El Niño and the 1998 Nationwide Water Crisis in Malaysia: Causes, Lessons, and Solutions

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Abstract

The onset of the El Niño in 1997 brought about significant environmental changes including drought, crop loss, forest fires, haze, high temperatures, and extremely dry conditions. The most severe effect of the El Niño was the precipitation of a water crisis that exposed the vulnerability of the densely populated urbanized areas in the federal capital of Kuala Lumpur, Petaling, Jaya in Selangor, Melaka, and Balik Pulau in Penang. The severe water crisis brought about long spells of stoppages in water supply, some areas being without water for months. The increased water demand due to the hot, dry, and hazy conditions further exacerbated the water resource crisis. In the Kuala Lumpur-Petaling Jaya area, residents had to go without piped water for weeks, some even months. Many, especially those in charge of water supply, blamed the crisis on the El Niño. However, other likely reasons are to be found in human mismanagement of water resources, including privatization, apathetic attitude of the public towards water use, reluctance of industries to recycle, a large non-revenue water loss, destruction of water catchments and pollution, and the low water tariffs that do not encourage water conservation. Other than looking at the conventional strategy of Supply Management (increasing supply), the authorities must increasingly explore the feasibility of Demand Management (reducing demand and wastage) where industry and the public can play a part in averting water crises.

Introduction

Water can be both a resource and a hazard, depending on how much or how little of it a region is getting. Water hazards and disasters have been well-documented (Alexander, 1993; Chan, 1997) as have water resources as life saviors in many countries (IRC International Water and Sanitation Centre, 1995). In the past, when the population was small, rainfall copious, and rivers unpolluted, water supply was never a problem in Malaysia. On the contrary, millions were annually flooded by a deluge of water caused by torrential monsoon rains followed by disastrous floods

and other environmental disasters. Hence, the notion that "Water is vital for life" becomes ironical at times. Such a scenario is typical of many parts of Malaysia. Nevertheless, water is just as necessary for life as it is crucial for the continued development of a rapidly developing country such as Malaysia. The country receives abundant rainfall almost year round, but the spatial and temporal distribution of this vital resource is uneven. In many parts of the country, there is a prolonged dry period for certain parts of the year. Elsewhere, some parts are better endowed with water resource compared to others. Thus, the main problem with water resources management in Malaysia is to manage this uneven distribution effectively. Additionally, rainfall patterns are changing due largely to regional and global weather and climate shifts. In recent decades, weather and climate have seen significant changes, the causes of which are debatable. The El Niño of 1997/98, one of the greatest this century, has significantly affected the water resource situation in Malaysia, precipitating a water crisis in parts of the country (Chan, 1999).

The 1997/98 El Niño

The El Niño phenomenon has seldom featured prominently in Malaysia's climate in the past, as the country is located away from the usual path of this phenomenon. However, climate is changing and El Niño events have increasingly begun to affect the country in recent years. During normal conditions, the trade winds manifest a westward direction, initiating a strong westward current which then carries water from the eastern parts of the Pacific (the west coast of South America) to the western Pacific (Indonesia and Australia). From July 1997 to June 1998, however, strong El Niño conditions prevailed. As a result, the trade winds have relaxed and slackened in the central and western Pacific Ocean, leading to the sloshing of warm waters from Indonesia-Australia towards the eastern Pacific Ocean.

In terms of water resources, the 1997/98 El Niño brought about a prolonged dry spell that precipitated in a severe water stress during the months of March to May 1998. The dry conditions without rain dried up many dams across the country, such as the Klang Gates and Semenyih dams (Kuala Lumpur), the Air Itam and Mengkuang dams (Penang), the Durian Tunggal dam (Melaka), and other reservoirs in Perlis and Negri Sembilan. The Titi Kerawang waterfall in Teluk Bahang (Penang) was completely dried up by February 1998 (The Star, 17.2.98). The El Niño also reduced the flow volume in the Muda River, which supplies 80% of Penang State's water needs. Normally, the flow is about 100 m^3/sec, but during the height of the El Niño, it was only about 20 m^3/sec.

