River RANGER 2.0

a GEC Environmental Education Programme

RIVER CARE
Module

Developed by

Global Environment Centre

Preface

Global Environment Centre (GEC) was established as a non-profit Organisation in Malaysia in 1998. For the last 20 years GEC has been supporting information exchange and capacity building as well as undertakes strategic projects focused on community involvement and biodiversity conservation as well as education, empowerment awareness and capacity building with various organisations, sectors and the public. GEC established a River Care Programme (RCP) focusing on promoting stakeholder especially community participation in river and water resource protection and sustainable use through the Civic Science approach as we believe that everyone has a role to play in the river management.

RCP mission is to promote the protection, restoration and sustainable use of rivers by enhancing multi-stakeholder participation and knowledge to stimulate local action and vision is to have clean, healthy, living and vibrant rivers for people and the environment. The RIVER Ranger Programme was one of the pilot programmes established by GEC to promote and support the integrated management of river basins with particular emphasis on ensuring that biodiversity, wetland conservation and community considerations are incorporated into river basin management.

RIVER Ranger (RR) was initiated by GEC in 2004 and was received and adapted by various agencies. It is a comprehensive program for the environment and water resources and its uses emphasising not only about water pollution but every aspect of freshwater ecosystems including the functions, values, biodiversity and benefits to mankind. The programme is targeted to various groups which includes and not limiting to public, community, school, government and private agencies.

In conjunction with GEC 20 year's celebration ,GEC is launching the improvised RIVER Ranger 2.0 (RR 2.0) to ensure more target group benefit from the programme. The RIVER Ranger 2.0 will be able to accommodate new elements introduced in the River Care Action Guide book which focuses on the community resilience on climate change esp. on flood preparedness, water scarcity and management, introduction of the RIVER Ranger Index (RRI) on river monitoring, and the most updated 4R2P Approach.

The 4R2P approach on river management in Malaysia focused on the elements of River Address, River Mapping, River Hydrology, River Monitoring, Protect and Proactive measures through the localized Integrated Water Resource Management (IWRM) in Malaysia. We hope that RR 2.0 module and the River Care Action Guide book will be a source of reference and guide for river engagement and initiatives. More information on the programme is available at www.riverranger.my

Faizal Parish

Director
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April 2019

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Introduction

The RIVER Ranger programme was initiated by Global Environment Centre in 2004. The RIVER Ranger programme is a comprehensive program on water resource management, which focuses on rivers and river basin management. It emphasizes not only about water pollution but every aspect of freshwater ecosystems including the functions, values, biodiversity and benefits to mankind. With new features and scopes for improvements identified along the 15 years, the RIVER Ranger programme is being upgraded to RIVER Ranger 2.0 (RR 2.0). The RR 2.0 will have more aspects that will help to harness knowledge on integrated river basin management (IRBM) in more practical manner while combating effects of climate change, particularly flood and droughts.

Two main components of the RIVER Ranger 2.0 Programme are the **Module** and the **River Care Action Guidebook**. The RIVER Ranger 2.0 module is comprehensive as it covers all the main elements of water and river; issues and solution, impact and ways forward, mitigation and ownership, policies and frameworks. In addition, one of the modules also shares the standard operational procedures undertaken by the stakeholders to initiative their action plans.

The River Care Action Guidebook on the other hand focuses on the 4R2P Approach which is centered on monitoring and auditing focusing on physical, chemical and biological monitoring, RIVER Ranger Index (RRI) and hands-on measures on site. The RR 2.0 training module includes the theoretical approach through the following **5 modules, including on-site practical field action guidebook** as summarized below:

Module 1: Human, Water and River

This module gives an introduction to what is a river and a river basin, and to rekindle the relationship between human and river-water. The module highlights the environment, water resources and rivers, and emphasizes every aspect of freshwater ecosystems including its biodiversity, functions, values and benefits to mankind.

Module 2: River Basins: Problems and Issues

This module gives an overview on the current status of rivers in Malaysia and Malaysia's water quality ranking at a global level. It also highlights the main sources of pollution here in Malaysia - industrial, agricultural and residential, and the effect and impact on humans especially on our drinking water and health. The module also highlights water/river related issues and, in response, mitigation undertaken esp. on water quality and resilience to climate change i.e. flood and draught as well as the impact of floatables.

Module 3: Integrated River Basin Management (IRBM)

The module highlights the component of Integrated Water Resource Management (IWRM) and incorporation of Integrated River Basin Management (IRBM) into the IWRM framework in Malaysia. In addition the module also summarizes the role of governance and arrangement of the water management in Malaysia.

Module 4: River Management through SMART Partnership

This module focuses on how to look after rivers by considering the whole river basin rather than just the river. What is the proper way and integrated approach to managing our rivers? It needs the involvement of all parties: the government, private sector and public. How we can make a difference? The way forward is civic science - awareness, knowledge and skill for the general public, which will leads to action.

Module 5: On-site Practical Field Training with River Care Action Guide Book

Participants will be taken to the river and carry out river mapping and river health check activities to assess the health of the river. The onsite practical will be focused on the 4R2P Approach. The approach includes the hands-on training which focused on the River Address, River Mapping, River Hydrology, and River Monitoring as well as action plans which emphasizes on the Protect and Proactive approaches. The RIVER Ranger Index (RRI) of the river will be emphasized by calculating scores based on the physical, chemical and biological assessment of the river health. The data obtained will then be used to create a monitoring database on the monitored rivers in Malaysia. The date can be uploaded and viewed in the www.riverranger.my and assessed for future reference.

Module 1
Human, Water and River

1.1 Environment

Environment is defined as environs or surrounds; surrounding conditions, influences, or forces, by which living forms are influenced and modified in their growth and development. Three main environmental elements are:

NATURAL
Water, air, plants, fishes, sunlight, wind, soil etc.
MAN MADE
Housing, roads, drain, rubbish, pollution etc.
BENEFICIARY
Flora, fauna, people

Environmental issues that occur in Malaysia are mainly interrelated to the following:

- Global climate change due to the greenhouse effects
- Continuous exploitation of natural resources and environmental degradation
- Pollution of water, beach, ocean, air and soil
- Unsustainable development
- Threat to life of human, flora & fauna
- Change to our ecology, hydrology, raining pattern, climate change and biodiversity

The environmental issues occurs are due to the human factors and how main environmental elements were harvested or exploited in the name of urbanisation and development. These events have significant impact on the ecological interaction that alters the ecosystem and the environments as summarized below:

- Bioavailability of portable water: water supply — cost and volume
- Flooding: due to volume of water and retention time
- Ecology: aquatic life forms' habitat — food supply, breeding site destroyed
- Economy: food production, productivity, cost of production and processing, export market (green consumerism)
- Social: natural behaviors, community livelihoods, our youth's discipline and crime problems
- Aquatic animal: fish population
- Health: wellness of people, human's productivity, water related disasters

It can be summarized that about 48% of the natural disasters are water related. Over the period 1995–2015, floods accounted for 43% of all documented natural disasters whereas droughts accounted for 5% of natural disasters, affecting 1.1 billion people, killing 22,000 more, and causing US$100 billion in damage over the same 20-year period (*Source: The United Nations World Water Development Report 2019*).

1.2 Water is Life

Water is of major importance to all living things. Where there is water there is life. 70% of earth's surface is covered by water and most of the main cities have been built on waterways. The total volume of water on our Earth are about 1.4 billion km^3 where 35 million km^3, or about 2.5% occurs as freshwater. Only 2.5% of total world water supplies are in the form of freshwater with the remaining in form of salt water (97.5%). Freshwater is available in various forms (**Figure 1**); i.e. 0.4% in the form of ponds, rivers, streams and lakes, 68.7% in the form of ice sheets, ice caps, glaciers and icebergs, with the remaining 30.9% as groundwater in aquifers and underground streams.

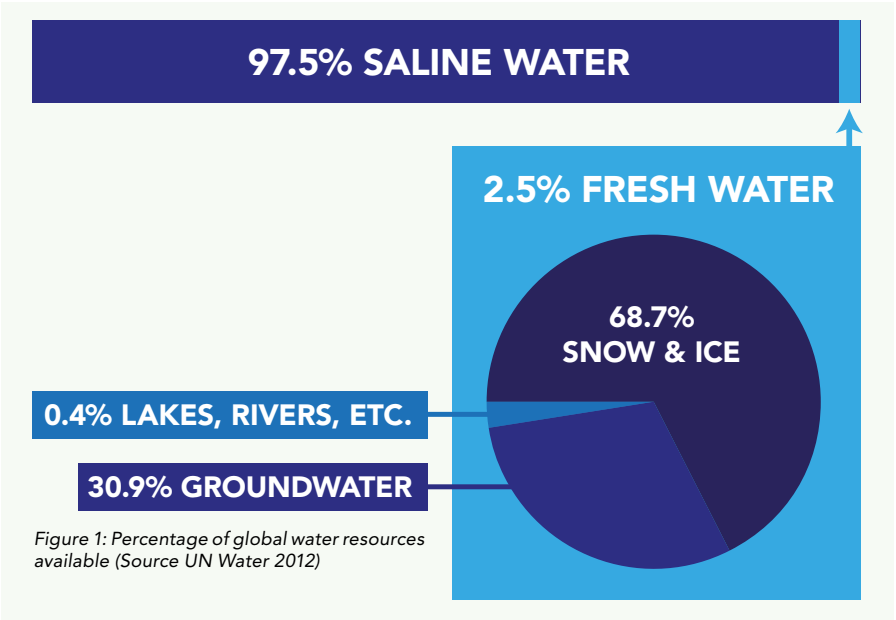
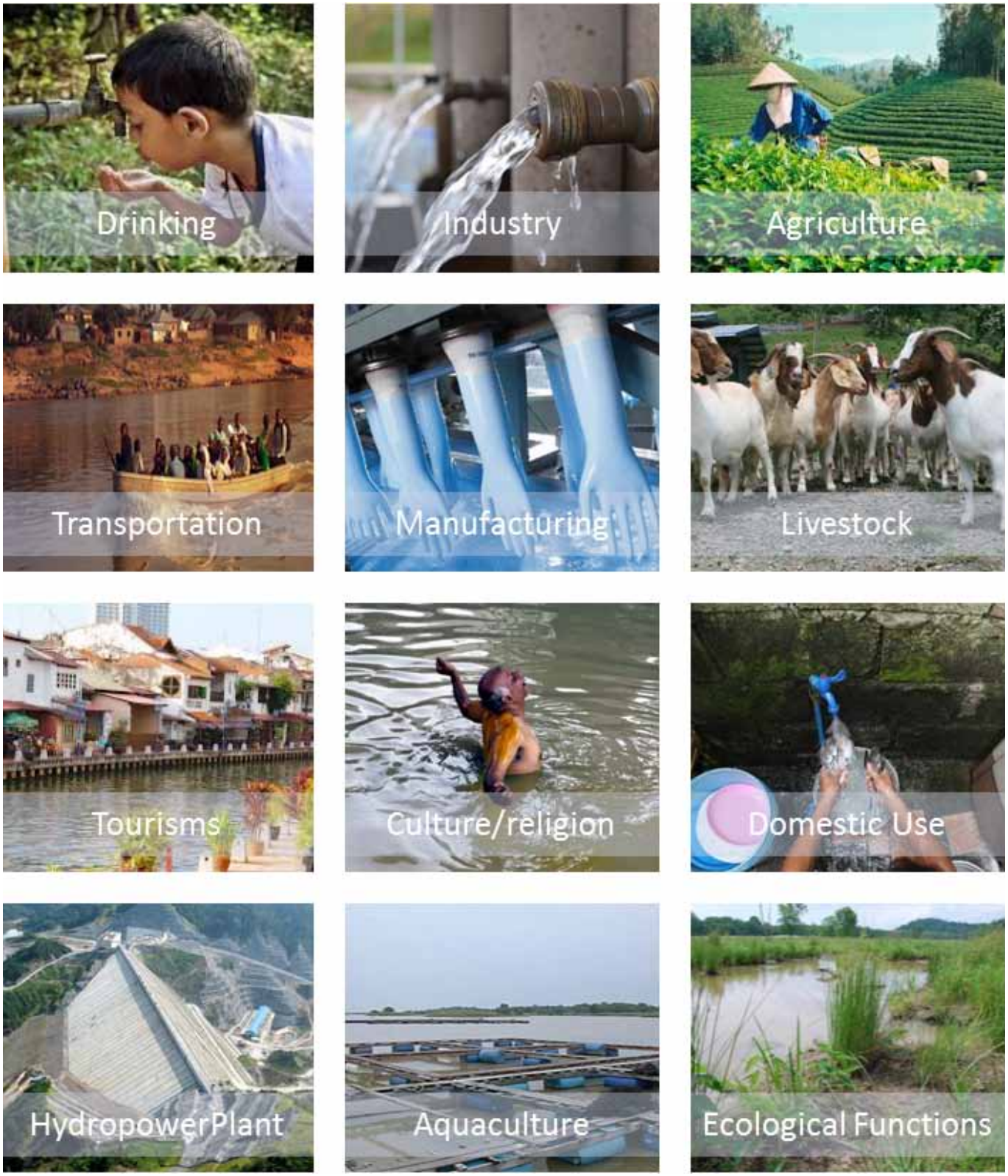


