A Study Report on

Groundwater Resources Development Project in the District of Batang Padang, Perak Darul Ridzuan

: A REMINDER TO MALAYSIA

Jointly reported by:

Federation of Malaysian Consumers Associations (FOMCA)

Water and Energy Consumer Association of Malaysia (WECAM)

Forum Air Malaysia

A STUDY REPORT ON GROUNDWATER RESOURCES DEVELOPMENT PROJECT IN THE DISTRICT OF BATANG PADANG, PERAK DARUL RIDZUAN

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"NO RECHARGE, NO DISCHARGE, SIME DARBY WILL BE CHARGED"

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Contents

Contents

List Of Figures In Report

List Of Tables

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Executive Summary

Malaysia has sufficient surface water resources which are not managed properly. The groundwater resources development project in Batang Padang District, Perak with large capacity will definitely give impact to the surrounding environment. Unfortunately, this was not mentioned clearly in the Environment Impact Assessment (EIA) study for whatever reason. Sime Darby Berhad used countries like Denmark, Switzerland, England and United States of America as an example of groundwater utilizing countries. However, their need for groundwater resources and its impacts were not reported.

In Part 2, we have shown clearly the groundwater abstraction impacts in Denmark, England, United States of America and few other countries. For example, in Denmark, which is the most experienced country to do groundwater abstraction is also affected with impacts such as sea water intrusion and declining water level. This effect is still seen even after extensive study and models of groundwater and hydrology to predict the recharge rates. All the impacts due to groundwater abstraction including land subsidence and declining water level will not be able to return the environment to its original condition. The similar issues will arise to the Batang Padang District and its surrounding areas because there is no details information in EIA report for this groundwater resources development project.

We in total reject the groundwater resource development project as it is like sucking blood out of live human by assuming the rate of blood replaced in the body. If the rate of recharge is disturbed, there will be serious impact to the environment. This echoes the theme of the report, **NO RECHARGE, NO DISCHARGE, SIME DARBY TO BE CHARGED**.

1.0 INTRODUCTION

(Please be noted that a detail explanation of groundwater and its properties are attached in Appendix)

Groundwater is water that is found underground in the cracks and spaces in soil, sand and rock. The area where water fills these spaces is called the saturated zone. The top of this zone is called the *water table*. The water table may be only a meter below the ground surface or it may be hundreds of meters down. Groundwater is stored in and moves slowly through the layers of soil, sand and rocks called *aquifer*.

Aquifers typically consist of gravel, sand, sandstone, or fractured rock, like limestone. These materials are permeable because they have large connected spaces that allow water to flow through. Aquifers come in all sizes. There are two types of aquifer: *unconfined aquifers* and *confined aquifers*.

The Earth's surface can be divided into areas: (i) where water falling on the surface seeps into the saturated zone and (ii) where water flows out of the saturated zone onto the surface. Areas where water enters the saturated zone are called ***recharge areas***. In a recharge area, precipitation (rain or snow) or runoff infiltrates (absorbs into) the soil to the saturation zone or aquifer.

Area where groundwater reaches the surface likes lakes, streams, swamps and springs are called ***discharge area***. Only a small percentage of rainfall and snowmelt reaches the water table.

When the usage rate of groundwater is greater than the rate at which it is replaced by natural processes, it is known as over-abstraction. The impacts of an over-abstraction can lead to a wide array of social, economical and environmental consequences including:

- ***Land subsidence and damage to surface infrastructure*** - Land subsidence is a gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials.
- ***Sea water intrusion*** - Sea water intrusion is the movement of sea water into fresh water aquifers. This caused by decreases in groundwater levels due to over-abstraction.
- ***Reduction of water in streams and lakes*** - A related effect of groundwater abstraction is the lowering of groundwater levels below the depth that streamside or wetland vegetation needs to survive. The overall effect is a loss of riparian vegetation and wildlife habitat.
- ***Critical changes in patterns of groundwater flow to and from adjacent aquifer systems is also recorded***.

2.0 CASE STUDY IN SEVERAL SELECTED COUNTRIES

2.1 Statistic of Water Resources Utilisation in Several Selected Countries

The compiled statistic in Table 1 shows the population, groundwater usage, and withdrawal of water resources in Denmark, Switzerland, England, United States of America, Malaysia, Australia, China and Bangladesh.

Table 1: Statistic of water resources utilisation in Denmark, Switzerland, England, United States, Malaysia, Australia, China and Bangladesh

Country	Population (Million) Year 2000	Groundwater usage percentage (%) (source: *various publication*)	Withdrawal of Water (from resources) Year 2000 (source: *Food and Agriculture Organisation, Population Division of The Department of Economic and Sosial Affairs of the United Nations, World Bank)*				
			Total withdrawal (Million cubic meter/m^3) Year 2000	Estimated withdrawal per capita (cubic meter/m^3 per capita) Year 2000	Estimated sectoral usage		
					Agriculture (%)	Industry (%)	Domestic (%)
DENMARK	5.32	99	1,267	238	42	26	32
SWITZERLAND	7.16	83	2,571	359	2	74	24
ENGLAND	58.53	30	9,541	163	3	75	22
UNITED STATES	284.95	20	479,293	1,682	41	46	13
MALAYSIA	23	1	9,016	392	62	21	17
AUSTRALIA	19.15	31	23,932	1,250	75	10	15
CHINA	1275.9	33	630,289	494	68	26	7
BANGLADESH	137.84	69	79,394	576	96	1	3

2.2 Impacts of Groundwater Abstraction

Groundwater abstraction is one of the methods to get water resources besides surface water. However, over-abstraction can cause several impacts such as land subsidence, sea water intrusion, declining of water level and recharge rates despite giving impact to ecosystem.

2.2.1 Land Subsidence

United States of America

- It is reported that more than 17,000 square miles in 45 states were having land subsidence problems. Approximately 83% of the problem took place due to groundwater abstraction. (Source : National Research Council, 1991).
- In many areas of the arid Southwest, earth fissures are associated with land subsidence. Earth fissures can be more than 100 feet deep and several hundred feet in length. One extraordinary fissure in central Arizona is 10 miles long is related to groundwater abstraction. (Source : U.S Geological Survey) (Refer to figure *1)*

China

- Following a large exploitation of groundwater abstraction, decline in water levels took place. This resulted consolidation and compression of the unconsolidated

sediments which caused land subsidence.