In terms of rainfall, the 1997/98 El Niño emerged in early 1997 but its effects were felt most severely towards the end of 1997, and most critically from the beginning of 1998 to mid-1998. Table 1 shows the long-term average monthly and annual rainfalls at 4 of the selected water catchments and that received during the 1997/98 El Niño. For every water catchment, it is clear that the rainfall for the peak El Niño months (January to May 1998) was much lower than the average normal rainfall.

The Waterfall Catchment experienced a rainfall deficit of 64.3 % for these months, while the deficits for the Batu Ferringhi, Air Itam, and Teluk Bahang catchments were 52.1%, 67.8% and 39.6% respectively. This drastic reduction in total rainfall amounts depleted whatever storage amounts available in the dams (Chan, 1999).

Table 1: Distribution of Monthly Rainfall at 4 selected river basins during the 1997/98 El Niño plotted against the average long-term monthly rainfall (mm).

	Long-Term Average				During 1997/98 El Niño			
Basin	1	2	3	4	1	2	3	4
January	63	86	63	66	5	11	0	7
February	94	132	75	78	29	217	112	134
March	166	164	119	150	9	58	58	28
April	253	301	175	253	52	183	88	137
May	322	296	269	317	171	220	123	146
June	244	262	196	216	476	278	89	231
July	232	283	219	266	368	195	77	121
August	319	380	256	272	404	213	219	106
September	456	481	352	437	870	363	247	129
October	487	433	365	481	673	264	184	262
November	340	350	270	347	400	269	181	192
December	145	134	117	114	50	113	49	65
Annual	3111	3216	2433	2984	1514	2384	1427	1558
% Deviation from Long-Term Average					-51.1	-25.9	-41.3	-47.8

Other Causes of the 1998 Water Crisis

The 1998 water crisis illuminated a whole range of lessons to be learnt in relation to water resource management in the country (table 2). For one, contrary to popular belief, the water situation in Malaysia is far from infallible. A general misconception about the "abundance" of water resources (often misled by the frequent occurrence of floods) has given rise to an apathetic attitude amongst both authority and the public, and this has contributed to a lot of wastage and poor management. Water pollution is also widespread and there is rapid development and destruction of water catchments. Other deficient areas include poor enforcement by the relevant authorities, inadequate protection of water catchments via gazettement, an apathetic attitude amongst suppliers and users (due to irresponsibility and low water tariffs), a high loss of water due to Non-Revenue Water (NRW), and a high amount of wastage amongst domestic and industrial users (Chan, 1999).

Recommended Solutions

Global changes in weather and climate patterns have been confirmed by the UN's Inter-governmental Panel for Climate Change (IPCC) (IPCC, 1992). Despite this apparent trend, most of our planning for water resources development does not take into account the effects of climate change. Planning for future development of

water resources, be it building dams, treatment plants, or reservoirs is based on projections of water demand from the domestic, industrial, and agricultural sectors. But the effects of the 1997/98 El Niño laid bare the fact that all our planning is inadequate if it does not take into account what an El Niño can do. Hence, the lesson is for water resources planners and water authorities to plan taking into account the negative effects of potential El Niño as well as La Niña events. The margin of error is reduced when these extreme events are accounted for in water resource planning.

Another solution is to treat water as a finite resource, as water resources in Malaysia are unevenly distributed both over time as well as space. Government cannot keep on increasing supply when the number of dams one can build is limited. The truth is that supply can never keep up with demand in Malaysia, as the latter doubles every two decades. While not suggesting that the government should stop building dams and building treatment plants to increase supply, it is recommended that the Government employ a comprehensive approach that includes addressing the demand side of the equation. Demand management can be used effectively to complement supply. More importantly, it is timely that Malaysia develops a vision for water resources rather than the fragmented development of this vital resource by individual states.

