

Water Resources Management in Malaysia: NGO Perspectives

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ABSTRACT

Water is expected to be the main issue in the 21st century as this vital resource becomes increasingly polluted and scarce. In the worse scenario, countries are expected to go to war over water. Malaysia is well endowed with abundant water resources, but mis-management, abuse, general apathy and other reasons have resulted in water crises that caused untold hardships. In the past, government and water authorities have managed water resources in a top-down approach, largely based on supply management. In the new millennium, however, the majority of Malaysians are already well educated, informed and affluent and they should play an increasingly active role as a “partner” of the government in helping to chart the future of the country. Government is also changing by employing a more “rakyat friendly” approach as it is to everybody’s advantage to consult the rakyat, as the latter has much to offer. Equally, the rakyat can no longer sit back and wait for things to happen. Total development of the country and overall welfare of the people, including the vital life-giving water supply, should always be a joint effort on the part of government and rakyat. In this respect, government should even increase the consultation and participation of the rakyat in all relevant developments. In fact, the government can go one better, and that is to tap on the expertise of the rakyat (including NGOs) in water resource conservation and other related areas. NGOs nowadays are made up of experts in every field - engineers, water resource experts, hydrologists, educators, sociologists, economists and others. They can contribute immensely if the government allows them to. The best thing is, unlike private consulting companies, NGOs offer their service for free in return for nothing. NGOs are also very committed as the issues that they deal with are close to their hearts. Hence, saving water and water conservation should be a joint effort between government and NGO. Notwithstanding the government-NGO partnership, it is equally important for the industrial and business community to be in partnership with government and NGOs as well. There are many avenues for industry-NGO partnerships. More than that, water conservation partnerships should involve all concerned. It should be everyone’s responsibility ranging from the government to water corporations, water authorities, water companies, consultants, industries (including hotels, resorts and theme parks), businesses, NGOs, and the rakyat. It is with all these partnerships that we can ensure that water resources remain sustainable and our children and future generations guaranteed with adequate and clean water.

Keywords

Water Resources Management, Water Conservation, Demand Management, NGO, Government-NGO Partnership

INTRODUCTION

The vital importance of water to life cannot be stressed often enough. Yet, it is the single most abused and ill-treated resource the world over. It has been widely mismanaged, depleted, wasted, polluted and changed beyond what is clearly recognizable as water. Unlike in the not too distant past when water was plentiful and populations scarce, water is now becoming a rare commodity in many parts of the world. This is especially true for water-stressed countries in Africa, the Middle East, Australia, many parts of continental Asia, and island states (Asia-Pacific Peoples’ Environmental Networks, 1998). In many countries, water has either to be sourced from sources outside their borders (from neighbouring countries) or sourced via desalination. On top of that, many countries that share the same river basin, are already now fighting over the resource

(International Committee of the Red Cross, 1999). It is therefore critical that available water resources be protected, conserved, managed and shared equally to ensure sustainable and high quality supply, as well as to maintain regional co-operation and peace.

In the new millennium, water has already become a scarce commodity in many parts of the world. It is now the source of quarrels among neighbours, disputes among sovereign states, confrontation among countries and even war among larger groups. Indeed, one of the critical issues of the United Nations when reviewing the implementation of the Agenda 21 (or the lack of it) is the fast approaching crisis in freshwater resources that is expected to hit many countries at the beginning of the next millennium (Clarke, 1991). The 1992 Earth Summit in Rio clearly recognised the importance of freshwater resources as one of the critical resources under threat from environmental

degradation. The World Water Council has pointed out that the demand for freshwater resources doubles every 20 years or so. Thus, while in 1950 the council estimated that only 12 countries with a total of 20 million people suffered water shortages, this figure has increased more than two folds to afflict 26 countries in 1990 with the affected population increasing to more than 15 folds at 300 million. The council has projected that by 2050, 65 countries will be hit by water supply problems with a total of seven billion people or 60 % of the world's population affected.

Unlike gold in the 19th century and oil in the 20th century, water will be the most vital resource in the 21st century. This is neither an exaggeration nor a threat, but a reality which is now becoming more and more apparent. Water is not only the vital resource for maintaining all our ecosystems and the survival of all forms of life, but it is also the common vector and essential capital for all types of development whether urban or rural. There can be no development without water. Since 1900 until now, the world's annual demand for water has increased 5 times, i.e. roughly once in every two decades. During the last half century when development has been most rapid world-wide, water demand has tripled and the gaps between available water resources, population growth and demand for more water has been steadily increasing, leading to water stress and water crises in many parts of the world, particularly in developing countries such as Malaysia. The situation is critically severe in many parts of Africa (Baral, 1999).

The United Nations has warned that the fight for control over water sources would become a major cause of wars between countries (if water problems are not solved amicably), especially in water-stressed regions. As water resources become scarce *vis-à-vis* increase in water demand via population increase the world over, agriculture and industrial development, business and commercial expansion and other increase in water use, the concomitant increase in water supply is anticipated to fall short of the demand in the coming millennium (Chan, 2000a). As a result of population increase and rapid development in developing countries, the increase in water demand doubles every two decades, but the increase in supply is much less and lagging far behind. Consequently, it is anticipated that water will become a critical constraint to development in the 21st century (Bouguerra, 1997).

Currently, the predominant approach to solving water demand in most countries is focussed almost solely on the supply side, i.e. via increasing water supply. Water supply management is also largely a top-down approach dependent on government or private sector water supply without involving the users, viz. the public, farmers and businesses/industries. As a result, water management is only tackling one side of the problem and even so, water supply management has been less than effective. This has

brought about countless water crises in many countries, including a rainfall abundant country like Malaysia. Clearly, there is a need to involve the public and NGOs, as well as other water users to bring about more efficient and less wasteful water use towards sustainable management of water resources.

CURRENT STATE OF WATER RESOURCES AND ITS MANAGEMENT IN MALAYSIA

In Malaysia, the 1990s have witnessed many water crises leading to a great deal of suffering and economic losses (Hamirdin Ithnin, 1997). This has made all concern to take note of the importance of water conservation. Unfortunately, Malaysians only take note when a crisis happens. The vast majority, including the relevant government authorities and water companies, tend to forget quickly as they have short memory spans (Chan, 1999a). Consequently, water is still treated like "dirt" since it is extremely cheap, costing the average consumer less than a tenth of what they normally pay for electricity. As a result, people continue to waste water, or at least not take positive actions to conserve water. Water pollution is rampant, the chief culprits being factories, farmers and households (Lim, *et. al.*, 1984). Water catchments continue to be destroyed as more and more forested catchments are opened for development, both legally and illegally (Chan, 1999b).

