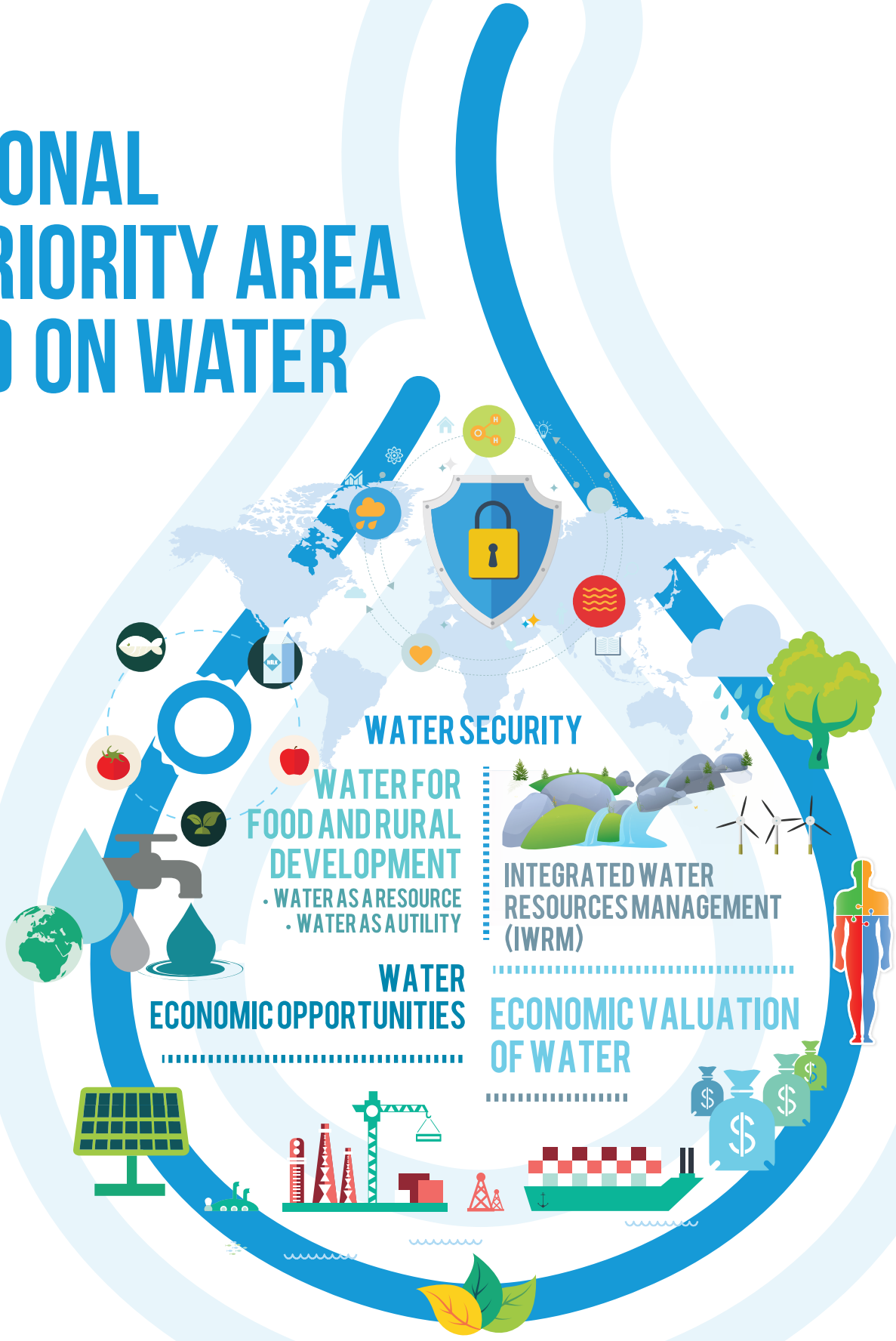
A NATIONAL KEY PRIORITY AREA (NKPA) ON WATER



ASM Advisory Report 1/2015

A NATIONAL KEY PRIORITY AREA (NKPA) ON WATER

2015

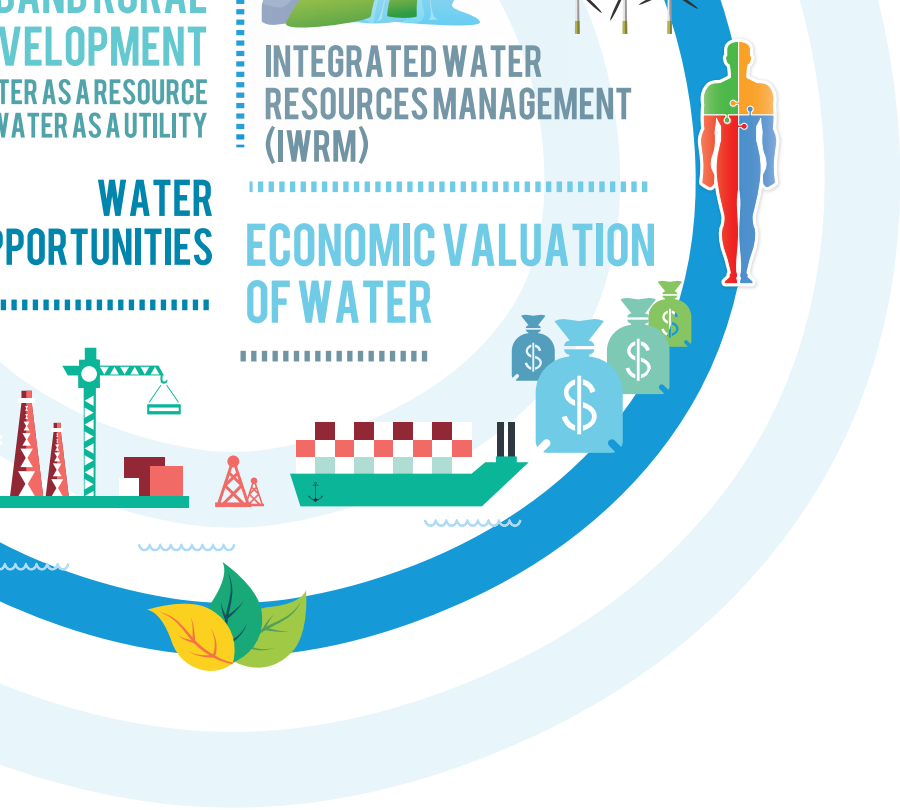
ADVISORY REPORT 1/2015

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

ASM Advisory Report 1/2015 : A NATIONAL KEY PRIORITY AREA (NKPA) ON WATER.
ISBN 978-983-2915-18-8
1. Water resources development--Research--Malaysia.
2. Water quality management--Research--Malaysia.
3. Water-supply--Malaysia. I. Akademi Sains Malaysia.
333.91009595


WATER SECURITY
WATER FOR FOOD AND RURAL DEVELOPMENT
- WATER AS A RESOURCE
- WATER AS A UTILITY
INTEGRATED WATER RESOURCES MANAGEMENT (IWRM)
ECONOMIC VALUATION OF WATER

CONTENTS



FOREWORD

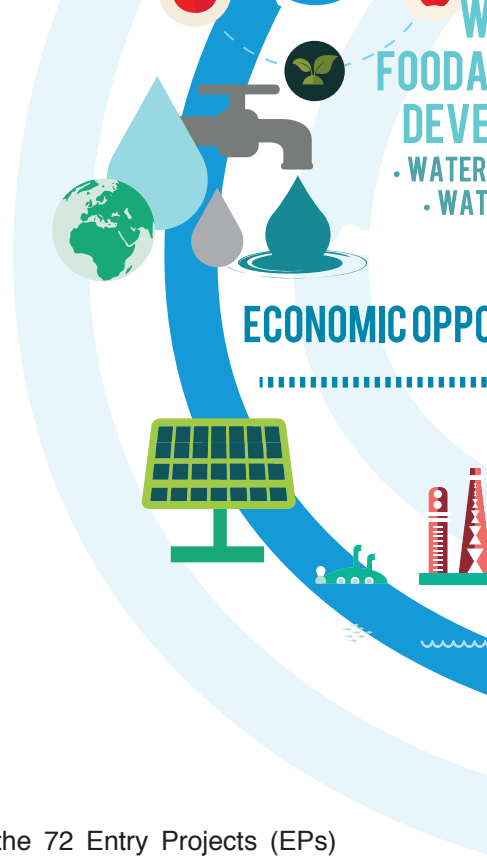
Academy of Sciences Malaysia (ASM) is an independent think-tank providing strategic advice to the Government on matters relating to Science, Technology and Innovation (STI). Since 2008, ASM has been undertaking studies pertaining to the water sector in view of the importance of water as a resource and for livelihood.

Water is undeniably essential for economic development and societal well-being. Water as an important resource for agriculture and energy production has given rise to the Water-Food-Energy Nexus which has gained global recognition. In Malaysia, although water is recognised as an important natural resource, it is often not valued in a commensurate manner. One contributing factor could be the perception that water is readily available due to the country's abundant rainfall. However, given the increase in population, urbanisation, industrial development and occurrence of of extreme climates, there is an urgency to look into the sustainable management line with the internationaly accepted Integrated Water Resources Management (IWRM) approach.

In support of the Government's efforts in providing sufficient water for the people and economic growth, ASM has prepared this Advisory Report for the consideration of the Government. This report advocates that water be considered as a National Key Priority Area (NKPA) to not only duty recognise the role of water but more importantly, enable the uptake of STI intervention for water to significantly contribute to economic growth. A synthesised set of recommendations is also present on how water, if recognised as a NKPA, can lead to the creation of more water sector market opportunities as well as collaborative partnerships to tackle water related challenges through STI, while safeguarding the country's water resources.

I would like to take this opportunity to congratulate the Working Group on Water as a NKPA for their dedicated efforts in producing this Advisory Report. I also wish to thank all stakeholders for their valuable input. I hope the recommendations in this report will be given due consideration towards enhancing Malaysia's water economy and security.

Tan Sri Dr Ahmad Tajuddin Ali FASc
President
Academy of Sciences Malaysia



PREFACE

In 2010, the Economic Transformation Programme (ETP) was launched to propel Malaysia to a high income nation, targeting a gross national income (GNI) per capita of US$15,000 by 2020. In order to achieve this target, twelve National Key Economic Areas (NKEAs) were selected as key prioritisation areas for the nation to promote investment and job opportunities. Water underlies all of the 12 NKEAs to varying degrees and scale. Some of the areas like agriculture rely heavily on the availability of water for growth and yet water was not explicitly recognised as an NKEA.

As 2020 draws closer, it may be too late for 'Water' to be adopted as the thirteenth NKEA. Even so, ASM recognises the need for 'Water' to be prioritised perhaps as a National Key Priority Area (NKPA) to safeguard our water resources while promoting more investment and new jobs for 2020 and beyond.

Participation of representatives from various ministries, agencies and industries was instrumental in developing this Advisory Report. The successful completion of this Advisory Report would not be possible without the participation of these stakeholders in a series of strategic consultations and interviews organised by ASM. I would also like to take this opportunity to thank the Working Group members for their support and commitment.

We are confident that the 72 Entry Projects (EPs) recommended in this report would play a role in contributing to a higher gross national income (GNI), more investment opportunities and creation of new jobs for both public and private sectors in Malaysia, while providing a water secured future.

Dr Low Kwai Sim FASc
Chairperson
Working Groups
A National Key Priority Area for Water

ADVISORY AND WORKING GROUPS

The Academy of Sciences Malaysia (ASM) wishes to acknowledge the contribution of the following towards the Advisory Report on "A National Key Priority Area for Water".

ADVISORS

ASM Science, Technology & Innovation Policy Advisory Committee (STIPAC)

Academician Datuk Fateh Chand FASc
ASM Senior Fellow and Chair of the ASM Water Committee (until July 2015)

Academician Tan Sri Dato' Ir Hj Shahrizaila Abdullah FASc
ASM Senior Fellow and Founding Chair of the ASM Water Committee

WORKING GROUP

Dr. Low Kwai Sim FASc
ASM Fellow and Chair of the Working Group

Datuk Ir Mohd Adnan Mohd Nor FASc
ASM Fellow

Prof. Dr. Jamal Othman
Universiti Kebangsaan Malaysia (UKM)

The Working Group also appreciates the efforts of **Dr Engr Jamie Chong Li Yean** and **Chong Sim Chung**

ASM ANALYSTS AND COMMUNICATION TEAM

Nitia Samuel
Senior Analyst (Science Policy)

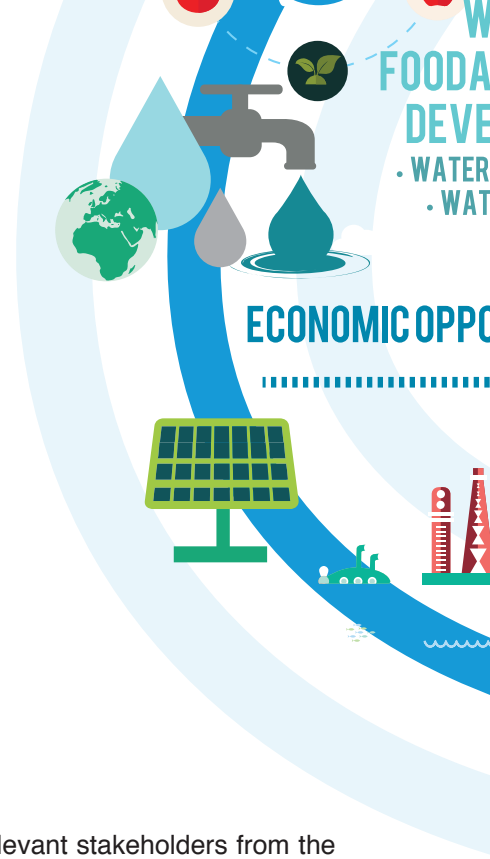
Vinod Gangatharan
Senior Executive (Science Communication & Information)

P. Loganathan
Research Fellow

Loh Chia Hur
Analyst (Science Policy)

Amirul Ikhzan Amin Zaki
Executive (Science Communication – Publications)

Mariatul Kibtiyah Silahudin Jarjis
Executive (Science Communication – Editor)



EXECUTIVE SUMMARY

Academy of Sciences Malaysia (ASM), an independent think-tank providing strategic advice to Government on Science, Technology and Innovation (STI) matters, has since 2008, been undertaking studies pertaining to the water sector considered strategic for the country's economic development. The studies have been overseen by a dedicated ASM Water Committee. Adopting IWRM as the central thrust and noting that Integrated Water Resources Management (IWRM) per se is a rather abstract concept, the Committee has for practical application in the Malaysian context, broken down IWRM into discrete subsets or sub-themes. Each of these subsets or sub-themes is then subjected to in-depth studies culminating in the preparation of a strategy plan or advisory report for consideration and adoption by the relevant authority or agency responsible for their implementation. The studies also undergo a process of strategic consultations with relevant institutional, community and private sector stakeholders.

This Advisory Report is prepared to underpin the Malaysian Water Vision and the Malaysian Water Resources Policy to realise the crucial role of water for life, national security and the economy. Because of the importance of water as a resource and for livelihood supporting all sectors of the economy, the ASM Water Committee while taking into consideration feedback from the Performance Management Delivery Unit (PEMANDU) and other relevant stakeholders from the Ministries felt strongly that there is a compelling need to explore the concept and rationale of incepting water as a National Key Priority Area (NKPA) even though it is too late (short cut-off by 2020) to consider it for a National Key Economic Area (NKEA), as a way forward for a water secure economy in the country.

The main objective in this Advisory Paper is to develop a rationale for the water economy (resource and livelihood functions of water) as a NKPA associated with the critical complementary objectives for:

(a) **Water security in the country:** Water is life and therefore it is necessary to ensure that there is sufficient water for everyone, the economy and the environment. Water has to be regarded as an integral resource along the lines as for forests, fisheries and minerals with great potentials to contribute to man, the economy and societal development. Undeniably, the vagaries of climate in the form of severe droughts and floods have caused tremendous miseries to many people in the country for which water and water security have to be re-examined more strategically and convincingly for the common good within the boundaries of Federal and State legislations, and the related institutional structures in the country.

(b) **Water related economic opportunities:** There is a need to unlock the vast potential investment opportunities through more efficient use of water and promoting scientific, technological and environmental solutions for water management amongst the multi and inter-disciplinary water sector uses in the country, as propounded through the NKPA, with least disruptions to the environment.

So far, water per se is not valued as an important natural resource or its economic value recognised according to the ministerial stakeholders interviewed. There is a perception that water is readily available because the country has abundant rainfall, and therefore the rivers would presumably be able to provide all the water needed for one's livelihood and for resource. Strategic planning is now needed more than ever, not only to dispel such implausible profound thinking, but more importantly, to being prepared and resilient to all hazardous events due to climate change. There is a need for water resources to be managed professionally and holistically for the common good.

This Advisory Report advocates for a new paradigm approach to promote water as a NKPA, to give credence to the role of water and to enable strong scientific and technological contributions from the scientific and industrial community and collectively that they become part of the overall Economic Transformation Programmes (ETPs) to enlarge the water economy for the benefit of the country. For a start, the Advisory Report has provided a list of 15 large water programmes and 72 Entry Projects (EPs) to underline the importance of a water NKPA.