- Nearly 50 cities in China recorded different level of land subsidence.
- From 1921 to 1965, the maximum depth of land subsidence was recorded at 2.63 meters in Shanghai City and in Tianjin City, it was recorded at 2.46 meters from 1959 to 1985. (Source : Hydrological Sciences Journal, 1994)

Figure 1: Earth fissures are caused by horizontal movement of sediments

Source: U.S Geological Survey

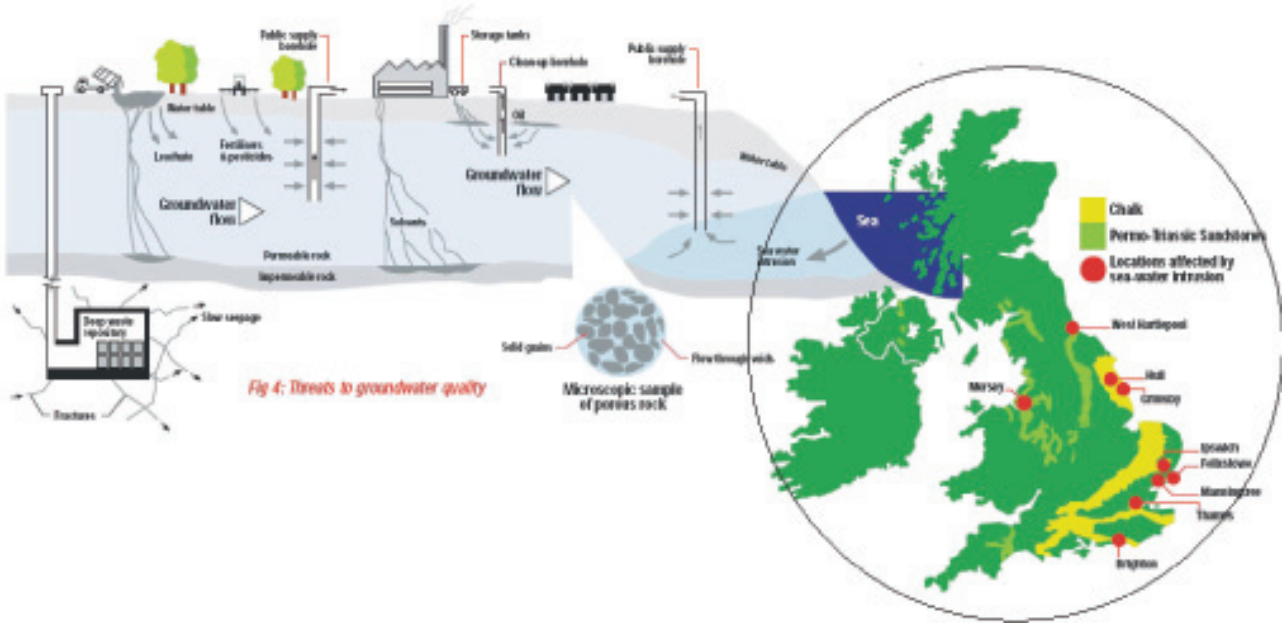
2.2.2 Sea Water Intrusion

England

- Rate of the sea water intrusion is increasing in this country. Demand of water resources by the growing population is the main cause for this problem. *(Refer to Figure 2)*
- Since the mid 1970s 11 groundwater sources belonging to water companies have been shut down due to sea water intrusion problems and 50 sites belonging to industry and private abstractors. (Source: Underground, under threat, Environment Agency, 2006)
- Boreholes around the Mersey Estuary have also suffered from sea water intrusion. In the past industry close to the estuary abstracted large volumes of water from the

sandstone aquifer underlying the Mersey basin, causing sea water intrusion. It has become less of an issue since the 1970s, when the problem was recognised and strategies were put in place to control the problem, but it still needs careful management. (Source: Underground, under threat, Environment Agency, 2006)

Figure 2: Sea Water Intrusion in England



Source: Geological Society of London

2.2.3 Declining of Water Level / Recharge Rate

Denmark

- The groundwater resources is being overexploited in several areas of the country (Copenhagen, Odense and Arhus) resulting in excessive stream flow depletion. (Source : Geological Survey of Denmark and Greenland)

United of States

- One of the case for water level declining is recorded for the sandrock aquifer at Chicago and Milwaukee (1864-1980) (Alley and other,1999). (*Refer to figure 3)*

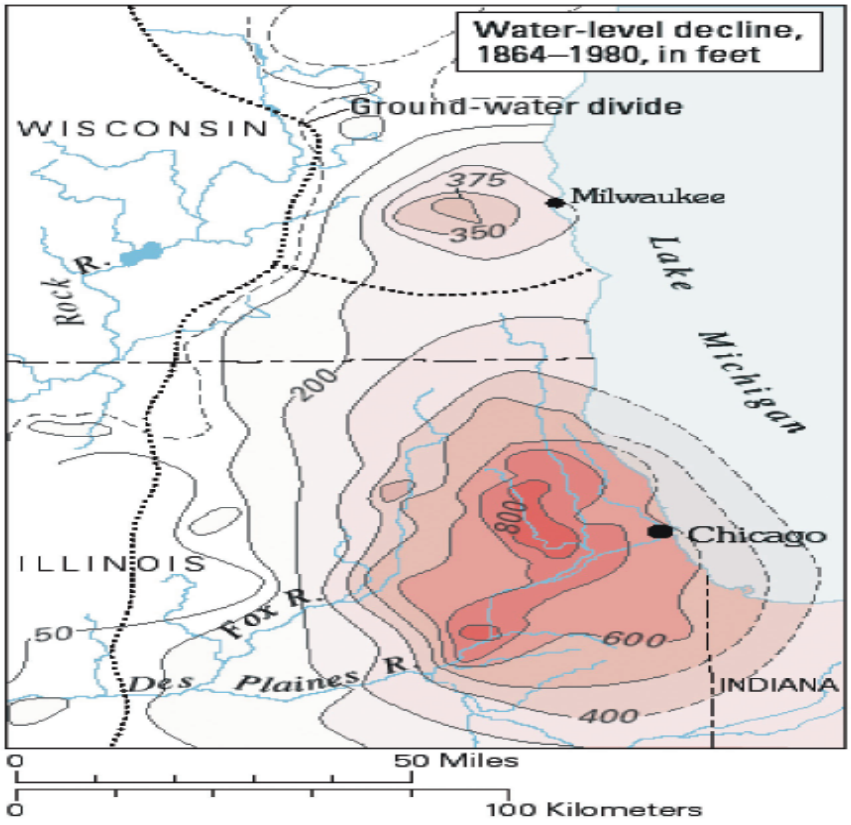
China

- After groundwater abstraction has been done for 35 years, China is facing challenges of declining water levels up to 20 meters. (*Refer to figure 4)*