Table 2: Causes of the 1998 Water Crisis in Malaysia

1	a misconception of the infallibility of the water resource base
2	a high rate of water wastage due to Non-Revenue Water (NRW)
3	a high rate of water wastage in industry/businesses and little incentive for industry to recycle water
4	a high rate of water wastage in public institutions
5	a high rate of water wastage in the home
6	a general apathetic attitude amongst Malaysians regarding water conservation
7	low water tariffs that discourage water saving and recycling
8	a high degree of water pollution
9	no water law to protect water catchments
10	global changes in weather and climate patterns that affect local weather are not accounted for in water resource planning
11	ineffective privatization of the water industry

Another solution is to address the high rate of water wastage due to Non-Revenue Water (NRW) via demand management. Demand management implies managing water demand through water conservation, reuse, and reduction of use. NRW is water lost either through breakage, theft, seepage or other unaccountable ways once it leaves the treatment plant. For Malaysia, the average NRW is about 38% (in 1995), while some states have NRW as much as more than50 % (Government of Malaysia, 1996). In 1995, a total of 9,442 million liters of treated water were produced per day in which a total of 3,587 million liters per day (MLD) were lost.

This amounts to a total lost of 1,309,255 million liters. At the selling price of 51.3 sen per cubic meter, this amounted to RM671.6 million (1 US$ = 0.2631 RM) in the whole country for 1995. One can argue that not all NRW is "lost" in that someone (public use and thieves) is using it, but however one looks at the issue, water unaccounted for is water lost.

Government can employ the tightening, strengthening, and stricter enforcement of legislation in relation to the protection of water catchments and water courses (rivers, lakes, swamps, underground water, etc.). In Malaysia, there are many laws that indirectly border on the protection of water catchments. The more prominent ones are The Land Conservation Act of 1960 (Revised 1989), The Land Acquisition Act of 1960, and The Environmental Assessment (EIA) Order of 1987. The setting up of the National Water Council in 1998, immediately after the 1998 water crisis, was seen as a good response and a lesson learnt. However, water resource protection has remained ineffective largely because of developers bending the rules and also because of poor enforcement. However, the Pahang State Government has taken a good step in making EIAs mandatory irrespective of the size of the area being developed. In other sates, EIAs are only mandatory for developments larger than 50 ha, a loophole which is easily by-passed by irresponsible developers. In the case of the latter, a new Water Supply Bill (1998)has been passed which provides for the gazettement of any water body in the State as a prescribed water source and any area to be a catchment area when necessary. Nevertheless, the effectiveness of old and new legislation still hinges on their effective enforcement, which is sadly still wanting. The Selangor State Government has also passed The Selangor Waters Management Authority Enactment (1999) which sets up a single authority to manage water resources. The Selangor State Development Authority (PKNS) has also embarked on building specifications to include a rainfall harvesting system as mandatory for government buildings and optional (with tax incentives) for private buildings/homes. This idea has also been proposed by the Ministry of Housing as an option for new houses, and the ministry hopes to pass legislation on it. This is an area with great potential, given the copious rainfall of more than 3,000 mm per annum that Malaysia receives.

Land use control is yet another demand management strategy that the Government can employ to protect water catchments (Jaseni Maidinsa, 1997). Planning authorities such as UPEN and the Town and Country Planning Department at federal, state, and local levels can play an important role by including prudent land use control in conserving water catchments. Rather than merely focusing on the economic and aesthetic benefits of development planning, planners must incorporate "green" development into their plans. For example, forested water catchments can be gazetted as permanent forest reserves or State/National parks. Also, city and country planners can use prudent town and country planning plans to restrict urbanisation and urban sprawl to control their encroachment into green areas.