TRANSFORMATION ROADMAP

The objective of the roadmap is geared to emphasise the need for a Water NKPA as a strategic way forward in the new paradigm approach. It recommends a wide range of EPs; committed through appropriate policies and investments for a more water-energy-food secure nation. The 72 EPs are by no means exhaustive, but they represent a slew of diversified products for investments and programmes for the scientific and business community to consider (see **Table 1)**.

The future of water, in terms of quantity and quality is highly uncertain, and some of this uncertainty is due to the vagaries of climatic conditions. However, the most critical factors are the key drivers of the water economy such as population growth, uncontrollable urbanisation and industrial expansion, low investments in water resources projects, indistinct allocation of water for various uses, reforms impasse in water management, as well as nominal scientific and technological innovations, all of which impede an efficient water future.

Water can and should be developed to get more from each drop. Water underpins food and energy security, and environmental sustainability. It is integrally linked to the health and survival of ecosystems, which helps to regulate the quantity and quality of water. A sustainable water scenario will dramatically increase the amount of water that can be allocated for environmental uses, connect all households to quality piped water, achieve lower per capita domestic water consumption, and sustain food and energy production, thereby achieving greater social equity and environmental protection.

The roadmap is divided into 15 water sector programmes, each with their EP Projects. Column 4 of **Table 1** indicates the timeframe to show that some EPs can be taken up immediately (one to three years) if the water agenda of having a NKPA is adopted, while others may take longer; midterm (five to nine years) and long-term (10 years) by the public and private sectors.

THE WAY FORWARD

There is no alternative to water resources unlike energy, which has alternative sources of energy. Presently, the country relies almost entirely on surface water (97%), and this situation is obviously untenable in the long run for water security reasons. At least five states are already facing water deficits that will require development of groundwater, but this source of water has yet to be developed although we have approximately 5,000 Billion Cubic Metre (BCM) of groundwater compared to 973 BCM of annual rainfall in the country.

The following are some recommendations to move forward:

- **Place water as a national water agenda:**

A NKPA will definitively place water on the national water agenda, imperative for economic growth and development in the country. We have already experienced both flood and drought conditions that had affected food prices, caused energy disruptions, trade constraints, undermine the work of authorities and even create a lot of temporary water refugees at the schools and community halls – straining the resources of hospitals to cope with waterborne diseases. From a local flooding problem, it has escalated into a national issue and has became a major challenge in the country as shown in the December 2014 floods. Water shortage also causes a lot of hardships to a great deal of people, and has negative impacts on the tourism industry; tainting the good image of the country, as experienced in the April 2014 drought. Thus, from the perspective of a sustainable water future, we need to have a national water agenda to determine all aspects of water management for the country.

- **Promote Scientific and Research Agenda on Water:**

In ASM's Mega Science 1.0 Study, 10 recommendations were put forward for wealth creation, which can easily be taken further through the 72 EPs proposed in the table below. The Mega Science 2.0 Study on the Environment Sector also advocated a new thinking on water management. A separate and detailed Advisory Report entitled "Setting a National Agenda for Integrated Water Research" has also been produced by ASM to emphasise the development of a water Research & Development (R&D) framework. However, what is more important is to ensure that our water security and water sufficiency is intact for all uses. In line with the above strategic thinking, there is also a need to achieve improvements in the ecological health of rivers, lakes, floodplains, wetlands and estuaries so that the many water sources and services they provide are maintained for the present and future use. It is increasingly difficult to argue for "a business as usual" scenario when the stakes are so high, and yet the responses to the water management issues around resource scarcity and the environment are so low, and hardly equal to the size of the problem.

- **Develop Water Benefits:**

The industrial sectors will have to move beyond public relation benefits to give water sustainability a seat at the table. They are realising that the interrelated problems of food, energy and water threaten their own industrial sustainability and production, and there is a business opportunity in increasing efficiency and reducing wastes. The National Water Resources Policy 2012 is a tipping point in amplifying the need for actions to a whole new generation of water resources development programmes for securing water resources or short, medium and long-term horizons. There are policy directions for four core areas, namely, water resource security; water resource sustainability; partnerships; and capacity building and awareness; with a total of nine thrust areas and 69 strategic action plans, to move the water agenda forward for a secured future.

- **Water-Food-Energy Nexus:**

Towards the end, we have to connect with the Water-Food-Energy nexus. At present, the food production does not commensurate with population growth (we have to import more than we produce) and the cost of food production is getting more expensive. Water, when not supplied at the right place and time needed for agricultural and energy production will only increase the cost of production and hardships faced by the people. In addition, the cost of energy production, which drives the economy, is also escalating at the expense of the consumers.This means that we have to strike a balance between the three legs of the nexus tripod. Water will be needed as a NKPA for the future survival of the country.

Table 1. Summary of Entry Projects (EPs) for a Water NKPA

Item	Water Sectors	Entry Projects	Uptake
	Water As a Resource		
1	Flood/ Drought Mitigations	• Develop and improve flood forecasting centre and technology;	• Immediate
		• Structural and non-structural flood mitigation works;	• Immediate
		• Develop flood sensitive designs/ solutions for commercialisation;	• Immediate to midterm
		• Improve flood relief, response and recovery mechanism/ institutions;	• Immediate
		• Develop drought infrastructure and alternative water sources; and	• Mid- to long-term
		• Develop catastrophe insurance industry.	• Immediate
2	Integrated Water Resources Management (IWRM)	• Set up IWRM Training Centers;	• Immediate
		• Setup RBOs for all major river basins;	• Immediate
		• Watershed management/ restoration programmes;	• Immediate to midterm
		• Develop Integrated Lake Basin Management (ILBM) and Integrated River Basin Management (IRBM); and	• Immediate
		• Develop transboundary water resources management.	• Midterm
3	Water Research and Innovation Cluster	• Set up a dedicated Water Research Centre;	• Immediate
		• Establish a Water Data Centre;	• Immediate
		• Developed Water Innovation and Industry Clusters; and	• Immediate to Midterm
		• Develop Centres of Water Excellence in Local Academia.	• Immediate
4	Ecosystem Services	• PES framework and mechanism for Malaysia;	• Immediate
		• Watershed rehabilitation and management of river basins and resources;	• Immediate
		• Lake brief and management plans for Malaysian lakes;	• Immediate
		• Wetland restoration and management; and	• Midterm
		• Mangrove replanting and coastal protection.	• Midterm

Item	Water Sectors	Entry Projects	Uptake
5	Climatic Change Adaptation	• Establish a Regional Water Hub for Climatic Change Adaptation; • Weather and climatic change forecasting and modelling; • Climatic change adaptation; and • Carbon sequestration/ financing.	• Immediate • Immediate • Midterm • Midterm
6	Water Pollution Monitoring and Rehabilitation	• River Basin Pollution Management Programme; • Superfund for clean-up of polluted rivers in Malaysia; • Modernising water quality monitoring network; • Develop water quality modelling tools and infrastructure; • Community river management programmes; and • Pollution control at the source.	• Immediate • Immediate • Immediate • Midterm • Midterm
7	Integrated Coastal Zone Management (ICZM)	• ICZM/ Integrated Shoreline Management Plan (ISMP) Network for all Malaysian states; • Coastal Erosion Monitoring and Rehabilitation Programme; • Estuarine and Marine Fishery Management; • Offshore Sand Mining, Reclamation and Dredging Industry; • Coral Triangle Initiative (STI); and • Transboundary Pollution Monitoring.	• Mid- to long-term • Midterm • Immediate • Immediate • Mid-to long-term • Midterm
8	Meetings, Incentives, Conference and Exhibition (MICE)	• Develop Malaysia as a Water Hub; • Develop Malaysia as MICE for water sector/ industry; and • Host global/ regional/ national water events.	• Immediate • Immediate • Midterm
9	Water-based Recreation and Tourism	• Water tourism products; • Conservation of high-value tourism areas; and • Hosting of water-related events, competitions and festivals.	• Midterm • Immediate • Immediate to Midterm

Item	Water Sectors	Entry Projects	Uptake
10	Waterfront and Water-sensitive City	• Develop integrated urban water resource management;	• Immediate
		• Improve stormwater management;	• Immediate
		• Rainwater harvesting;	• Immediate to midterm
		• Water efficient design/ buildings; and	• Midterm
		• River of Life.	• Immediate to midterm
	Water as a Utility		
1	Water Supply Sector	• Privatisation/ corporatisation of water supply sector;	• Mid-to long-term
		• Smart water network monitoring systems for non-revenue water reduction;	• Immediate to midterm
		• Improve urban and rural water supply infrastructure;	• Immediate
		• Develop water demand management initiatives;	• Immediate to midterm
		• Inter-basin water transfer schemes; and	• Mid- to long-term
		• Commercialisation of technology and expertise.	• Mid to long-term

Item	Water Sectors	Entry Projects	Uptake
2	Water, Wastewater and Energy Sector	• Expand sewerage infrastructure and regionalisation of sewerage networks;	• Mid- to long-term
		• Waste to wealth – bio-effluent, bio-solids and bio-gas industry;	• Mid- to long-term
		• Potable and non-potable wastewater recycling;	• Mid- to long-term
		• Tertiary treatment for sewage to reduce eutrophication in public waters;	• Mid- to long-term
		• Develop industrial wastewater treatment systems;	• Mid- to long-term
		• Zero-discharge and zero-energy for wastewater facilities;	• Mid- to long-term
		• Hydropower development; and	• Mid- to long-term
		• Improving efficiency of water use in thermal power plants.	• Mid- to long-term
3	Groundwater Development	• Groundwater mapping and abstraction;	• Immediate
		• Groundwater metering and licensing;	• Mid- to long-term
		• Groundwater recharge technology; and	• Long-term
		• Groundwater infrastructure and service sector development.	• Immediate to midterm
4	Agricultural Water Management	• Water metering for irrigation areas;	• Immediate to midterm
		• Improve productivity of agriculture water;	• Immediate
		• Reuse of wastewater for irrigation;	• Immediate
		• Recycling systems for aquaculture industry;	• Immediate
		• Livestock waste treatment systems; and	• Midterm
		• Urban farming.	• Midterm

Item	Water Sectors	Entry Projects	Uptake
5	Commercial water to Shipping	• Water supply for shipping;	• Immediate
		• Navigational channel and port dredging;	• Immediate
		• Ballast water monitoring, management and treatment systems; and	• Immediate
		• Urban water transport.	• Immediate

LIST OF ANNEXES

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ASM	—	Academy of Sciences Malaysia
BCM	—	Billion Cubic Metres
BO	—	Business Opportunities
CTI	—	Coral Triangle Initiative
DID	—	Department of Irrigation and Drainage
EEZ	—	Exclusive Economic Zone
EGS	—	Environmental Goods and Services
E&E	—	Electronics and Electrical
EP	—	Entry Project
EPP	—	Entry Point Project
ETP	—	Economic Transformation Programme
GCM	—	Global Circulation Models
GDP	—	Gross Domestic Product
GIS	—	Geographic Information System
GNI	—	Gross National Income
GTP	—	Government Transformation Programme
HTC	—	Humid Tropic Centre
ILBM	—	Integrated Lake Basin Management
ICZM	—	Integrated Coastal Zone Management
ISMP	—	Integrated Shoreline Management Plan
IRBM	—	Integrated River Basin Management
IUWM	—	Integrated Urban Water Management
IWK	—	Indah Water Konsortium Sdn Bhd
IWRM	—	Integrated Water Resources Management
KeTTHA	—	Ministry of Energy, Green Technology a nd Water (Kementerian Tenaga, Teknologi Hijau Dan Air)

KPKT	—	Ministry of Urban Well-being, Housing and Local Government (Kementerian Kesejahteraan Bandar, Perumahan dan Kerajaan Tempatan)
LUAS	—	Lembaga Urus Air Selangor
MADA	—	Muda Agricultural Development Authority
MBJB	—	Majlis Bandaraya Johor Bahru
MICE	—	Meetings, Incentives, Conference and Exhibition
MKRA	—	Ministerial Key Result Area
MPIC	—	Ministry of Plantation Industries and Commodities
MSMA	—	Manual Saliran Mesra Alam
NEAC	—	National Economic Action Council
NAHRIM	—	National Hydraulic Research Institute of Malaysia
NERI	—	National Environmental Research Institute
NEWRI	—	Nanyang Environment and Water Research Institute
NKEA	—	National Key Economic Area
NKPA	—	National Key Priority Area
NKRA	—	National Key Result Area
NRE	—	Ministry of Natural Resources and Environment
NRF	—	National Research Foundation
NRW	—	Non-Revenue Water
NTU	—	Nanyang Technology University
NUS	—	National University of Singapore
NWRC	—	National Water Resources Council
NWRP	—	National Water Resources Policy
O&G	—	Oil and Gas
PBAPP	—	Perbadanan Bekalan Air Pulau Pinang Sdn Bhd
PE	—	Population Equivalent
PEMANDU	—	Performance Management Delivery Unit
PES	—	Payment for Ecosystem Services
R&D	—	Research and Development
RBO	—	River Basin Organisations
ROL	—	River of Life
SAJ	—	Syarikat Air Johor
SCADA	—	Supervisory Control and Data Acquisition
SCORE	—	Sarawak Corridor of Renewable Energy
SMART	—	Stormwater Management and Road Tunnel
SME	—	Small and Medium Enterprise
SRI	—	Strategic Reform Initiative
STI	—	Science, Technology and Innovation
SWRC	—	State Water Resources Council
SYABAS	—	Syarikat Bekalan Air Selangor
TMDL	—	Total Maximum Daily Load
WEHAB	—	Water, Energy, Health, Agriculture and Biodiversity
WSIA	—	Water Services and Industry Act
WWF	—	World Wide Fund for Nature Malaysia

A NATIONAL KEY PRIORITY AREA (NKPA) ON WATER

PREAMBLE

Malaysia has been committed towards the implementation of Integrated Water Resources Management (IWRM) for the sustainable management of the country's water resources since the late 1990s. The National Water Resources Policy formally launched in March 2012 further reaffirms the adoption of IWRM, which calls for the balanced development and management of "water as a resource" and "water for livelihood". Implementation of the IWRM agenda involves the integration of both natural and human systems set within an overall framework that provides the enabling environment with effective institutional arrangements and supported by necessary management instruments. Implementation of IWRM across all sub-sectors and levels of hierarchy are guided by the internationally endorsed 1992 International Conference on Water and the Environment (ICWE) Dublin Principles*.

Academy of Sciences Malaysia (ASM), an independent think-tank providing strategic advice to Government on STI matters, has since 2008, been undertaking studies pertaining to the water sector considered strategic for the country's economic development. The studies have been overseen by a dedicated ASM Water Committee. Adopting IWRM as the central thrust and noting that IWRM per se is a rather abstract concept, the Committee has for practical application in the Malaysian context, broken down IWRM into discrete subsets or sub-themes. Each of these subsets or sub-themes is then subjected to in-depth studies culminating in the preparation of a Strategy Plan or Advisory Report for consideration and adoption by the relevant authority or agency responsible for their implementation. The studies also undergo a process of strategic consultations with relevant institutional, community and private sector stakeholders.

***The Dublin Principles on Water (ICWE 1992)**

Principle No. 1 – Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.

Principle No. 2 – Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.

Principle No. 3 – Women play a central part in the provision, management and safeguarding of water.

Principle No. 4 – Water has an economic value in all its competing uses and should be recognised as an economic good.

1.0 INTRODUCTION

This report was originally prepared as a Concept Paper for a case to incept water as a **National Key Economic Area (NKEA)** amongst the existing 12 NKEAs in the country. It was initiated by the Academy of Sciences in Malaysia (ASM) as early as March 2014, to provide the key rationale for this initiative as part of the Water, Energy, Health, Agriculture and Biodiversity (WEHAB) Programme. A series of meetings with relevant stakeholders have been held, culminating in two stakeholders workshops held on 3 April 2014 and 26 June 2014.

In the course of discussions with the relevant stakeholders in the Ministries, Performance Management Delivery Unit (PEMANDU) and amongst the ASM Committees on the subject, it was found that it might by now be too late to put water as an NKEA, the reason being the short cut-off entry points for all NKEAs by 2020 (less than 6 more years left). Nevertheless, according to PEMANDU, water is and should already be within most of the other 12 NKEAs although not explicitly stated, and therefore not necessary to have a separate water NKEA.

Because of the importance of water to livelihood and to all sectors of the economy, the 20th ASM Water Committee Meeting on 13th October 2014 felt that there is still a need to explore the concept and rationale of incepting of water, not as a NKEA, but as a **National Key Priority Area (NKPA)** because of its importance, as a way forward in the country. Underpinning this NKPA initiative is the vision to realise the crucial role of water for life, economy and our national security under the context of Water-Food-Energy nexus. Thus this Advisory Report will do the same, to examine the context and types of potential areas that could form the NKPA if it were to be **incepted** in the future.

Water is a renewable and finite resource. All our social systems and economic activities have placed a heavy demand on water. There are already indications that the renewable capacity of surface freshwater lags far behind its current rate of utilisation and the saying goes that tomorrow's water is being used to meet today's needs. Hence, in 1992 at the International Conference on Water and the Environment in Dublin, and later in the same year, at the Earth Summit in Rio de Janeiro, all Heads of States affirmed the economic value of water in all its competing uses and water was recognised for its economic good. Since then, there was a strong water agenda covering all sectors of the social and political economy worldwide.