Bangladesh

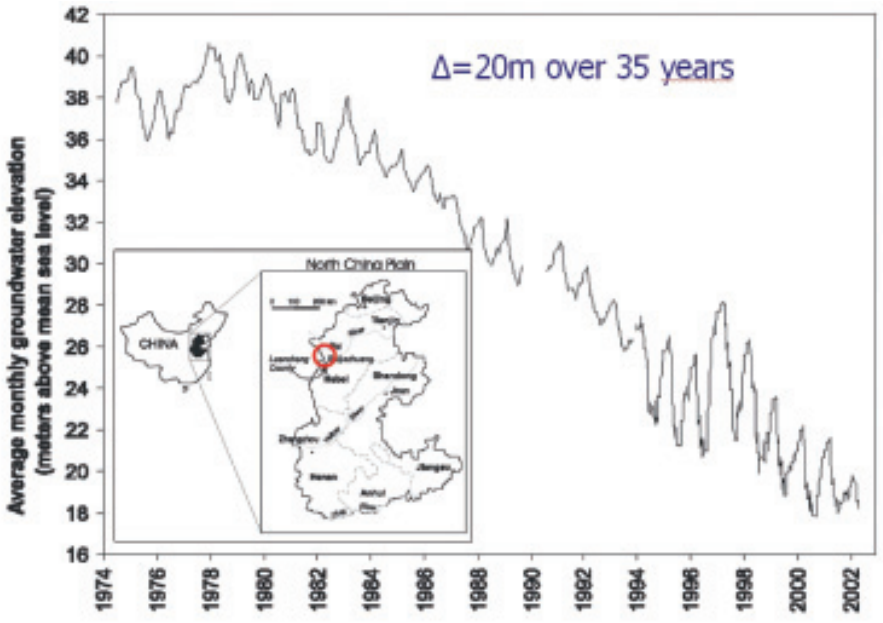
- Dhaka public supply wells has recorded decline in the water level. (*Refer to Figure 5)*

Figure 3: Decline in groundwater levels in Chicago & Milwaukee



Source: Alley and others, 1999

Figure 4: Hydrograph depicting water-table elevations in China



Source: Hydrological Survey of Denmark and Greenland

Figure 5: Decline in the rest level of water in Dhaka

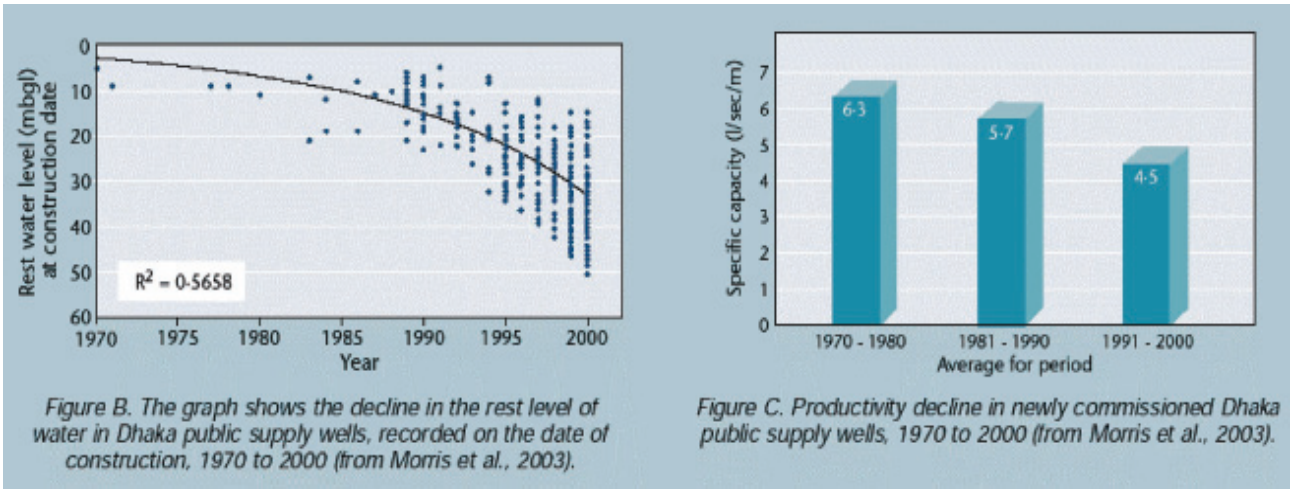


Figure B. The graph shows the decline in the rest level of water in Dhaka public supply wells, recorded on the date of construction, 1970 to 2000 (from Morris et al., 2003).

Figure C. Productivity decline in newly commissioned Dhaka public supply wells, 1970 to 2000 (from Morris et al., 2003).

Source: Hydrological Survey of Denmark and Greenland

3.0 COMMENTS ON EIA REPORT FOR PROPOSED GROUNDWATER RESOURCES DEVELOPMENT PROJECT IN THE DISTRICT OF BATANG PADANG, PERAK

3.1 Introduction

Sime Darby Berhad has proposed a groundwater resources development project in Batang Padang District, Perak which covers an approximate area of 2,712 km^2. This project is aimed to supply raw water to Klang Valley. The project is estimated to extract 50 Million Liter per Day (MLD) of groundwater in the end of year 2009 and expected to increase the capacity to 500 MLD in the end of year 2010.

Section 34A of the Environmental Quality Act 1974, item 19 (b), states that development of groundwater for industrial, agriculture or urban water supply greater than 4.5MLD is subject to an Environmental Impact Assessment (EIA) study.

Based on the EIA report was submitted by Sime Darby Berhad, we found that some of the main aspects are not taken into the provisions of the EIA report. Therefore, after a detailed review on the report, we have sound proofs to decline the EIA report and support fully to cancel the groundwater resources development project in Batang Padang District, Perak Darul Ridzuan.

3.2 EIA Study Report

An EIA study must be able to identify, evaluate and disseminate information of the impacts to the environment from a proposed project. However, in this EIA report we found that is more likely to be a general literature review which resembles a study that usually done by an undergraduate. This should not have taken place as this study consists of technical experts in environmental impacts assessment and development of a large capacity groundwater abstraction project.