Malaysia's Vision 2020 clearly underlines our country's desire to become a fully developed country. Since the 1970s, development has been rapid in all spheres - be it in agriculture, industry, tourism, manufacturing, urbanisation, communications, housing etc. Development has been rapid and the Malaysia we see now is vastly different from the "sleepy-hollow" of the colonial era as well as the early post-colonial period. Agricultural estates and farms have evolved into small towns; towns have developed into mega-cities complete with densely built-up sky-scrappers; industries have dominated the peripheral areas of towns and cities; adjacent urban areas have merged into huge conurbations (e.g. the Kuala Lumpur-Petaling Jaya-Shah Alam-Klang conurbation); and infrastructures line the country from end to end with international airports, bridges, dams, super-highways, the Multimedia-Super-Corridor, etc. We see all these, and we are very proud of what our country has achieved. What we do not see and realise, however, is the fact that none of these would have been possible without water. For most of us, the value of water is something we hardly ever think about unless of course we happen to be one of the tens of thousands who were afflicted with the water crisis in 1998. This is mostly because water comes to us rather easily. All we have to do is switch on the tap. Water is also dirt cheap - so cheap that nobody ever pays any attention to saving it in the same way as we would save electricity. In fact the average Malaysian family's water bill is only about 10 %

of its electricity bill. Yet, water is indispensable and irreplaceable. Unlike food which one can switch from one type, for example chicken (during the boycott of chicken meat recently) to another, for example fish, beef or mutton, there is no substitute for water. One can even switch from being a carnivore or omnivore to being an herbivore but one cannot switch from being a *hydrovore* to anything else!

Despite its vital importance to life and development, everywhere we go we see water in rivers (our main source of water supply) being polluted (often deliberately). Industries dump their hazardous wastes that get into the water system, eventually polluting it. Untreated wastes from old houses, old hotels, small towns and farms (both animals and crops) are threatening to further pollute our waters. The Malaysian Environmental Quality Report 1998 (Department of Environment, Ministry of Science, Environment and Technology Malaysia, 1999) reported that out of 836 water samples collected from all over the country, 94.5 % did not comply with standards for oil and grease, 73.7 % did not comply for total suspended solids, and 29.7 % for E.coli (Reported in NST, 3.12.99). The most alarming fact is that less than 17 % of the 5,409 treatment plants run by IWK comply with the discharge standards detailed in the Environmental Quality (Sewage and Industrial Effluent) Regulations 1979 of the DOE (The Star, 23.12.99). In terms of toxic wastes, the high tariffs charged for treating industrial wastes have resulted in many factories dumping their wastes illegally. Of these, a small number of these culprits are caught but the rest that are not tells us that somewhere the ground is poisoned and this will eventually poison our waters as well. Every year the Department of Environment receives hundreds of complaints about water pollution from all sources: factories; companies; farms; moving sources (e.g. motorised vehicles) as well as individuals.

Elsewhere, water catchments are developed haphazardly and illegally for a variety of environmentally destructive activities such as logging, resorts, highways, farming and others that lead to their destruction. There is a great deal of treated water being wasted through leakage and pipe bursts that are not quickly attended to. Due to the cheap water tariffs, industries, hotels and businesses that use a lot of water find it uneconomical to install re-cycling plants. As an example, some huge international class hotels or water-intensive industries can use more water than a small town. Even on the domestic front people are not doing anything to save water. Instead, over-usage and hence wastage is the general rule in most households. This is the current scenario we are facing now. We have had one bad experience where hundreds of thousands had to go without continuous water supply for months in 1998. This water crisis that came simultaneously with the El Nino dry spell cut water production by 50 %, affecting more than 600,000 people in the Klang Valley (The Sun, 28.3.98).

If we harbour any hope of not having to endure such a painful experience again, we all need to change the way we look at water and more importantly the way we use water. Contrary to popular belief and misconception, conservation of water resources and water saving is not the sole responsibility of the government or the appointed water authority/corporation. For water conservation to be totally effective, everybody has to do his/her bit. It has to be the responsibility of all.

MAJOR WATER ISSUES FACING MALAYSIA

The first major issue facing Malaysia is one of ignorance amongst its policy makers with regard to the water resources base. Certainly, the majority of those in charge are of the opinion that Malaysia has no water shortage problems (until the water crises that hit Melaka in 1991 and Selangor and Kuala Lumpur in 1998). The high frequency of flooding may have reinforced such a belief. Yet, despite the country's wet humid equatorial climate regime with heavy year round rainfall averaging more than 2,000 mm (equivalent to about 990 billion cubic metres (BCM) (1 BCM = 1 million Megalitres) per annum, and the more than 150 river systems which are the country's major sources of water supply, many parts of the country suffer from periodic water stress. Theoretically, the total surface runoff is the amount of available water (about 556 BCM per annum), giving Malaysia a per capita renewable water of more than 20,000 cubic meters per year, as compared to some many middle eastern water starved countries with per capita renewable water of less than 1,000 cubic metres per year. That means one person in Malaysia has access to more than 20 times the water available to someone in Yemen! (Figure 1). Yet, ignorance amongst policy makers with regard to total available water resources has contributed to water crises in many parts of the country.

Another major water issue in Malaysia that needs to be urgently addressed is that of the high domestic water usage per capita. In the 1970s, Malaysians use only about less than 200 litres of water per capita per day (LPD). This figure then increased to about 250 LPD in the 1980s and then to more than 300 LPD now. In urban areas, it has been estimated that the average person uses about 500 LPD (Renganathan, 2000). If we consider the fact that the International Standard for water use recommended by the United Nations is 200 LPD, then Malaysians now are guilty of wasting 100 LPD. Malaysians living in the urban areas waste more than 300 LPD, i.e. an amount that can be used to sustain six persons in Sudan. In Malaysia, most of the wasted water goes to flushing toilets, bathing, washing cars, clothes, floors, watering plants (gardening) and other unnecessary chores - i.e. activities which we can reduce and hence reduce water use. As a comparison, an average Indian (in India) uses only 100 LPD and a Sudanese uses even less, about 50 LPD. You may ask me why and how

they can get by with so little water. The answer is in our urban way of life! Hence, reduction of usage is a key to water saving amongst Malaysians. If only each person could reduce his/her water use, even by a small amount per day, the amount of water saved can be significant. Picture the following scenarios:

Scenario 1: If every person in Malaysia reduces his/her consumption of water by a mere 10 % of his/her daily needs, i.e. 30 litres per capita per day, the total amount saved by the 23.26 million people (Government of Malaysia, 1996) in the country would be about 697.8 million litres per day (MLD). This amounts to about 20.9 billion litres per month or 251.2 billion litres per year.

Scenario 2: If every person in Malaysia can reduce his/her consumption of water by a mere 20 % of his/her daily needs, i.e. 60 litres per capita per day, the country could save about 1.4 billion litres per day. This amounts to about 41.9 billion litres per month or 502.4 billion litres per year. *Scenario 3:* If every person in Malaysia can reduce his/her consumption of water by a drastic 50 % of his/her daily needs, i.e. 150 litres per day, the country could save about 3.5 billion litres per day. This amounts to about 104.7 billion litres per month or 1256.0 billion litres per year.