The concept of Integrated Water Resources Management (IWRM) as stated in the Preamble was established as an integral guiding principle for water conservation and development, by the Ministerial Declaration at the Hague in March 2000 as part of the **economic good of water**. The IWRM approach has now been accepted internationally and nationally (including Malaysia) as the way forward for efficient, equitable and sustainable development and management of the world's finite resources and for coping with conflicting water demands (United Nations International Decade for Action "Water for Life" 2005 – 2015).

Based on the above global scenario, Malaysia has reviewed the water agenda, taking the Waters Act 1920 as a base, to reflect on commitments to meet the nation's future water needs sustainably. The Waters Act 1920 is an archaic legislation that would need complete overhauling, indeed especially if Malaysia were to adopt the IWRM concept as a key approach for water resource management and to initiate and implement water reforms in water governance to professionally and effectively manage water.

The formation of the National Water Resources Council (NWRC) as an apex advisory and coordinating body for water resources in the country in 1998 is a milestone in water governance in the country. However, its full mandate to function effectively was and still is found wanting. By itself, it could not underline the full importance of the water sector, especially in sustainable water resource management. The major challenge faced by NWRC is the constitutional bond of Federal versus State jurisdiction. This gives rise to the fact that water is under the purview of the respective state governments, which control water resources but water utilities are under the concurrent list in the Federal Constitution, arising from the Water Services and Industry Act 2006 (WSIA). The WSIA 2006 is often impugned on for splitting the water sector into two; water resources and water for utilities, which subsequently placed water supply and services under the shared auspices of both the Federal and State governments. This is the present position of water management in the country, which poses a huge challenge to IWRM.

The "*Review of the National Water Resources Study 2000 – 2050*", recommended that each state establish a State Water Resources Council (SWRC) that is aligned to the NWRS to manage its water resources, which is under the state list. To date, some states have done so, such as Lembaga Urus Air Selangor (LUAS), Lembaga Urus Air Kedah (LUAN), Sarawak Water Resources Council and Sabah Water Resources Council, while Pahang, Perak, Negeri Sembilan and Johor have their own forms and functions in water management under various formats of privatisation and corporatisation (DID, 2012).

So far, in the water resources sector per se, water is still not valued as an important natural economic resource, even with the gazette of the National Water Resources Policy 2012 (NWRP). Water is not considered as a commodity that cuts across all sectors of the economy, which it should. The perception regarding water is that, it is readily available because the country has abundant rainfall and therefore integrated river basin management (IRBM) would presumably be able to take care of all the water requirements for utilities to tap on, and for everyone to use. This thinking has to be debunked because it is now a well-known fact that we are subjected to the vagaries of climatic change, and the long dry spell from January to mid-March 2014 is a testimony that everyone is affected by the climatic systems; and water resources will have to be managed professionally and holistically now for the common good.

An important change approach is to promote water as a NKPA, to give credence to the role of water and to enable strong scientific and technological contributions from the scientific and industrial community to be part of the overall Economic Transformation Programmes (ETPs), to widen the water economy for the benefit of the country.

2.0 OBJECTIVES

The main objective of this report is to develop a rationale for the water sector (resource and utility functions of water) as a NKPA. Associated with this main objective are the critical complementary objectives for:

a) **Water security in the country:** where water is life and therefore it is necessary to ensure that there is sufficient water for everyone, the economy and the environment. Water must be regarded as an integral resource such as forests, fisheries and minerals with great potential to contribute to the economy and societal development.

b) **Water economic opportunities:** unlocking the vast investment potential opportunities of implementing the water NKPA for the country through more efficient use of water and promoting scientific, technological and environmental solutions for water management amongst the multi- and inter-disciplinary sectors in the country.

3.0 THE WATER AGENDA

The Water Agenda embodied in the Malaysian Water Vision and Mission spelt out the need for commitment to develop and manage water in a sustainable and equitable manner. To carry this water agenda forward, the water sector has to be one of the NKEAs or as a separate NKPA to play its full pivotal role as a socio-economic driver for the country; one which the government and the private sector would find it attractive to invest in and to develop.

3.1 The Malaysian Water Vision

The Malaysian Water Vision was a coalescence of many water policy statements formalised in 2000 as follows:

"In support of Wawasan 2020 (towards achieving developed nation status), Malaysia will conserve and manage its water resources to ensure adequate and safe water for all (including the environment)."

The key objectives of the Malaysian Water Vision (details are in **Annex 1**) are as follows:

(a) **Water for people** – all communities will have access to safe, adequate and affordable water supply, hygiene and sanitation;

(b) **Water for food, agriculture and rural development** – provisions of sufficient water to ensure national food security and promote rural development;

(c) **Water for economic development** – provisions for sufficient water to spur and sustain economic growth within the context of a knowledge-based economy and e-commerce;

(d) **Water for the environment** – protection of the water environment to preserve water resources (both surface and groundwater resources) and the natural flow regimes, biodiversity and cultural heritage as well as the mitigation of water related hazards; and

(e) **Water for Energy** – this was added in to reflect the current trends on the water-energy-food nexus, looking at it in terms of both policy and process, as water is inextricably linked to agriculture, food production and where there is an urgent need for continuous improvements in water and energy efficiencies to ensure sustainable economic growth.

3.2 The Malaysian Water Mission

Following from the Malaysian Water Vision, a National Framework for Action for Water Reforms was structured to achieve the key objectives of the Vision, entailing:

(a) Managing water and water resources efficiently and effectively (addressing both quantity and quality aspects) as water demands increase in tandem with population growth and industrialisation;

(b) Moving forward towards IRBM and ILBM taking full cognizance of river and lake basins as geographical units with well-defined boundaries containing the sum of all hydrological processes operating within them, and transcending political and administrative constraints, making them ideal water management units to address water problems;

(c) Translating awareness to political will and capacities to create an enabling environment for the much needed institutional reforms to deal with deterioration of water quality, decrease in water availability and conflicts among users (irrigation, hydropower, industry and domestic users). There is also a need to instil awareness of the economic, social and environmental values of water among politicians, decision makers and all stakeholders; and

(d) Moving towards adequate (safe) and affordable water services (befitting a developed nation status by 2020) through the provisions of adequate infrastructure for water delivery to all sectors of the economy.

Developing water as a NKPA is thus a continuum step towards realising the Water Vision as an integral component of the National Transformation Programmes moving in tandem with the other 12 NKEAs and Water Resources Policy to drive the country towards a high-income status, be competitive globally in the production of goods and services and to ensure water security in the country.

It is also part of the ASM Mega Science 1.0 Study which recommended water for wealth creation for the economy of the country (details of 10 proposals in Mega Science 1.0 in **Annex 2**).

4.0 KEY DRIVERS FOR A WATER NKPA INITIATIVE

The water sector is a fast growing socio-economic sector as population increases in the face of water becoming more variable and scarce. So far, Malaysia, like many countries, still focuses on supply-oriented approaches, drawing from a water system that is already stressed to meet water demands.

Increasingly, this approach is growing untenable, placing massive pressures on water resources that are already facing water quality impairments, affecting both human and ecosystem health. If nothing is done at present, the overall detrimental impacts will be enormous. It will constrain socio-economic development, lower the standard of living of everyone; and exponentially increase the cost of water source protection, water treatment and distribution, and rehabilitation of the environment.

The above scenario will need closer scrutiny on how best to reduce the pressures on water resources from the expected key drivers of the water NKPA Initiative, which are as follows:

(a) **Population growth and urbanisation**: The dynamics of population growth will mean an ever increasing water demand. Investments in water resources and water infrastructure will have to increase in tandem with higher water consumption demand patterns; and investments will definitively play a major role in the water future.

(b) **Industrial development**: Rapid industrial and manufacturing development will require an increasing supply of water, while development of thermal and hydropower infrastructure will require enormous amounts of water to generate electricity.

All these future development will have to be factored in the short to long-term water agenda.

(c) **Changing food demand and consumption patterns**: Feeding a growing population will raise the tension of stress on agricultural production, a sector which is the main consumer of water. Changes from traditional grain diet to higher protein/ meat due to growing affluence will also add to the water demand in future.

(d) **Climatic change impacts**: Uncertainty in climatic change will require adaptation strategies to improve resilience to overcome issues of water availability and reliability, including issues of increasing risk of sea level rise and natural disasters (intense storms, floods and drought).

All the above will require effective water management with appropriate approaches on conservation, efficiency, re-use and replenishment of natural water sources and systems, where investments in water innovations and technology in water development, efficiency and sustainability, will play a large part. Singapore is an example of a country that has become a leader in water reclamation and recycling; Israel leads the world in irrigation efficiency; and Canada is internationally recognised for its water treatment technology.

The term coined for this water future is the 'Blue Economy' (Henderson & Parker 2012) but related to this, is the current paradigm shift in many countries to move away from dependency on 'blue water' which includes surface and groundwater, towards utilisation of "grey water". Grey water is now treated in many countries with innovative technology rendering it non-polluting to the water sources, rivers and seas. On the industrial front, the key focus is on water footprints of all industrial and manufactured products; a conservation index to account for water savings. Related to this is the water-energy-food nexus, which calls for a multi-faceted approach to improve efficient management of the three critical sectors to maximise the benefits for all end users and for national security reasons.

4.1 Global Investment Water Sector Scenario

Globally, the water industry generates numerous investments in the business of managing water resources, water supply and wastewater treatment for various uses. An indication of the vast potential of water as a NKPA in the economic development of the country include investments in:

(a) **Utilities:** The whole sector of municipal water and wastewater services

(b) **Infrastructure:** Equipment, technology and services to water utilities especially in the development of water treatment and sewerage infrastructure

(c) **Services:** Consultancy, engineering, construction works

(d) **Regulations:** Monitoring and regulation of environmental standards related to water quality and safety

(e) **Technology Development:** Development of technology for treatment of water and wastewater, etc.

(f) **Research and Development (R&D):** Constant R&D on water in research institutions and universities

The global water industry market is estimated to be within the range of USD$360 billion with an annual growth rate of 4 – 5% (refer to **Figure 1**). The private sector market alone is worth USD$229 billion, making it an attractive sector for investment. An example of the breakdown of the sector shows the scale of investments generated worldwide:

(a) The majority of the market share, totalling USD$185 billion, is for municipal services of which the private sector accounts for 20 – 22% (USD40 billion).

(b) 26% – 27% (USD$100 billion) are under consulting, engineering, construction operations and other services.

(c) 21% – 22% (USD$80 billion) are from sale of equipment and technology.

(d) 2% – 3% (USD$9 billion) are for residential treatment equipment.

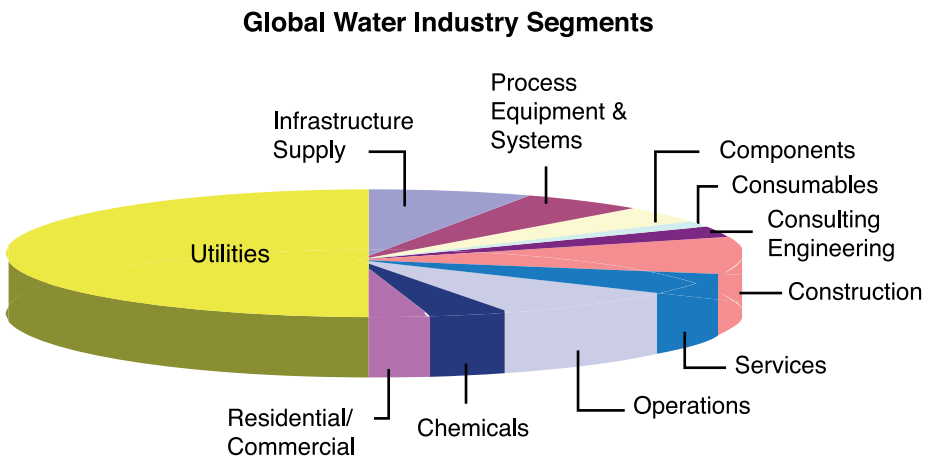


Figure 1. Global Water Industry Segments

Source: http://www.snetglobalwaterindexes.com/market.html n.d.

4.2 The Malaysian Water Sector Scenario

In terms of water business investments in Malaysia, it is far from being nondescript. The Environmental Goods and Services (EGS) sector (water, air and waste management, renewable energy, monitoring, analysis and assessment) for example, accounts for a major sector in the country's economy (refer to **Figure 2**).

An analysis of 11 service and equipment segments under the EGS shows an estimated total revenue of RM 7,060 million in 2009 (1.38% of Malaysia's gross domestic product), employing directly an estimated 29,700 workers in 2,700 private companies alone. This does not include those who are employed in the public sector that regulates and monitor the industry, where water plays an important role. In comparison, neighbouring countries such as Thailand and Indonesia, water (including electricity and gas) forms about 2.8% and 0.75% of their GDP respectively, compared to 3% in Canada and 1.38% in Malaysia.

The largest contributor to revenue and employment falls under environmental infrastructure service companies related to water utilities, wastewater treatment and waste management (76% of total EGS) (refer to **Table 2**). Thus, even within the country, water has already provided vast opportunities for investments in the economy.

Table 2 and **Figure 2** have not registered in the developmental potential of water resources yet, which is another vast area of opportunities in the water industry. There are over 90 large lakes and 189 major river basins in the country that are now requiring management, rehabilitation and restoration with potentials for passive and active development. All these are untapped investment opportunities awaiting public and private participation where the economic and financial rewards will be substantial, including the large multiplier effects and number of jobs that will be created. Thus, the rationale to have a specific water NKPA cannot be underestimated.

Table 2. Malaysian Environmental Market (2009)

Sector	Market Size (RM million)	No. of Companies	No. of Employees
EQUIPMENT			
Water equipment and chemicals	950	200	1,820
Air pollution control	180	80	270
Instruments and monitoring systems	170	60	320
Waste management equipment	300	140	580
SERVICES			
Solid waste management	1,800	1,100	14,400
Hazardous waste management (scheduled waste)	150	100	800
Consulting and engineering	340	290	1,550
Remediation/industrial services	70	80	280
Analytical services	150	60	750
Wastewater treatment (municipal and individual)	1,130	400	4,120
Water utilities	2,560	200	4,820
Core environmental goods and services	7,800	2,710	29,710

Source: Asia-Pacific Economic Cooperation Secretariat 2010

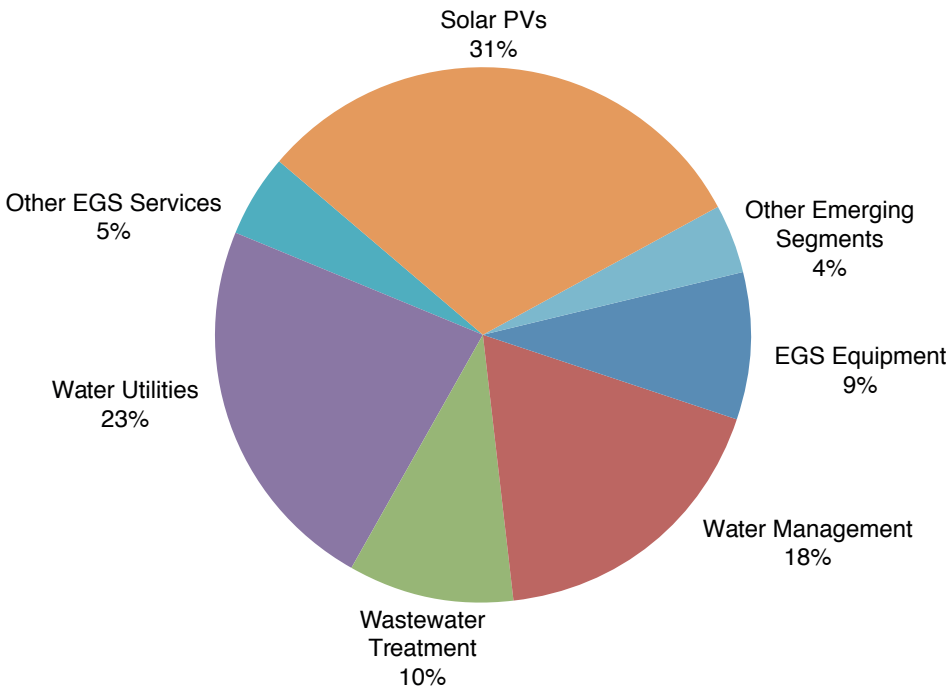


Figure 2. Malaysian Environmental Industry Segments (2009)

Source: Asia-Pacific Economic Cooperation Secretariat 2010

5.0 THE GOVERNMENT TRANSFORMATION PROGRAMME (GTP)

Since it is already too late to incept water as a NKEA, we have to look at water to becoming a potential NKPA, and for this we will have to reflect again on the **intent** of the GTP and the ETP.

The GTP, unveiled on 28 January 2010 by Prime Minister Dato' Sri Mohd Najib Tun Abdul Razak, is a broad-based programme of change to fundamentally transform the Government into an efficient and people-centred institution. The two main objectives of the GTP are:

(a) **Priorities that matter most to the people** – this is where water is a good candidate, as it matters to everyone.

(a) **Delivering fundamental changes on a nationwide basis** – time is ripe for a fundamental change in attitudes towards water conservation and sustainability through the IWRM approaches.