Points that can be disputed in this EIA report are as the following;

- ***No simulation model to get recharge rate for a long period present***
- ***Ambiguity in method of groundwater abstraction either at confined aquifer or unconfined aquifer. The current method reported in the EIA report is unconfined aquifer abstraction which gives direct impact to water level.***
- ***The factors that ensure the recharge rate exceed the rate of abstraction is not mentioned. Any development or changes in recharge areas will give direct impact to recharge rate (i.e. reduction in recharge rate value)***
- ***All EIA report must identify specific locations for a proposed project. Unfortunately, no specific location was indicated in the EIA report for this project. This indicates blanket approval.***
- ***Water level fluctuation estimation is not present. This is again due to no specific location was detailed in the EIA report.***
- ***An EIA report must represent quantitative and qualitative evaluations. However, impacts outlined in this EIA report are more of literature information (qualitative evaluation). No detailed impacts were tabulated.***

3.3 Discussion on the EIA Report

For each groundwater abstraction project which produce high output that is 50 MLD up to 500 MLD, a simulation model must be developed to predict the effect for a certain period. Each groundwater model plays an important role in budgeting parameters, data preparation and study of dynamic and sensitivity of groundwater system (Anderson,et al.1992).

3.3.1 Water Balance Equation

Based on our findings in this EIA report, there is an equation used to describe the simulation model for groundwater in Batang Padang District. The equation is known as water balance equation:

Precipitation = Trans-evaporation + Runoff +Infiltration

In the water balance equation explanation, the EIA consultants have defined that the groundwater abstraction is from unconfined aquifer. This causes more concerns as unconfined aquifer is a high impact zone to the environment.

This EIA study also failed to elaborate on the relationship between the amounts of rain water, recharge rate, and groundwater available based on specific location study. This must further be modelled to identify problems that may arise based on field data. Our study concludes that there are several aspects need to be considered in order to get the right data for each groundwater resources abstraction locations. The several aspects are as following:

- A larger number of data is needed for each specific locations
- Calculation should be repeated (iteration process) for each location with different data of rainfall, trans-evaporation, crop type and soil type
- Impact to water level
- Impact to recharge area and its rate

The next challenge is what will be the social, economic and environmental impacts from the large scale abstraction of groundwater for the next 5 years? Will the project be able to abstract groundwater in the same quantity during project implementation? How does deforestation, land use and climate change interfere in this groundwater abstraction? This was not answered in the EIA report.

One of the example can be referred is abstraction of groundwater in Sabah (Source: www.iczm.sabah.gov.my – Integrated Coastal Zone Management). Basically, Sabah is the second states with the highest utilization of groundwater in Malaysia. Water management in Sandakan was privatized and because of the recommendation from consultants, the groundwater abstraction was increased from 15 MLD up to 30 MLD. Just after a year of operation, problems occurred in the amount of yield. Then, a research was carried out on the groundwater aquifer condition. The study concluded that there was reduction of recharge rate due to land use change and has caused groundwater levels to decline. Due to this, the total abstraction of groundwater was reduced to 25 MLD to stabilize the recharge rate. This proves that groundwater abstraction process without a detailed study will give impact to social, economic and environment properties.

Based on the case in Sabah, how the Sime Darby Berhad can formulate that the groundwater abstraction for 50 to 500 MLD in the Batang Padang District, Perak can be sustainable only with use of water balance equation and Malaysia's average recharge rate data (6%)?

3.3.2 Data Used To Obtain Recharge Rate For This Project

For each groundwater abstraction project, comparison between recharge rates and discharge rates is very important to ensure that the groundwater abstraction does not give impact to natural flow and usage of water in the ecosystem. Failure to do so may lead to problems like land subsidence, sea water intrusion, declining of stream level and loss of habitat.

The EIA study used an average data of recharge rate from Country Water Resources Study (Peninsular Malaysia 2000-2050) which recorded 6%. This EIA report proves that there was no site specific study done to determine the recharge areas as well as its rates for Batang Padang District, Perak.

If a specific value for both recharge and discharge rate is not determined, how a project can be approved as a sustainable groundwater abstraction project. The failure in producing specific recharge rate, discharge rate and its relationship to abstraction rate in this study is a **MAJOR FLAW**.

3.3.3 No Specific Abstraction Location Were Defined

From our observation, this EIA study did not specify the numbers of well and its location. The report has also stated that the stream level will decline, but there is no specific value determined. This study is seen as an attempt to get blanket approval without accurate study.

If the groundwater abstraction is in the confined aquifer, the recharge area is too specific and small in any case. These areas usually will fall in highland areas. After our review on topographic maps of Batang Padang District (via Google map), there are land areas that have high elevation exceeding 1200 meters. This elevation will give high pressure head at the confined aquifer abstraction downhill and water loss will be faster than recharge rate. This will also lead to loss of habitat as such recharge areas may fall in dense forest.

Besides that, impact to water treatment plants that relies on raw surface water supply from Batang Padang District was not analyzed in detail.

4.0 SOLUTION FOR WATER MANAGEMENT IN MALAYSIA

4.1 Introduction

Increase of water demand due to the growing population encourages us to seek the alternative water resources to ensure water supply is sufficient for consumption. Although the proposed groundwater development project in Batang Padang District, Perak can be seen as an alternative, we believe that it should not be implemented based on our findings against the EIA report. The impacts related to groundwater abstraction had been outlined in Part 2 and 3.

However, we still believe there are many ways that we can manage our water demand needs especially in Klang Valley areas.

4.2 Preservation and Conservation of Surface Water Resources

In Malaysia, surface water resources (mainly rivers) are more abundant than groundwater resources. Budgeted amount of surface water resources in Malaysia is 566 km^2 compared to 64 km^2 of the groundwater resources (FAO, 2005). This clearly shows that Malaysia should emphasis to the preservation and conservation of surface water resources. This includes sustainable utilization and conservation responsibility for surface water by all stakeholders.

The water resources preservation includes protection of raw water resources, efficient management of rivers, ensuring water needs of flora and fauna are met and ensuring water catchment areas are gazetted as permanent reserves.

The conservation of water resources will be a good move compared to investment of millions of Ringgits to build new infrastructures such as dam, reservoir, treatment plant and distribution network system. In longer run, this will be more economical. We should also bear in mind that surface water contamination will give direct impact to groundwater. This will eventually make the groundwater not suitable for consumption. What will we turn to after that?