Considering the fact that in the total water demand in the whole country is about 2,000 billion litres per year, Malaysians would have saved 12.56 % (scenario 1), 25.12 % (scenario 2) and 62.8 % (scenario 3) of total water demand. The above three scenarios are taken for slight water stress (scenario 1), moderate water stress (scenario 2) and severe water stress (scenario 3). It is not impossible for a person to reduce his/her water consumption by 10 to 20 %, although arguably reducing it by 50 % would be too drastic and may lead to health and other ill effects. One cannot reduce the amount of drinking water a person needs (about 7 glasses per day) but one can certainly reduce the number of times one takes a shower, waters the plants, washes the car, mops the floor and change the water in the aquarium. One can even reduce the number of washes by always ensuring that a wash load is full. There are, of course, numerous other ways to conserve and reduce water use (Chan, 2000b). Given a concerted effort, individuals can significantly help reduce water demand and make a telling difference.

Public attitude and general apathy with regards to water use is another major issue that needs to be addressed if the country harbours any hope of sustainable water supply in the 21st Century. It is not just the individuals who have an apathetic attitude but also private companies, water authorities and politicians (policy makers). For example, the Selangor State authorities have been warned repeatedly about over-logging and its effect on the destruction of water catchments since the National Water Resources Study was completed in 1982. In 1991, it was

again warned by the Selangor Forestry Department to restrict excessive logging. Even the Prime Minister advised the State to impose a total ban on logging in 1991. Again, in 1993, the DID made the same call and in 1995, it was the Selangor Waterworks Department which projected a severe water shortage from 1997. However, while appearing to heed some of these calls with minor actions, the Selangor State government did not do enough. Its obsessive aim of “rapid development” overshadowed everything else. Hence, its apathetic attitude towards its forest, water catchments and the natural environment in general. Studies have shown that over-logging and development of hill land can lead to excessive soil erosion, landslides, destruction of water catchments, water pollution and downstream flooding.

A lackadaisical attitude amongst State and local authorities is also responsible for water woes in many states. While water catchments are scarce in Penang (Penang draws 80 % of its water needs from Kedah), it is ludicrous how the authorities can approve a grandiose plan to develop Penang Hill in 1990. Fortunately, widespread public outcry and concerted efforts from NGOs have managed to “convince” the State authorities to reject the plan. However, recently in 1997, the approval of the Penang Hill Structure Plan whereby a significant portion of water catchments in the area will be subject to development is yet another case of apathy towards water conservation. Because of hill land development and deforestation of Penang Hill, Paya Terubong hill and other hills, water resources are being depleted (as is happening in the recent water stress in the Balik Pulau area) and water hazards such as flash flooding and the spread of waterborne diseases are on the increase. The Penang State EXCO’s lifting of the 20-year freeze on development above the 75 m contour on 6th January 1998 can also be viewed as “short-sighted” or apathetic. This “blind” move, ostensibly due to lack of land in Penang (although the current economic crisis has slowed down the construction industry substantially and demand for housing has also slackened), has effectively opened up all land for development in the state, including water catchment land. To compensate for this blunder, the Chief Minister of Penang has subsequently passed a new Water Supply Enactment in June 1998 for the gazette of water catchments (The Star, 22 May 1998). This is a welcome move but the effectiveness of such a law needs to be seen. There are current laws to protect water catchments indirectly such as The Land Conservation Act 1960 (Revised 1989), The Land Acquisition Act 1960, The EIA Order 1987 and others, but they have been largely ineffective because of poor enforcement. Hence, what is needed is better enforcement of the law. Elsewhere in the country, it is again apathy on the part of the relevant authorities that has contributed to the Durian Tunggal episode in Malacca in 1991, destruction of water catchments in the Lojing Highlands in Kelantan in

1997 and the diesel spills in the Langat River in Selangor in 1997 and the Sungai Dua plant in Penang 1998. The 1998 El Nino induced water crisis that affected many states was also squarely blamed on the authorities inability to forecast and tackle the problem. There are many more incidents of such apathy if we care to dig up the records but these few examples should suffice.

Of course, to be fair to the authorities, the general public's apathy towards water use and the environment in general is also to be blamed for much of today's water woes. For example, while the authorities have to take part of the blame for the destruction of water catchments and the siltation of the lake in Cameron Highlands for allowing too much development, vegetable farmers in the area must surely be responsible for their apathetic attitude towards the environment for the loads of pesticides, weedicides and chemicals from fertilisers that they have poured into the soil and the water system. Here again, profits take priority over everything else and hence farmers have no qualms about poisoning the land and water. The general Malaysian public must also take part of the blame for being apathetic when it comes to littering and rubbish disposal. One only needs to look at the condition of our rivers to see the proof of such apathetic attitude. Rivers are Malaysia's main water sources (since underground water is rare) but are treated as raw sewers by the public as everything from domestic rubbish to furniture and even old cars are dumped into rivers. Sources in the Municipal Council of Penang Island confirmed that at least 10 lorry loads of rubbish are cleared from the Sg Pinang everyday. Hence, one of the major causes of flash flooding in urban areas is the clogging of drains and waterways due to irresponsible rubbish dumping. Finally, not many Malaysians (barring those affected by the recent water crisis) have embarked on saving water. The time has come for all Malaysians to practise a less wasteful lifestyle. There is no need to save water to the extent of endangering one's family hygiene, as prudent and careful use of water should suffice.

Apathetic attitude must change for the better if we are to conserve our water resources. More importantly, the Malaysian public must surely do something now that those responsible are losing the battle to conserve as well as supply enough water to all. Since the authorities and water companies can only do so much (not forgetting their inadequacies), the public must do its part, at least by saving water. Hence, notwithstanding what the authorities and the private water companies have done or are still doing to alleviate water woes, the public must not "wait and see" but take proactive action. Other than saving water, the public must exercise their rights and see to it that water companies (a relatively new phenomenon in their infancy) perform and be accountable. The public should not be docile and inactive until such a time when a water crisis strikes. They must now play a more active role

by telling water authorities and water companies that they will not sit still if negligence is found.

Increasingly, abnormal weather has hit Malaysia. That the years 1997/1998 are El Nino years are unquestionable. What is questionable, however, is the blaming of everything ranging from forest fires, haze, drought, flood, crop loss, water shortages, etc. on El Nino. Pointing fingers will serve no purpose, even though it is a common habit amongst Malaysians, especially amongst those responsible. When the water crisis dawned on Selangor, politicians at the Federal level pushed the blame on to the State Government citing water to be a State matter. The State then passed it on to the Water authority that in turn blamed El Nino. This is unacceptable as it implies that those responsible have not taken abnormal weather into their planning. Putting the blame on the El Nino is an exercise in futility. With such abundant rainfall and surface water resources available, not even the greatest of all El Ninos will have more than a mere side effect on the water security situation in the country, i.e. had those responsible done a fairly good job in managing our water resources. But putting the blame squarely on those responsible would also be useless, given the fact that those in high places often get away scot-free (no big shots were punished for the Durian Tunggal episode in Melaka in 1991, neither was anyone implicated for the February 23 1998 incident which spilled 2,700 litres of diesel into a raw water canal at the pump station in Lahar Tiang, Sungai Dua, Penang or the ammonia pollution of the Langat River in March 1998). Even under the 1998 most stressful and difficult water crisis in Selangor, which has affected hundreds of thousands, no one was blamed let alone prosecuted barring old scapegoat El Nino. Certainly, if Malaysia wants to be recognised as a developed nation, then there is absolutely no place for using the weather as a scapegoat for one's mistakes and incompetence.