The GTP's structure is intuitive. It identifies areas that need the most attention, and to focus attention on the said areas. Of the seven pressure points, designated as National Key Results Areas (NKRAs) to improve the socio-economic growth of the country, water touches on at least five of the seven pressure points (in bold) by intent:

- Reducing Crime
- Fighting Corruption
- **Assuring Quality Education.**
- **Raising Living Standards of Low Income Households**
- **Improving Rural Development**
- **Improving Urban Public Transport**
- **Addressing Cost of Living**

The GTP also contains a Ministerial Key Result Area (MKRA) component, which addresses developmental goals not covered by the NKRAs, and which water can be considered too.

6.0 THE ECONOMIC TRANSFORMATION PROGRAMME (ETP)

The ETP was launched on 25 September 2010 as part of Malaysia's National Transformation Programme. Its goal is to elevate the country to a developed-nation status **by 2020**, targeting a gross national income (GNI) **per capita of USD15,000.** To achieve this, USD444 billion in investments is targeted, which will **create 3.3 million new jobs.**

The ETP's targets for 2020 will be achieved through the implementation of the 12 NKEAs (refer to **Annex 3**), representing economic sectors which account for significant contributions to GNI and job creation. The ETP is also centred on raising Malaysia's competitiveness through the implementation of six Strategic Reform Initiatives (SRIs), comprising of policies which aim to strengthen the country's **commercial environment** to ensure Malaysian companies are globally competitive.

The ETPs are driven mainly by the NKEAs and SRIs. The 12 NKEAs are as follows:

1. Oil, Gas and Energy	7. Wholesale and Retail
2. Palm Oil and Rubber	8. Education
3. Financial Services	9. Healthcare
4. Tourism	10. Communications Content and Infrastructure
5. Business Services	11. Agriculture
6. Electronics and Electrical	12. Greater Kuala Lumpur/ Klang Valley

As can be seen from the 12 NKEAs, water touches on all of them to varying degree and scale. Each NKEA has Entry Point Projects (EPPs), which explore new growth areas, and business opportunities (BOs), to enable the sector to move further up the value chain. To date, a total of 152 EPPs have been identified of which 149 have been announced from the 12 NKEAs.

As of 31 December 2012, the total investments for the 149 projects announced were RM211.3 billion although the GNI in year 2020 is targeted to be RM135.6 billion and jobs created are 408,443 (Annual Report on ETP, 2012).

Being one of the main contributor to economic developmen, water is assumed to have been omitted from NKEAs by default rather than by intent. The original process of developing the 12 NKEA sectors was based on a definition of 32 broad sectors by a classification of 71 National Account sectors, where **water was categorised under utilities**. Based on the GNI projection up to 2020, assessed on the basis of historical sector growth rates, global projected sector growth rates, and qualitative assessment of Malaysia's competitive advantage relative to sector best practice, **utilities was ranked 16th among the 32 sectors,** in terms of incremental GNI impact. Thus, water was omitted from the 12 key sectors or NKEAs and is only recognised as a key support utility.

However, it must be noted that putting **water under utilities**, limits the full potential and importance of the water sector; which has far wider ramifications in content and context, as it cuts across multiple sectors of the economy (refer to **Section 7** for further details). Even among the 12 NKEAs, the presence of water is widely embedded in all sectors such as the NKEAs for Greater Kuala Lumpur/ Klang Valley (Wastewater treatment plants, gross pollutant traps, sewage network improvements, River of Life), Tourism (ecotourism, resort development, Biodiversity Hub), Agriculture (seaweed farming, integrated aquaculture zones, Business sector (green technology development) and Oil, Gas and Energy (hydropower, renewable energy).

By just factoring in the water sector contributions alone in these existing 12 NKEAs, the true economic and financial value of water in these NKEAs is already significant. Secondly, in terms of water as a stand-alone NKEA, there will be substantial job creation and the GNI will also be high when the focus is on: (a) water as a resource and (b) water as a utility, whereby there are already substantial ongoing investments in the water utility sector. Therefore, rather than focusing on water solely under **utility** (which includes other non-water utilities), a reassessment of water **both as a resource and as a utility**, is necessary and indispensable because of its significance to the nation.

If water cannot be considered for a NKEA, then it should be considered as a NKPA either in the GTP or as a special component in the ETP, or in a separate state economy grouping all together, for all the reasons mentioned above and in **Section 7.**

7.0 ECONOMIC VALUATION OF WATER

Water serves two broad roles in the economy. First, as input in the economic process to derive the economic output (goods and services), which cannot be produced without water. Secondly, water is a natural amenity in terms of ecosystem services and life sustenance (refer to **Figure 3**).

So far, the economic value of water and its importance per se are not reflected accurately in the GDP, which are the reasons for it to be put under the category of utilities in the assessments for NKEAs. For example, in the Malaysian input-output table, water is not explicitly categorised in the economic sector of the economy. Its importance is only implicit under the waterworks sector, which encompasses the monetary value of all types of work activities involving the use and supply of water. Since all sectors in the economy use waterworks as an intermediate input to produce their respective outputs, this sector in turn, will also utilise inputs from other sectors.

This feature is clearly evident in the 2005 input-output table (latest), where waterworks constituted only 0.28% of the total intermediate inputs used by the economy, while its value-add was about 1% of GDP. The value of waterworks consumed by the final consumers was about the same as that of intermediate input. Related to this sector is water transportation (shipping etc.), which accounted some 1.6% of total intermediate inputs and 1% of total value added in 2005. This figure simply means that the financial cost of water provision as an input in the economic process is hidden by other intermediate values. Hence, reliance on such figures will only portray that the contribution of water to GDP is minute, relative to the other sectors.

It is clear that without water, the economy will cease to operate. Even so, not the entire value (cost) of water as an input is captured by GDP or GNI. Consider the huge amount of water, which is being used to produce paddy in our rice bowl areas. If water is supplied at a very low rate (or subsidised), then the cost of water as an

intermediate input (as reflected in our GDP accounts) in the paddy sector will be grossly underestimated and will be perceived to be unimportant, and hence, the perceived low value and unimportance of water.

On the benefits provided by water in terms of ecosystem services and life sustenance, none of these are reflected in the GDP or GNI account. It is similar to the case of agriculture where the external benefits from agriculture such as rural landscape and its role in protecting the vitality of rural resources, culture and heritage are not captured by GDP/GNI. Similarly, the benefits from the ecological functions of forest resource such as storm protection, coastal stabilisation and water catchments are not directly captured by GDP. Whatever expenses incurred in the economy to protect the water resources such as pollution clean-up expenditures by the government due to oil spill or public defensive costs to maintain the resilience of our forest so that it will continue to provide the various ecological functions, including water catchment, goes to GDP through value added activities within the waterworks sector.

In short, the GDP/GNI will not be an appropriate indicator to reflect the real importance and value of water as an input as an environmental resource. Its importance in monetary terms may be reflected through other measures such as ecosystem valuation, productivity change or a production function approach.

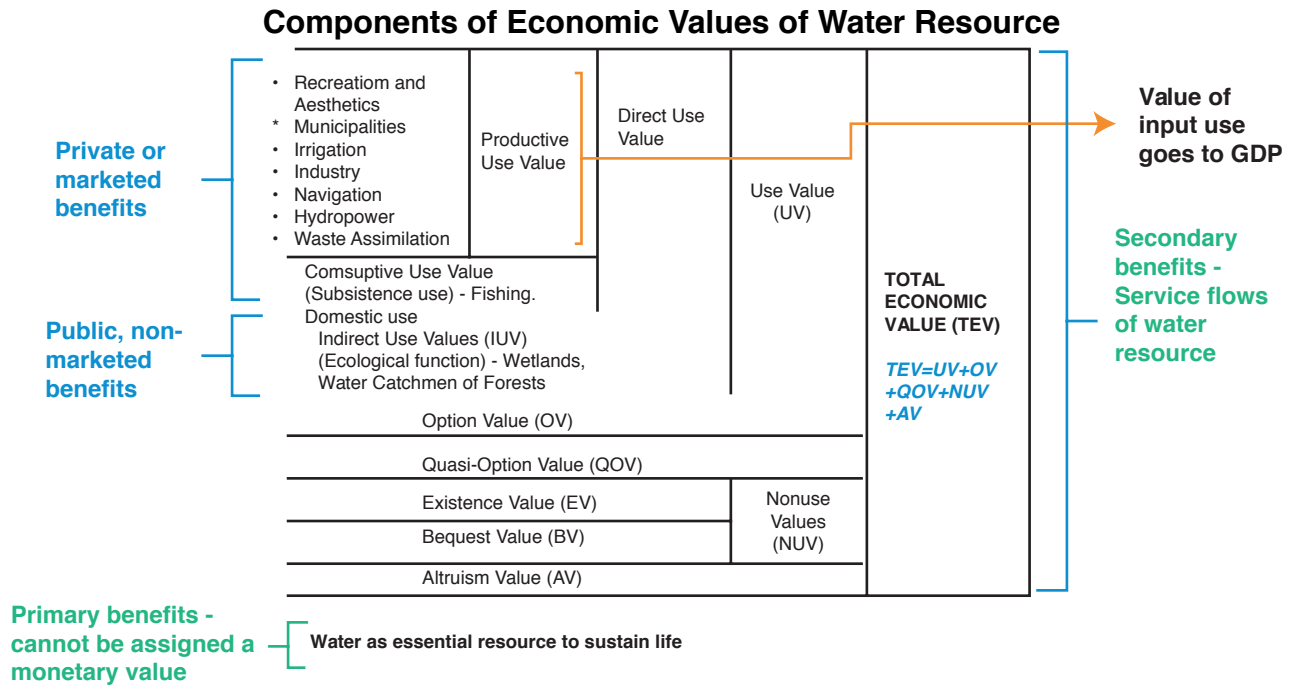


Figure 3. Components of Economic Values of Water Resource

Source: Jamal Othman 2014

8.0 A WATER NKPA

The water industry in Malaysia is big, but is fragmented, and therefore hidden due to traditional categorisation, such as manufacturing, construction, services, etc., whereas in other countries like the United States, the water industry is recognised as a distinct industry by itself, providing significant contributions to the nation's revenue and charts growth rates of 6 – 7% per annum. Other developed countries are already investing intensively in developing new and more efficient technologies and exporting these technologies and services such as Singapore.

In Malaysia, the water services industry alone can be a thriving business sector especially if it includes other water sub-sectors such as water resources, irrigation and drainage, sewerage, flood management, environmental management, groundwater, marine sector, etc. Likewise the push for greater adoption of Green Technology and on climate change adaptations increases the potential areas for investments, particularly to the Blue Ocean industry and services. The contributions of water to the non-marketed benefits are so significant that there should be mechanisms to incorporate the true value of water in the socio-economic chain, e.g. industrial water footprints and Payment for Ecosystem Services (PES).

Water can easily be embedded into the GTP and ETP as a NKPA, as it is undoubtedly an important resource in the country, similar to forests and minerals. It contributes substantially to the national GDP directly and indirectly (as seen in **Section 7**) via its stored resource areas, or through ecosystem services and through its use by the utilities under the water industry sector. It has a strong economic value chain of its own when it is used for water supply, sale of water to neighbouring country, tourism, agriculture, transportation, etc. Thus, water cannot be undervalued and should be an important component of the ETP similar to the other NKEAs such as for oil and gas, agriculture, tourism etc. In fact, a study of the main attributes of the existing 12 NKEAs indicates aspects that a water NKPA can also provide:

(a) Inclusivity of employment for a broad spectrum of the population (e.g. wholesale and retail, business services, tourism, etc.);

(b) Life, living and business comfort and sustainability development (e.g. Greater KL/ Klang Valley, etc.); and

(c) GNI driver (e.g. in all 12 NKEAs).

Three policy principles in the NWRP 2011 will form the core rationale for a water NKPA:

(a) **Water Resource Security:** Water security, similar to food and energy securities in the country, is to ensure that water is readily available to meet all demands of society and the environment. It has an intrinsic as well as a financial cost value that could be much higher than those of other economic sectors.

(b) **Water Resource Sustainability**: Water is a catalyst for national development and for societal and environmental well-being. It should be sustained for present and future uses. This opens up vast opportunities to develop the water industry and to explore the use of alternative water sources through science, technology and investments.

(c) **Collaborative Governance:** Inclusiveness and collaboration are essential elements towards ensuring the security and sustainability of water resources as well as achieving the common goals of addressing multiple resource use, governance and priorities.

The core rationale will be discussed in more detail in **Section 9**, where potential EPs for NKPA have been identified under each water sector to meet the country's targets by 2020 and beyond (not in any order of priority). These EPs are divided into two components (a) EPs for water as a resource; and (b) EPs for water as a utility (refer to **Sections 9** and **10,** respectively).

In preparing and identifying the original EPPs for the Concept Paper for a water NKEA, two Stakeholder strategic consultative workshops were held (3 April 2014 and 26 June 2014) to get feedback from various government agencies as well as separate engagements with key ministries comprising the Ministry of Energy, Green Technology and Water (KeTTHA), Ministry of Natural Resources and Environment (NRE), Ministry of Urban Wellbeing, Housing and Local Government (KPKT), Ministry of Tourism and the Ministry of Plantation Industries and Commodities (MPIC) (details refer to **Annex 4a**).

The findings from the Workshops and engagements with the various Ministerial stakeholders affirmed that the timeframe is too short for a water NKEA, and therefore, this separate report was written as an Advisory Report to incept water as a NKPA (see details from stakeholders in **Annex 4b**).

9.0 ENTRY PROJECTS (EPS) FOR WATER RESOURCES

Altogether there could be as many as 15 large programmes and 72 EPs, with water both as a resource and utility, as shown in the Table 3, with a brief description of each EP.

Some of these were developed during the concept paper for the NKEA and from the recommendations of Mega Science 1.0 and 2.0 Projects to create new wealth opportunities using water such as ecotourism, market and export high quality water; clean water for aquaculture industry, Malaysian brand for domestic water purification unit; downstream water tapping; rainwater harvesting and zero pollutant discharge technologies. Many EPs point to new opportunities for investments, with R&D pushing the Science, Technology and Innovation (STI) frontiers to new levels in the water sectors. These are discussed in **Sections 9** and **10.**

Table 3. Number of Programmes and Entry Projects

Water Resources			Water Utilities		
	Programmes	**Potential EPs**		**Programmes**	**Potential EPs**
1.	Flood/ Drought Mitigation	6	1.	Water Supply Sector	6
2.	Integrated Water Resource Management	5	2.	Water, Wastewater and Energy Sector	7
3.	Water Research and Innovation Clusters	4	3.	Groundwater Development	4
4.	Ecosystem Services	5	4.	Agricultural Water Management	5
5.	Climate Change Adaptation	4	5.	Commercial Water to Shipping	4
6.	Water Pollution Monitoring and Rehabilitation	5		**TOTAL**	**26**
7.	Integrated Coastal Zone Management	6			
8.	Meetings, Conferences and Exhibitions	3			
9.	Water-based Recreation and Tourism	3			
10.	Waterfront and Water-sensitive Cities	5			
	TOTAL	**46**			

9.1 Flood/ Drought Mitigations

Presently, there is heavy investment in structural measures for flood mitigation works including flood protection bunds, deepening river channels, bypass of flood pathways, flood retention ponds and flood retention dams. From 1971 to 2000, and from 2001 to 2005, RM 1.642 billion and RM1.790 billion respectively, were spent on structural flood mitigation measures. For the Ninth Malaysia Plan (2006 – 2010), allocation for structural flood control works escalated to RM3.834 billion and for the Tenth Malaysia Plan, estimates for flood mitigation works was RM17 billion. The Stormwater Management and Road Tunnel (SMART) for example, which was built to divert flood waters to control flooding in Kuala Lumpur, cost a total of RM1, 887 million (DID 2007).

The flipside to flooding is drought, which is worsened by ever increasing water demands from all sectors. The 1997/1998 (El Nino) drought crisis in the Klang Valley and the recent February/March 2014 drought have led to water rationing. Prolonged drought results in extensive environmental, economic and social impacts. This is because Malaysia depends exclusively on surface water sources such as rivers for its water supply while groundwater only accounts for 3% of total supply.

In terms of investments in flood/drought mitigation, structural works alone accounts for large amounts of government spending. While both structural and non-structural measures have been developed, floods and droughts still remain major risk factors in the country. Investments in effective flood/drought forecasting technologies would help in creating an early warning system and facilitate a proper response time to manage such crises.

As floods prevail, the private sector may have a large market to invest in. Improvements in disaster response, especially for flood/drought, is another avenue. Lastly, the insurance sector can potentially look into disaster insurance coverage as a growth sector.

Potential EPs:

- Develop and improve flood forecast centre and technology;
- Structural and non-structural flood mitigation works;
- Develop flood sensitive designs/ solutions for commercialisation;
- Improve flood relief, response and recovery mechanism/ institutions;
- Develop drought infrastructure and alternative water sources; and
- Develop catastrophe insurance industry.

9.2 Integrated Water Resources Management (IWRM)

The adoption of IWRM approach for sustainable management of water resources in Malaysia is well defined in the NWRP and the Malaysian Water Vision. IWRM implementation progress in Malaysia can be seen in the following areas:

(a) Water laws have been streamlined especially on water resources and water services management. The Water Services Industry Act (2006) and National Water Services Commission Act (2006) have been gazetted while states such as Selangor, Kedah, Sabah and Sarawak have created their own state legislations for the said purpose.