Figure 1: Percentage of global water resources available (Source UN Water 2012)



Freshwater is the main source of living, where all living organisms; human, animal and plants dependent on it. Moreover humans depend on freshwater supply for activities such as for domestic use, agriculture and industry. Water for irrigation constitutes one of the greatest pressures on freshwater resources as agriculture accounts for ~70% of global freshwater withdrawals (up to 90% in some fast-growing economies) followed by industrial (22%) and domestic usage (8%) (UNDP, 2012). As for humans, up to 72% of our body is made up of water (adults average 65% - babies up to 90%). Therefore the quality of water we drink is very important.

1.3 Water Cycle

Water moves around the earth forming the water cycle. Water moves up into the atmosphere by evaporation and back down to the earth's surface as precipitation. Water evaporates from the sea, lakes, reservoirs, rivers and stream (surface water) and rises into the atmosphere. As air hits the mountain side, it is forced upwards causing the water vapour to cool and condense, forming rain clouds. When rain clouds become heavy, water falls in form of rain and is transported into rivers and streams. The sun plays major role in the water cycle, especially during the evaporation and transpiration process as shown in **Figure 2**.

A more comprehensive water cycle (**Figure 3**) includes the processes involved when the water was collected for water supply, treated for drinking, domestic and manufacturing as well as when the water turn into wastewater and later treated and returned back to the nature for the cycle to continue.

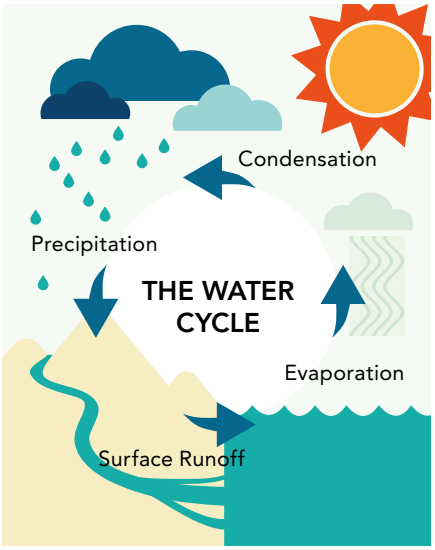
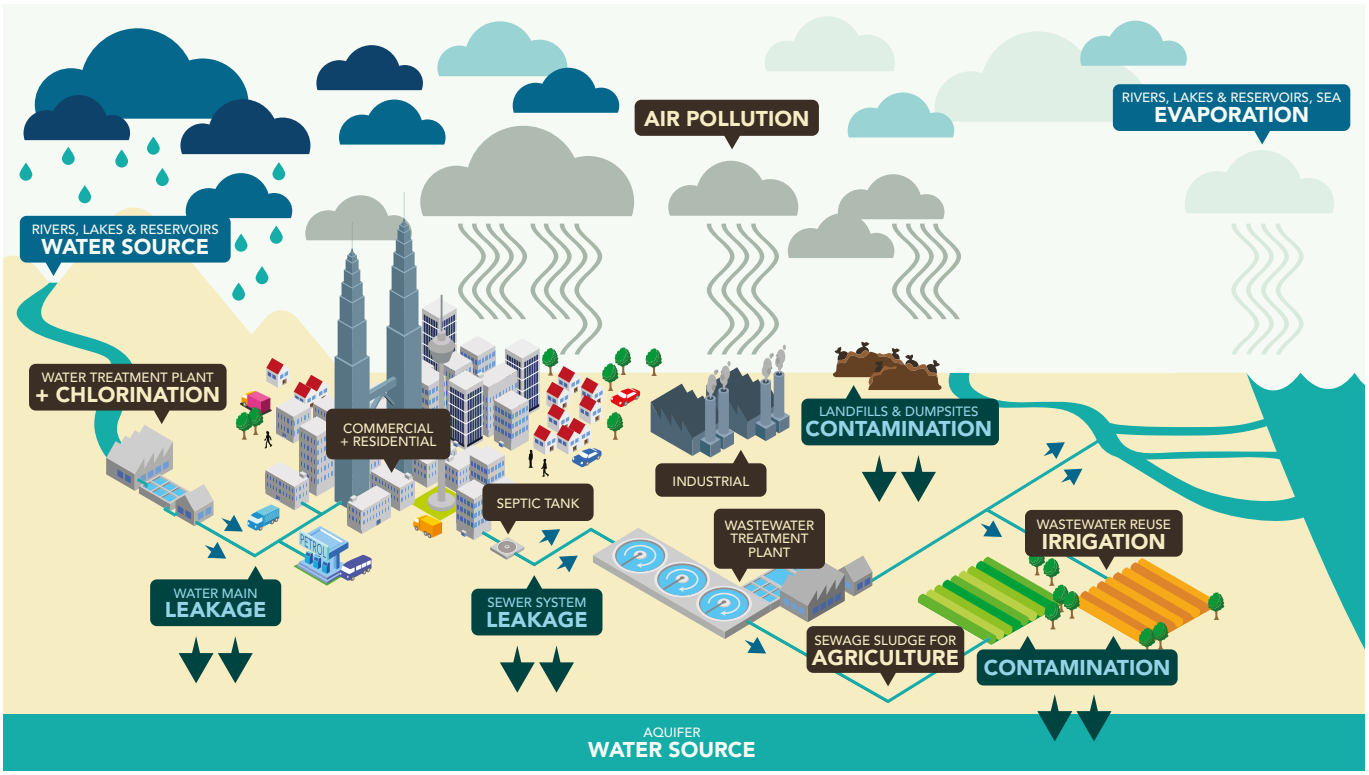


Figure 2: Common Water Cycle

Figure 3: Comprehensive Water Cycle



1.4 Water Issue: Availability and Distribution

With the demand for freshwater constantly increases, withdrawal of the water also increases. However with up to 90% of wastewater in developing countries flows untreated into rivers, lakes and highly productive coastal zones, the health, food security and access to safe drinking and bathing water is threaten . Deterioration of clean water due to pollution caused by human anthropogenic activities leads to serious water scarcity issues if actions are not taken (Asolekar *et al.*, 2015) .

The impact of water scarcity due to pollution not only effects human, but also for the seas and ocean ecosystems, where de-oxygenated dead zones caused by the discharge of untreated wastewater are growing rapidly, affecting an estimated 245,000 km^2 of marine ecosystems, affecting fisheries, livelihoods and food chains (UNDP, 2017). Water stress or scarcities will leads to water conflicts among the countries especially transboundary water conflicts when the demand for water resources and potable water exceeds the supply, and because of control over access or disputed allocation of water.

Elements of a water crisis may put pressures on affected parties to obtain more of a shared water resource, causing diplomatic tension or outright conflict as well as severely threatening national water security and economic growth. Other contributing factors for water stress or scarcity includes insufficient clean water, lack of adequate infrastructure, due to financial, technical or other constraints or lack of institutions for a reliable, secure and equitable supply of water (FAO 2012).

1.5 Water Resource in Malaysia

In Malaysia, 1,190 km^2 out of the 329, 847 km^2 total land area is made up of water such as rivers, lakes, or other internal water body. Malaysia is blessed with annual rainfall up to 990 billion m^3, where 360 billion m^3, is lost to atmosphere via evapo-transpiration (Keizrul & Azuhan, 1998), with the remaining 630 billion m^3 available in the form of renewable water resources (**Figure 4**). The renewable water in Malaysia available in the form of surface runoff; 566 billion m^3; that ends up in the river and the remaining 64 billion m^3 as groundwater recharge. These water bodies contribute to the 97% of total water supply available in Malaysia.

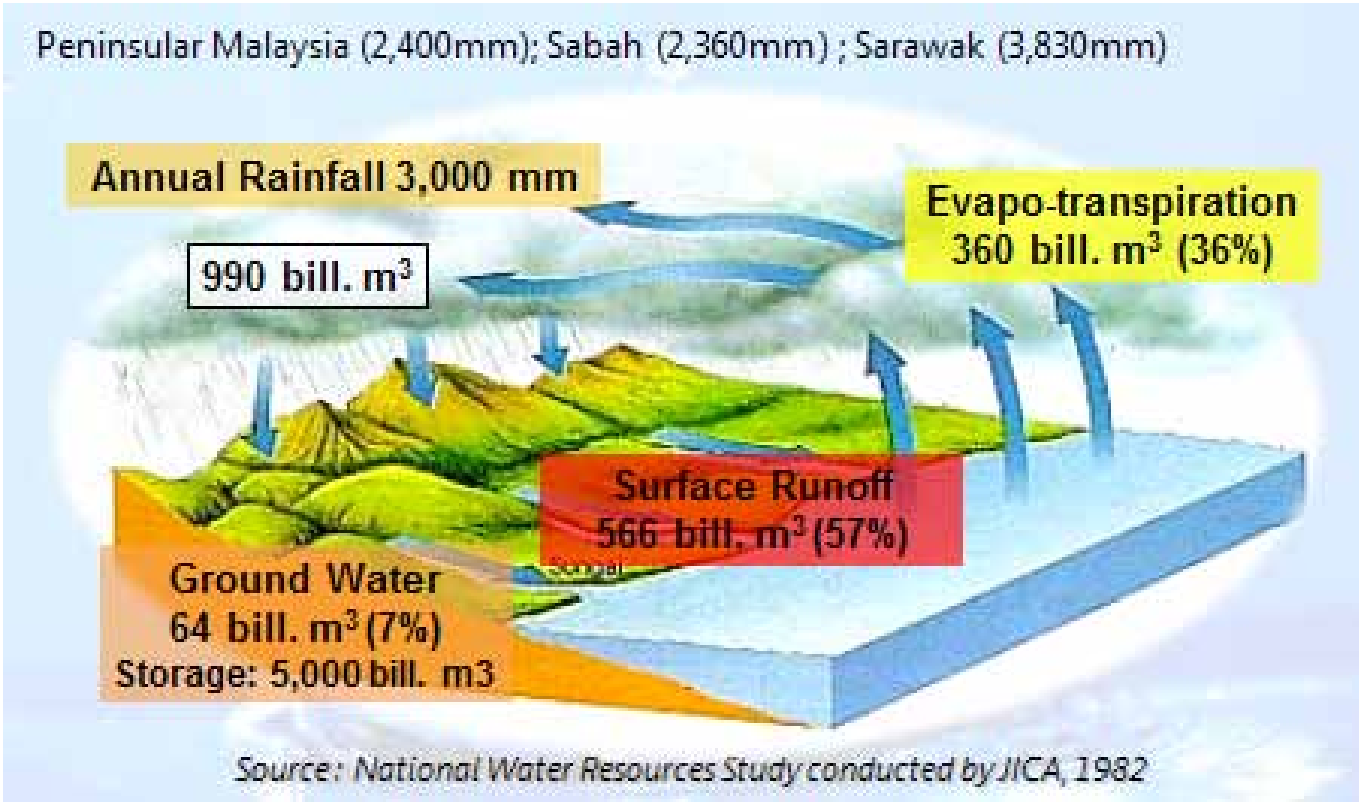


Figure 4: Rainfall Distribution In Malaysia

Rapid and unsustainable developments lead to disruption of natural hydrological cycles causing greater frequency of and severity of flooding, water shortage as well as pollution. Summarized causes are as highlighted below:

- Demand for Clean Water: The usage for water increases as population grows until the demand sometimes overshoots the supply or availability. Every watershed is affected by what takes place on land.
- Floods are exacerbated by the followings: raining pattern, drainage system, disposal of solid wastes into waterways, sediments from land clearance and construction areas and increases in the impervious areas.
- Water Shortage: Changes in the weather pattern, growing demands and pressure on water resources, per capita availability of water is decreasing as we are reach practical limits of surface water resources development as well as due to inter-basin and inter-state water transfers.
- Water Quality Trend: the reduction in the number of clean river increases the vulnerability to access the resources.