4.3 Reduction Of Non-Revenue Water, (NRW)

Non-Revenue Water (NRW) can be categorised as loss in production for every water supply industry. In Malaysia, NRW value can reach approximately 40% for the whole water supply industry (Malaysia Water Industry Guide 2006). This remains to be the main factor of losses in income for water industry in general. The International Water Association (IWA) has defined NRW to three components as following:

i) Unbilled Authorised Consumption (UAC) - Include water used for fire fighting or free water distributed at standpipes or provided to religious institutions

ii) Apparent Losses - Comprised of unauthorised consumption and metering inaccuracies. This also includes illegal connections, meter inaccuracies and misreading water meters.

iii) Real Losses - Comprises leakage from transmission or distribution mains, leakage and overflow from utility storage and balance tanks and leakage in reticulation systems.

Steps to reduce NRW value need to be continued as NRW means loss in treated water and revenue. Reduction of NRW also means that we can accommodate more water demand without new investment to build additional infrastructures like groundwater development project in Batang Padang District, Perak.

4.4 Water Demand Management

The water demand is exponential with population of a country. There are a few methods that can be used to ensure water demand management to be implemented efficiently such as exposure of important water resources to community, rain water harvesting, reuse and recycle of water.

4.4.1 Exposure On Efficiency In Water Usage and The Importance of Water Resources

Water usage is basically divided into domestic, industrial and agricultural sector which contributes 17%, 21% and 62% respectively (Food and Agriculture Organisation, Population Division of The Department of Economic and Sosial Affairs of the United Nations, World Bank). We acknowledge the importance of domestic water demand management. However, the impact is greater through industrial and agricultural water demand management to substitute to overall increasing water demand.

Management of surface water (mostly rivers) is vital as it contributes to almost 99% of raw water resources for consumption. The protection of these resources is still lacking in Malaysia. The supply and demand trends blends together and increases wastewater in large amount. This is currently being overlooked.

4.4.2 Rainwater Harvesting

Rainwater harvesting is an alternative to substitute water demand to carry out activities such as flushing toilet, watering plants, washing vehicles and other non-potable (non-drinking,

non-eating, and hygiene) purposes. This step can help to reduce the consumption of treated water in the house and industries to carry out such activities.

Many do ask what if its drought, there will be no rainwater harvesting. This also means that there is no recharge of groundwater due to no rainfall. At this point groundwater abstraction has to stop. We know that in average the recharge rate of groundwater is only 6%. However, for rainwater harvesting it's free for all at 100%. We are conducting 5 rainwater harvesting projects which are gravity based design. These units are running efficiently to reduce dependency on treated water for non-potable water usage.

4.4.3 Reuse and Recycle of Wastewater

The domestic wastewater is divided into greywater and darkwater. Greywater means wastewater produced from daily activities and eventually channelled to sewerage treatment or directly to the rivers. These activities are clothes washing, kitchen water usage, bathing, etc. However, this is not including toilet wastewater. The toilet wastewater is known as darkwater and not suitable to be reused or recycled. According to statistics, 50% – 80% of domestic wastewater is greywater. Reusing and recycling greywater can help in efficient water usage which further improves domestic water demand management. Reusing is basically using greywater to wash drains, flush toilet and other suitable non-potable use.

Industrial wastewater is usually contaminated with unwanted residues. To reuse the wastewater, industries must at least carry out a simple treatment. In a case the requirement for water quality is high, recycling of wastewater needs to be incorporated and this requires high investment. There should be incentives given to industries which reduce their ***water footprint*** per unit product or per unit service rendered.

4.5 Responsibility to the Environment

The government, industries and public are responsible towards the environment. The prosperity we are enjoying without sound management is directly impacting the environment. The day we loose it, we loose everything. Developments which fail to consider the safety factors and damages to the environment is the main cause of unsustainability to natural balance of the environment.

Therefore, the roles and responsibilities played by all parties are vital to ensure the conservation and preservation of water resources. **We are borrowing the environment from the future generation**. It is their right to enjoy the environment just as we would like to.

Appendix

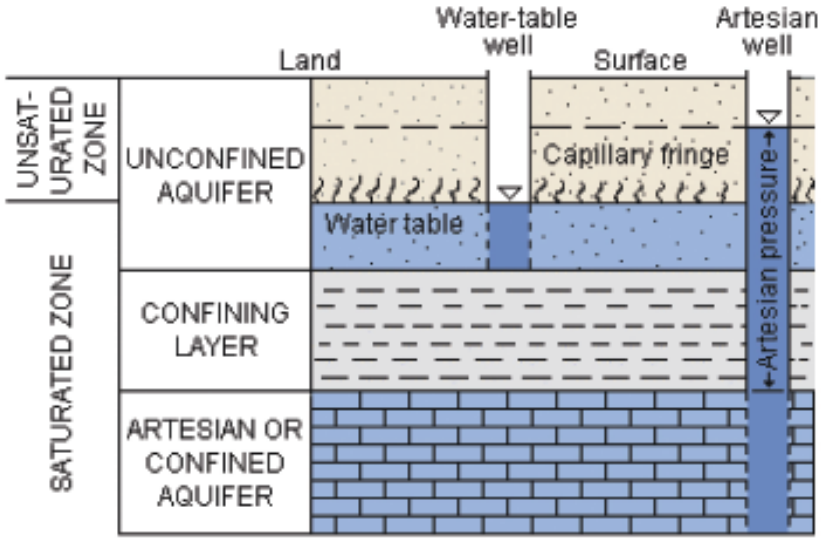
TERMS AND EXPLANATION ON GROUNDWATER

A WHAT IS GROUNDWATER?

Groundwater is water that is found underground in the cracks and spaces in soil, sand and rock. The area where water fills these spaces is called the saturated zone. The top of this zone is called the *water table*. The water table may be only a meter below the ground surface or it may be hundreds of meters down. Groundwater is stored in and moves slowly through the layers of soil, sand and rocks called *aquifer*.

Aquifers typically consist of gravel, sand, sandstone, or fractured rock, like limestone. These materials are permeable because they have large connected spaces that allow water to flow through. Aquifers come in all sizes. There are two types of aquifer; *unconfined aquifers* and *confined aquifers* (Refer to Figure 1).