Another potentially feasible strategy is to encourage large water users such as industries and hotels to recycle. The high rate of water wastage in industry/businesses is in part due to few incentives for industry to recycle water as well as the low water tariffs. Hence, another demand management strategy that can be effectively used by the government is that of encouraging water recycling amongst big users of water, notably hotels and factories. Currently, recycling of water amongst these big users is almost non-existent. In many States, the amount of water used by a few large factories and hotels may be as much as that, if not more, of a small town. Factories are unwilling to recycle water mainly because it is so dirt-cheap at the moment. It certainly does not make economic sense to install a recycling plant costing a few million Ringgit when water is so cheap. There is simply no incentive to recycle. Hence, the Government can help by providing tax incentives for industries to install recycling plants. The Government can also make it mandatory for large businesses to obtain ISO 14,000 certification, which automatically requires factories to recycle.

Pricing can also be an effective tool but must be employed so as not to deny the poor of access to water. For example, government can increase water tariffs (for industrial use) to such an extent that recycling becomes an attractive option. In this respect, "price phasing" (i.e., rates are based on a staggered ladder of increasing rates) can occur to make it economically attractive and viable for factories and businesses to recycle. For example, the current rate for industry in the Federal Territory of Kuala Lumpur is 0.90 sen per m^3. The tariffs can be phased out as shown in table 3 based on the principle of "the more you use the more you pay." If such a strategy is still not sufficient to convince factories to install recycling plants, the government needs to impose limits or quotas on water use. This is what occurred during the water crisis in 1998.

The high rate of water wastage in public institutions is very embarrassing for the government and the problem is difficult to address. The government should emphasize the need to reduce water use amongst government agencies. Perhaps a minimum water use may be calculated with indicators such as the number of employees and type of activity/function. Government agencies using more than the stipulated minimum water allowed would be fined accordingly. Pumps and a system of pipes should be connected to rivers, ex-mining ponds, and lakes for the purpose of fire fighting, watering plants in public parks, public fountains, public toilets and other public amenities. The installation of automatic taps to all government facilities, public toilets, universities, schools and other public buildings may help reduce water wasting significantly.

Table 3: Proposed Industrial/Non-Domestic Water Tariff

Amount of Water Used (m^3)	Tariff (RM per m^3)
0 - 50,000	0.90
50,001 - 75,000	1.80
75,001 - 100,000	3.60
100,001 - 150,000	7.20
150,001 - 200,00	14.40
> 200,000	28.80

Installing another system of mains for untreated water (for industrial, commercial and other uses that do not require clean water) may be another alternative that the government can consider (Renganathan, 2000). Such a system can also be used for fire fighting, watering public gardens and plants (landscaped plants along roads and parks), flushing of public toilets, and other non-consumptive uses. In fact, such a system may also be connected to domestic users for flushing toilets and washing of cars, gardening and washing clothes. The only draw-back is that it takes time and may be costly.

Another solution to reduce water crises is to change the public's attitude towards water conservation. Currently, there is a high rate of water wastage in the home due to a general apathetic attitude of "Tidakapa" (indifference) amongst Malaysians regarding water conservation. Both are closely related to the fact that low domestic water tariffs do not encourage people to save or recycle water. This apathetic attitude is also responsible for the high degree of water pollution by people and industry. To tackle this group of issues, there is first of all, a necessity for a review of pricing tariffs for domestic usage. Admittedly, pricing is one sensitive issue that has often been deliberately avoided by politicians, especially so during an impending election year. Based on the current water rates for domestic consumers whose water bills are only about 10 % of their electricity and telephone bills, it is clear that few will pay any attention to saving water.

The international standard recommends that each person has access to at least 165 liters of water per day. The per capita average use in Africa is about 50 liters per day, but the average Malaysian uses about 300 liters per day. Hence, 200 liters per day is adequate for all purposes (Chan, 2000). Based on a mean family of 5 persons, a family would need 200 liters X 5 = 1000 liters per day, or 30,000 liters per month. This is the basic amount that a family of 5 needs. A family using not more than this amount is considered to be using water normally without wastage. Families using 40,000 liters per month would be classified as "Slight Water Wasters"; those using 50,000 liters per month are "Moderate Water Waters"; those with water consumption of 60,000 are "High Water Wasters"; and those using 70,000 liters or more per month are "Excessive Water Wasters." To address

these issues, families could be charged on an escalating rate, known as "phasing" of water tariffs (Chan, 1998).