(b) River basins as a planning unit have been adopted to complement traditional spatial planning.

To actualise IWRM, sectoral programmes are developed for:

(a) **IWRM Capacity-building:** Training centres to impart IWRM to water managers is required to improve on knowledge and skills.

(b) **River Basin Organisations (RBOs):** Dedicated RBOs need to be set up to administer the various river basins throughout the country. This is to enable systematic management of river basins in line with IRBM practices. Such models should be based on

existing organisations, for instance, those already set up by LUAS for Sungai Selangor and Sungai Langat basins.

(c) **Integrated Lake Basin Management (ILBM):** Lakes have not been well studied until recently through the National Lake Study by National Hydraulic Research Institute of Malaysia (NAHRIM), in association with the ASM, which has identified 90 major lakes within the country. This has led to the setting up of a National Lake Information Database for Malaysia and moving towards a strategic framework for the development and management of the Malaysian lakes.

(d) **River Basin Restoration:** There are 189 big river basins, and some of which are in various degree of degradation, thus requiring integrated river basin or watershed management plans to be developed to restore them.

(e) **Transboundary Waters:** Transboundary waters for Malaysia is not a significant issue as the country does not share any large water systems with neighbouring countries, with the exception of the Sungai Golok (Thailand and Malaysia), Straits of Johor (Singapore and Malaysia), Straits of Malacca (Indonesia and Malaysia) and groundwater aquifers within Borneo (Indonesia and Malaysia). However, these transboundary waters will still need innovative ideas to administer them especially when water is scarce.

Potential EPs:

- Set up IWRM Training Centre;
- Setup RBOs for all major river basins;
- Watershed management/restoration programmes;
- Develop ILBM; and
- Develop transboundary water resources management.

9.3 Water Research and Innovation Cluster

Malaysia has abundant water resources which can enable the country to position itself in the forefront of water and environmental technology and products. NAHRIM, for example, has been at the forefront of R&D in the field of hydraulics with research covering coastal and geohydrology. It is also involved in studying climatic and sea level changes through modelling, rainwater harvesting technology, tsunami modelling and forecast, lake assessment. Besides that, it has also been host to various forums, conferences and technical exchanges. Other research centres such as the Humid Tropic Centre (HTC) under DID and centres of excellence with Malaysian Universities, researching on water-related fields has also been established.

The Malaysian water industry will see further grow if it actively attracts collaboration from international, regional and local water companies to set up private sector investments and research centres within the country. In the spirit of how Penang and Kedah has been at the forefront in the E&E industry, Selangor for industrial development, and Terengganu as the O&G cluster, there should be greater investment to turn Malaysia into an attractive destination hub for water innovation and technology. In turn, these innovation clusters should have access and linkages with water laboratories, research centres and to the Academy, globally.

Singapore, for instance, has invested SGD470 million through the NRF into R&D, in the water sector and aspires to be a 'Global Hydrohub'. Funds are allocated to attract industries, venture capital and investors focusing on cutting-edge technology and research in water technology. The water sector is estimated to contribute a total of SGD1.7 billion by 2015 to Singapore's GDP while creating 11,000 new professional and skill-based jobs. Companies that were attracted include General Electric, Black & Veatch, Marmon Water and Pall Corporation from the United States; Nitto, Denko and Toray Industries from Japan; Siemens from Germany and Veolia and Suez from France. It has also managed to bolster local companies to become regional leaders such as Hyflux (global water and environmental solutions provider), SembCorp Industries (water utility company and waste management company) and Keppel Integrated Engineering (environmental engineering and technology). Academic collaborations with the industry are also well-developed with the formation of the Nanyang Environment and Water

Research Institute (NEWRI) at the Nanyang Technology University (NTU) and the National University of Singapore (NUS)'s National Environmental Research Institute (NERI). Both institutes are actively involved in urban environmental and water R&D in the field of membrane technology, environmental biotechnology, eco-efficient water treatment and smart sensing and engineering technology and to effect commercialisation of technology.

Malaysia should review its own home-grown water industry to determine potential sectors that need to be developed as well as key research areas to pursue. Rather than just be a consumer of "plug and play" technology from other countries, it is high time to develop our own local products and services, which can be exported to other countries instead.

Potential EPs:

- Set up a dedicated Water Research Centre;
- Establish a Water Data Centre;
- Developed Water Innovation and Industry Clusters; and
- Develop Centres of Water Excellence in Local Academia.

9.4 Ecosystem Services

The ecosystem services framework (refer to **Figure 4**) as described in the Millennium Ecosystem Assessment (2005) indicates that assets and services provided by the natural environment can be divided into provisioning, regulating, cultural and supporting services. So far, only services related to provisioning services (water supply and extractive use) typically have market prices while many other ecosystem services provide non-market benefits.

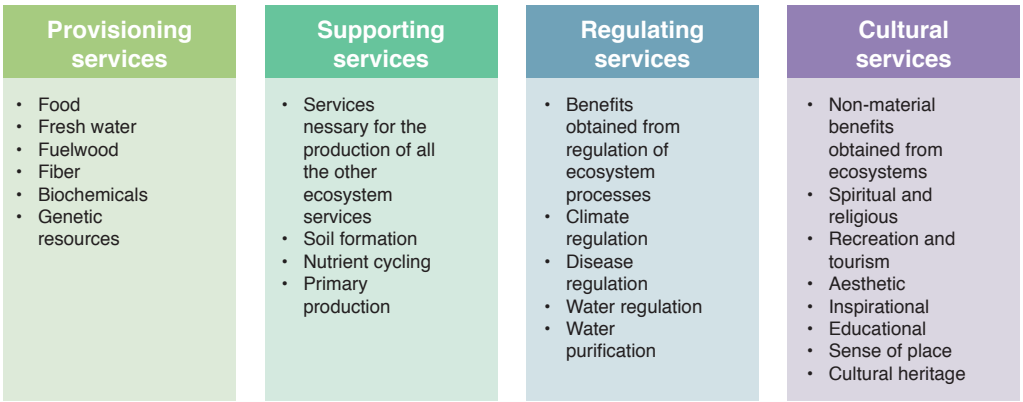


Figure 4. Ecosystem Services

The total value of the world's freshwater ecosystem services (including fish production, groundwater recharge and climate regulation) has been estimated to be worth USD$5 trillion annually. In Asia alone, the economic value of services provided by river and lake ecosystems is about USD$1.75 trillion per year.

One way to monetise the ecosystem is to define them as natural infrastructure (green infrastructure) which is defined as the strategic use of networks of natural lands, working landscapes and open spaces to conserve ecosystem values, functions and provisions of associated benefits to the human population. These natural green infrastructures comprise forests, wetlands, riparian buffers and other natural elements of the landscapes. Through preservation and conservation, it can help generate income or to mitigate against costly infrastructure and rehabilitation needs (World Resources Institute 2013).

Natural green infrastructure investment can also include human built infrastructure that mimics replacements of the natural function of these ecosystems, such as rain gardens, green building

technology, green roof, water sensitive infrastructure and constructed wetlands.

The incidence of water pollution and rapid development in river basins may result in economic losses and reduction in the quality of life in the country. As such, the high ecosystem services value means that investing in maintaining the existing natural infrastructure would contribute significantly to the economy of the country, and it would be less than the cost needed to remediate degraded waterways while reducing the need for extensive water treatment processes (refer to **Table 4**). Failure to recognise the actual economic value of ecosystem services often leads to widespread degradation and loss of ecosystem services.

Table 4. Estimated Costs and Benefits of Restoration Projects for Different Biomes

Biome/ecosystem	Typical cost of restoration (high-cost scenario)	Estimated annual benefits from restoration (avg. cost scenario)	Net present value of benefits over 40 years	Internal rate of return	Benefit/cost ratio
		US$/ha	US$/ha	%	Ratio
Coastal	232,700	73,900	935,400	11%	4.4
Mangroves	2,880	4,290	86,900	40%	26.4
Inland wetlands	33,000	14,200	171,300	12%	5.4
Lake/river	4,000	3,800	69,700	27%	15.5

Note: Adapted from TEEB (2009a)

Source: UNEP 2011

The mechanism for PES is not well-developed in Malaysia, and therefore a framework for PES must be developed. Primarily, the mechanism would involve incentive-based financing whereby custodians for natural infrastructure are compensated to conserve, sustainably manage and/or restore ecosystems to maintain their ecosystem services. Usually, this would entail downstream beneficiaries paying for upstream landowners.

A river basin ecosystem valuation was carried out by the WWF on the contribution of Ulu Muda Forest Reserve to water supply to the states of Kedah and Pulau Pinang. In 2005, the Muda catchment contributed RM157 million to Kedah and RM139 million to Penang, in terms of annual potable water supply. However the annual profits to water supply companies does not take into account the ecosystems value, which extends beyond RM296 million. In terms of other uses of water such as irrigation input for farming, the calculated income benefit of the MADA irrigation scheme was estimated to be worth RM776 million in 2006 (WWF 2009). Overall, the total benefits that can be derived from water and ecosystem services are tremendous.

Infrastructure plays a critical role in water storage and treatment, but natural infrastructure investments can also reduce or avoid costs and enhance water services and security, complementing the necessary built infrastructure as part of an integrated system to deliver cost-effective and safe drinking water to the public (WRI 2013).

Potential EPs:

- PES framework and mechanism for Malaysia;
- Watershed rehabilitation and management;
- Lake brief and management plans for Malaysian lakes;
- Wetland restoration and management; and
- Mangrove replanting and coastal protection.

9.5 Climatic Change Adaptation

Climatic change scenarios based on 15 GCMs have indicated changes towards precipitation, evaporation, soil moisture and run-off rates. Weather changes will lead to greater water variability; scarcity in some areas and higher precipitation rates in others. Impacts will be felt by major water resource systems and sectors including urban infrastructure (water supply and sanitation, urban drainage), water-related natural disasters (flood, droughts, landslides), rural development (agriculture, food security, livelihood), energy, transportation, health and the environment.

Due to the uncertainties brought about by climatic changes, which will increase the country's vulnerability and risk to water security, understanding the impacts of climatic change is essential to ensure adaptation measures can be implemented to buffer the mid and long-term impacts. Climatic change forecasting and modelling will be an important sector to consider in the immediate future to prepare for climatic change adaptations. A more accurate climatic change model for the country would allow assessment of the current water resources status, calculation of risks to ensure policy and decision-makers can carry out short and long-term planning.

It is inevitable that climate change adaptations to reduce the nation's vulnerability towards potential impacts would involve greater investments in the economy. This, in turn, would give rise to a whole new investment sector, which the government and private sector can be involved, essentially turning climatic change into an economic opportunity for innovative design and services.

Potential EPs:

- Establish a Regional Water Hub for Climatic Change Adaptation;
- Weather and climatic change forecasting and modelling;
- Climatic change adaptation mechanisms for business; and
- Carbon sequestration/ financing.

9.6 Water Pollution Monitoring and Rehabilitation

Water pollution generated from urban, industrial, energy generation and agriculture results in severe water degradation. One major area of impact is polluted waterways, which supply nearly all of Malaysia's raw water for water supply, resulting in increased treatment costs and also water supply disruptions at times. The cost of rehabilitating polluted water is significant while ecosystem degradation also results in a loss of ecosystem services.

Existing pollution control laws in Malaysia mandate treatment of wastewater from industries, sewage treatment plants and landfills to ensure pollution is managed. This requirement is a driver for investments in effluent and wastewater treatment systems to effectively to meet the necessary standards. This market would further expand as tighter environmental regulations are introduced especially in the oil palm and rubber production sector to improve discharge of their waste products, and also for SMEs to improve wastewater discharge quality (currently, under the Environmental Quality Act 1974, the wastewater treatment requirement is only mandated to premises generating over 60 cubic meter of wastewater a day).

Another area that has not been fully explored is addressing non-point source pollution. Mandating TMDL control could spur the need for investments in point/non-point source pollution control, stormwater control, oil and grease recycling and other green infrastructure.

Nutrient pollution is a growing issue that would likely see more stringent limits in the future. There will be an emergent market to develop and introduce

advanced technologies for nutrient removal and recovery. At present, the majority of wastewater treatment plants apply secondary treatment (activated sludge, sedimentation tanks). Tertiary treatment such as nitrification and denitrification systems for nutrient removal to meet standards of 4 mg/L (Bosma 2013) is not fully developed.

The pollution monitoring network in Malaysia also needs to be upgraded to a more integrated and automated network rather than depending on manual sampling and analysis. The technology for automated monitoring of pollutants is readily available for adoption. Having such systems in the country would improve monitoring efforts significantly through improved data collection, faster data acquisition and analysis and allow for greater response time, faster sharing of information and facilitate improved decision-making by the relevant agencies.

Potential EPs:

- River Basin Pollution Management Programme;
- Superfund for clean-up of polluted rivers in Malaysia;
- Modernising water quality monitoring network;
- Develop water quality modelling tools and infrastructure; as well as
- Community river management programmes.

9.7 Integrated Coastal Zone Management (ICZM)

Malaysia has a coastline of 9,323 km, home to a significant number of people. The coastal areas have vast untapped natural and mineral resources, as well as high value ecosystems. Utilisation of estuarine and marine resources can provide jobs and alleviate poverty for coastal communities but it may also speed up depletion of these very delicate ecosystems through increasing pollution, habitat loss and degradation of the environment.

Investments in coastal and marine systems for most parts are exploitive/extractive activities including coastal development and reclamation, fisheries, marine trade and shipping, energy generation (seawater cooling), etc. Impacts on its hinterland also ultimately find their way to the ocean through conveyance via waterways resulting in pollution accumulation, salinity intrusion and degradation of the ecosystem.

Developing sustainable utilisation of coastal and marine resources has been a cornerstone for nations bordering the South China Sea, whereby ICZM and ISMP were developed as an effective management framework. The development of ICZM and ISMP within Malaysia has yet to be fully developed with only several states having their own ICZM/ISMP plans including Sabah, Sarawak, Pahang, Johor and Penang.

Malaysia's coastline faces a host of issues including severe erosion, water pollution, loss of coastal forests and mangroves, saline intrusion into groundwater, overfishing, natural disasters (tsunami and flooding), river mouth siltation, coral bleaching, off-shore sand mining, mineral exploitation and unsustainable reclamation. Thus, there is an urgent need to address the problems by protection works, the setting up of coastal monitoring stations for better monitoring of coastal retreat/ accretion and allow for improved mitigation for critical coastal stretches. The last major undertaking was carried out by DID under the National Coastal Erosion Study 1985 and has yet to be updated (at present proposal is out for an update of the 1985 study).

While coastal erosion is a significant threat, it also provides opportunities for investment, particularly from the private sector. The key areas of participation would be in providing coastal structural solutions such as breakwaters, groynes, coastal armour and retention walls. Beach reclamation and reforestation of coastal areas are some of the non-structural measures to offset coastal erosion. In tandem, reclamation works are another significant sector especially in states like Penang, Malacca and Johor while dredging activities to ensure sustainability of ports, marinas and shipping channel are other avenues for private investors.

Coastal water pollution is another area requiring investments. While monitoring for rivers have been carried out, the coastal and marine water monitoring system can still be further developed, especially in terms of early warning systems, for instance oil spills. Frequent episodes of red tide and algal bloom due to nutrient inputs and *E.coli* contamination from human wastes also affect the fishery and tourism sectors. Transboundary monitoring networks with our neighbouring countries also can be improved, especially in the monitoring of pollution.

For ecological management, more sustainable fishery management is required, such as low-impact aquaculture, coastal and deep sea fishery stock management. The fishery industry is a multi-billion dollar industry that contributes significantly towards the national economy, and in case of a stock collapse, can prove severe for the fishery community dependent on the sector. Development of cage and tank culture for freshwater and marine fishery is also highly dependent on unpolluted water.

One major marine programme is CTI of which Sabah forms part of the multi-nation effort to preserve the important seascapes and its resources. The Sabah coastline is also home to many important high-value ecosystems such as coral reefs, marine parks, islands and seagrass and seaweeds beds, which generate income through ecotourism. The various national and regional programmes proposed under the CTI offer opportunities such as conducting of oceanographic surveys, fish management, research opportunities, aquaculture/ mariculture development, ecotourism and support many downstream industries.

Potential EPs:

- ICZM/ ISMP Network for all Malaysian States;
- Coastal Erosion Monitoring and Rehabilitation Programme;
- Estuarine and Marine Fishery Management;
- Offshore Sand Mining, Reclamation and Dredging Industry;
- CTI; and
- Transboundary Pollution Monitoring.

9.8 Meetings, Incentives, Conference and Exhibition (MICE)

The water industry has various conferences, events and platforms for governments, business communities and the public to participate in. Some of the major events include:

Event	Organisers
World Water Week	Stockholm International Water Institute
World Water-Tech Investment Summit	UK Trade and Investment
Water 2 Money – Global Water Investment Summit	EuroMoney Water Events
IWA World Water Congress and Exhibition	The International Water Association
International Young Water Professional Conference	The International Water Association
AQUATECH	Amsterdam Rai
Ozwater	Australia Water Association
International Congress on Water, Waste and Energy Management	C3/IPP (Portugal), Extremadura University (Spain) and Salamanca University (Spain)
Singapore International Water Week	Singapore International Water Week Pte Ltd
Asia Water Conference	United Business Media (M) Sdn Bhd
International Conference on Urban Drainage	Ministry of Natural Resources and Environment, DID, IWA, CEDEX
Malaysia Water Resources Forum	Malaysian Water Partnership
Water Malaysia	Malaysia Water Association

Source: http://water-conferences.com/

Business tourism generally focuses on high-yield travellers. The number of tourism arrival in 2012 was 25.03 million, with business related tourists amounting to 5% of the number, or 1.2 million. The expenditure from international business travellers accounted for RM11.0 billion (2012) while the economic impact value was estimated at RM18.2 billion (MyCEB 2014).