Figure 1: Confined and Unconfined Aquifer

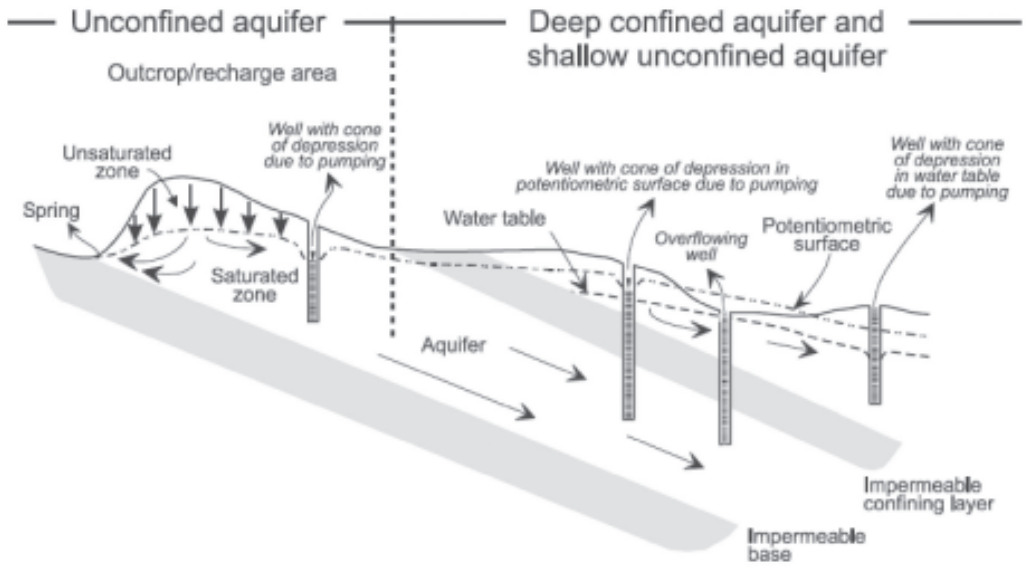


Source: Alberta Environment – Education and Information Centre

Unconfined Aquifers have an upper boundary defined by the water table. This means that the water level can rise or fall as the recharge [e.g. from surface precipitation (rainfall or snow) and infiltration] and discharge [e.g. to lakes and rivers, or other formations] conditions change over time.

Confined Aquifers are those which are bounded above and below by a low permeability confining layer, which tends to keep the water in the aquifer mostly contained. Movement is generally through the aquifer itself as opposed to up and down between layers. They tend to have relatively constant pressure heads, unless they are tapped by a well. Depending on the pressure head within the confined aquifer, the well may be Artesian, meaning it can flow freely toward the surface (or even reaching the surface) without pumping required.

Figure 2: Schematic Cross Section illustrating confined and unconfined aquifer



Source: Prentice Hall, 1979

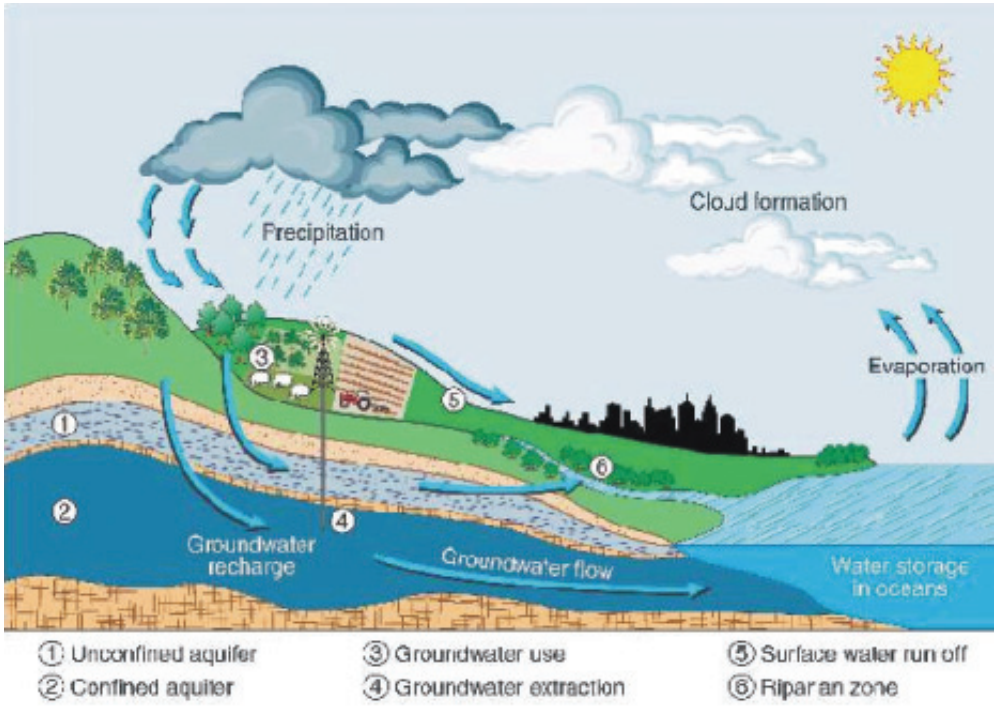
B GROUNDWATER RECHARGE AND DISCHARGE

The Earth's surface can be divided into areas where some of the water falling on the surface seeps into the saturated zone and other areas where water flows out of the saturated zone onto the surface. Area where water enters the saturated zone are called ***recharge areas*** because the saturated zone is recharged with groundwater beneath these areas. In a recharge area, precipitation or runoff infiltrates (absorbs into) the soil to the saturation zone or aquifer.

Area where groundwater reaches the surface likes lakes, streams, swamps and springs are called ***discharge area*** because the water is discharged from the saturated zone. Only a small percentage of rainfall and snowmelt reaches the water table. Most precipitation evaporates from the soil surface, transpires to the atmosphere from plants, or flows over the surface as runoff. On average, about six percent of annual precipitation becomes groundwater. Areas with coarse, gravely soils and shallow fractured bedrock collect the greatest amounts of rainfall becoming groundwater.

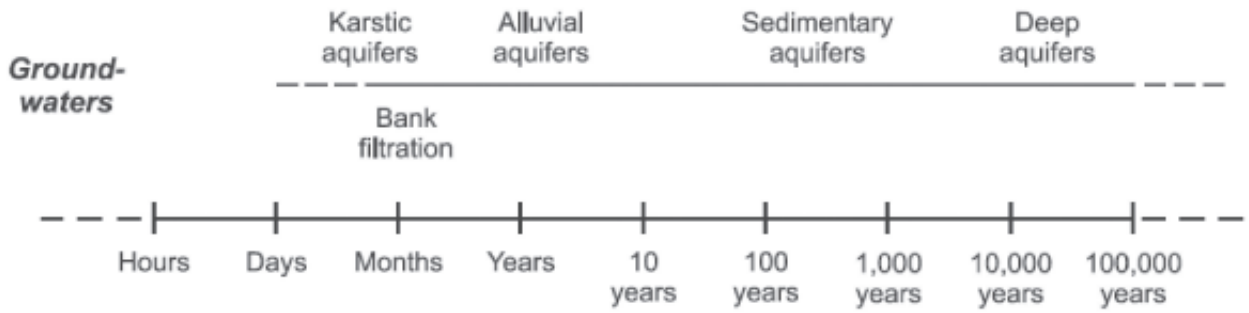
Discharge areas are located where the water table intersects the land surface. Groundwater becomes surface water when it discharges into springs, streams, lakes or wetlands. Often groundwater feeds directly into streams below the waterline and goes unnoticed. The length of time it takes groundwater to naturally reach the surface varies. Water may spend days or weeks underground; sometimes 10,000 years or more.