Privatisation of the water industry is another contentious issue. Water is a vital resource where everybody is entitled to its access. Hence, the government has a moral responsibility to provide the people with adequate and quality water supply. Water is an essential good needed by people of all race, creed and status. Both the poor and the rich are entitled to adequate water. Even the homeless and those living in remote villages must not be deprived of this vital resource. Without water, nothing works. Because of its importance, water should never be privatised despite claims by many quarters (including private water companies) that privatisation of the water industry would improve effectiveness. While there have been many cases of successful privatisation of the water industry in western countries, there is none so far in Malaysia. States that have privatised part or all its water industry are now having problems as evident in the current water crisis in certain States. While privatisation may not be entirely bad, the appointment of suitable candidates for the privatisation

exercise is vital. Here, meritocracy must be the only criteria. The company taking over the water industry must be established and have adequate experience in the field. This is not the case in many water companies in Malaysia. Even taking into consideration the climate of the current economic crisis which necessitates the awarding of contracts to local companies, it does not make sense to award water contracts to an inexperienced company. Here, perhaps a joint partnership between an international company and a local one may be the solution. Whatever the choice, the authorities should make it transparent to the public, a policy so preached by the government.

Arguably, privatisation has created more problems than it has solved. Arguably, there are areas in which privatisation has worked, but such cases are few and far between. On the other hand, if we start counting the failures, the list would be long. To be fair, though, there are certain goods that can be privatised and some that should not be, for the sake of the people. It is okay to privatise the Inland Revenue Department and the Postal Service but health care, water, public education and other basic necessities are a different matter. When privatised, these goods will no longer be treated as necessities. Instead, the companies appointed would simply treat them on a monetary basis or based on the principle "You pay you get". Private companies are not welfare companies. They are run on the profit motive, and money will be their top priority and not the welfare of the public. Water companies will only supply the water if they are making profits. What if it a company is running at a loss due to some unforeseen circumstances? Is it going to increase its tariffs? What would the effect on price be if there were a great drought that lasts for years? In the worse scenario, what if the water company collapses? Where will the water come from then? Water is simply too precious a resource to leave it to the hands of private companies. The government must keep this responsibility at all costs. It is its moral responsibility to the people. For states which have already privatised their water functions, they must ensure that the appointed water companies be controlled by the State in some ways.

Finally, pricing is one sensitive issue that has been kind of left aside by politicians, ostensibly to ease the public's burden during the current economic slowdown. Based on the current water rates for domestic consumers in Penang (22 sen per litre for the first 20,000 litres; 42 sen per litre for the subsequent 20,001 to 60,000 litres; and 70 sen per litre for anything higher), it is clear that no one will pay any attention to save water. The current rates are simply too dirt-cheap! Such a cheap tariff, while ensuring that everybody has access to water, is counter-productive as it inadvertently encourages over-usage and wastage. The international standard recommends that each person have access to at least 165 litres of water per day. But to make sure nobody suffers any water stress and that everybody

has more than enough water for their entire daily needs, a 200 litres per day limit is proposed. Based on a mean family of 5 persons, a family would need 200 litres X 5 = 1000 litres per day or 30,000 litres 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 litres per month would be classified as "Slight Water Wasters"; those using 50,000 litres per month will be "Moderate Water Wasters"; those with water consumption of 60,000 are "High Water Wasters"; and those using 70,000 litres or more per month are "Excessive Water Wasters".

NGO-GOVERNMENT-BUSINESS PARTNERSHIPS

Water management in Malaysia has always been one of Supply Management, possibly because of the misconception that water resources are abundant in the country. Hence, the "Top-down" approach is adopted. Government has always been responsible for water supply and should rightly remain so as it has a moral obligation to the citizens for providing adequate, uninterrupted, safe and quality water to all. However, water management cannot be sustainable if the users do not co-operate with the suppliers as many river systems have probably already reached their supply limits (Hj Keizrul Abdullah, 1999). It is therefore imperative that users play an equally vital role in reducing water demand via conserving water. This is where NGOs can play a vitally important role. Government must not view NGOs as enemies (though admittedly, there are some irresponsible politically-driven NGOs with ulterior motives). Government must in fact view NGOs as "partners" in the country's development and involve NGOs as much as possible, especially in water conservation and management. NGOs form the link between government and people as well as between government, industry and consumers.

NGOs are made up of professionals as well as ordinary concerned citizens. As such, NGOs have rich human resources that can be used in water management. NGO experts can be used profitably as consultants to water authorities, sitting on EIA panels, or as watchdogs for water crime. NGO personnel can also be used as teachers in public awareness programmes for the community and schools. Another related area where NGOs can play an important role is that of capacity-building (CB). This is currently being tried by the Drainage and Irrigation Department (DID) in collaboration with WWF Malaysia, Wetlands International, Malaysian Nature Society and Water Watch Penang in integrated water resources management (WWF Malaysia et al., 2001). However, CB alone is not enough to implement IRWM. We need also Public Pressure, Public Responsibility and Public Action. If for example, the public feels that a water scheme is not beneficial, it should voice its opinion and

explore all avenues (within the law, that is) to show the authorities why that scheme is bad. The public should not be apathetic but responsible and take action. All the CB will come to zero if the public refuses to stand up, expose the crime (of the perpetrators) and take action. It is extremely important for the public to be aware of their rights and this should be a part of CB. The public has the right to adequate clean water but at the same time, it should also have the right to say "No Thank You" to water that is forced down their throat.

Since NGOs represent the people, they need to be consulted by the authorities in all water management developments. Water is a finite resource and water resources in Malaysia are unevenly distributed both over time as well as space (Hj. Keizrul bin Abdullah, 1998). Government cannot keep on increasing supply as the number of dams one can build is limited. When a dam is absolutely necessary, and all professional studies indicate so, then even the NGOs will come out in support of the government. Before a dam is built, there should be public meetings and forums to debate the issues. This is where NGOs can co-operate and give their inputs. Unfortunately, NGOs are often put into EIA panels and committees as a form of "greenwash" and their views are not taken seriously enough. With regards to dam building, the truth is that supply can never keep up with demand. 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 come out with a vision for water resources rather than the fragmented development of this vital resource by individual states (Shahrizaila Abdullah, 1999). The setting up of the National Water Council was a good move but its effectiveness remains to be seen, as no NGOs are represented and considering the suspicions of many state governments about losing their grip on water, a state matter.

One important way is for the Government to reduce the rate of *Non-Revenue Water* (NRW) or water that is 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 than 50 % (Government of Malaysia, 1996). This is where NGOs can play an important role and be a partner of the government. For the government and water authorities, NRW is an embarrassing issue and NGOs can help remove some of that embarrassment. Notwithstanding all the unsavoury aspects of NRW, government and water authorities should change their mindset from one of solely concentrating on increasing water supply, i.e. Supply Management (more prestigious and more profitable), to a more balanced approach involving both Supply and Demand Management (one of which is via reduction of NRW). Government should realise that the losses from NRW are substantial and NGOs can help reduce such losses (Table 1).

