlan Said, "Discussion with Singapore Stalled Due to Water Issue" in The New Straits Times, 22 Jan 2002

Regan, Naomi, "From a Distance: Turning the Bloom into Desert" in The Jerusalem Post, 3 May 2001

Reme, Ahmad, "Tariff Hike may Double Water Rates in Kuala Lumpur" in The Straits Times, 16 Feb 2001

Riyah, M., "Israel and Arab Water in Historical Perspective" in Farid and Sirriyeh, eds., Israel and Arab Water (London: The Arab Research Centre, 1985)

Rozli, Ali, "The Media's Not a Diplomat" in The New Straits Times, 8 Apr 2002

Sario, Ruben, "Malaysia's Conditions for Water Supply" in The Star, 8 Jul 1998

Saw, Swee Hock, The Population of Singapore (Singapore: Institute of Southeast Asian Studies, 1999)

Schmida, L., "Israel Water Projects and Their Repercussions on the Arab-Israeli Conflict" in Farid and Sirriyeh, eds., Israel and Arab Water (London: The Arab Research Centre, 1985)

Shahrum Sayuth, "Singapore was Ready to Go to War" in The New Straits Times, 8 Apr 2002

Shanti Nair, Islam in Malaysian Foreign Policy (London: Routledge, 1997)

Sharmilpal Kaur, "In the Pipeline – More Recycled Water Plants" in The Straits Times, 20 Jan 2001

———, "Cheaper to Desalinate Sea Water Than to Import It" in The Straits Times, 15 Mar 2001

———, "30m Gallons a Day to Drink" in The Straits Times, 22 Mar 2001

———, "Every Drop Counts" in The Straits Times, 22 Mar 2001

———, "Ultrasound May Make Waves in Sea-water Processing" in The Straits Times, 11 Sep 2001

———, "Water Supplier has Burning Ambition" in The Straits Times, 19 Sep 2001

Shiklomanov, Igor, "World Freshwater Resources" in Peter H. Gleick, ed., Water in Crisis: A Guide to the World's Fresh Water Resources (New York: Oxford University Press, 1993)

Sim, Bak Heng and A. Hafiz Yatim, "Johor's SAJ Supplies Water Daily to Malacca at Cost" in The New Straits Times, 22 Mar 2002

Simson, I., Singapore – Too Little, Too Late: The Failure of Malaya's Defence in 1942 (Singapore: Asia Pacific Press, 1970)

Singapore 1999 (Singapore: Ministry of Information and the Arts, 1999)

"Singapore Seeks to Break Reliance on Malaysian Water", available online at: http://www.stratfor.com (May 2002)

Smith, Paul J. and Lt. Col. Charles H. Gross, Water and Conflict in Asia (Honolulu, Hawaii: Asia-Pacific Center for Security Studies, 2000)

Soh, Natalie, "Underground Water Found" in The Straits Times, 30 Apr 2002

Spurgeon, David, Water: A Looming Crisis, available online at: http://www.irri.org/Looming.html (May 2002)

The Straits Times, "Add, Multiply to Meet Water Needs", 26 May 2001

———, "Arsenic in Cambodia's Drink Water", 19 Aug 2000

———, "China Drought Sparks Riots", 22 Jul 2000

———, "China Faces Water Shortage in 10 Years", 21 Aug 2000

———, "Cisterns that Use Only Half the Water of Existing Ones", 23 Mar 1997

———, "Daim: We have to Move on", 26 Aug 2000

———, "Eight More Storm-water Ponds to be Built", 28 Jan 1999

———, "Ex-Mentri Besar Recalls 'War Threat'", 9 Apr 2002

———, "5 Million People? Not Likely", 20 Oct 1999

———, "Half of Bintan Water for Domestic Consumption", 1 Dec 1993

———, "Hot and Cold", 1 Sep 2000

———, "Industrial Water: SembCorp Eng to Process", 9 Mar 1999

———, "Johor MB to Critic: Water Project Not a Disadvantage to Malaysia", 10 Apr 1990

———, "KL Approves $318m Waterworks for Johor", 19 Aug 2000

———, "More Babies Wanted as Birth Rate Dives", 6 Apr 2002

———, "New Plant Sells Potable Water", 3 Jan 2000

———, "North Pole Melting", Editorial, 24 Jul 2000

———, "Now Up to Officials to Flesh Out Details of the Pact", 6 Sep 2001

———, "Pricier Water from July", 27 Feb 1999

———, "PUB Checks to Weed Out Water Wasters", 24 Mar 1990

———, "PUB Seeks More Non-potable Water", 12 Nov 1997

———, "Remember When SIA Went Supersonic?", 27 Jul 2000

———, "Seawater Helps to Save a Cool $3m", 4 Apr 1990

———, "Singapore and Indonesia Sign Agreements on Sumatra Water, Bintan Development", 30 Jan 1993

———, "S'pore is Short of 200,000 Babies", 20 Oct 1999

———, "S'pore Sells Subsidised Water to Johor", 6 Sep 1998

———, "Singapore Team Finds Water Potential in Riau", 10 Apr 1990

———, "States Agree to Set up National Water Council", 12 Jun 1992

———, "3 Water Plants for S'pore by Year 2011", 4 May 1998

———, "20% of Sewage Water Can Be Recycled", 30 Jan 2001

———, "Using Recycled Water", 30 Jul 1997

———, "Waterworks Visit Among 'Save Water' Activities", 12 Jun 1997

———, "What It Should Have Been", 7 Sep 1999

The Sunday Times, "The Big Polar Meltdown", 20 Aug 2000

Tan, Andrew T. H., Intra-ASEAN Tensions, Discussion Paper 84, The Royal Institute of International Affairs (London: Chatham House, 2000)