Figure 3: Groundwater Flow Diagram



Source: The Groundwater Foundation

Figure 4: Water Residence Time For Groundwater



Source: Meybeck et al.,1989

C CHANGES IN THE GROUNDWATER SYSTEM

When groundwater is used at rates which are greater than the rate at which it is replaced by natural processes, it is also known as over-abstraction. The impacts of a over-abstraction can lead to a wide array of social, economical and environmental consequences including :

- Land subsidence and damage to surface infrastructure
- Sea water intrusion
- Groundwater pollution
- Critical changes in patterns of groundwater flow to and from adjacent aquifer systems
- Declines in stream base flows, wetlands, etc. with consequent damage to ecosystem and downstream users.

C.1 Land Subsidence

Land subsidence is a gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials. It occurs when large amounts of ground water have been withdrawn from certain types of rocks, such as fine-grained sediments. The rock compacts because the water is partly responsible for holding the ground up. When the water is withdrawn, the rocks falls in on itself. Land subsidence is a global problem in groundwater.

Land subsidence causes many problems including:

i. Changes in elevation and slope of streams, canals, and drains

ii. Damage to bridges, roads, railroads, electric power lines, storm drains, sanitary sewers, canals, and levees

iii. Damage to private and public buildings

iv. Failure of well casings from forces generated by compaction of fine-grained materials in aquifer systems

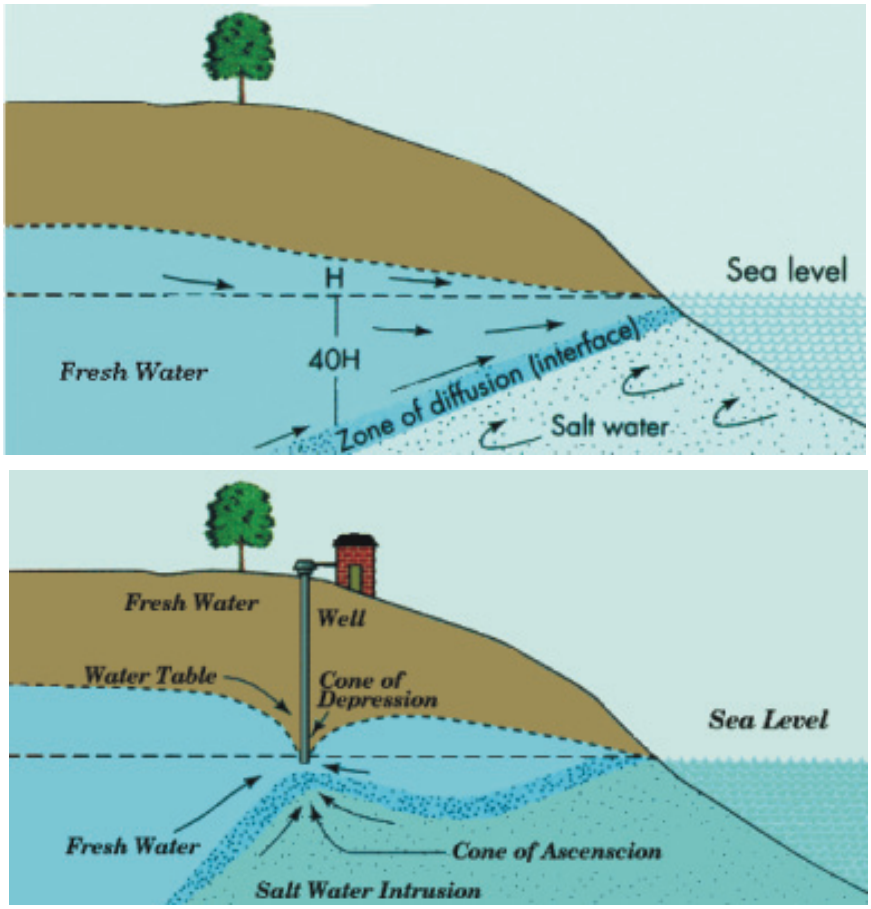
v. In some coastal areas, subsidence may result in tides moving into low-lying areas that were previously above high-tide levels.

C.2 Sea Water Intrusion

Sea water intrusion is the movement of seawater into fresh water aquifers due to natural processes or human activities. Seawater intrusion is caused by decreases in groundwater levels or by rises in seawater levels. When you pump out groundwater rapidly, you lower the height of the freshwater in the aquifer forming a cone of depression. The salt water rises 40 feet for every 1 foot of freshwater depression and forms a cone of ascension. (*Refer to*

figure 5). Intrusion can affect the quality of water that not only at the pumping well sites, but also at other well sites and undeveloped portions of the aquifer.