Module 2
River Basins: Problems and Issues

2.1 River Basin Concept

The river ecosystem is comprised of water in the river, channels of water that flow directly into the river, flood plain or watershed area, the river basin and tributaries (**Figure 5**). All of these areas are a part of the river ecosystem and home for a wide variety of aquatic plants and animals. Basically rivers begin at the source (headwater), and end at the mouth (delta). Tributaries are smaller rivers which join the main river, where the area of water at which the two rivers join is called a confluence. The area drained by the river and its tributaries is called the drainage or river basin. The space in which the water flows (unless the river floods) is called the river channel.

At the source, the drainage basin (an area of land drained by a river and its tributaries) contains V-shaped valleys where the dominant process is erosion. In the middle section of the drainage basin the river starts to erode laterally. This section contains meanders formed over time when a river flows around obstructions across a wide valley or flat plain. Oxbow lakes are formed when a meander loop gets cut off from the rest of a river creating a crescent shaped lake to the side of the river. As the river flows towards the lower drainage basin, the valley is at its widest and deltas and estuaries are major landforms and habitats.

2.2 What is River Basin?

River basin is defined as the portion of land drained by a river including its tributaries. River basins are synonymously known as watersheds, water catchment area and drainage basins as well as river valleys. River basins can be hilly, mountainous, or nearly flat varying in shape and size depending on the geographical factor. It also formed by combination of different places like the natural formation, housing areas, agriculture, and industry.

Rivers are defined as a wide, natural stream of freshwater that flows into an ocean or other large body of water and is usually fed by smaller streams, called tributaries that enter it along its course. Rivers, the flowing bodies of water are dynamic and are constantly changing according to the water flow. Some of the changes are to do with space or location along a river - these changes are spatial. Some of the changes are to do with time, especially the season of the year – these changes are temporal. Some changes happen suddenly, others happen much more gradually. Some changes are caused by humans. Locally, besides '*sungai*', there are also many other terms referring to river; including *alor* (Kelantan), *carok* (Kedah), *parit* (Johor), *batang* (Sarawak) and *terusan*.

Rivers change the landscape through which they flow. They alter it by erosion, transportation and deposition. Erosion happens when the moving water in a river erodes or removes material such as rocks, soil, vegetation from the bed and banks of the river. The eroded materials are then transported downstream; a process called transportation. When the flow of the water is too slow as the water moves towards the downstream, the materials transported will be deposited or dropped. This is known as the deposition process and the deposited material is called sediment.

2.3 Characteristic of the River

2.3.1 Natural River

Natural rivers are "free flowing" streams or tributary of a flowing body of water, including streams which exist or flow in natural condition without impoundment, diversion, straightening or other modifications. Some of the important characteristic of a natural river that will lead to deterioration of the ecological niche of the river are:

i. **Meanders** usually appear wherever a river goes down a gentle slope, flowing around obstructions, through fine-grained soil that easily erodes but sticks together well enough to make firm banks. Meandering of the river helps to control the river flow and plays an important role on flood mitigation. The meandering controls the movement of the water especially at the bend. The water flows faster in these deeper sections and more slowly in the shallow areas.

ii. **Wetlands** cleanse and filter out the pollutants in the water before the water flows into the river. Plant surfaces provide for filtration, the absorption of solids and add oxygen to the water. Wetland plants take up nutrients for growth – preventing them from entering the river where they may cause excessive aqua plant growth and upset the ecological balance of the river. Water entering the river cleansed by wetlands in turn protects downstream environments.

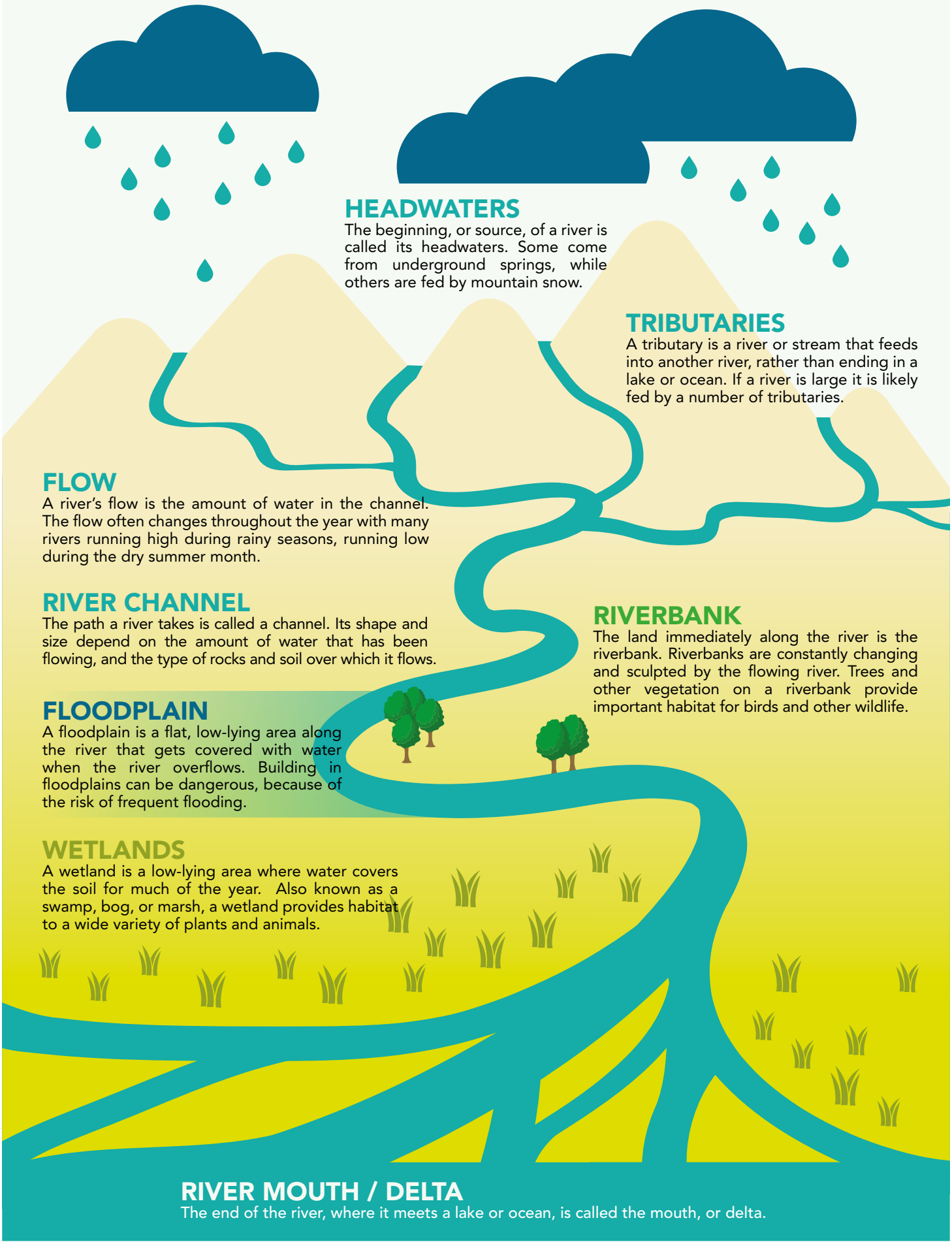


Figure 5: River Basin

iii. **Riffles** are parts of the stream where there water flow is controlled by the rocks. The rocky bottom provides protection for the macroinvertebrates against predator and the weather. The turbulence due to the mixing of the water against the rocky surface results in high dissolved oxygen concentration. A stream/river can be a challenge for organisms that live in water as flowing water can move mud, sand, and gravel. The faster the water flows the larger the particles it can move. As the water slows, particles will settle out and be deposited. High velocity can scour areas that create pools, which support plankton, and larger animals like frogs and fish. Riffles or areas of gravel help provide dissolved oxygen as the water mixes with the atmosphere.

iv. **Microhabitat** is the abiotic condition of the stream formed with the combination of run (straight flow of river/ stream) connecting riffles and pools. The abiotic conditions (dissolved oxygen, turbidity, light and temperature) of these microhabitats will influence which aquatic species can survive and reproduce at that given location and time. Macroinvertebrates studies are carried out mainly to study the condition of the stream/river by identifying the type of aquatic organisms living within the site.

In order to ensure the stream of the river is a living entity, pools, riffles, run and microhabitats are important. These characteristics ensure the flow of the water is suitable as habitat for the living organisms, mitigate or reduce the impact of the flooding as well as have the required concentration of dissolved oxygen (4-8mg/L) to ensure the organisms can survive the stream/river.

2.3.2 Urban River

"Urban rivers" refer to those that originate from or flow through a city, including some artificial canals and canal systems which have developed the characteristics of natural rivers over the years. Infrastructure projects implemented in river basins for the purpose of flood control, storage of water or to generate power, such as dams, normally involve channelization of rivers running through urban areas, river diversion, deepening, straightening and widening along with clearing of riparian vegetation. These activities cause shifts in flow regimes, changes in river water chemistry and processes, and sediment deposition resulting in alteration of the natural river ecology and hydrology.

These rivers cannot be returned to its original condition as an area develops into an urban area. Thus rivers are transformed into concreted rivers or simply, drain. By affecting river flows and sediment transport, urban development affects the size, form and dynamics of river channels. Where river channel change is seen to be a management problem as well as a risk, urban rivers are often reinforced with concrete, sheet-piling, gabions, etc. Channelised rivers to have significant impact on the ecology and the biodiversity when the following activities are carried out; clearing of the riparian, channelization of the river and modification of the flow patterns as well as introducing barriers to movement and migration will reduce the water quality and provide a conducive ecosystem for the invasive fishes to populate our local rivers.

Sg Penchala, Urban River

Upstream of Urban Penchala

2.4 Rivers in Malaysia: Issues and Challenges

In Malaysia, rivers are the main source of drinking water for Peninsular, Sabah, and Sarawak with more than 1800 tributaries and 189 main river basins (DID, 2009). The 95% of land area in Malaysia is the river basin of 189 rivers (**Table 1**). Rivers in Malaysia were categorised into the followings: Category 1 - river wholly within a state (state river), Category 2 - river shared by more than one state (national river) and Category 3 - river shared with one other or more country(ies) (international river).

CATEGORY OF RIVER BASIN	NUMBER OF RIVER BASINS		MAIN RIVER BASIN (>80 KM²)	
	No.	Area (km²)	No.	Area (km²)
Within One State	2,958	263,499	168	248,724
Shared By More Than One	22	56,841	17	56,639
Shared with another country	6	7,558	4	7,501
TOTAL	**2,986**	**327,898**	**189**	**312,864**

Table 1: River Basin in Malaysia

It is well known that 97% of water supply in Malaysia is from surface water sources, primarily rivers. River pollution has become a major cause of unscheduled water disruptions in the country as the quality is deteriorating due to the pollution caused by human anthropogenic activities.