Promoting Malaysia as a water MICE centre will contribute to foreign exchange earnings, offer opportunities for trade and export promotion, increase Malaysia's international profile and exposure, promote business networking and collaborations, attract industry players and investors to the country, allow knowledge sharing, etc.

Malaysia already plays host to several internationally recognised forums such as the Malaysia Water Resources Forum and Asia Water Week. It will also host the International Conference on Urban Drainage in 2014. The goal of this sector is to bring higher profile events to the country, which would be attractive to the largest water industry players.

Potential EPs:

- Develop Malaysia as Water Hub;
- Develop Malaysia as MICE for water sector/ industry; and
- Host global/ regional/ national water events.

9.9 Water-based Recreation and Tourism

Water-based tourism in Malaysia covers a host of high-value tourism products that generate income to the country as well as provide jobs. These include:

(a) **Water Theme Parks:** Legoland Water Park, Sunway Lagoon, A Famosa Water Theme Park, Bukit Gambang Water Park, Desa Water Park, Bukit Merah Laketown Water Park, Lost World of Tambun, Gold Coast Morib Water Theme Park, Water World I-City

(b) **Cruise:** Star Cruises, Princess Cruises, P&O Cruises

(c) **Island Resorts:** Redang Island, Tioman Island, Langkawi Island, Pangkor Island, Perhentian Island, Kapas Island Sipadan Island, Mabul Island, Turtle Island, Mataking Island, Labuan Island

(d) **Beaches:** Batu Feringghi, Sepang Gold Coast, Morib Beach, Port Dickson, Cherating, Desaru

(e) **Festivals/ Competitions:** Malaysia Water Festival, Labuan International Sea Challenge, Regatta Lepa, Royal Langkawi International Regatta, Penang Dragon Boat Race, International Pahang Rafting Expedition, Melaka River Fiesta, 1 Malaysia International Tourism Night Floral Parade, Sarawak Regatta

(f) **White Water Rafting:** Padas and Kiulu (Sabah), Kuala Kubu Baru (Selangor), Ulu Slim, Gopeng and Grik (Perak)

Water ecotourism is an essential income earner for the country and to attract greater interest from tourists, new tourism products should be built while areas of natural beauty should be preserved to ensure their sustainability. Generally, ecotourism forms part of PES as tourism earnings compensates for the opportunity costs of conserving such areas as compared to land development.

Potential EPs:

- Water tourism products;
- Conservation of high-value tourism areas; and
- Hosting of water-related events, competitions and festivals.

9.10 Waterfront and Water-Sensitive City

Rapid urbanisation (currently at 71%) has led to the growth of urban centres, particularly those of the major conurbations of Penang, Kuala Lumpur and Johor Bahru. These areas are major centres of population, industry, institutions, commerce and services. The concentration of population within these urban centres results in stress to water supply, stormwater management, pollution, infrastructure provision and risks of urban related disasters.

The growth of cities undergoes several transition phases (refer to **Figure 5**), which includes meeting basic water and sanitation needs to managing resultant runoff and finally evolving to include sustainability and water sensitive designs. Malaysia has succeeded in

providing water supply and sewerage infrastructure but has yet to undergo a transition to a more sustainable city development model.

Eco-design and the development of water sensitive cities not only focus on making infrastructure more water and energy efficient but also in the development of new technologies and innovation that are able to generate jobs and growth. In Europe, the Eco-design Directive Working Plan lists 12 major sectors for development, of which one major sector focuses on water efficient devices and products (e.g. taps, showers, consumer products).

Turning cities that are currently intensive users of water and sources of pollution into a sustainable one, would entail a rethinking of cities acting as water catchments instead, to effectively closing the loop in the urban hydrological cycle. This can be done through minimising the use of water (through water demand management) while improving on reuse of wastewater for non-potable use (toilet flushing, irrigation) and capturing stormwater run-off. One such existing example is Singapore.

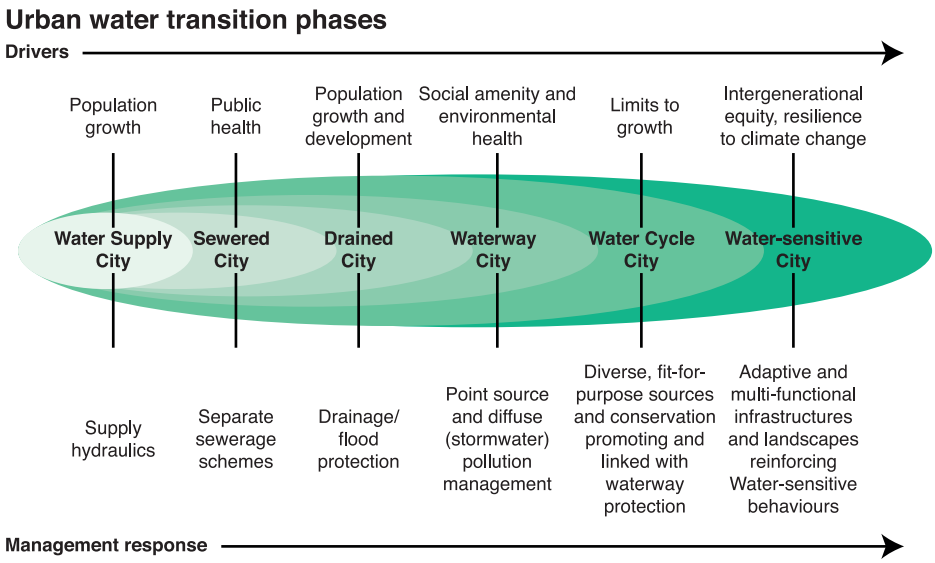


Figure 5. Water-sensitive Cities Framework

Source: Wong & Brown 2009

In terms of IUWM, several key areas of investments include:

(a) **Stormwater management** in Malaysia has progressed from mainly infrastructure intensive conveyance of stormwater from cities to more sustainable and environmentally-friendly management of run-off as espoused through *Manual Saliran Mesra Alam (MSMA)*, published by the DID. Stormwater capture and reuse is another avenue to increase available water resources, coupled with water pollution controls and catchment management, similar schemes to those implemented in Singapore, such as the clean up of Marina Barrage and Kallang River which could increase water resource reserves for the nation, particularly in urban areas where water use is intensive.

(b) Implementation of rainwater harvesting systems for residential, commercial and institutional land use to maximise water capture while reducing stormwater run-off. This should be coupled with water demand management through reuse of grey water and adoption of **water efficient utilities** (washing machine, shower heads, sprinkler systems and toilets). Six states (Perak, Selangor, Johor, Malacca, Kelantan and Perlis) in Malaysia have provisions under the Uniform Building By-laws 1984 to make rainwater harvesting systems mandatory in premises with 100m^2 of rooftop.

(c) The **River of Life (ROL)** is tied closely with the water sector as it encompasses river rehabilitation, beautification and riverbank development. The ROL and other similar river rehabilitation works can be a significant sector for Malaysia especially in the context of urban rivers. Similar programmes include the Malacca River Rehabilitation, which is now a major boon for tourism of the state. The Republic of Korea has invested in a USD17.3 billion project for the Four Major River Restoration Project, which is expected to create 340,000 jobs and generate USD31.1 billion in the economy.

(d) **Water sensitive design and eco-labelling** relates to improving the eco-efficiency of cities by optimising the benefits of water resources in the most beneficial way. Investing in water sensitive design and eco-efficient infrastructure makes sense as it could ultimately reduce the overall cost of water pollution and investments in conveyance, treatment and flood-mitigation systems.

Potential EPs:

- Develop integrated urban water resource management;
- Improve stormwater management;
- Rainwater harvesting;
- Water efficient design/ buildings; and
- River of Life.

10.0 EPs FOR WATER UTILITIES

10.1 Water Supply Sector

Water supply infrastructure is one of the most basic investments in the water sector. Rapid urbanisation requires ever greater investments to improve water storage, treatment, supply network, conservation and re-use. Worldwide, water supply and demand applications are estimated to be a USD450 – 500 billion (refer to **Figure 6**).

The water sector value chain can be divided into three main categories: infrastructure, treatment and utilities:

Water infrastructure

(a) Pumps, pipes and valves (global growth of 2% to 4% and as high as 10% to 15% in emerging markets)

(b) Water reuse, conservation and recycling equipment (global growth of 6% to 12% and as high as 16% in emerging markets)

(c) Demand reduction products and metering infrastructure

(d) Infrastructure projects (global growth of 6% bust as high as 12% to 24% in emerging markets)

Water treatment

(a) Chemical treatment for municipal/utility water sources as well as industrial water and wastewater

(a) Filtration, membrane technology and desalination (growth rates of 15% to 20%)

(a) Physical water treatment utilising technology such as ultraviolet and ozone disinfection. Ballast water treatment is an emerging market (global growth rates of 2% to 4% but can be as high as 20% in emerging markets)

(a) Pollution monitoring and testing equipment (global growth rates of 5% to 7% but as high as 15% to 20% in emerging markets)

Water Utilities

(a) Private investment in the water sector, such as water asset management, treatment and supply

(b) Provision of expertise in water related sectors, such as engineering, operations, system provision, monitoring and consultancy

	Pump, pipes, valves	Water treatment equipment	Desalination, membranes	Water testing equipment	Irrigation	Water, wastewater project market
Global	2-4%	2-4%	15-20%	5-7%	6-12%	6-2%
China	10-15%	13.5%	26.0%	11%	14-16%	24.0%
India	>15%	15-20%	15-20%	15-20%	16.0%	12-15%

Figure 6. Global Growth Rates of Selected Water Sectors

Source: Impax Asset Management Limited 2013

Water infrastructure investments in Malaysia are significant, which encompasses dam construction, water treatment plants, water delivery networks and wastewater treatment plants. Large-scale projects such as the Pahang-Selangor water transfer project accounted for RM3.9 billion alone and generated many jobs related to its construction and down line supply chain such as material supply, equipment sales and machinery. Foreseeing greater water demands and deficits in Malaysia and in the absence in investments in alternative water supply schemes, inter-basin water transfer will be essential.

Large-scale and high-capital infrastructure works with good returns on investments will likely see active private sector interest to invest in the sector. Already water infrastructure development and supply in the country has been privatised or corporatised with the emergence of companies such as SAJ, SYABAS, Puncak Niaga Holdings, Ranhill Utilities and Konsortium ABASS.

Most of the companies are only involved in water treatment, which has high profit margins as they are not burdened in building infrastructure works or maintaining water mains/pipelines. A success story on privatisation is the case of Perbadanan Bekalan Air Pulau Pinang Sdn Bhd (PBAPP) due to the fact that it was involved in the entire spectrum of the water supply sector from catchment to consumers (Chan 2009). Aging water infrastructure, results in high loss of water through NRW. In Selangor and Kuala Lumpur, for example, 40% of the distribution system comprise of old asbestos cement pipes with some sections as old as 35 years. Damage and inefficient infrastructure accounts for 40% to 60% of NRW in Malaysia alone, highlighting the urgency of replacing old infrastructure as well as new investments in more sustainable water delivery systems. Replacing the aging pipelines is estimated to require at least RM1 billion annually for capex cost alone (Vanitha Nadaraj 2014).

Smart water networks include fully integrated products, solutions and systems to enable water utilities to remotely and continuously monitor and diagnose problems, pre-emptively prioritise and manage maintenance issues, and control and optimise all aspects of drinking water network using data-driven insights (Bosma 2013). The drive for greater water efficiency would require investments in a whole new sector which includes:

(a) Instrumentation: Measurement and sensing devices (smart water meters, electromagnetic and acoustic sensors)

(b) Real time communication channels: For data gathering from sensing devices and instructing devices

(c) Data management software: For processing data and visualisation with GIS, spreadsheets or graphs including work order management and customer information systems

(d) Real time data analytics and modelling software for real time monitoring and analysing responses

(e) Automation and control tools for conducting network management task remotely and automatically, such as the SCADA system

The technology is already made available by water sector companies such as Innovyze, Sensus, GE Water and Power IBM, Neptune and CH2MHILL, but it is not fully implemented in Malaysia. The benefits of the smart water network will be in addressing the high NRW in the country as well as to enable water utility companies to improve their services and costs by reducing economic losses and better optimise infrastructure performance and lifespan.

Potential EPs:

- Privatisation/ corporatisation of water supply sector;
- Smart water network monitoring systems for non-revenue water reduction;
- Improve urban and rural water supply infrastructure;
- Develop water demand management initiatives;
- Inter-basin water transfer schemes; and
- Commercialisation of technology and expertise.

10.2 Water, Wastewater and Energy Sector

In Malaysia, the wastewater is managed by the national concession company, IWK. Its services cover throughout Malaysia excluding Majlis Bandaraya Johor Bahru (MBJB), Kelantan, Federal Territory of Labuan, Sabah and Sarawak.

Many areas are also still not connected to centralised sewage treatment systems while rural areas mainly depend on pour flush, pump flush, individual septic tanks and non-mechanised sewage treatment systems (refer to **Figure 7**). Similar to water supply networks, aging sewerage pipelines also require costly replacements.

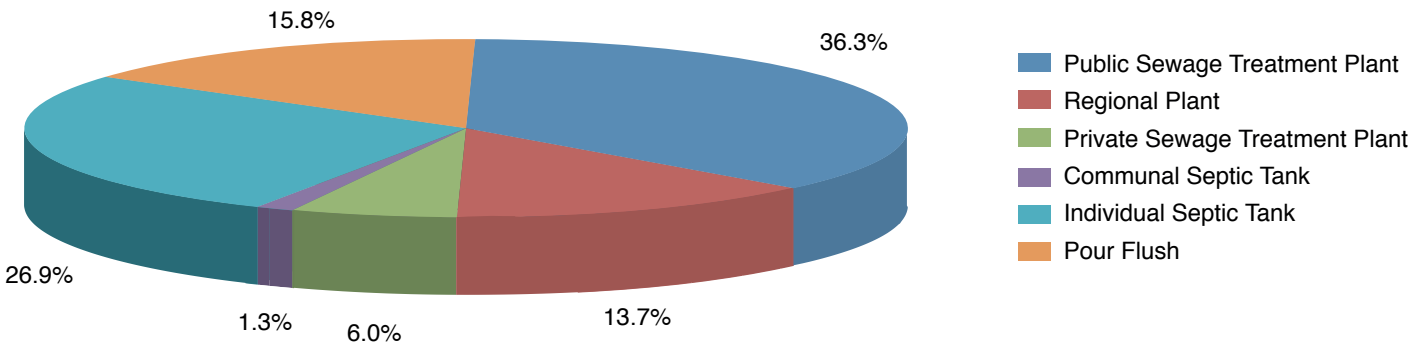


Figure 7. Population Equivalent (PE) Served by Sewerage Systems

Thus, the outlook for the sewerage industry as one of the growth engine looks promising as the need for sewerage network coverage and expansion are set to increase. Major works through sewerage catchment development strategies will see investments in infrastructure and upgrading work for sewage and sludge management facilities throughout the country. Another avenue that has not been developed in Malaysia is the connection of sullage streams into the sewer system and its eventual treatment.

In the past, wastewater from sewage treatment and industrial processes were treated as useless by-products that were flushed out into rivers, resulting in pollution. However, wastewater as a resource, is gaining attention as water scarcity increases and affects the profits. The wastewater treatment delivery equipment, instrumentation, process equipment and treatment market alone is estimated to be USD$57 billion in 2011 and is expected to exceed USD$93 billion by 2016, with an annual growth rate of 10.4%.

Resource recovery through wastewater reuse and recycling, biosolids production and energy recovery (biogas) would enable wastewater treatment plants to become resource generators and renewable energy generators. Technology exists to turn wastewater treatment plants that are capable of recovering the energy required to operate and could potentially fullfil 10% of national electricity demand (Water Environment Research Foundation).

Nutrient recovery through wastewater and sewer mining is a growing sector worldwide, driven by the need to reduce nutrient pollution to the environment. Economic drivers worldwide, such as the need to meet stricter environmental standards (nitrogen, phosphorus) and play a part in economising the reuse and recovery of material/wastewater. Capturing nutrients from wastewater would transform what would otherwise be waste products, into environmentally friendly and commercially viable fertilisers. Research and development have improved the types of materials that can be recovered through wastewater mining, including metals, thermoplastics, ammonia, hydrogen, methane, etc. (Bosma 2013).

Malaysia is still very much dependent on surface water treatment as a main source of water supply. In order to diversify the water resource supply, new sources must be tapped. One avenue would be to look at the potential for wastewater recycling as potable water source (indirect potable use) to supplement rainwater and river capture supply. Malaysia has not invested much in membrane technology nor desalination and these technologies are still costly and require high energy inputs which are prohibitive with the current water pricing in Malaysia. However, with increasing water scarcity and supply, especially to urban areas, there may be markets to tap into such areas. However, if recycled water is not feasible for potable water supply, its utility as industrial water and agriculture water is still very much untapped.