———, Problems and Issues in Malaysia-Singapore Relations, Working Paper No. 314 (Canberra: Strategic and Defence Studies Centre, Australian National University, 1997)

———, Singapore's Defence Policy in the New Millennium, Working Paper No. 322 (Canberra: Strategic and Defence Studies Centre, Australian National University, 1998)

Tan, Andrew T. H. and Boutin, J. D. Kenneth, eds., Non-traditional Security Issues in Southeast Asia (Singapore: Select Publishing for Institute of Defence and Strategic Studies, 2001)

Tan, Hsueh Yun, "Singapore's First Desalination Plant to be Ready in 2003" in The Straits Times, 11 Jun 1997

———, "How Water Price Hikes Affect 3 Families" in The Straits Times, 12 Jun 1997

———, "Desalinated Water will Get Back a Pinch of Salt" in The Straits Times, 12 Nov 1997

Tan, Joceline, "Veteran Journalists Praise Bilateral Pact" in The Straits Times, 10 Sep 2001

Tan, Siok Choo, "It's a Question of Fair Price" in The New Straits Times, 29 Jan 2002

Tan, Tarn How, "Water: S'pore to Rely Less on KL" in The Straits Times, 6 Apr 2002

Teh, Hooi Ling, "PUB Issues Desalination Project Tender Documents" in Business Times, 1 Dec 2001

Toh, Eddie, "Suspend Fresh Ties with S'pore, Urges UMNO Youth Chief" in Business Times, 4 Aug 1998

"Treaties Supplement No.1, Agreement between the Government of the Republic of Singapore and the Government of Indonesia on Economic Co-operation in the Framework of the Development of the Riau Province", Government Gazette, 1990.

Tully, Shawn, "Water, Water Everywhere" in Fortune Vol. 141 No. 10 (15 May 2000), pp. 69–78

United Nations Environment Programme (UNEP), Environmental Data Report 1993–1994 (Oxford: Blackwell, 1994)

Ven Sreenivasan, "Companies Spared Brunt of Water Tariff Hikes: Self-sufficiency in Water Possible, but Costly: BG Lee" in Business Times, 11 Jun 1997

———, "Don't Take Our Goodness for Granted, Mahathir Tells S'pore" in Business Times, 5 Aug 1998

Wan Hamidi Hamid, "Malaysia-Singapore War: 'A Zero Possibility'" in The Straits Times, 16 Oct 2000

Wæver, Ole, "Securitization and Desecuritization" in Ronnie Lipschutz, ed., On Security (New York: Columbia University Press, 1995)

Wells, Carveth, North of Singapore (London: Jarrolds Publications Ltd, 1940)

White, B., The Water Resources of Singapore Island: Report on Investigations into the Extent and Water Bearing Capacity of the Alluvial Plain (London: Wolfe Barry & Partners, 1952)

Williams, Paul, "Turkey's H_2O Diplomacy in the Middle East" in Security Dialogue Vol. 32 No. 1 (2001), pp. 27–40

Winpenny, J., Managing Water as an Economic Resource (London: Routledge, 1994)

Wong, M. Q., "Evolution of PUB's Tariffs" in PUB Digest No. 14, (1993)

World Meteorological Organisation, Comprehensive Assessment of the Freshwater Resources of the World (Geneva: World Meteorological Organisation, 1997)

Yap, Adriel Lian Ho, "Water for Singapore: Management of a Resource in a Subregional Economic Zone", B.A. (Hons) Academic Exercise, National University of Singapore, 1994/95

Yeo, Cheow Tong, Minister for Trade & Industry, "Launch of the National Save Water Campaign," 24 June 1995, National Archives of Singapore

Yeoh, En-Lai, "Riau in Sumatra Keen to Fill S'pore's Water Needs" in The Straits Times, 2 Jul 2000

Yeoh, En-Lai and Liang Hwee Ting, "Massive Water Project is Floated" in The Straits Times, 2 Jul 2000

Zachary, G. Pascal, "International Water Pressure: Nations Scramble to Defuse Fights Over Supplies" in The Wall Street Journal, 4 Dec 1997

Zainal Aznam Yusof, "Pay Market Rates for Water" in The New Straits Times, 8 Feb 2002

Additional Resources

Agence France-Presse (various editions)

Public Utilities Board, Annual Report (various years)

Water Department, Annual Report (various years)

Hansard (Official Report: Parliamentary Debates Singapore) (various issues)

Jane's Defence Weekly (various issues)

Meteorological Service Facts & Figures, available online at: http://www.mot.gov.sg/key_nav/main5.htm (Apr 2002)

The New Straits Times (various issues)

The Star (various issues)

The Straits Times (various issues)

Department of Statistics, Yearbook of Statistics (various years)

Singapore depends upon Johor for about half of its daily supply of potable water. This dependence upon Malaysia for water is perceived in Singapore to compound its vulnerability. Malaysian threats to cut its supply of water to Singapore whenever it has a disagreement with the latter have confirmed Singapore's worst fears. Is this issue of supply of Johor water the equivalent of the sword of Damocles hanging over Singapore-Malaysia relations? This issue of water in Singapore-Malaysia relations is in large part driven by an increasing demand for water not only in Singapore, but also in Malaysia and the pressure on the supply of water from catchment areas threatened by urbanisation, industrialisation and agriculture.

The three essays in this Monograph examine the prospects of new technology meeting this increasing demand for water and challenges to its supply in Singapore and Malaysia. The essays take different approaches to examining the prospects of moving the issue of water in Singapore's relations with Malaysia from the vicious cycle of vulnerability and threats to the virtuous cycle of conflict avoidance and co-operation.

Institute of Defence and Strategic Studies

Nanyang Technological University

ISBN 981-04-6768-0

9 789810 467685