The public's degree of awareness can be increased via public awareness campaigns and education. Water saving campaigns have been effective in urging the public to conserve and reduce water use but should be carried out regularly with long-term goals rather than only during water crises. One good example is the Drainage and Irrigation Department's "Love Our River" campaign. The idea is to start the campaign amongst school children. The ultimate aim of such campaigns is to incorporate environmental education (inclusive of water conservation) in the school curriculum and make it a compulsory examination subject. The Government should also have a regulation on all TV channels specifying a certain number of relevant educational "advertisements" in between the large numbers of "market oriented" commercial advertisements now being aired.

Rivers also need to be restored and "cleaned," as there is currently a high degree of pollution. Hj Keizrul Abdullah (1999) noted that 25 river basins have been identified as areas experiencing water stress, mostly due to pollution of their rivers. In Malaysia today, as in many other developing countries, the state of rivers is appalling, and in many urban areas rivers have been literally turned into open sewers, some to the extent of being non-rehabilitable. Various sources of pollution occur in Malaysia, mainly from agriculture (fertilizers, pesticides, and sediments from soil erosion), livestock farming (animal wastes), domestic homes (human wastes), urban areas (greywaters and untreated wastewater) and industries (industrial effluent) (Department of Environment Malaysia, 1999). Squatters are another major source of river pollution. It is not uncommon to find toilets constructed on stilts in the river. Squatters are also guilty of dumping all sorts of rubbish into rivers. Along the Sg. Klang alone, it is estimated that about 40,000 families live in squatter settlements. The squatters need to be relocated if river restoration is to be effective.

Finally, another solution is to ensure that privatization of the water industry is justified and based on merit. Currently, privatization of the water industry is far from satisfactory if the experiences of some states are considered. In the meantime, people have suffered as supply was interrupted and less than satisfactory. Ethically, the government has a moral responsibility to provide the people with adequate and quality water supply. Water is an essential public good. Without water, nothing works. Because of its importance, the authors contend that water should not be privatized despite claims by many quarters (including private water companies) that privatization of the water industry would improve effectiveness.

Conclusion

Notwithstanding the effects of El Niño and climate change, mismanagement of water resources and human attitude have also contributed equally to the occurrence of water crises in Malaysia. Malaysia is a country endowed with

copious rainfall and abundant water resources, currently using only less than 4 % of its total available water (surface runoff). Despite such fortune, the country must discard the misguided idea that the water resource base is infinite, because not all the surface runoff can be utilised. This is due to depletion of water sources, pollution, inaccessibility, and the fact that all water eventually flows back into the sea. In addition, much of the rain Malaysia receives varies significantly over time and space.

Some states (Pahang, Perak, and Sarawak) are better endowed with water resources than others (Penang, Melaka, and Selangor). Hence, it is envisaged that inter-state transfer of water is the likely solution in the new millennium considering the fact that states would not give their water for free. In addition, states must not be caught again by extreme events such as the El Niño.

The high rate of NRW, high rate of water wastage in industry/businesses, public institutions, and in the home must also be addressed. More importantly, the general apathetic attitude of "Tidakapa" amongst Malaysians regarding water conservation must be replaced by a more responsible and caring attitude. Water tariffs are very low, but if water becomes scarce and highly polluted, it may cost more to treat. This may see an increase in tariffs. In fact, it is recommended that the government raise both industrial and domestic tariffs based on a phasing rate where the water savers will pay less whilst the wasters pay more. Industry must be encouraged to save water and recycle water. The National Water Authority has been established, and one of its first tasks is to draft and ask Parliament to pass a Water Law for the protection of water catchments and a River Law for the protection of rivers. Finally, the government must review its policy to privatise the water industry, as so far, privatisation of the water industry is far from satisfactory.

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