In terms of hydropower development, Malaysia still has numerous potential areas for development of hydropower as a source of renewable energy. Hydropower forms only 15% of the total energy, and are from dams, the latest ones being Nenggiri (450 MW), Lebir (272 MW), Galas (108 MW), Ulu Terengganu (516 MW), Tekai (156 MW), Telom (91 MW) and Maran (109 MW) dams. Sarawak is planning 12 dams to support the Sarawak Corridor of Renewable Energy (SCORE) with a total capacity of 7,000 MW of electricity. For Sabah the only dam proposed has been the Liwagu (164 MW) Dam (Thahirah & Bodger 2009).

Potential EPs:

- Expand sewerage infrastructure and regionalisation of sewerage networks;
- Waste to wealth – bio-effluent, bio-solids and bio-gas industry;
- Potable and non-potable wastewater recycling;
- Develop industrial wastewater treatment systems;
- Zero-discharge and zero-energy for wastewater facilities;
- Hydropower development; and
- Improving efficiency of water use in thermal power plants.

10.3 Groundwater Development

Groundwater remains an untapped resource for Malaysia despite National Economic Action Council (NEAC) identifying the resource for development in 1998. To date, groundwater only accounts for 3% of the total of water utilisation in Malaysia, equivalent to 446 MLD.

Currently, industries use groundwater for their plant operations and cooling systems mainly in Selangor (groundwater abstraction is regulated through LUAS) while the major large-scale development of groundwater resources for potable use is in Kelantan. An initial private venture to develop groundwater at Batang Padang Perak by Sime Darby was planned. Other schemes mainly utilise artisanal wells or tube wells in Perlis, Sabah, Sarawak, Labuan, Pahang and Terengganu.

The development of groundwater in Malaysia would involve a whole new industry, which encompasses the entire supply chain from abstraction, treatment, supply and recovery as well as downstream industries supply construction materials, process systems and workforce requirements. Likewise, new developments in governance, regulatory mechanisms and legislation would have to be put in place.

Another area of groundwater development would be through conjunctive use of the resources, such as through river infiltration and aquifer storage and recovery, whereby rainwater, flood runoff or treated wastewater can be used to replenish the aquifers that have been reduced through abstraction activities. River Bank Filtration and Horizontal Collector Well technologies have been successfully implemented in Jeli, Kelantan and holds promise for similar use in the country. All these provide ample opportunities for public and private investments if the incentives are adequate.

Potential EPs:

- Groundwater mapping and abstraction;
- Groundwater metering and licensing;
- Groundwater recharge technology; and
- Groundwater infrastructure and service sector development.

10.4 Agricultural Water Management

Agriculture is one of the major consumers of water (70%), and with increasing need for food production, more water would be required in future. Traditional irrigation techniques are inefficient, where only 30% to 40% of the irrigation water going towards crop uptake, and the remainder is lost through evaporation or leakage. Moreover, environmental degradation due to agriculture, especially from nutrient run-off and excessive drainage is becoming a challenge.

Previous water investments in agriculture involve infrastructure development especially in irrigation systems for wet paddy cultivation, allowing for double cropping to increase the yield per acre of field. There are eight major granary schemes in the country contributing 70% of the national rice output, comprising Muda, Penang, Kerian/Sungai Manik, Kerian, Sungai Manik, Seberang Perak, Barat Laut Selangor, Besut/Setiu, Kemasin-Semerak and Kemubu.

The Muda Irrigation scheme for example, has managed to improve irrigation efficiency up to 70% (2010) while the remaining schemes have efficiencies of 40% to 50%. To improve target efficiencies of 75% by 2050, irrigation water demand management will have to be implemented. While this can be done through non-structural measures, additional methods such as increasing water rates or installation of irrigation water meters have not received favourable responses.

However, water metering is vital for water resource management as it provides data on water consumption and enables detection of leakage, illegal connection and conveyance losses (major sources of NRW). Water metering schemes is viable if implemented in estates or large-scale commercial farming areas. In other countries wastewater is used for irrigation. New avenues for investments in the agricultural water sector encompass improving efficiency in irrigation through metering of water, improved conveyance and delivery methods (drip irrigation), changing crop management practices, groundwater recharge and the reuse of wastewater.

For non-paddy crops, major water users include fruits, vegetables and horticulture. Their water requirements would need greater research for better management of water that includes introduction of drought resistant variants, reduction of excess irrigation, soil conditions and ensuring crops are grown in suitable agro-climatic zones.

Livestock wastes are main sources of pollution in the river systems. Most of the waste treatment systems are primitive at best or non-existent altogether. Thus, to ensure that livestock wastes does not contaminate water, especially in the case of pig farming, a more

modern livestock management system must be developed. Some of the waste treatment systems available are structural in nature while other forms of natural treatment such as constructed wetland systems have been proposed. Clearly this is one agronomic sector that has yet to be looked into.

Potential EPs:

- Water metering for irrigation areas;
- Improve productivity of agriculture water;
- Reuse of wastewater for irrigation;
- Livestock waste treatment systems; and
- Urban Farming.

10.5 Commercial Water to Shipping

The shipping industry is a significant sector for Malaysia, which is located among one of the busiest marine lanes in the world, the Straits of Malacca. The major ports within the country are as follows:

Peninsular Malaysia	**Sabah and Sarawak**
• Port of Penang	• Kuching Port
• Lumut Port	• Rajang Port
• Port Klang	• Bintulu Port
• Port Dickson	• Miri Port
• Sungai Udang Port	• Labuan Port
• Malacca Port	• Kota Kinabalu Port
• Tanjung Pelepas Port	• Sepanggar Bay Oil Terminal
• Johor Port	• Kudat Port
• Pasir Gudang Port	• Sandakan Port
• Kuantan Port	• Lahad Datu Port
• Kertih Port	• Kunak Port
• Kemaman Port	• Tawau Port

The shipping industry needs a lot of freshwater supply for consumption and operations. The sale of freshwater to local and international shipping companies generates income to the nation.

Another aspect of water contribution to shipping is marine pollution. The shipping industry generates pollution through various sources. The most significant of which is ballast and bilge water, which have the potential to pollute coastal waters (from pollutants and from introduced species) if discharged without prior treatment. As Malaysia is a signatory to the International Convention for the Control and Management of Ships' Ballast Water and Sediments (via Malaysian Shipping Notice MSN 04/2012), ships constructed after June 2012 with ballast water capacity of 5,000 cubic meters or more, are required to conduct ballast water management when operating within the country's Exclusive Economic Zone (EEZ).

In a sense, ballast water has yet to be viewed as a pollutant in the country, and thus, is largely unregulated and unmanaged. Many Malaysian ports are not equipped with ballast management and treatment facilities, and occurrences of illegal discharges in the marine waters. Infrastructure and technological development can include ballast water exchange systems, on-board treatment systems, port reception and treatment facilities and improvement in ship design.

Threats from uncontrolled ballast water may lead to harmful algal blooms and introduction of alien species which may result in degradation of high-value ecosystems along the coast; affecting the fishery and tourism industry. Dredging activities for development of ports, jetties and marinas is another major economic activity. Existing ports are also expanding to accommodate the new generation of super tankers such as Post-Panamax, which requires greater draft and space to manoeuvre. In other areas, tourism is expected to grow, which means increased demand in marinas, cruise terminals and airport extensions. Other factors such as potential deep sea mining and sand sourcing will drive demand for dredging.

Lastly, many cities are looking into investing into urban water transport. As part of public transport development, cities with rivers are exploring alternatives to landward transport and are considering water transport as a tenable option. Sarawak is the only major inland transport user for both passenger and cargos. Other markets for urban water transport include river cruises, such as those found in Malacca.

Potential EPs:

- Water supply for shipping;
- Navigational channel and port dredging;
- Ballast water monitoring, management and treatment systems; and
- Urban water transport.

11.0 TRANSFORMATION ROADMAP

The transformation roadmap is geared to the precise objective of contributing to a need for a Water NKPA, with recommendations involving a number of wide-ranging EPs, as shown earlier, committed through appropriate policies and investments for a more water-energy-food secure nation. The number of EPs is by no means exhaustive, but they represent the range of products for investments and programmes that the scientific and business community can undertake in the future.

The future of water is highly uncertain and some of this is due to the vagaries of climate. However, the most critical factors are the key drivers of population growth, uncontrollable urbanisation and industrial expansion, low investments in water resources, indistinct allocation of water to various uses, impasse reforms in water management, and nominal technological changes.

Water can and should be developed to get more from each drop. Water underpins food and energy security, and environmental sustainability. It is integrally linked to the health and survival of ecosystems, which help to regulate the quantity and quality of water. A sustainable water scenario will dramatically increase the amount of water allocated to environmental uses, connect all households to quality-piped water, achieve lower per capita domestic water consumption, as well as sustain food and energy production. Thereby, achieving greater social equity and environmental protection.

A number of EPs have been summarised in **Table 5** for further discussions and refinement. The roadmap is inserted in column 4 of Table 4 to show that some EPs can be taken up immediately (one to three years) if the water NKPA is adopted, while others may take longer; midterm (five years) and long-term (ten year) for uptake by the public and private sectors.

Table 5. EPs for a Water NKPA

Item	Water Sectors	Entry Projects	Uptake
	Water As a Resource		
1	Flood/ Drought Mitigations	• Develop and improve flood forecasting centre and technology; • Structural and non-structural flood mitigation works; • Develop flood sensitive designs/ solutions for commercialisation; • Improve flood relief, response and recovery mechanism/ institutions; • Develop drought infrastructure and alternative water sources; and • Develop catastrophe insurance industry.	• Immediate • Immediate • Immediate to midterm • Immediate • Mid- to long-term • Immediate
2	Integrated Water Resources Management (IWRM)	• Set up IWRM Training Centres; • Setup RBOs for all major river basins; • Watershed management/ restoration programmes; • Develop ILBM and IRBM (ILBM); and • Develop transboundary water resources management.	• Immediate • Immediate • Immediate to midterm • Immediate • Midterm
3	Water Research and Innovation Cluster	• Set up a dedicated Water Research Centre; • Establish a Water Data Centre; • Developed Water Innovation and Industry Clusters; and • Develop Centres of Water Excellence in Local Academia.	• Immediate • Immediate • Immediate to Midterm • Immediate

Item	Water Sectors	Entry Projects	Uptake
4	Ecosystem Services	• PES framework and mechanism for Malaysia; • Watershed rehabilitation and management of river basins and resources; • Lake brief and management plans for Malaysian lakes; • Wetland restoration and management; and • Mangrove replanting and coastal protection.	• Immediate • Immediate • Immediate • Midterm • Midterm
5	Climatic Change Adaptation	• Establish a Regional Water Hub for Climatic Change Adaptation; • Weather and climatic change forecasting and modelling; • Climatic change adaptation; and • Carbon sequestration/ financing.	• Immediate • Immediate • Midterm • Midterm
6	Water Pollution Monitoring and Rehabilitation	• River Basin Pollution Management Programme. • Superfund for clean-up of polluted rivers in Malaysia; • Modernising water quality monitoring network; • Develop water quality modelling tools and infrastructure; • Community river management programmes; as well as • Pollution control at source	• Immediate • Immediate • Immediate • Midterm • Midterm
7	Integrated Coastal Zone Management (ICZM)	• ICZM/ ISMP Network for all Malaysian States; • Coastal Erosion Monitoring and Rehabilitation Programme; • Estuarine and Marine Fishery Management; • Offshore Sand Mining, Reclamation and Dredging Industry; • Coral Triangle Initiative (STI); and • Transboundary Pollution Monitoring.	• Mid- to long-term • Midterm • Immediate • Immediate • Mid-to long-term • Midterm

Item	Water Sectors	Entry Projects	Uptake
8	Meetings, Incentives, Conference and Exhibition (MICE)	• Develop Malaysia as Water Hub; • Develop Malaysia as MICE for water sector/ industry; and • Host global/ regional/ national water events.	• Immediate • Immediate • Midterm
9	Water-based Recreation and Tourism	• Water tourism products; • Conservation of high-value tourism areas; and • Hosting of water-related events, competitions and festivals.	• Midterm • Immediate • Immediate to Midterm
10	Waterfront and Water-sensitive City	• Develop integrated urban water resource management; • Improve stormwater management; • Rainwater harvesting; • Water efficient design/ buildings; and • River of Life.	• Immediate • Immediate • Immediate to midterm • Midterm • Immediate to midterm
Water as a Utility			
1	Water Supply Sector	• Privatisation/ corporatisation of water supply sector; • Smart water network monitoring systems for non-revenue water reduction; • Improve urban and rural water supply infrastructure; • Develop water demand management initiatives; • Inter-basin water transfer schemes; and • Commercialisation of technology and expertise.	• Mid-to long-term • Immediate to midterm • Immediate • Immediate to midterm • Mid- to long-term • Mid to long-term

Item	Water Sectors	Entry Projects	Uptake
2	Water, Wastewater and Energy Sector	• Expand sewerage infrastructure and regionalisation of sewerage networks;	• Mid- to long-term
		• Waste to wealth-bio-effluent, bio-solids and bio-gas industry;	• Mid- to long-term
		• Potable and non-potable wastewater recycling;	• Mid- to long-term
		• Tertiary treatment for sewage to reduce eutrophication in public waters;	• Mid- to long-term
		• Develop industrial wastewater treatment systems;	• Mid- to long-term
		• Zero-discharge and zero-energy for wastewater facilities;	• Mid- to long-term
		• Hydropower development; and	• Mid- to long-term
		• Improving efficiency of water use in thermal power plants.	
3	Groundwater Development	• Groundwater mapping and abstraction;	• Immediate
		• Groundwater metering and licensing;	• Mid- to long-term
		• Groundwater recharge technology; and	• Long-term
		• Groundwater infrastructure and service sector development.	• Immediate to midterm
4	Agricultural Water Management	• Water metering for irrigation areas;	• Immediate to midterm
		• Improve productivity of agriculture water;	• Immediate
		• Reuse of wastewater for irrigation;	• Immediate
		• Recycling systems for aquaculture industry;	• Immediate
		• Livestock waste treatment systems; and	• Midterm
		• Urban farming.	• Midterm
5	Commercial water to Shipping	• Water supply for shipping;	• Immediate
		• Navigational channel and port dredging;	• Immediate
		• Ballast water monitoring, management and treatment systems; as well as	• Immediate
		• Urban water transport.	• Immediate

12.0 THE WAY FORWARD

As indicated in the Introduction for this Advisory Report, it is hoped that water can be a NKEA amongst the 12 NKEAs for the reasons and justifications given above. However, if water cannot be included as an NKEA because of the short-time factor, as indicated by all the relevant Ministerial stakeholders involved, then an alternative is to have the water sector as a **NKPA**, for the very same reasons stated earlier. The importance of water cannot be taken lightly as it is a part of life – without water, there is no life.

There is also **no alternative to water resources** unlike energy which can have alternative sources of energy. Presently, the country relies almost entirely on surface water (97%). This situation is obviously untenable in the long run for water security reasons. At least five states are already facing water deficits that will require development of groundwater, but this source of water has yet to be developed, although we have approximately 5,000BCM compared to 973 BCM of annual rainfall in the country.

A NKPA will definitively place water on the **national water agenda**, imperative for economic growth and development in the country. We have already experienced both flooding and drought conditions that caused severe ramifications on food prices, energy disruptions, trade constraints, undermining the work of authorities and even creating a lot of temporary water refugees at schools and community halls; straining the resources of hospitals to cope with water-borne diseases. From a local flooding problem, it has escalated into a national issue and has become a major challenge in the country. Water shortage has also caused negative impacts on the tourism industry. As a result, it has tainted the good image of the country. Thus, from the sustainable water future perspective, we need to have a national agenda to determine all aspects of water management for the common good.

The Mega Science 1.0 Study on Water has provided 10 recommendations for wealth creation, which can easily be taken further through the 72 EPs, as proposed earlier. However, what is more important is to ensure our water security and water sufficiency is intact for all uses.

There is also a need to achieve improvements in the ecological health of rivers, lakes, floodplains, wetlands and estuaries so that the many water sources and services they provide are maintained for the present and future use. Climatic conditions have become unpredictable and images of water variability are causing serious hardships to a lot of people in the country. It is increasingly hard to argue for "a business as usual" scenario when the stakes are so high, and yet the responses to the water issues around resource scarcity and the environment are dismal, as compared to the size of the problem.

The industrial sectors have also moved beyond public relations benefits to provide water sustainability prominence. They are realising that the interrelated problems of food, energy and water threaten their own industrial sustainability, and that there is gain to be made in increasing efficiency and reducing wastes in the environment. The **National Water Resources Policy of 2012** is a tipping point in amplifying the need for actions to a whole new generation of water resources development programmes for securing water resources or short, medium and long-term horizons. There are policy directions for four core areas, namely, water resource security; water resource sustainability; partnerships; and capacity building and awareness; with a total of nine thrust areas and 69 strategic action plans, to move the water agenda forward for a water secured future.