2.5 Source of River Pollution

Pollution is contamination of the water bodies by foreign matter, e.g. effluent, litter, sewage or runoff which changes the physical, chemical, biological or thermal properties of the water. These changes will deteriorate the water quality and affect aquatic life as well as other beneficial uses.

There are two categories of pollution; point source and non-point source pollution. Point source pollution comes from a specific point or location which is relatively easy to identify, quantify and control, more readily identifiable and measurable and generally more toxic. The pollution will be discharged directly into the river from this point. For example; oil spill from a tanker, oil leak from the vehicles, discharge from municipal sewage treatment plant or runoff and leachates from industrial processes with continuous/intermittent flows.

Non-point source pollution comes from many sources and locations. Characteristically, non-point source pollutants are difficult or impossible to trace to a source, enter the environment over an extensive area and sporadic timeframe, are related to certain uncontrollable meteorological events and existing geographic/geomorphologic conditions, have the potential for maintaining a relatively long active presence in the global ecosystem, and may result in long-term, chronic (and endocrine) effects on human health and soil-aquatic degradation. Non-point source pollution is also known as water pollution affecting a water body from a diffuses of sources, such as runoff from impervious surfaces, construction sites, leaking septic systems, or pollutant runoff from agricultural areas or nutrients from runoff from fertilizers and waste applications

Main contributing factor of water quality deterioration in Malaysia are non-point source (NPS) pollution compared to point source as the source of the pollution from non-point is more difficult to control due to discharges through pipes or channels from distinct source. Pollution is not only affecting the water supply at the upstream but also that of urbanised river flowing through the main cities and industrial areas.

2.6 Water/River Related Issues

Table 2 highlights the issues based on the study of effective implementation of Integrated Water Resource Management (IWRM) in Malaysia by National Hydraulic Research Institute of Malaysia (NAHIM) in 2008 and subsequent study by Department of Irrigation and Drainage (DID) Malaysia in 2011. **Figure 6** shows the main issues highlighted which need to be addressed to ensure the water source and supply are protected.

1	River Water Quality
2	Catchment / Land use Management
3	Flooding
4	Potable Water Supply
5	Institutional Arrangement
6	River Corridor Management
7	Wetlands Management
8	Water Borne Diseases
9	Biodiversity
10	Drought
11	Environmental Flow
12	Excess Water
13	Water shortages
14	Water pollution
15	Threats from climate change
16	Current state of water governance

Table 2: Water Related Issues in Malaysia

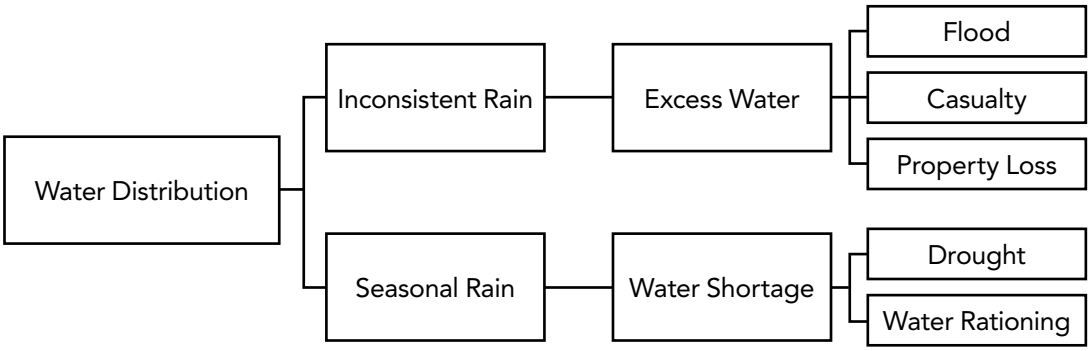


Figure 6: Highlights the distribution and the issues faced

2.6.1 River Water Quality

The Department of Environment (DOE) Malaysia has monitored the water quality on an annual basis from the year 2008 (**Figure 7** was extracted from the Malaysia Environmental Quality Report 2017). In 2017, a total of 477 rivers were monitored; 219 rivers (46%) categorised as Clean, 207 rivers (43%) as slightly polluted and 51 rivers (11%) as polluted rivers. The river water quality in terms of Water Quality Index (WQI) had shown a slight decrease in 2017. The percentage of clean rivers has slightly decreased to 46% in 2017 compared to 47% in the previous year. The percentage of polluted river has slightly increased from 10% in 2016 to 11% in 2017.

The development of Water Quality Criteria and Standards for Malaysia was carried out by the Malaysian government in 1985 to develop standards for monitoring river water quality. The focus on the study was to develop standards for domestic water use, fisheries and aquatic breeding, livestock drinking, recreation, and agricultural use with the support of a multidisciplinary team of experts from universities throughout the country.

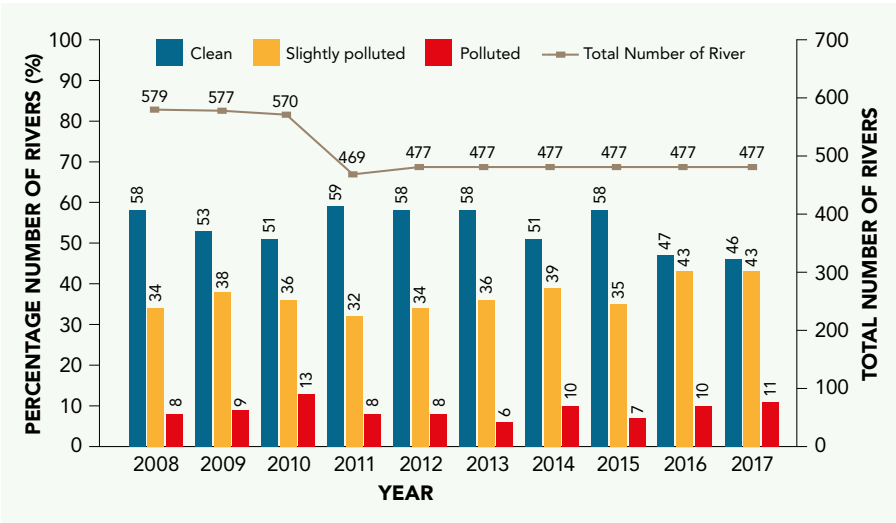


Figure 7: Water Quality Trend in Malaysia from 2008-2017

The WQI formula was developed by DOE to assess the relationship between pollution load and river water classification under the National Water Quality Standards (NWQS) for Malaysia. WQI calculated based on the six (6) parameters; Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solid (TSS), Ammoniacal Nitrogen (AN) and pH. The NWQS defined six classes (I, IIA, IIB, III, IV and V) with about 72 physico-chemical parameters, which applies to six water use classes for surface water as in **Table 3**.

Table 3: DOE Water Quality Index for Malaysia

PARAMETER	UNIT	I	IIA	IIB	III	IV	V
pH		6.5 - 8.5	6.0 - 9.0	6.0 - 9.0	5.0 - 9.0	5.0 - 9.0	-
DO	mg/L	7	5 - 7	5 - 7	3 - 5	<3	<1
BOD	mg/L	1	3	3	6	12	>12
COD	mg/L	10	25	25	50	100	>100
SS	mg/L	25	50	50	150	300	300
AN	mg/L	0.1	0.3	0.3	0.9	2.7	>2.7

CLASS	DEFINITION
Class I	Conservation of natural environment Water supply I: Practically no treatment necessary (except by disinfection or boiling only) Fishery I: Very sensitive aquatic species
Class IIA	Water supply II: Conventional treatment required Fishery II: Sensitive aquatic species

CLASS	DEFINITION
Class IIB	Recreational use with body contact
Class III	Water supply III: Extensive treatment required Fishery III: Common of economic value and tolerant species; livestock drinking
Class IV	Irrigation
Class V	None of the above

2.6.2 Floatable Waste

In Malaysia, polluted rivers in urban areas are due to high concentration of pollution load originating from multiple sources such as wastewater plants, industries and commercial premises. In addition to effluent pollutant, solid waste also contributes significantly to the river issues in Malaysia.

According to Department of Irrigation and Drainage (DID) Malaysia in 2016, 2,200 tonnes of rubbish (equivalent to the combined weight of more than 300 adult African elephants) is dumped into rivers, drains and waterways of Malaysia every month.

Moreover, annually the government has been spending millions of ringgit on rubbish collection from the river, upgrading the drainage system as well as on the maintenance of the rubbish trap, gross pollutant trap, log boom and many of the structural measures have been installed. GEC's SMART (Start Managing All Resources Today) Ranger Module gives more information on the waste minimization and management programme (GEC, 2002). The SMART Ranger Module highlights the Zero Waste Concept and 4R2C (Rethink, Reduce, Reuse, Recycle, Compost & Close the loop) Approach in daily life.

2.6.3 Water Scarcity Issues: Conservation Management

The demand for freshwater is the highest in Malaysia for agriculture at 76%, followed by 13% for industries and 11% for municipal water supply (Ahmed & Begum, 2014). It is a known fact that less than 1% of available water resources available are used for supplying drinking water whereas more than 99% of the 566 billion m^3 are withdrawn for agricultural, development, manufacturing, economical and industrial usage.

On average, water consumption in Malaysia is 210 litres per capita per day, which is 27% higher than the 165 litres per capita per day recommended by the World Health Organisation. We use approximately 25% of treated water at home to flush our toilets. More information on the Water Conservation and Management is available in the GEC DrH_2O Module (GEC, 2014). The module covers the importance of water source, the issues, usage and possible actions that can be undertaken to reduce the water wastage in our daily living.

2.6.4 Excess Water

Localised heavy monsoon varies from a series of storms continuously or frequently cause flooding when the rate of rainfall exceeds the drainage capacity of the area. When this occurs on open field, logged area or on-going development sites, it can result in a muddy flood where sediments are picked up by run-off and carried as suspended matter. Rapid flooding events, including flash floods occur more often occur in smaller rivers, rivers with steep valleys, and rivers that flow for much of their length, over impermeable terrains.

Meanwhile, coastal areas may be flooded by storms at sea, resulting in waves over-topping defenses or, in severe cases, by tsunami or tropical cyclones. Urban flooding, on the other hand, occurs in a built environment, particularly in more densely populated areas, and is caused by rainfall overwhelming the capacity of the drainage systems, such as storm sewers. Although sometimes triggered by events such as flash flooding, urban floods are a condition that causes systemic impact on the community, such as those in Kuala Lumpur,Klang or Penang. River flood also affect large rural areaw such as Kelantan, Terengganu, Pahang Johor, Perak and some parts of Selangor especially during the monsoon seasons.

2.7 FLOOD Ranger

Section 2.7 will cover in detail the FLOOD Ranger sub-chapter which was developed in partnership with Malaysia Water Partnership (MyWP), with support of agencies such as Department of Irrigation and Drainage Malaysia, National Disaster Management Agency (NADMA), and local Authorities.

As way forward, to ensure the communities are prepared to adapt to the flood, the following actions were emphasised through the Flood Ranger Module:

- Catalyst changes by enhancing the communities to evoke appropriate actions (from both disaster management agencies and victims)
- Strengthen and utilise the network among various stakeholders (agencies, higher learning institutions, research bodies, NGOs and CBOs) in sharing their expertise
- Introduce and promote the Hazard Mapping; E-Map on Hazard Management, Grab Bag, 72 Kits and drinking water supply during a flood.
- Create platform and support for the communities to undertake initiatives to strengthen and mitigate actions towards flood preparedness
- Generate financial and volunteerism support from the public and corporates to strengthen the empowerment and capacity sharing among the local communities

2.7.1 History of Floods in Malaysia

Two major types of floods occur in Malaysia, including monsoon floods and flash floods. Malaysian history of major flooding events started back in 1886. In 1886, a severe flood with gale-force winds caused extensive damages in the state of Kelantan, Major flooding of 1926 affected most of the Peninsular Malaysia, including Johor, resulting in extensive damages to property; road systems; and agricultural land and crops. In 1967, disastrous floods surged across the Kelantan, Terengganu and Perak river basins claiming 55 lives. Johor was not spared from the floods in 1967 and 1968. Then in 1971, another major flood swept across many parts of the country whereby Pahang was severely affected with a death toll of 24. Kuala Lumpur, the federal capital, also suffered from the impact of the flooding.