Table 1: Water Supply Capacity and Non-Revenue Water in Malaysia

Year	Capacity (MLD)*	Consumption (MLD)	Water Loss	Water Loss (MLD)	Estimated Loss in Revenue Per Day (RM)	Annual Loss (RM)
1995	9,442	7,704	3,587	38 %	1.84 m**	671.6 million
2000 ^e	11,800	9,160	3,304	28 %	1.69 m	616.9 million

* MLD = million litres per day (1 litre = 0.001 m³; 1 MLD = 1,000 m³ per day).

** Based on cost of water sold at 51.3 sen per m³ (Based on average price in Penang).

e For the year 2000, all values are estimated.

(Source: Government of Malaysia, 1996)

Everyday, millions of litres of precious treated water are lost. In 1995, a total of 9,442 million litres of treated water was produced per day. With a NRW loss rate averaging at 38 % in 1995, a total of 3,587 million litres per day (MLD) was lost. This amounted to a total lost of 1,309,255 million litres. At the selling price of 51.3 sen per cubic metre, this amounted to RM671.6 million in the whole country for 1995. One can argue that not all NRW is "lost" as someone (public use and thieves) is using it,

but however one looks at the issue, water unaccounted for is water lost.

The NRW rates are staggering in many states ranging from more than 20 % to more than 60 % (Figure 2). In some states, the NRW is more than 50 %! Even in Penang where NRW is the lowest at about 20 %, the amount of NRW losses (in Ringgit) are staggering. In 1981, 1990 and 1995, the losses accruing from NRW were 6.86 million, 13.55 million and 24.68 million respectively. For the

whole country, the amount of losses would be at least ten-fold or more.

NGOs can assist government as “watch dogs”. In the area of strengthening of enforcement of *legislation* in relation to the protection of water catchments and water courses (rivers, lakes, swamps, underground water etc.), NGOs become the “eyes” of the government, reporting all illegal activities that threaten water resources. In Malaysia, there are many laws that indirectly border on the protection of water catchments. The more prominent ones are The Land Conservation Act 1960 (Revised 1989), The Land Acquisition Act 1960 and The EIA Order 1987. However, as far as water resource protection is concerned, they have been ineffective largely because of developers easily get round them and also because of poor enforcement. However, some States such as Pahang and Penang (as have others) have passed legislation to protect water sources and water catchments. In the former, EIAs in environmentally sensitive areas are not confined to 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. And NGOs can help here. Recently, there have been talks about legislation for building specifications to include a rainfall harvesting system as mandatory for government buildings and optional (with tax incentives) for private buildings/homes. The Ministry of Housing as an option for new houses has recently proposed this idea, but since then, it has died a natural death. Here again, NGOs could have been roped in to promote the idea amongst the people. Rooftop rainfall harvesting is already widely practised in rural areas and is an area with great potential, given the copious rainfall of more than 3,000 mm per annum that we receive in Malaysia (Hj Jamaludin Shaaban, 1999).

Arguably, NGOs are best equipped in the field of public awareness and education. Government can form partnerships with NGOs in *water saving campaigns* to urge the public conserve and reduce water use. One good example is the Drainage and Irrigation Department’s “Love Our River” campaign (Ahmad Darus and Abd. Razak Mohd. Noor, 1999). However, despite its immense potentials, success in the campaign is limited by the DID’s resources (both monetary and human). Certainly, if NGOs such as WWF, MNS and WWP were partners, the campaign would have attained greater heights and wider participation. One good example of government-NGO partnership is that of the Perbadanan Bekalan Air Pulau Pinang’s (PBAPP) “Water Awareness and Education Campaign” launched in 1999. This campaign is jointly organised with Water Watch Penang (WWP), an NGO

(Water Watch Penang, 1999). 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. Even though we tend to believe that “Old habits die hard”, the adults too need to be educated about water conservation. Others Governmental programmes include advertisements to be aired on the national TV on water pollution, fostering the love for nature and the need to protect and save our water, and other programmes relating to wise water use. Given the expensive nature of air time, the Government should have a regulation on all TV channels specifying a certain number of such educational “advertisements” in between the large numbers of “market oriented” commercial advertisements now being aired. NGOs such as Wetlands International, WWF, MNS and WWP have also come into partnerships with local dailies via publications of water conservation articles. For example, WWP has maintained a steady flow of water conservation articles and letters to the major papers (Chan, 2000c).

Another area whereby government can work with NGOs is that of getting industry and the public to *recycle, reuse and reduce* water. 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, than 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. Or alternatively, increase water tariffs (for industrial use) to such an extent that recycling becomes an attractive option. The Government can also make it mandatory for large businesses to obtain the ISO 14,000 certification.

Finally, as a final resort, Government can use “*pricing*” of water tariffs to control the abuse of water. Admittedly, pricing is one sensitive issue that is politically sensitive, especially so during an impending election year. This is where NGOs can help in convincing the public that a certain amount of price hike is fair and necessary. If government employs a participatory approach by including NGOs and the public in the price negotiations, then there is a higher likelihood that any price hike would be more acceptable. In the recent water tariffs increase in Penang, WWP’s role in supporting the increase was vital and justified as based on the current water rates for domestic consumers in Penang (22 sen per litre for the first 20,000 litres; 42 sen per litre for the subsequent 20,001 to 60,000 litres; and 70 sen per litre for anything higher), it is clear that no one will pay any attention to saving water. The current rates are simply too cheap! Such a low tariff, while ensuring that everybody has

access to water, is counter-productive as it inadvertently encourages over-usage and wastage. The international standard recommends that each person have access to at least 165 litres of water per day (As a comparison the per capita average use in Africa is about 50 litres per day. The average Malaysian probably uses slightly less than 300 litres per day). But to make sure nobody suffers any water stress and that everybody has more than enough water for their entire daily needs, a 200 litres per day limit is proposed (Chan, 2000d). Chan (1998a) has calculated that based on a mean family of 5 persons, a family would need 200 litres X 5 = 1000 litres per day or 30,000 litres 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 litres per month would be classified as "Slight Water Wasters"; those using 50,000 litres per month will be "Moderate Water Wasters"; those with water consumption of 60,000 are "High Water Wasters"; and those using 70,000 litres or more per month are "Excessive Water Wasters". Families should be charged on an escalating rate, known as "Phasing" of water tariffs (Chan, 1998b). Hence, contrary to popular belief, use of pricing to control wasteful water consumption can be fair and not necessarily "burden" the people. Once implemented, the authorities could stipulate that the "Extra" income derived by water authorities and water companies be set aside for replacement of old mains, rebuilding old infrastructure or for new schemes. It should not go directly into the profits of the companies.