Towards this end, we have to tie in more closely at the Water-Food-Energy nexus. Presently, the agricultural sector is producing food at a rate that is not commensurate with population growth (we have to import more than we produce) and the cost of food production is getting more expensive. Water, not being in the right place at the right time needed for agricultural and energy production, will only increase the cost of production and hardships to the people. Moreover, the cost of energy production which drives the economy, is also rising at the expense of the consumers. It means one thing – we need to strike a balance between the three legs of the nexus tripod. Water will be needed as a NKPA if it cannot be an NKEA since agriculture and energy are both NKEAs.

REFERENCES

Air Kelantan Sdn Bhd n.d., *Economics of Groundwater Engineering: Case Study of Groundwater Abstraction, Treatment and Supply, Based on Life Cycle Cost Analysis*, Air Kelantan Sdn Bhd, Kelantan.

Asia-Pacific Economic Cooperation Secretariat 2010, *Malaysia Environmental Industry 2010 Case Study*, Asia-Pacific Economic Cooperation Secretariat, Singapore.

Asian Development Bank 2012, 'Good Practices in Urban Water Management', eds Chiplunkar, A, Seetharam, K & Tan, CK, *Asian Development Bank*, Manila.

Mohamed, Azuhan 2010, 'Promoting Sustainable Development and Management of Groundwater – Sime Darby Bhd Perspective', in *Workshop on Groundwater in the Context of IWRM*.

Barilla Center for Food and Nutrition 2011, *Water Economy*, Barilla Center for Food and Nutrition, Italy.

Bosma, MA 2013, *The Water Technology Sector in the United States: Examining Stakeholders, Trends and Opportunities in the American Water Technology Centre*, Netherland Office for Science and Technology, Washington, USA.

Chan, NW 2009, 'Issues and Challenges in Water Governance in Malaysia', *Iran J. Environ. Health. Sci. Eng.*, vol. 6, no. 3, pp. 143-152.

Kaur, Cheryl Rita 2008, 'Ballast Water Management in Malaysia: Issues and Concerns', in *International Conference on Biofouling and Ballast Water Management*, *Gao, India,* 5 – 7 February 2008.

Department of Irrigation and Drainage 2007, *Flood and Drought Management in Malaysia,* Department of Irrigation and Drainage, Kuala Lumpur.

Department of Irrigation and Drainage 2012, *Review of the National Water Resources Study 2010 – 2050*, Department of Irrigation and Drainage, Kuala Lumpur.

Department of Irrigation and Drainage n.d., *Projects: Flood Forecasting and Warning System Programme*, viewed March 2014, <http://www.water.gov.my/index.php?option=com_content&task=view&id=272&Itemid=625>.

Economic Planning Unit and United Nations Country Team, Malaysia 2011, *Malaysia: The Millennium Development Goals at 2010*, United Nations Country Team, Malaysia, Kuala Lumpur.

EuroMoney n.d., *Untitled,* viewed March 2014, <http://www.euromoneyenergy.com/Assets/22/6976/index.htm>.

Food and Agriculture Organisation n.d, *Malaysia's Water Vision – The Way Forward*. viewed March 2014, <http://www.fao.org/docrep/004/ab776e/ab776e02.htm>.

Future Ready Singapore n.d., *Environment and Water,* viewed March 2014, <http://www.edb.gov.sg/content/edb/en/industries/industries/environment-and-water.html>.

Henderson, R & Parker, NR 2012, *The Blue Economy: Risks and Opportunities in Addressing the Global Water Crisis*, Canadian Water Network, Canada.

Impax Asset Management Limited 2013, *Investing in Water: Global Opportunities in a Growth Sector,* ed Gottelier, Simon, Impax Asset Management Limited, London.

C, Mohamad Ismail, & Abd Karim, Mohammed Hatta n.d., 'Minerals and Geoscience Department of Malaysia', *Groundwater Availability and Quality in Malaysia*.

Malaysian Convention and Exhibition Bureau n.d., *Untitled*, viewed March 2014 <http://www.myceb.com.my/factsheets>.

Ministry of Health n.d., *Untitled*, viewed March 2014, <http://www.moh.gov.my/index.php/pages/view/324>.

Ministry of Natural Resources and Environment 2012, *National Water Resources Policy*, Ministry of Natural Resources and Environment, Kuala Lumpur.

S-Network Global Water Indexes n.d., *S-Network Global Water Indexes*, viewed March 2014, <http://www.snetglobalwaterindexes.com/>.

S&P Global Water Index n.d., *Untitled*, viewed March 2014, <http://us.spindices.com/indices/equity/sp-global-water-index>.

Searates.com, n.d., *Sea Port of Malaysia*, viewed March 2014, <http://www.searates.com/maritime/malaysia.html>.

Spring Singapore n.d., *Singapore's Water Industry Doubles to 100 Companies*, viewed March 2014, <http://www.spring.gov.sg/NewsEvents/PR/2012/Pages/Singapore-water-industry-doubles-to-100-companies-20120607.aspx#.UxVKXs7m6R4>.

Syed Jalal, Thahirah & Bodger, P, 2009, 'National Energy Policies and the Electricity Sector in Malaysia', in *Proceedings of ICEE 2009 3rd International Conference on Energy and Environment,* 7-8 December 2009, Malacca, Malaysia.

Wong, Jack E 2014, 'Baram, Baleh Dams Get Go-ahead', *The Star Online*, 19 February, viewed March 2014, <http://www.thestar.com.my/Business/Business-News/2014/02/19/Baram-Balleh-dams-get-goahead-Projects-will-raise-Sarawak-hydro-power-capacity-to-nearly-6000MW/>.

Wong, T & Brown, RR 2009, 'The Water Sensitive City: Principles for Practice', *Water Science and Technology*, vol. 60, no.3, pp. 673-682

United Nations 2004, *World Population to 2300*, Department of Economic and Social Affairs – Population Division, United Nations, New York.

United Nations Environment Programme 2011, *Water: Investing in Natural Capital*, United Nations Environment Programme.

Nadaraj, Vanitha 2014, *Selangor Water Industry in Malaysia: The Privatisation that Leaked*, viewed March 2014, <http://www.establishmentpost.com/selangor-water-industry-malaysia-privatisation-leaked/>.

Water Conferences 2000, *World Water Vision*, World Water Council, Earthscan Publications Ltd, United Kingdom, viewed March 2014, <http://water-conferences.com/>.

World Resources Institute 2013, eds Gartner, T, Mulligan, J, Schmidst, R & Gunn, J, *Natural Infrastructure: Investing in Forested Landscapes for Source Water Protection in the United States*, World Resources Institute, Washington.

World Wide Fund for Nature 2009, 'A Background Study: Economic Benefits of the Muda Catchment', ed KF Lee, *World Wide Fund for Nature*, Malaysia.

Hashim, Zainab 2010, 'Development of Atmospheric Based Flood Forecasting and Warning System for Selected River Basins in Malaysia', in *National Seminar on Meteorology: Enhancing Weather and Climate Services,* 9 November 2010, Kuala Lumpur.


WATER SECURITY
WATER FOR FOOD AND RURAL DEVELOPMENT
• WATER AS A RESOURCE
• WATER AS A UTILITY
INTEGRATED WATER RESOURCES MANAGEMENT (IWRM)
ECONOMIC VALUATION OF WATER

THROUGH WEHAB 2014

ANNEX 1: MALAYSIAN WATER VISION

A1. WATER FOR PEOPLE

Water for people is equated to access of good freshwater for basic use. The main challenge is access to fresh clean potable water. Water pollution has become a major problem in the country and many of the rivers are polluted. Statistics from the Ministry of Health Malaysia (2002) revealed that vector-borne diseases such as dengue fever, dengue haemorrhagic fever, malaria and typhus remain major concerns. Meanwhile, diseases such hepatitis A, hepatitis E, cholera, typhoid, dysentery and food poisoning still persist, and are increasing – impairing the quality of life, imposing financial burdens on households, and limiting the people's income-generation opportunities.

A2. WATER FOR FOOD AND RURAL DEVELOPMENT

Agriculture is the biggest user of water, accounting for almost 70% of all water withdrawals and is a major non-point source polluter of water in Malaysia. The main issues faced are low efficiency of water use and the disproportionate balance of water versus its economic value. Water losses in the production of food crops, for instance, can be as high as 50%, whereas a large volume of water is withdrawn and lost (such as through evaporation). This is often not accounted for in the total economic value of water. By factoring in on virtual water to account for total water used to generate the economic products and water loss, very often the cost of agricultural products sold in the markets are less than the cost of water used in its production. This results in a disproportionate balance of the true value of water versus the economics of agricultural production in the country.

As water security is closely linked to food security, and food security is linked directly to population growth, any increase in population will generate a demand for more food and water. Population in the country has already risen to 26 million in the 2010 Census, and is projected to increase to 42 million by 2050 (medium range projection, in NWRS, 2010), both water and food demands will be escalating.

Water for food also encompasses livestock farming, forestry management, fishery resources and aquaculture. Agriculture not only uses vast quantity of water, it is also one of the main producers of non-point source pollution due to intensive use of industrial fertilisers and herbicides, which are carried via run-off into the groundwater and waterways. In the coastal areas, large expanse of coastal mangroves have been cleared to make way for aquaculture farming but again there are many opportunities that are not fully explored to improve farming efficiency that will reduce water use in the agricultural sector.

A3. WATER FOR ECONOMIC DEVELOPMENT

Water is a basis of all productive activities (commerce and industry) where it is used as raw material, medium, coolant or mode of transport in production processes. Industrial use of water accounts for 20% of global water consumption and will likely increase in future.

Each time goods are brought or services rendered, there is a virtual exchange of water, which should be accounted for in the total volume of water used in manufacturing a product or providing the services. Most often, this virtual water is not fully accounted for in the economic cost of production.

All of the above can be translated into business opportunities, and even its wastes and wastewater can provide financially, scientifically and technological opportunities. There are many examples, namely industries and business that generate wastewater, which is then returned to the environment; treated and untreated. Even as environmental standards are met, most often the amount of pollution load from industries exceeds the carrying capacity of the waterways leading to the degradation of the environment. When this occurs in water catchments, it will reduce the supply of readily available water resources, and as a result, increase the cost of water treatment. All these can be viewed in terms of the incurred challenges in improving the treatment systems by the business community, through the NKEA.

A4. WATER FOR THE ENVIRONMENT

Ecosystems are highly reliant on water quantity and quality. In turn they play a key role in the hydrological cycle to provide raw materials and regulate a host of ecosystem services. The water systems are also significant in human cultural and religious practices while water-related activities such as water sports, ecotourism and recreation are highly desirable. Development in river basins and water catchments should be balance with ecosystem sustainability. Without accounting for the actual economic value for maintaining the environment, the urge to develop these areas for economic activities will only intensify. Payment for Ecosystem Services (PES) has been proposed as a mechanism to enable for the monetisation of the ecosystem services to ensure its preservation. Nevertheless, the system has yet to be adopted in the country due to resistance.

A5. WATER FOR ENERGY

Presently, there is a focus on the Water-Energy-Food nexus worldwide, and Malaysia is also been looking at it in terms of both policy and process. While water is inextricably linked to food, it is also essential to provide energy. Both energy and water are used in the production of crops, some of which can in turn be converted to energy such as through biofuels.

As energy and water demand increases in tandem with increasing population and income, the shift from provision of basic needs, to meeting the expectations of new lifestyles and diets will result in an increasing demand for more energy, which will drive water demand higher. Thus there is an urgent need for continuous improvements in water and energy efficiencies to ensure sustainable growth.

Water is needed in almost all energy generation processes. As fossil fuels deplete and energy costs increase, the heavy dependence on conventional power plants will have to make way for renewable energy or nuclear. Water has been identified as a potential source of cheap renewal energy, resulting in rivers being dammed up to harness their energy production potential. However, while hydropower provides unlimited clean energy, its development requires the clearing of large tracts of forests for inundation, which will have downstream impacts to the river ecosystems. Uncontrolled land use development within water catchments can also lead to increased siltation and sedimentation which further shortens the lifespans of dams.

Other forms of alternative energy such as harnessing wastewater and sewage will likely see greater adoption and contribution to the nation's energy supply. Likewise competition for water use for production of crops for energy generation through biofuel production will further complicate the water, energy and food nexus. The drive for more efficient water use in energy generation will be a driver for greater adoption of renewable energy.

ANNEX 2: MEGASCIENCE PHASE 1

RECOMMENDATIONS FOR WATER:

Creating New Wealth Opportunities (2011 – 2050)

- Ecotourism around high ecological value sites
- Urban water-based tourism
- Market and export high quality water
- Clean water for aquaculture industry
- Malaysian brand for domestic water purification unit
- World leading tropical aquatic research and education
- Knowledge export
- Downstream water tapping
- Rainwater harvesting
- Zero pollutant discharge

ANNEX 3: LIST OF NKEAs

1	Oil, Gas and Energy
2	Palm Oil & Rubbert
3	Financial Services
4	Tourism
5	Business Services
6	Electrical & Electronics
7	Education
8	Healthcare
9	Communications Content & Infrastructure
10	Agriculture
11	Wholesale & Retail
12	Greater Kuala Lumpur/ Klang Valley

ANNEX 4A: SUMMARY OF FINDINGS FROM WORKSHOP

Questions for Break Out Session

Please answer the questions based on the theme of your group:

(1) Why should water be an NKEA?

(2) How can the private and public sector participate in the water industry?

(3) What is the existing roadmap for water in your organisation?

(4) How can Malaysia achieve global standards in the water industry?

ANNEX 4B: SUMMARY OF DISCUSSIONS FROM STAKEHOLDER ENGAGEMENTS

1. Ministry of Energy, Green Technology and Water (KeTTHA)

- Focus more on the social aspect of water management than the business aspect.
- Raising public awareness on water saving measures is a priority.
- The Restructuring of Water Industries Road Map policies are based on directions from the cabinet, but no policy document exists.
- A study was carried out by KPMG, but has not been incorporated into a Wastewater Management Roadmap.
- Water infrastructure should be privatized especially in laying infrastructure and providing services in maintenance. May result in improved maintenance levels and reduce NRW level.
- Water supply and water infrastructure should be separate entities as the cost of infrastructure is high.
- Underground storage of rainwater can be utilised for non-potable uses

- The River Bank Filtration and Horizontal Collector Well technologies implemented in Jeli, Kelantan should be implemented elsewhere in the country.

2. Ministry of Urban Well-being, Housing and Local Government (KPKT)

- Rainwater harvesting systems (SPAHs) have the potential to be turned into an EPP, but collected rainwater should not be utilised for potable use.

- Six states (Perak, Selangor, Johor, Malacca, Kelantan, Perlis) have enacted the amendments of *Undang-undang Kecil Bangunan Seragam 1984*, making SPAHs mandatory for houses with roof areas above 100m^2.

- Rainwater retention efforts play a bigger role in flood mitigation than water production.

- Pollution should be looked at as an opportunity, there is great potential for grease traps maintenance and fats, oil and grease recycling to be made into an EPP.

- DOE classifies brown grease as "scheduled waste", which makes collection and recycling illegal, whereas this should be made legal.

- The installation of grease traps and recycling of grease can create jobs and revenue.

3. Ministry of Tourism and Culture

- The Ministry urged for focus on forming water-based EPPs;

- The Ministry urged for focus on GNI and Jobs Created from said EPPs;

- The Ministry urged ASM to bring up water agenda as a NKRA for rural development. The Ministry is currently active in implementing its own EPPs on tourism with focus on attracting high quality visitors. Tourism is ranked as the 6th GNI contributor with Malaysia ranked as the top 10 countries for arrivals and top 15th in tourist receipts globally; and

- Concurred that tourism EPPs have a direct connection to water, and should be further developed.

4. Ministry of Natural Resources and Environment (MONRE)

- Stormwater is much cleaner than effluent water. Water drained by the SMART Tunnel should be captured and recycled.

- Pollution control and mitigation can be an EPP. The cleaning up and rehabilitation of polluted areas can create jobs and revenue.

- New water act is currently being drafted to take into account of new pollutants and development in environmental management and standards.

- A study group/think tank/lab/forum should be held to develop EPPs for water.

- EPU does not see opportunities and good outcomes/ outputs in seeing water as a resource.

- Suggestion to explore ideas of recharging aquifers with floodwater, aquifers can dilute pollutants and filter out dissolved solids.

- Water footprint should be looked into in Malaysia.

5. Ministry of Plantation Industries and Commodities (MPIC)

- Commodity crops currently consume 70% of land usage.

- Most commodity crops (rubber, oil palm, kenaf, pepper and timber) are rain fed crops.

- Rubber requires a distinct dry season to grow.

- Oil palm is grown over peat swamps in many areas. Special care must be taken when developing such areas.

- Pepper has to be washed in water as a part of its downstream process.

- With *El Nino* and climate change on our doorsteps, our country has to make preparations for water shortages.

- Suggest that water EPPs be broad based (e.g. Green Technologies).

- MPIC is cautious to take on any sustainability standards as it might incur increased production costs (e.g. Roundtable on Sustainable Palm Oil).

- Smallholder crops such as pepper, cocoa and kenaf might not be able to bear these costs.

Academy of Sciences Malaysia
Level 20, West Wing, MATRADE Tower,
Jalan Sultan Haji Ahmad Shah, off Jalan Tuanku Abdul Halim,
50480 Kuala Lumpur,
Malaysia

Phone : +6 (03) 6203 0633
Fax : +6 (03) 6203 0634

ISBN 978-983-2915-18-8