Between 2006 - 2007, the major meteorological phenomena that hit Johor on the 19th December 2006 (first wave) and the 12th January 2007 (second wave) were claimed to be the worst flood disaster in Johor in a 100 years. A series of flood were experienced in the northern states in year 2010. In 2011, Kajang flash flood shocked the entire nation, where in less than 10 minutes; part of the town was flooded. Dumping of rubbish into the river, coupled with the fact the bridge is only about two metres above the water level believed to cause the river to overflow. In 2014-15 from 15 December 2014 - 3 January 2015, the east coast flood affected more than 200,000 people while 21 were killed. This flood has been described as the worst floods in decades in Malaysia.

Flood in Segamat town (2006-2007)

Flood in Alor Star (November 20, 2011)

Kajang Flash Flood (December 2011)

East Coast Flood in 2014-2015

Northern state; Penang Flood in 2017

2.7.2 Definition of Flood

Floods in Malaysia are not always due to rainfall, although most of the flood events are caused by one or two rainfall incidents of high intensity, particularly when the soil is saturated at the latter part of the rainy season. Other contributing factors can be development activities such as unsound construction of roads, irrigation canals, railway lines, and settlements in the flood plains whereas landslides upstream can be due to hill cutting, deforestation and logging.

There are two types of flood; riverine as well as localised and urban floods. Riverine floods are referred as monsoon flood (slow on-set floods) which can last for weeks or months characterised by a slow rise in the water level and due to steady on-going rainfall. Localised and urban floods happen in areas with inadequate drainage, stormwater management and flood evaluation systems. This flooding which occurs in a sudden and unexpected manner is also referred as flash flooding. It is usually caused by slow-moving thunderstorms that deposit an extraordinary amount of water in a relatively short period of time and may remain for a long duration of time.

2.7.3 Causes of Flood

Floods were identified to be resulting from interactions between natural processes as well as human activities. Three major causes of flooding are meteorological, hydrological and anthropogenic. Out of the three main causes listed, anthropogenic is related most closely to us, human beings. We have to realise that our everyday activities contribute to flooding. Some of the key activities which may exacerbate flooding are:

- Poor drainage and/or clogging due to foreign debris
- Lack of adequate infrastructure to moderate the flow of water
- Settlement on floodplains
- Urbanisation
- Uncontrolled logging and lack of land management
- Accumulation of sand along rivers due to agriculture or construction

METEOROLOGICAL
Prolonged & intense rainfall, cyclones, typhoons, storms and tidal surges.
HYDROLOGICAL
Impermeable surface, saturated land, poor infiltration rates and land erosion.
ANTHROPOGENIC
Population growth, land use: deforestation, Intensive agricultur, unplanned flood control measures, socio-economic development, urbanisation and climate change.

2.7.4 Flood Prone Area

Floodplain is a relatively flat area adjacent to streams, rivers, lakes and oceans that are covered by water during major flood. It is build, layer upon layer, of nutrient-rich sediments deposited by the river during floods. Floodplains also act as nature's water treatment works, removing vast quantities of pollutants and sediments from inland rivers. They attract human settlements as they are flat and spacious for cities, suitable for agriculture and provide good access to the river for waste disposal and transport methods. The biodiversity of a flood plain also provides an ideal ecosystem to sustain life.

Flooding becomes more widespread causing nuisance and disruption of daily socio economic routines as development encroaches into the flood plains, creating hindrances to the natural flow of water. Under natural conditions, this flooding will cause little to no damage. But, uncontrolled development will cause increased in discharge resulting in a flood that may lead to damage of properties and sometimes loss of lives. It is important to acknowledge and address encroachment to flood plain as it reduces the flood storage

The primary effects of flooding include loss of lives and damage to buildings and other structures, including bridges, sewerage systems, roadways, and canals. Floods also frequently damage power transmission and, sometimes, power-generation facilities, which then has a knock-on effect caused by the loss of power. This includes the loss of water treatment and water supply, which may result in a lack of drinking water or severe water contamination. It may also cause the loss of sewage disposal facilities. Lack of clean water combined with human sewage in the flood waters raises the risk of waterborne diseases such as typhoid, giardia and cholera, depending upon the location of the flood. Floodwaters typically inundate farm land, making the land unworkable and preventing the planting and harvesting of crops, thus leading to a shortage of food for both humans and animals.

2.7.5 Mitigation Measures

There are varieties of structures designed to keep floods away from people such as:

a. Flood Storage Reservoirs: controls floods by detaining and storing a portion of floodwater, thus reducing the destructive flood peak.

b. Confinement of flow by dykes, levees and embankments: designed to protect areas from flooding by confining the water to a channel, thus protecting the areas immediately behind them.

c. Channel improvement like widening and deepening of the channel: this will only increase the erosion rate thus leads towards damages to riparian, roads and property whereas dredging will only decrease the flood height as much as the channel is deepened.

d. Bypass Channels and Floodways: used as tunnels or open channels which diverts water elsewhere.

e. Floodplain Management: community program of corrective and preventative measures for reducing flood damage.

f. Flood Mapping: develop a 2-Dimensional river model covering the flood plain of the particular river to the river mouth to generate flood risk map for various return periods.

2.7.6 Integrated Flood Management (IFM)

The integrated flood risk management system involves human, natural and flood environment in an intricate relationship whereby each influenced the other resulting in either negative or positive impacts. This approach needs the participation of multi stakeholder and involvement of multi- and cross-sector involvement which catalyses the formation of links and networks of dialogue between government ministries, implementers, NGO's and the community.

The integrated approach for an effective and efficient flood mitigation management is focused on maximising the efficient use of flood plains and minimising damage to properties and preventing loss of life. The IFM concept of 'Living with flood' is based on the following principles:

- Employ a basin approach;
- Treat floods as part of the water cycle;
- Integrate land and water management;
- Adopt a mix of strategies based on risk management approaches;
- Enable cooperation between different agencies; and
- Ensure a participatory approach

It is our ultimate goal that especially the communities benefits from this module which aims to create a platform and pathway to the communities to be flood-proofed and adapted for the climate resilience. More information on the Flood Ranger is available in GEC's "*Peranan Komuniti dalam Pengurusan Banjir Bersepadu*" Module (GEC, 2015) .

2.8 Pollution Effect and Impact

> **"In its natural state rivers play an important role in maintaining the ecological balance of the river basin. Through its self-purification abilities, the river is able to absorb and cleanse itself of wastes and impurities, thus maintaining a threshold of river water quality that is able to enrich the natural beauty and to support an abundance of flora and fauna. The opening up of catchment areas for human activities have resulted in adverse changes to the river regime, with more severe floods during the wet season and more pronounced dry spells. Consequently, the roles played by the river have diminished in importance, and its ability to support the eco-system is greatly threatened. Today, many of our rivers are in an appalling state and in many urban areas, have been turned into open sewers."**
>
> *Hj Keizrul Abdullah (2002)*

Pollution will significantly affect the quality and the quantity of the water supply. Urbanization and economic growth increases the demand for clean water source, however with the growth, pollution issues that affect the quality arise from industries effluent, untreated sewerage, illegal squatters and improper domestic waste management. The threat of pollution also leads to clogged drainage causing flash flood. Moreover this also affects the other living organisms within and along the waterbodies.

Major rivers in Malaysia has reached the limits of their availability and storage facilities, where inter-basin and inter-state water transfer e.g. Pahang - Selangor is turned to in order to meet our needs during the dry seasons. Sedimentation plays a significant role as pollutant due to an increase in the land use through transformation and rapid development from forest to agriculture and then from agriculture to industries. Moreover, in rural areas expansion of plantation agriculture has depleted large areas of natural jungle whereas mining operation, housing and road development, logging and clearing of forest are major causes of high concentration of accumulated suspended sediment in downstream stretches of rivers. In addition, squatter settlements, sullage water and domestic effluents also lead to the river which is river both the source of water as well as a means of waste disposal.

The effect of toxic contaminants (metals, organic compounds, microplastic, microorganisms) on human health can be classified as either acute or chronic. Acute toxicity is the reaction to a substance causing serious illness or death in an individual within 48 hours after exposure whereas chronic toxicity will have a long term effect on health due to frequent exposure to small amounts of a toxic substance.

There are some aspects of water pollution include:

a. **Algal Blooms**: are a consequence of eutrophication. Algae blooms are formed in water bodies caused by a combination of high concentrations of nutrients, adequate light, low turbidity (i.e. high water clarity), suitable temperatures, and lack of turbulence and sufficiently long residence time in the water. The phenomena of algal blooms can reduce light and oxygen and may release toxic compounds into the water, often killing other aquatic organisms. They may also restrict fish migration, boating, fishing and other recreational activities.

b. **Introduced Species**: Introduced species of exotic fishes, represent a biological pressure on ecosystem health. In the polluted rivers, there have been many introductions of alien invasive species of fish, other animals and plants to local waters. Many alien species such as tilapia are more resistant to pollutant than local species and multiply easily preventing recovery of local fish. Introducing exotic species into new environments can threaten the integrity of natural communities, and the existence of rare and endangered species. Invasive species can easily spread throughout the ecosystem of the river.

c. **Transsexual or Intersex animal**: In the polluted rivers, the gender of fish will also be affected by pollution. The cause of the problem may be due to hormones from poultry/human waste that is dumped/ends up in the river.

There are three indicators for a good and healthy river which include the clean water source, good physical conditions and sufficient water flow (**Figure 8**) to ensure the river and the water source are protected. Therefore the solution to address the effect and the impact of the pollution is important. All rivers are not same where each river needs a different approach. In order to solve the problem, we have to work with nature and not against it by emphasising on "basic objectives/needs" with balanced achievement for all purpose/usage i.e: environment, economic, social, religious, human, animal, and plants.