NGOs can also form a link between government and industry. Admittedly, many industries/businesses are big users of water. They are in fact the greatest users of water. In 1997, the Malaysian Water Industry Report indicated that the consumption per non-domestic user (i.e. commercial, industrial and other businesses) averaged about 100 m³/month (about 100,000 litres/month) (Water Supply Branch, Public Works Department Malaysia, 1998). In an industrialised state such as Penang, for example, the figure is as high as 234 m³/month (about 234,000 litres/month). As a comparison, the average consumption of domestic users is 31 m³/month (35,000 litres/month) and 35 m³/month (31,000 litres/month) for Malaysia and Penang respectively. This means that the average factory/business in Penang uses as much water as nearly seven households. This is, however, an under-estimation when it comes to the "big boys" of industry/businesses, i.e. multi-nationals (MNCs), international hotels, large factories and others. The Penang Development Corporation (PDC) ran a study on the factories in the Free Trade Zone in 1998 during the height of the water crisis and found that some large factories use as much as between 100 to 150 million litres/month (Perbadanan Pembangunan Pulau Pinang, Undated). This is equivalent to the water use for 4,871 households, almost

the whole of Mukim Batu Feringghi which has a total of 4,848 households (Department of Statistics Malaysia, 1995). It is also widely known that an international class hotel in Batu Feringghi uses more water than the whole of Teluk Bahang town (2,964 households).

The same PDC study has shown that some factories have consulted PDC and WWP on tips to conserve water use. As a result of this consultation, many industries have taken the necessary steps to reduce water usage, including the installation of recycling plants have managed to save huge quantities of water. For example, one factory reported that using three methods of: (i) the RO/DI pre-treatment backwash reclaim system; (ii) recycling of RO Reject water for chemical drum washing; and (iii) the recycling of sampling water enabled it to save up to more than 650 million gallons (2460 million litres) of water for a 36 months period. Hence, the monthly amount of water saved is about 68 million litres, i.e. enough water for 2,193 household. In terms of Ringgit, the savings amounted to about RM1.722 million for the entire period. Hence, it makes sense for these big businesses to install recycling and water reclaiming mechanisms in their plants.

Finally, the public must be involved if any water conservation initiative is to be successful. In fact, the role of the people begins with the NGOs, who are really concerned groups of people. The role of NGOs in water conservation is currently grossly under-valued. NGOs not only help raise greater awareness of the need to conserve water but also help to educate the public on water education, provide water saving tips to both industry and public, become the link between the public, organisations/industry and government, and mobilise all the players towards creating a water saving society. Currently, Water Watch Penang (WWP) is probably the only water NGO in Malaysia, although other NGOs such as the Malaysian Nature Society (MNS), the Environmental Protection Society Malaysia (EPSM), Sahabat Alam Malaysia (SAM) and to a lesser extent consumers associations such as the Consumers Association of Penang (CAP) and the Consumers Association of Selangor (CAS) have from time to time dealt with water issues. The Malaysian Water Association (MWA), is of course concerned about water, but it is not an NGO as much as it is an exclusive member-based association for water engineers/professionals. The MWA should open its doors to the public to make it more acceptable to the public.

NGOs such as WWP and MNS have worked closely with the Government and have contributed significantly towards greater environmental protection, awareness and conservation. For example, the work of WWP, a water NGO is remarkable. Since its formation in November 1997, WWP has done a lot of community work, creating greater awareness for water saving, writing articles in

newspapers, educating people and school children about the importance of water conservation, contributing our expertise in national forums and workshops on water, helping the government draw up plans and programmes for water conservation and a lot more. Projects such as “River Walk - Caring For Our Rivers Campaign”; “Clinic for Penangites on the importance of looking after rivers”; “Adopt a river project”; and “Water Conservation and Educational Programme with the Perbadanan Bekalan Air Pulau Pinang Sdn Bhd (PBAPP) (Water Watch Penang, 1999). In the National Committee on World Water Day Celebration 2000 to be held in Penang, the WWF and WWP have been invited to sit in the committee by the JPS, the organisers. Both NGOs are currently playing an active role in the exhibition targeted at raising community awareness. This is a good move as NGOs can contribute much and be a partner to the government. NGOs work at the grassroots level and are close to the people. They can form the missing link between government and rakyat. In many countries, NGOs also form the link between businesses and people, and between businesses and government.

Penang is probably a very good example whereby there is close government-NGO partnerships working in tandem. While it cannot be denied that Penangites are very caring people as reflected in the high number of NGOs in the state, credit must not be taken away from the state government. The state was responsible for building the Caring Society Complex (a place where NGOs are housed), the formation of the Socio-Economic and Environmental Research Institute (SERI) - a think tank for the government, and a whole lot of “people-centred” developments and projects. In fact, both SERI and WWP are almost fully supported by the state (WWP being supported by funding from the Penang Water Supply Corporation or PBAPP Sdn Bhd). Hence, NGOs must justify the confidence that the state and people have put in them. It is their responsibility to ensure the water conservation projects are completed and the message reached the people. Certainly, it does nobody any good for NGOs to merely find fault in the government or any authority. Such non-constructive methods are futile. NGOs must be responsible in all their actions and be genuinely concerned about the outcome of what they do. Hence, it is their responsibility to ensure their objectives are reached in partnership with the state, and not to employ the irresponsible “Reach our objectives at all costs” approach. Equally, the confrontational approach must be discarded as it benefits few but destroys a lot. The useful kinds of partnerships between NGOs and government in Penang can be extended to the other states, if there are still none yet. Ideally, the state should allow people and NGOs to play a more active role not merely via consultation alone but to be actively involved as “partners” since it is impossible for the state to do everything. The case of the Malaysian Nature Society

working in tandem with the Selangor state government in many projects is another good example of synergy. The state can build dams and increase water supply but this may not solve our water woes if people, industry and others keep wasting this precious resource. This is where NGOs like WWP comes in. WWP is a good example of a successful “smart-partnership” between NGO and government. WWP forms a link between people and government (Rasagam and Chan, 1999).

There are other examples of NGOs working effectively on water conservation in Malaysia. For example, Wetlands International - Malaysia's training programmes focus on providing training to protected area managers and development planners, using techniques ranging from community facilitation processes to teaching technical aspects of natural water purification process (WWF Malaysia et al., 2001). Water and wetlands are inextricably linked. In fact if wetlands are managed well, then needless to say that water resources will also be inevitably managed to the same degree. Wetlands International - Malaysia has assisted in setting up both the Nature Interpretation Centre at Taman Wetland in Putrajaya and the Tasek Bera Visitor Centre, Pahang with exhibits and interpretative materials.

The Malaysian Nature Society (MNS) has the distinction of being the oldest NGO in the country. Though its aim is wide, water resources conservation is one of its many aims. Amongst its many programmes related to water is a water forum in 2000 which focussed on raising awareness among local communities targeting resident associations and other grass root organizations. Essentially a member-based organization, the MNS works alongside other NGOs and government officers to complement each other's efforts rather than duplicating them.