Figure 5: Sea Water Intrusion

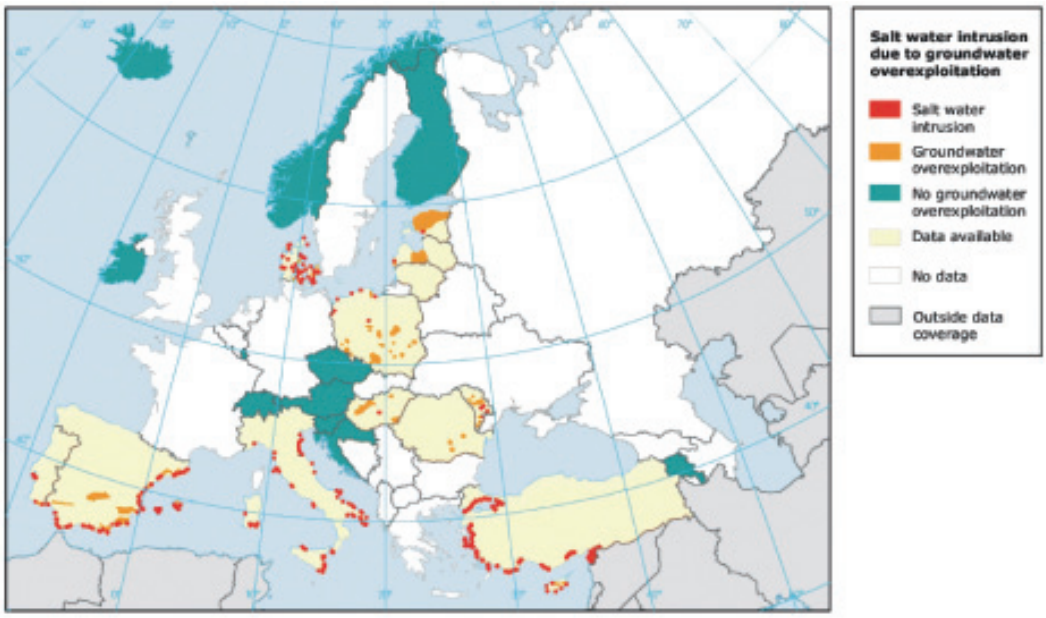


Source: Lenntech

C.3 Reduction of Water in Streams and Lakes

Groundwater contributes to streams in most physiographic and climatic settings. The proportion of stream water that comes from ground water inflow varies according to a region's geography, geology, and climate. Ground-water pumping can alter how water moves between an aquifer and a stream, lake, or wetland by either intercepting groundwater flow that discharges into the surface-water body under natural conditions, or by increasing the rate of water movement from the surface-water body into an aquifer. A related effect of groundwater pumping is the lowering of groundwater levels below the depth that streamside or wetland vegetation needs to survive. The overall effect is a loss of riparian vegetation and wildlife habitat.

Figure 6: Salt Water Intrusion Due To Groundwater Over-exploitation In Europe



Source: EEA, 2003

References

1. www.groundwater.org – (The Groundwater Foundation: What is Groundwater ?)
2. J.Chilton and K.P. Seiler, Groundwater Occurrence and Hydrogeological Environment, pg 6- 10
3. Prof. Stephen A. Nelson, 2003, Groundwater, pg 1-5.
4. U.S Geological Survey Fact Sheet 103, 2003, Groundwater Depletion Across The Nation.
5. D.L Galloway, D.R Jones, S.E Ingebitsen, 2000. Land Subsidence in the United States.
6. S.A. Leake, 2004, Land Subsidence From Groundwater Pumping, U.S. Geological Survey,
7. National Research Council, 1991, Mitigating losses from land subsidence in the United States: Washington, D. C., National Academy Press, pg 58.
8. Geological Survey of Denmark and Greenland, 2008, Groundwater monitoring in Denmark: Copenhagen, pg 1-8.
9. www.iczm.sabah.gov.my (Integrated Coastal Zone Management)
10. Eawag News 65e, 2008, Research Reports: Water Resources and Climate Change, pg 3.
11. www.lenntech.com – (Seawater intrusion in groundwater)
12. Cally Oldershaw, 2002. The Geological Society of London: London, The earth is in your hands: Groundwater
13. D. Ai Song and J. Jianhua, 1994. Hydrological Sciences Journal, Land subsidence, sinkhole collapse and earth fissure occurrence and control in China, pg 245-256.
14. S.Hidayah, 2005. Non-Revenue Water Reduction Control: District Meter Area Method, pg 1-5.
15. E.Kendy, Y.Zhang et.al, 2002. Groundwater recharge from irrigated cropland in the North China Plain: case study of Luancheng County, Hebei Province, Institute of Geographic Sciences and Natural Resources: Beijing, China
16. M.N. Fatimah, I.Hadibah et.al. 1992. Hidrologi Kejuruteraan (Terjemahan), Universiti Teknologi Malaysia:Skudai, Johor, pg 89-115.
17. The Malaysian Water Association, 2008. Malaysia Water Industry Guide 2007
18. Unit Perancang Ekonomi Malaysia, 2000. Kajian Sumber Air Negara (Semenanjung Malaysia) Jilid 4
19. Food and Agriculture Organization Of The United Nations (FAO), 2003. Groundwater Management:The Search For Practical Approaches
20. Population Data (for per capita calculations): Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2002.New York: United Nations
21. Food and Agriculture Organization of the United Nations (FAO): Water Resources, Development and Management Service. 2002
22. www.jmg.gov.my – (Facts About Groundwater)
23. www.purdue.edu – (Groundwater Primer)
24. www.environment-agency.gov.uk – Underground, Under Threat – the state of Groundwater Report, 2006

National Consumer Campaign 2008 - 2012

On 6th of May 2008, the Federation of Malaysian Consumers Association (FOMCA) together with the National Council of Women Organizations (NCWO), the Malaysian Youth Council (MBM) and the Congress of Union Employees in the Public and Civil Services (CUEPACS) signed a Memorandum of Understanding to undertake the National Consumer Campaign, for 4 years, from 2008 to 2012. The campaign is called the 3K Campaign (Kempen Konsumer Kebangsaan). PETRONAS joined the Campaign on 1st January 2009.

The campaign is a response to a deteriorating world economic situation that has brought on a negative impact on the lives of Malaysian consumers.

- Food prices have gone up
- Oil prices are extremely volatile
- We are facing Climate Changes
- Water scarcity is the next looming crises
- We are facing a Financial Crisis

How are Malaysian consumers responding to this situation?

- Some become angry and blame the government, or oil producers, or greedy middle men.
- Others expect the government to continue to increase subsidies, so that they can continue to maintain their old lifestyles.

Yet in truth, these are global factors over which the government has almost no control. Malaysians are used to their relatively comfortable lifestyle. Change is difficult.

Instead of blaming others, the only effective way of to cope with this situation is through lifestyle changes that each individual has to make. We have to assess our life, distinguish between our needs and our wants, and learn new knowledge and skills to address this new situation.

Most important of all, we have to change our mindset to address this new global scenario. To face these challenges, Malaysian consumers have to take greater personal responsibility of their lives.

We have to learn to better manage our spending, plan our finances and often give up old our beliefs and prejudices that are obstacles to making these changes.

In essence, the Malaysian consumer has to move towards more mindful consumption.

The National Consumer Campaign endeavors to empower consumers to make these changes. The theme of the Campaign is “Change Begins With Me”

visit **www.kkk.org.my** and find out more!

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