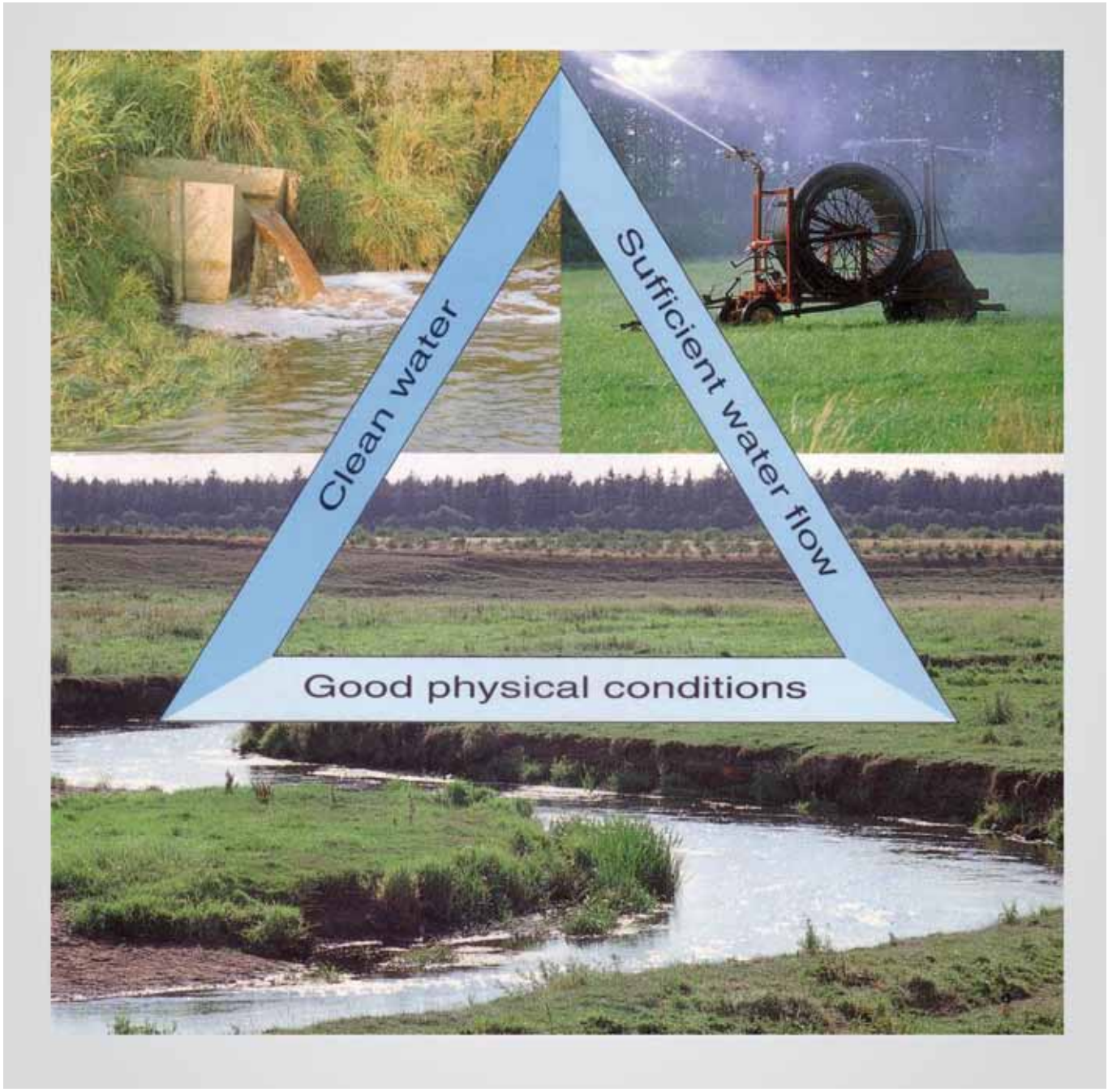


Figure 8: Indicators for a good and healthy river

Module 3
Integrated River Basin Management (IRBM)

3.1 Introduction to IWRM

According to Global Water Partnership (GWP), "Integrated Water Resource Management (IWRM) is a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems". IWRM as a holistic and integrated approach developed to protect the ecosystem and river basin rather than focus on the river itself and it is designed for planning, sustainable development, allocation and monitoring of water resource used in the context of social, economic and environmental objectives. IWRM incorporated various elements and river related issues/management as in **Figure 9**.

IWRM was recognized in Agenda 21 of the United Nations Earth Summit on Environment and Development that was held in Rio de Janeiro in 1992. The Dublin principles, formulated through a global level consultative process at the International Conference on Water and the Environment in Dublin, in 1992 provide the basic guiding principles underpinning IWRM. These principles have received universal support and acceptance amongst the international community as a useful guide to IWRM. Much of the water sector reforms worldwide, subsequent to 1992, have occurred based on the **four Dublin principles**:

1. Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.
2. Water development and management should be based on a participatory approach, involving users, planners and policymakers at all levels.
3. Women play a central part in the provision, management and safeguarding of water.
4. Water has an economic value in all its competing uses and should be recognised as an economic good as well as a social good.

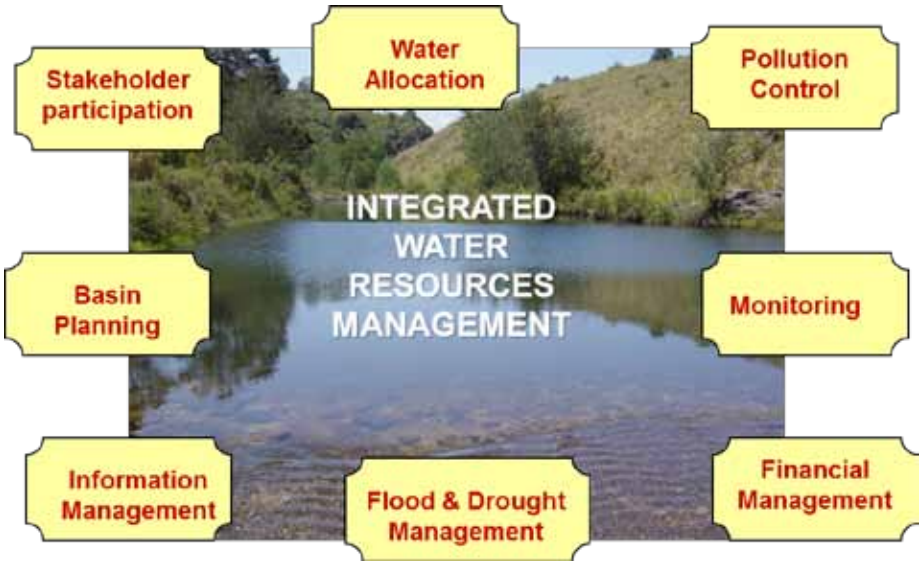


Figure 9: IWRM and its Element of Approach

3.2 Malaysia and IWRM

Malaysia in its 10th Malaysian Plan have embraced IWRM via:

- The management of resources across the entire water cycle will be reassessed and that is from where water is drawn to how water is treated and supplied to citizens and how wastewater is returned to the environment.
- The implementation of Integrated Water Resources Management (IWRM) and Integrated River Basin Management (IRBM) approaches will be expanded to include planning, managing, protecting and rehabilitating water resources.

Malaysia too developed Malaysia's National Water vision where in support of Vision 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 IWRM implementation process in Malaysia is as per **Figure 10**.

Significant gap were identified and remain with respect to the ability of present institutional frameworks to effectively implement IWRM. For instance, inappropriateness and overlap of roles and functions of current water-related institutions within the context of IWRM and lack of coordination and integration means among concerned stakeholders hinder the implementation of IWRM policies. This is fundamentally because the existing water resources management culture and its associated institutional arrangements, legislation and instruments — which take a sector-based approach, are inadequate to achieve integrated and participatory IWRM that is multi-sectoral oriented by its nature.

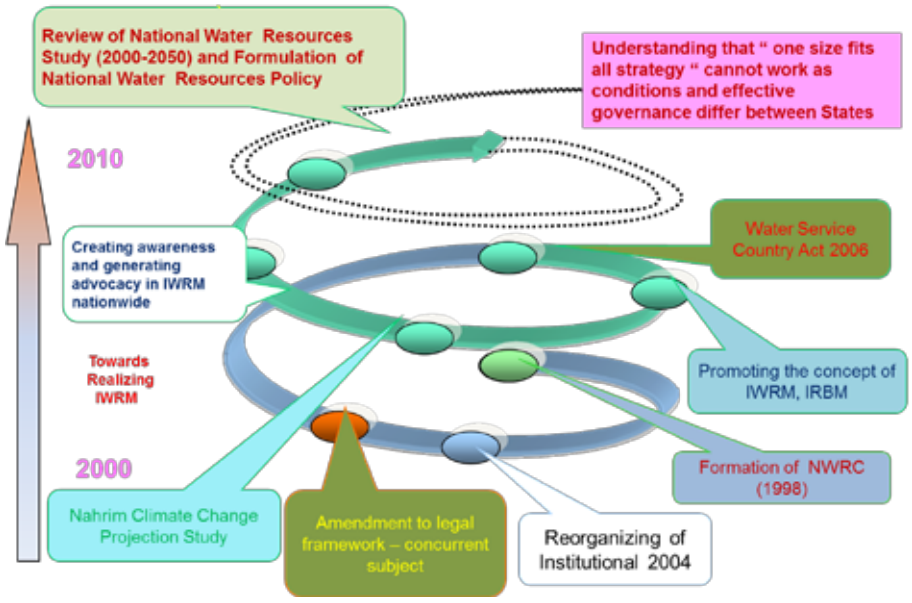


Figure 10: IWRM in Malaysia

Figure 11: IWRM Integrated Approaches

Other challenges observed for the implementation of IWRM in Malaysia includes lack of involvement from community based organizations (CBOs) and local communities, gross lack of capacity on IWRM in water-related implementing agencies (public, private) as well as absence of Best Management Practices (BMPs) in IWRM that is appropriate in a Malaysian context. To overcome the challenges, partnership arrangements between public sector organizations and communities, NGOs, and private firms should be made with a more integrated approach with different methods and skills compared to internally oriented administrative processes employed by many public agencies.

The three main players identified in the recognition of IRWM are central/federal government, local government, and community (**Figure 11**) . However there is one collaboration between the federal and local governments as well as community approaches, whereby each player working alone is not sufficient to address all the challenges faced at the local level. Each approach offers useful methods for promoting local development, but each has limitations.

A local approach with significant synergies required to bring the three approaches together. This will allow policymakers and program managers to select the methods best adapted to the local conditions to formulate more effectively integrated strategies for IRWM policy. In sum, these integrated approaches will enhance the prospects for effectively promoting equitable and sustainable human, social, and economic development at the local level.

3.3 Integrated River Basin Management (IRBM)

Integrated River Basin Management (IRBM) is a subset of IWRM for water planning and development which was introduced in the Ninth (9th) Malaysia Plan. By focusing on coordinating the management of resources in the natural environment (air, water, land, flora, and fauna), IRBM emphasizes on balancing man's needs with necessity of conserving resources to ensure sustainability by providing sufficient water to the respective needs (**Figure 12**). It is believed that the IRBM approach will lead to cleaner rivers due to better protection, restoration and rehabilitation of riverine ecosystems and thereafter improvement of the status of biodiversity. IRBM was identified globally in the Hague Ministerial Conference on Water in March 2000 and locally in the Malaysian Vision for Water in 2025 as one of the key approaches to ensure the effective management of water resources of each basin.

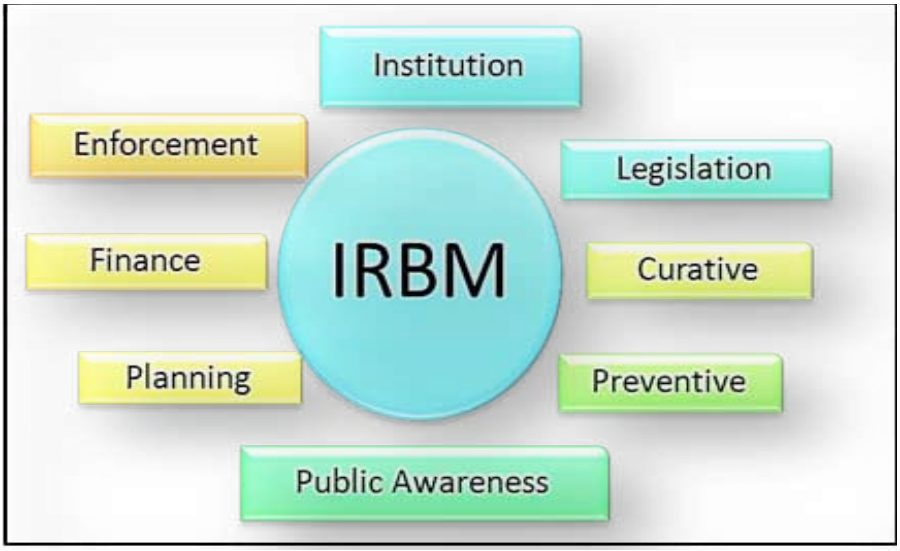


Figure 12: Components of IRBM

3.4 Legislation Arrangement for Water and River Management in Malaysia

As per the report developed by Akademi Sains Malaysia (ASM) Task Force on Integrated River Basin Management (2014), the Federal Constitution has defined the jurisdiction of the Federal and State Governments over water resources. They are as follows:

a. States have jurisdiction over water resources and related aspects such as land, forest, agriculture and rivers.

b. Federal Government also has jurisdiction over the following matters related to water resources:

   i. International treaties and agreements

   ii. Transboundary rivers

   iii. Transfer of water (if not resolved between states)

   iv. Data and information collection and management

   v. Scientific research

   vi. Setting of national standards, safety and security

Thus, the current institutional status for water resources management in the country can be summarized as follows:

1. Each state is responsible for the management of its own water resources. Thus, some states have created their own state water resources management organizations to manage their water resources, such as Selangor, Sabah and Sarawak, whereas others depend on the Federal Government's water-related technical departments to provide the necessary technical support for the management of their state's water resources.
2. The key Federal water-related technical departments are as follows:
   i. Department of Irrigation and Drainage (DID) for the physical management of rivers and coastal water resources.
   ii. Department of Environment (DOE) for the management of the water quality of the rivers, lakes, coastal and ground water resources.
   iii. Department of Mineral and Geosciences (DMG) for the physical management of ground water resources.
3. To facilitate co-ordination and uniformity of decision-making on water resources among the states the National Water Resources Council (NWRC) was set-up in 1998. The NWRC was chaired by the Prime Minister (PM) until 2009 when it was transferred to the Deputy Prime Minister. Now (2019), the council is known as National Water Council (NWC) and chaired by the Prime Minister
4. The other NWC members are:
   i. Minister of Finance;
   ii. Minister of Water, Land and Natural Resource (KATS) [previously known as Natural Resources and Environment (NRE)];
   iii. Ministry of Energy, Science, Technology, Environment & Climate Change (MESTECC) (previously known Ministry of Science, Technology and Innovation (MOSTI) and Energy, Green Technology and Water (KeTTHA) were merged together];
   iv. Ministry of Agriculture and Agro-based Industry (MOA) [previously known as Minister of Works; Minister of Agriculture and Agro-based Industry (MOA)];
   v. Minister of Federal Territories;
   vi. Minister of Housing and Local Government (KPKT) [Previously known as Minister of Urban Wellbeing, Housing and Local Government (KPKT)];
   vii. Minister of Primary Industry [previously known as Ministry of Plantation Industries and Commodities];
   viii. Menteri Besar's of Perlis, Kedah, Perak, Selangor, Negeri Sembilan, Johor, Pahang, Terengganu and Kelantan; and
   ix. Chief Ministers of Pulau Pinang, Melaka, Sabah and Sarawak.

The roles and functions of the NWC are as follows:

1. Water management on a national basis to ensure long-term sustainability of water supply.
2. Resolution of water resource disputes among states, including the establishment of a mechanism for agreeing of terms.
3. Address legal and other issues needed to allow the increase use of water through inter-basin and inter-state water transfers.
4. Coordinate the implementation of water resources development projects.
5. Advise State Governments on the conservation, control and gazettal of water catchments areas.
6. Water resources data management.
7. Act as an apex body for water resources governance.
8. Set general policy directions on water resources (planning, development and management)
9. Inter-state matters and state water-related matters requiring advice and recommendations.
10. All international water-related matters.

The key institutional issues have been identified in the National Water Resources (NWR) Study that was completed in 2010. They involved the four institutional components that need to be aligned to support the implementation of the National Water Resources (NWR) Policy 2012 and are as follows:

a. **New Federal institutional structure for water governance**
   The NWC is currently not formalised by legislation. This situation will change when the proposed NWR Law comes into effect. The proposed NWR Law has made provisions to formalise the NWC with membership, roles and functions clearly defined by law. The NWC provides a forum for direct Federal-State and inter-State communication on water issues, because all States are represented through their heads of States, who are members in the Council. When fully mandated, the NWC can be a very effective apex body for water resources management in the country because of the membership in the Council.

b. **Revision to the existing Institutional arrangement in all the States**
   The current institutional arrangement between the Federal and the States in terms of water resources management is fragile in terms of sharing common functions such as data collection, research and training. This situation has led to the non-integration of water resources management in the country. However, the relationship is very strong in terms of development of water projects where the States depend on the Federal Government for funding, expertise and management at the State level.

c. **Creation of a National Water Resources Management Department (NWRD)**
   Currently, the various aspects of water resources management and development are carried out separately by the various technical departments. There is a need to create a National Water Resources Management Department (NWRD) to co-ordinate the technical functions of water resources management and development in the country.

d. **Alignment of functions and responsibilities with the NWR Policy and proposed NWR Law**
   Currently, the functional responsibilities for water management are carried out by a number of agencies and Ministries. Also, with the enactment of the Water Services Industry Act (WSIA) 2006 the water sector is divided into the water resources sector that is under the jurisdiction of the states and the water services sector which is under Federal jurisdiction. Thus, there is a need to streamline the functions and responsibilities in the water resources sector to align them with those proposed in the NWR Policy and the proposed NWR Law.

e. **Pricing model for water resources**
   The Study highlighted that water resources has economic value just like any other natural resources such as minerals and timber from forests. The Study stated that the economic value of water resources has to include the non-financial components such as the environment, which is often difficult to monetize, but is nevertheless important in the overall water resources pricing mechanism. The water pricing model for the water resources sector will be different from the model for the water services sector. This is because the objectives of the water resources sector is to sustain and conserve the natural water resources environment, whereas the water services sector is to provide a service to water consumers. The different objectives of the two water sub-sectors will have a fundamental effect on the way the economic value of water resources is derived.

Module 4
River Care through SMART Partnership

4.1 Element of RIVER Ranger Approach

RIVER Ranger programme focused awareness and action by connecting people back to their memory (balancing hard and heart approach), with the civic and applied science approach, integrating both practical and hands-on approach, action orientated and with bottom up approach. The combination of approaches as in **Figure 13** will be incorporated into the implementation plan.

RIVER Ranger is a comprehensive program on the environment, water resources and rivers, which emphasizes not only about water pollution but every aspect of freshwater ecosystems including its biodiversity, functions, values and benefits to mankind. The RIVER Ranger programme highlights the following key elements:

- River as Living Entity: Work with nature and not against
- Political will (at highest possible level)
- Knowledge (not science alone, but through multi-sector sources of information and expertise)
- Institutional arrangements (start with existing institutions, but (re)-define mandates clearly)
- Community involvement (it takes time to put it in place and it is a long-term and reliable investment)

It is important to understand river management and to sustain the initiative; all the identified stakeholders need to significantly contribute. As highlighted in the findings of the IWRM, the three main pillars are central/federal government, local government, and community. Collaboration between the federal, local government and community approaches must be beneficial to all the relevant parties to ensure acceptance among the stakeholders. Some of the key approached that can be implemented include:

- Multi-stakeholder
- Participatory and practical
- Active consultation
- Integrated river basin approach
- Collaboration
- Communicative
- Pollution prevention at source
- Sustainability and sharing of resources
- Ownership, connectivity and beyond

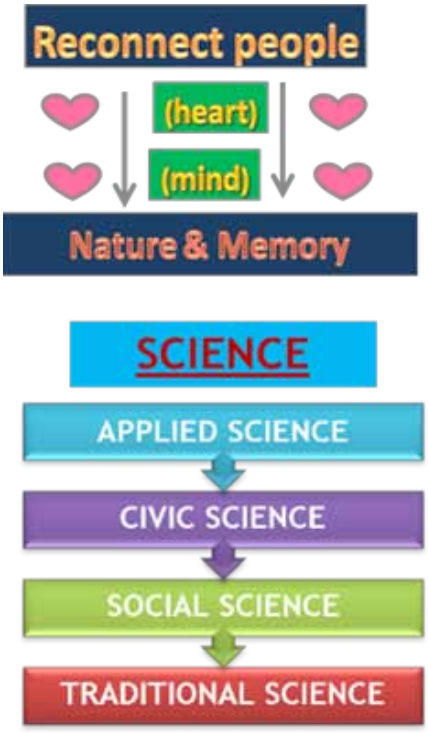


Figure 13: The Concept and Approaches incorporated into the RIVER Ranger 2.0 Programme

4.2 River Stakeholder

Who are the Stakeholders of the river/water? To ensure the approaches are workable, the stakeholders of the river need to be identified? In order to identify and implement the programmes in addition to identifying the stakeholders, we also need to understand the concept of the river basin, ecosystem, the interconnection, river concept, river address, health assessment check and action as well as the outcome of our action which will be explained in detail during the On-site Practical Field Training and in the River Care Action Guide Book. The details are also included in Module 5.

Everyone have to understand that river management cannot depend solely on the government only. Communities must be involved in the river basin management and report illegal activities (e.g. Pollution activities in the river) or to mitigate the polluted areas/condition. Cooperation between the government, private sector and community is the key to successful river management. However the real stakeholders/beneficiaries are flora and fauna followed by humans (**Figure 14**). Therefore humans have to protect the flora and fauna to ensure the resources are available for their usage.

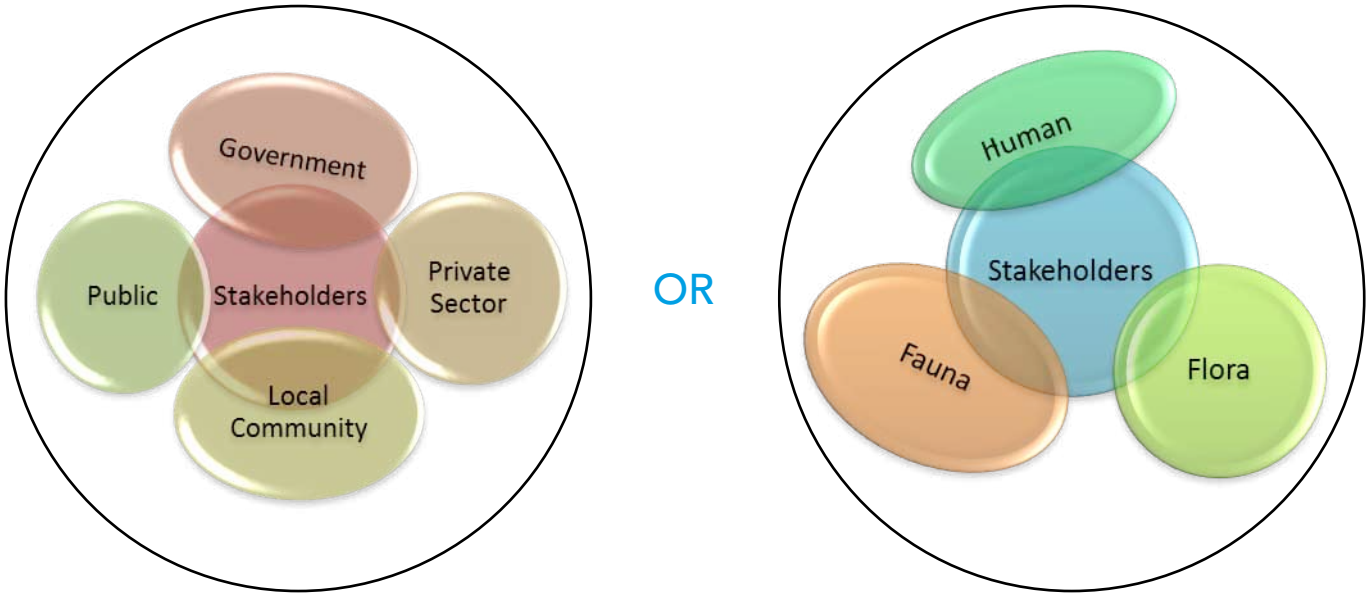


Figure 14: Who are the real stakeholders?

4.3 SMART Partnership

SMART Partnership is when the responsibility for the management of rivers has now been widely recognized that unless a broad range of stakeholders including many government agencies, service provider, politician, general public, private sector, local communities and NGOs become actively involved – efforts towards river management with be neither successful nor sustainable (Bent Lauge Madsen, 1995a, 1995b).