WWF Malaysia, a relative newcomer to the Malaysian scene which has held the limelight in recent decades, is now considered the prime NGO on environmental conservation. This is possible largely because of its international reputation and substantial overseas funding. Unlike the MNS and WWP, both of which are member-based organizations run by voluntary (non-salaried personnel), WWF Malaysia is run by paid professionals. WWF Malaysia is involved in proactive local community-based work aimed at raising environmental awareness. One example is the grass roots community organisation (REACH) that has been established in the Cameron Highlands area. REACH (the EXCO has many WWF Malaysia employees) is concerned over rapid development and its undesired effects in Cameron Highlands, including illegal land clearing, and subsequent effects on water supply and landslides. REACH has managed to generate heightened public concern and commanded national attention, putting the

importance of highland water catchments high on the government's agenda. REACH's membership is largely made-up by local people living in the Cameron Highland area.

In Malaysia, the rakyat has been generally blamed for having an "apathetic" attitude when it comes to water conservation (Chan, 1998c). However, this is changing as people become more educated, informed and caring. Gone are the days when the rakyat is a "sleeping partner" and relies fully on government for the development of the state. Increasingly, like it or not, the public has a very important role in shaping the kind of society we want to live in the future. Some states such as Penang are very "rakyat friendly" and "environmentally friendly" in the sense that it allows for, and in fact sometimes goes a long way, to seek public views and opinions in relation to the development of the state. Some pertinent examples are the rejection of the proposed Penang Hill development project in 1991, involving the public in the subsequent drafting of the Penang Hill Local Plan as well as other local plans. In the new millennium, people are envisaged to become an "active" partner of the government and in the area of water conservation, their co-operation is vital.

CONCLUSIONS

The days are over when NGOs are made up of locals with little professional expertise. NGOs are now made up of professionals and concerned citizens. As such, NGOs have rich human resources that can be tapped by government in government-NGO partnerships in water management. Increasingly, in this new millennium NGOs comprise Malaysians who are well educated, informed and affluent and they want to play an increasingly active role as a "partner" of the government in helping to chart the future of the country. Likewise, government is also changing by employing a more "rakyat friendly" approach as it is to everybody's advantage to consult the rakyat via NGOs, as NGOs have much to offer. Equally, the rakyat can no longer sit back and wait for things to happen. They need to either join NGOs or form groups of concerned citizens to assist government. Total development of the country and overall welfare of the people, including the vital life-giving water supply, should always be a joint effort on the part of government, industry, NGO and rakyat. In this respect, government should even increase the consultation and participation of all parties, especially NGOs in all relevant water resources developments. In fact, the government can go one better, and that is to tap on the expertise of the NGOs in water resource conservation and other areas. NGOs nowadays are made up of experts in every field - engineers, water resource experts, hydrologists, educators, sociologists, economists and others. They can contribute immensely if the government allows them to. The best thing is, unlike private consulting companies, NGOs offer their service for free in return for nothing. NGOs are also very committed

as the issues that they deal with are close to their hearts. Hence, saving water and water conservation should be a joint effort between government and NGO. Notwithstanding the government-NGO partnership, it is equally important for the industrial and business community to be in partnership with government as well. There are even avenues for industry-NGO partnerships. More than that, water conservation partnerships should involve all concerned. It should be everyone's responsibility ranging from the government to water corporations, water authorities, water companies, consultants, industries (including hotels, resorts and theme parks), businesses, NGOs, and the rakyat. It is with all these partnerships that we can ensure that water resources remain sustainable and our children and future generations guaranteed with adequate and clean water.

REFERENCES

- Asia-Pacific Peoples' Environmental Network (1998) *Water Watch – A Community Action Guide*. Abdul-Razzaq Lubis: Penang.
- Ahmad Darus and Abd. Razak Mohd. Noor (1999) "Love Our Rivers" Campaign. Paper presented at the National Conference on "Rivers '99 - Towards Sustainable Development", Universiti Sains Malaysia, Penang.
- Baral, H. (1999) *Water Demand Management (W.D.M) – A Tool To Address Urban Water Demand in A Sustainable Manner*. Paper presented in "Rivers '99: Towards Sustainable Development", 14-17 October, Universiti Sains Malaysia, Penang, Malaysia.
- Bouguerra, L. (1997) "Foreword on Water Resources in the 21st Century". In Chan N W (Editor) *Proceedings of the international conference Meeting Water Challenges in the 21st Century*. Water Mobilising Programme of the Alliance for a Responsible and United World, Paris, pp i-ii.
- Chan, N.W. (1998a) "Priceless water not valued". *The Star* 29 July 1998, North, p. 6, 7.
- Chan, N.W. (1998b) "Water: Too cheap to prompt people to save". *The Star* 29 July 1998, North, p. 2, 3.
- Chan, N.W. (1998c) *Institutional Issues for Water Management in Malaysia*. In Selected English Papers of The Asian Conference on Water and Wastewater Management, Tehran, March 2-4 1998, PR Committee of Asian Conference on Water and Wastewater Management, Tehran, 27 - 42.
- Chan, N.W. (1999a) *Water Conservation, ReUse and Reduction of Water Use*. Paper presented in the workshop on "Sustainable Management of Water Resources in

- Malaysia”, 20 July, Kuala Lumpur. Organised by Global Environment Centre (GEC), Department of Irrigation and Drainage (DID), National Hydraulic Research Institute of Malaysia (NAHRIM), The Malaysian Water Association (MWA), Environmental Management and Research Association of Malaysia (ENSEARCH), and Selangor Waterworks Department (JBAS).
- Chan, N.W. (1999b) “Hill Land Development”. In Kerajaan Negeri Pulau Pinang 1999 *Penang Environmental Conservation Strategy: Technical Report: Data, Analysis and Tools*. DCT Consultancy Services Sdn. Bhd. Consultancy Report prepared for the Penang State Government, Pulau Pinang, 84-97.
- Chan, N. W. (2000a) *Saving Water for the Future: The Responsibility of All*. Paper presented at the National Conference – “World Day For Water Seminar 2000”, March 20 - 21, Cititel, Penang. Jointly organised by MANCID-YPF, IHP, MMS and DID.
- Chan, N. W. (2000b), *Opening Speech*. Speech given at the Launching of Water Watch Penang (WWP) in Conjunction with World Water Day Celebration, 22 March 2000, Botanic Gardens, Penang.
- Chan, N. W. (2000c) *Current Environmental Issues in Malaysia – Press Releases*. Water Watch Penang, Penang.
- Chan, N.W. (2000d) *Management of Water Use in the Home: The Key to Sustainable Management of Water in the 21st Century*. Paper presented at the *World Day For Water Seminar 2000*, 20 & 21 March 2000, Cititel, Penang.
- Clark, R. (1991) *Water: The International Crisis*. London: Earthscan Publications Ltd in association with the Swedish Red Cross.
- Department of Environment, Ministry of Science, Environment and Technology Malaysia (1999) *The Malaysian Environmental Quality Report 1998*. Kuala Lumpur.
- Department of Statistics Malaysia (1995) *Population and Housing Census of Malaysia 1991 - Population Report For Mukim*. Kuala Lumpur.
- Government of Malaysia (1996) *Seventh Malaysian Plan 1996 - 2000*. Government of Malaysia, Kuala Lumpur.
- Hamirdin Ithnin (1997) “Are we heading for a water crisis?” In Consumers Association of Penang *State of the Malaysian Environment*. Consumers Association of Penang, Penang, pp 142-145.
- Hj. Jamaludin Shaaban (1999) *Alternative Water Supply Options: Rainfall Harvesting*. In *Sustainable Management of Water Resources in Malaysia – A Review of Practical Options*. Global Environment Centre, Petaling Jaya, 62-77.
- Hj. Keizrul bin Abdullah (1998) *Hydrology for Sustainable Water Resources Planning, Development and Management in Malaysia*. Keynote paper presented at the International Conference on Hydrology and Water Resources of Humid Tropics, 24-26 November 1998, Ipoh, Malaysia.
- Hj. Keizrul bin Abdullah (1999) *Integrated River Basin Management*. Paper presented at the National Conference on “Rivers '99 - Towards Sustainable Development”, Universiti Sains Malaysia, Penang.
- International Committee of the Red Cross (1999) *War and Water*. International Committee of the Red Cross, Geneva.
- Lim, P.E., Seng, C.E. and Liew, K.W. (1984), *Water Pollution In Environmental Quality Study of Penang Island*. Technical Report No. 13, Penang Island Municipal Council.
- NST, Various issues.
- Perbadanan Pembangunan Pulau Pinang (Undated) *Industrial sector - Water Supply Feedbacks*. Unpublished Report of Perbadanan Pembangunan Pulau Pinang, Penang.
- Rasagam, G and Chan, N. W. (1999) *The Role of Non-Governmental Organisations in Public Awareness and Environmental Education Towards Protection, Conservation and Rehabilitation of Rivers: Some Examples from the Work of Water Watch Penang*. Paper presented at the National Conference on “Rivers '99 - Towards Sustainable Development”, Universiti Sains Malaysia, Penang.
- Renganathan, M. (2000) *Taking Care of Water, the Responsibility of All*. Paper presented at the national Seminar on Environmental Management Plan for the Proposed Beris Dam project in Kedah Darul Aman, 28 Feb - 1 March, Sungai Petani.
- Shahrizaila Abdullah (1999) *Towards A Malaysian And Global Vision For Water, Life And Environment*. In *Sustainable Management of Water Resources in Malaysia – A Review of Practical Options*. Global Environment Centre, Petaling Jaya, 17-24.
- The Star*, Various issues.

The Sun, Various issues.

Water Supply Branch, Public Works Department Malaysia (1998) *Malaysia Water Industry Report 97/98*. JKR 20200-0040-98, Kuala Lumpur.

Water Watch Penang (1999) *WWP Activities 1998/98*. Water Watch Penang, Penang.

WWF Malaysia, Wetlands International, Malaysian Nature Society and Water Watch Penang (2001) *Capacity Building in Integrated Water Resources Management (IWRM): an NGO perspective*. Paper presented at the forum on Capacity Building for Integrated Water Resources Management (IWRM) in Malaysia, 29 October 2001, Kuala Lumpur.

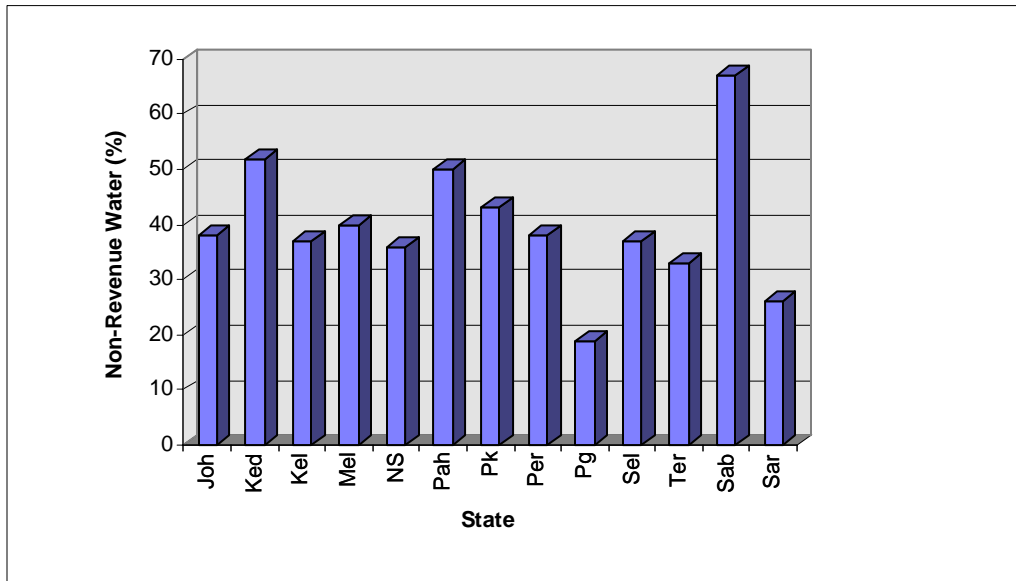


Figure 1: Per capita renewable water (m³/year) in water stressed countries compared with Malaysia (Notice the stress line is about 1,700 m³/year).

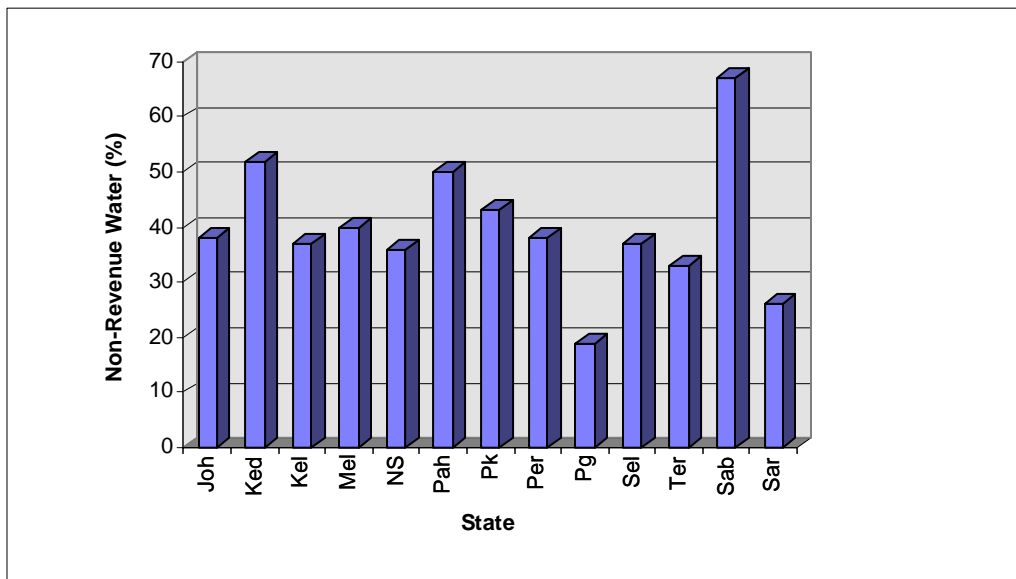


Figure 2: Amount of Non-Revenue Water (NRW) by State in Malaysia (Source: Malaysia Water Industry Report 97/98).