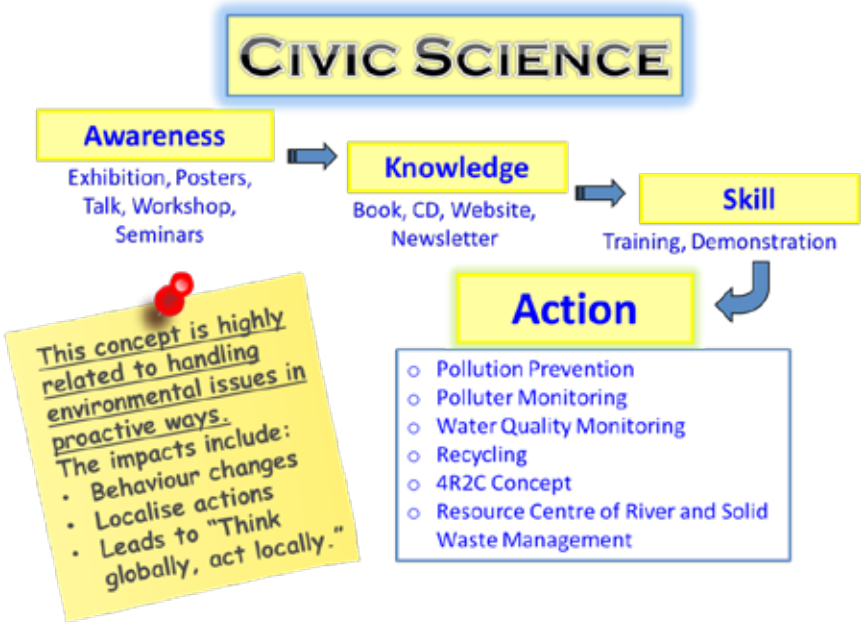


Figure 15: Civic Science Approach

In order to ensure the SMART Partnership is able to be sustained, participation of the local communities is importance. The community need to be empowered with civic science approach This is carried out by providing knowledge and basic skills to assess, identify, understand, resolve, restore, rehabilitate and monitor the river basin (**Figure 15**). Knowledge and basic skills will be provided to assist, initiate, and motivate the public to participate in activities and/or initiate actions to safeguard the environment and acknowledge their achievement.

4.4 Formation of RIVER Ranger 2.0 team

River Ranger 2.0 Programme involves four easy steps. This chapter provides a vital step-by-step guide on how to start to mitigate environmental issues which in this case – i.e.: river issues.

1. Identify a localized issue

It is important to identify an issue in the targeted project area because this will capture and sustain the participants' interest. Try to think of a problem that gives a direct impact on daily lives that needs to be and can possibly be solved. You might be aware of the problem but you may not know how to solve it.

By identifying the localized issue and providing solution, people will be more willing to join you because they too are aware of the issue. To identify a localized issue, conduct a pre-assessment study or survey or go through the internet or simply find through the issues raised by mass media.

2. Establishing the core members of a RIVER Ranger 2.0

STEP 1: SELECTION PROCESS

This step involves the establishment of a working group to plan and implement the actions. Local communities, education institutions, private sectors or agencies have to identify the core members ideally 5 - 20 to participate in the programme. (Take note: in a community or organisation this can involve parents/leaders and children. The option of setting up teams or committee depends on the scale of the problem to be solved)

STEP 2: SUPPORT GROUP

Once the core members have been decided, they must set up the RIVER Ranger club or a specific team that solely focused on being RIVER Ranger 2.0. This group will then have to set up a small working committee. The support from the main committee, community or school is important to ensure that the programme gets full cooperation from everyone. Other support groups includes community management, and local government, environmental steering committee or local politician.

STEP 3: TRAINING

The selected members will be trained by qualified RIVER Ranger Trainers or GEC based on training modules prepared by the latter. Upon completing the modules, they will be given a certificate of recognition and they will be fully certified RIVER Ranger. As RIVER Ranger, they are responsible for educating new members, their communities, and/or fellow students in their respective schools on water resource management, water conservation, and sustainable water usage as well as on wastewater management. At the same time, the Rangers will be able to monitor and help conserve their local rivers and its basin. They should also prepare a Local Action Plan for their next course of action.

4.5 River Conservation and Community Participation

GEC believes that empowering the communities with the knowledge and skill to handle water and river is essential if we are to be a responsible and sustainable nation within regards to river management. Conservation, rehabilitation and protection actions preferred in handling environmental degradation are to be tackled as 'prevention rather than cure' through proactive communities' involvement.

The main objective of involving the communities in our river conservation and restoration programme is to enhance awareness of the importance of sustainable river management (protection, conservation and rehabilitation) by providing knowledge and basic skills to assess, identify, understand, resolve, restore, rehabilitate and monitor river basin. Knowledge and basic skills provided will assist, initiate, and motivate the public to participate in activities and/or initiate actions to safeguard the environment and acknowledge their achievement. Formation of the community in River Conservation and Restoration Programme is as per **Figure 16**.

Figure 16: Flow of the Communities in River Conservation and Restoration Programme

4.6 Community Preparedness in Flood Proofing and Adaptation for Climate Resilience

It is important for the communities to know the importance of being prepared to face the flood before the flood as help for the victim usually comes during and after the disaster. Therefore the hands-on trainings are focused on the followings (please refer to GEC's FLOOD Ranger hand book for details):

4.6.1 Town watching/ Flood Hazard Mapping

The Flood Hazards 'Town-watching' training focuses on identifying the routes travelled during disasters such as flooding and its consequences. Mapping conducted based on the concept of flood hazards 'township' safe passage using the sketch map as localized flood preparedness measures. This will allow the communities to ensure the route is maintained for evacuation and to ensure the message delivered to the respective community/residence.

4.6.2 Flood e-Map

How to access online information about the status of flood, developing flood e-Map, Flood Alarm and Alert system, in addition to how to read the flood benchmark and exposure to Standard Operation Procedure (SOP) in flood detention ponds during floods. This is importance for the communities to keep track of and be well versed in the mitigation and alert systems developed by the relevant agencies to assist the communities during disaster.

4.6.3 Provision of 'Grab Bag' and 72H Kits

Grab Bag is a vital bit of kit to have prepared and ready to take in the event of an emergency. 72H (hours) kit is a kit that you can carry it with you if you ever need to evacuate your home. It is also important to prepare one for each member of your family who is able to carry one.

4.6.4 Water Treatment Apparatus:

Boiling and chemical treatment are two common methods used to effectively to disinfect small quantities of filtered and settled water. However this can be tricky during flood. Currently, there are various tools and apparatus available to treat the drinking water during the flood (please refer to GEC's FLOOD Ranger hand book for details):

Module 5
River Care Action Guidebook

River Care Action Guidebook was developed to assist the RIVER Ranger programme carried out at the site. The RIVER Ranger programme was initiated by Global Environment Centre in 2004. RIVER Ranger is a comprehensive program on water resource management, which focuses on rivers and river basin management. It also emphasizes not only about water pollution but every aspect of freshwater ecosystems including the functions, values, biodiversity and benefits to mankind The followings are being highlighted in the RR 2.0 River Care Action Guidebook as detailed out below.

5.1 River Care, We Care

There are various elements that can be implemented under the RIVER Ranger Initiatives. Overall it can be covered by 4R2P approach. The initiatives are based on the river basin; river address; catchment; conservation; rivers rehabilitation; pollution management; river adoption or/about drain.

5.1.1 River Initiatives

Can be focused on any type of activities or programmes centered on creating awareness through training and workshop, Capability building to build the team and engage them. Activities focused on specific targeted issues/area; drainage system, pollution reduction, rehabilitation, protection and conservation, adoption or auditing and monitoring.

5.1.2 River Action

Can be focused into two main categories (a) protection of clean surrounding/stream where pollution is yet to take place; (b) rehabilitate or restore the condition of the polluted or affected stretches of stream, river or ecosystem to ensure the ecological integrity of the area being restored. The actions that can be taken to address the issues but not limited to are listed on the right.

5.1.3 River Monitoring and Reporting

River Monitoring is carried out through three methods: Physical, Chemical and Biological Monitoring which generates the RIVER Ranger Index (RRI). The RRI will be used to assess the river health of the stream/river monitored. In order to ensure a database of the data is available for reference and future sure, the data were included in the RIVER Ranger Monitoring Database (www.riverranger.my). Detailed monitoring techniques and guideline is available in GEC's RIVER Ranger 2.0 River Care Action Guidebook.

5.1.4 Environmental Education Programme

Scope of education programmes are based on resource management and brown issues, i.e.: Green issues: forest and water resource protection and conservation activities or brown issues as water or river pollution as well as solid waste issues. Engagement can be through education base - incorporate into existing education module and syllabus or through co-curriculum or event/activity based as below.

RIVER ACTION

CONSERVATION

- PROTECTION
- RESTORATION
- BIODIVERSITY CONSERVATION
- EXPEDITION

REHABILITATION

- POLLUTION REDUCTION
- WATER QUALITY IMPROVEMENT
- HABITAT CREATION / ENHANCEMENT
- RIVER FLOW / HYDROLOGY

CLIMATE CHANGE RESILIENCE

- FLOOD
- DROUGHT
- ISLAND ISSUES
- MARINE (GARBAGE PATCH)

ENVIRONMENT EDUCATION PROGRAMME

EDUCATION

- GENERAL ENVIRONMENT
- SPECIFIC RESOURCE
- SPECIFIC ISSUES
- SPECIFIC ENVIRONMENTAL DAYS EVENT

ACTIVITIES

- SMART RANGER, RIVER RANGER, ISLAND RANGER & DRH2O
- ESTABLISH ENVIRONMENTAL PROACTIVE COMMUNITY GROUP
- YOUTH PROGRAMME
- CORPORATE SOCIAL RESPONSIBILITY (CSR)

5.1.5 Capacity Building

Establishment of Environmental Proactive Community, which work together to identify and initiate action plans to address the issues within the respective areas. in additon to the foramation of friends of communities, religious groups, education accosiation, community based organisation and other NGOs also were engaged to conduct programmes. Currently we are moving towards an umbrella groups of Friends of Rivers.

Friends of Rivers in Malaysia

Friends of Sungai Nenggiri

Friends of Kelana Jaya Park

Sahabat Komuniti Sungai Way

Religious Groups

Education Association

CBO/NGOs

5.1.6 Environmental Days

Conduct environment related activities in conjunction with World/National Environmental Days.

World Wetlands Day February 2	Global Recycling Day March 18th	World Water Day March 22
Earth Day April 22	World Biodiversity Day May 22	World Environment Day June 5
World Oceans Day June 8	World Cleanup Day Third Saturday in September	World Water Monitoring Day September 18
World Environmental Health Day September 26	World Rivers Day Last Sunday of September	World Habitat Day First Monday of October

5.1.7 Resource Management

The 4R2C Approach (Rethink, Reduce, Reuse, Recycle, Compost and Close the loop) of the SMART Ranger programme developed by GEC were used to implement the initiatives undertaken under the pollution reduction component. The approach, in addition by ensuring the rivers are protected from trash mainly recyclables and organics waste by reducing the amount of waste that ends up in the river and landfill also supports to generate alternative income for the communities and schools.

ZERO WASTE CONCEPT

USING 4R 2C APPROACH

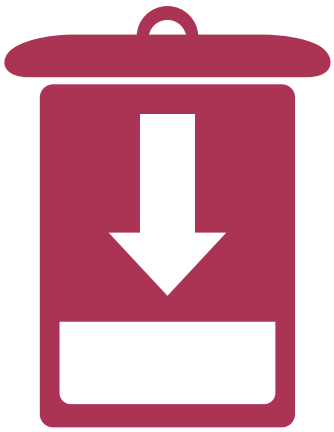
YOU CAN ACHIEVE A ZERO WASTE LIFESTYLE BY FOLLOWING THESE 3 SIMPLE STEPS!

WASTE MINIMIZATION

USE LESS!

You do not need to use everything that is given to you. Instead of using several pieces of tissue, just use a hankerchief. Bring your own tupperware to pack food from the stalls or a basket or a re-usable bag instead of using the plastic bags to hold your groceries.

IT IS AS EASY AS THAT!



WASTE MANAGEMENT

PRACTICE THE 4R2C CONCEPT!

RETHINK: do I really need it?
REDUCE: buy less!
REUSE: be creative!
RECYCLE: papers and the rest!
COMPOST: your fruits and veggies!
CLOSE THE LOOP: buy recycled items!

OFFSET YOUR WASTE

PLANT TREES or buy carbon credits to offset your carbon emissions produced from your waste!

MAKE THIS YOUR GOAL TODAY AND TOGETHER, WE CAN BUILD A BETTER FUTURE!

River Care
WE CARE

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