MINISTRY OF ENVIRONMENT AND WATER

DEPARTMENT OF IRRIGATION AND DRAINAGE MALAYSIA

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UNDP

Global Environment Centre

GUIDELINE:
MAINSTREAMING BIODIVERSITY CONSERVATION INTO RIVER MANAGEMENT

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CONTENTS

ABBREVIATION

AIS	Alien Invasive Species
BMPs	Best Management Practices
CBOs	Community-Based Organisation
CSR	Corporate Social Responsibility
DBKL	Kuala Lumpur City Hall / *Dewan Bandaraya* Kuala Lumpur
DID	Department of Irrigation and Drainage
DoA	Department of Agriculture
DoE	Department of Environment
DoF	Department of Fisheries
DSK	*Denai Sungai Kebangsaan*
EPU	Economic Planning Unit
FoKRB	Friends of Klang River Basin
FoSK TMR3	Friends of Sungai Klang Taman Melawati River Three
FoSP	Friends of Sungai Penchala
FoRs	Friends of Rivers
FTKL	Federal Territory of Kuala Lumpur
GEC	Global Environment Centre
GEF-5	Global Environment Facility
IRBM	Integrated River Basin Management
IUCN	International Union for Conservation of Nature
IWK	Indah Water Konsortium
JAKOA	Department of Orang Asli Development / *Jabatan Kemajuan Orang Asli*
KASA	Ministry of Water and Environment
KeTSA	Ministry of Energy and Natural Resources
LA21	Local Agenda 21
MPAJ	Ampang Jaya Municipal Council / *Majlis Perbandaran* Ampang Jaya
NBN	National Biodiversity Council
NbS	Nature-based Solutions
NPBD	National Policy on Biological Diversity
NGOs	Non-Governmental Organisations
NRCF	National River Care Fund
OA	*Orang Asli*
PPP	Public–Private Partnership
PPR	*Program Perumahan Rakyat*
ROLPOP	River of Life Public Outreach Programme
PMU	Project Management Unit
PSC	Project Steering Committee
PWC	Project Working Committee
PWG	Project Working Group
RAs	Residents Associations
ROL	River of Life
RRI	RIVER Ranger Index
SDGs	Sustainable Development Goals
TOL	Temporary Occupation License
UNDP	United Nations Development Programme

MANUAL GUIDE

The Guideline for Mainstreaming Biodiversity Conservation into River Management is developed by the Department of Irrigation and Drainage (DID) Malaysia and Global Environment Centre (GEC), initiated by the Mainstreaming Biodiversity Conservation into River Management Project. The project was implemented by DID Malaysia and the Ministry of Water and Environment (KASA) with the funding provided by the Global Environment Facility (GEF-5) with the facilitation by the United Nations Development Programme (UNDP).

The Guidelines focuses on mainstreaming biodiversity conservation into riverine landscapes in Malaysia, through improved river planning and management practices whilst highlighting Best Management Practices (BMPs) for critical riverine habitats. The pilot sites highlighted in this guideline are Upper Kinta River, Perak and Klang River Basin, Selangor/Federal Territory of Kuala Lumpur (FTKL). The aim of this project is to address the root causes and challenges of the conversation of riverine biodiversity through the development of strategies and the promotion of BMPs as well as capacity building for stakeholders. However, the finding of the project differs from one site to another due to the differing nature of each basin. While Upper Kinta Basin focuses on strengthening biodiversity management through improved water reservoir catchment and slope management, Klang River Basin emphasises more on integrating riverine biodiversity and habitat management into planning and implementation of urban river management. The guideline also highlights the initiative undertaken through government-initiated public programme.

The guideline highlights that mainstreaming biodiversity conservation can be, and is being, achieved in many different ways, at different scales and within different tiers of stakeholders i.e. government, private sectors, community-based Non-Governmental Organisations (NGOs) and Community-Based Organisations (CBOs). At the national level, it can work both ways — learning and serving as examples on mainstreaming biodiversity at different levels of government institutions. It is also made possible through community engagement and private partnership. Taking into account that the consultation and the engagement shared refers to different landscape and objectives, they can be localised to fit the need. The overarching message of the guideline is that stakeholder engagement should be the key towards sustainable river management and as such, should be the central of Mainstreaming Biodiversity Conservation into River Management.

The content of the Guideline is segmented as per the below chapters:

Chapter 1 - Introduction to the river components and its biodiversity focusing on the concept of environment and its beneficiaries.

Chapter 2 - Highlights of river health components and the roles of key stakeholders in different platforms including strategies to be used during stakeholder consultation, community engagement and empowerment.

Chapter 3 - Findings of case studies from pilot sites and the initiatives undertaken by the local communities.

Chapter 4 - Recommendations and the way forward on the expansion and duplication of the BMPs to mainstream the biodiversity conservation action plans.

This guideline serves as a reference and is the on-the-ground practical guiding material based on DID Malaysia and GEC's years of experience on community engagement for sustainable management of rivers. This guideline will also act as a model for future initiatives in mainstreaming biodiversity conservation. Practical modules and additional information are available to support and encourage the execution of the initiatives. Scan the QR codes provided at selected sections of the guideline for relevant reference materials.

CHAPTER 1:
RIVER AND BIODIVERSITY

1.1 Defining Biological Diversity

Rivers are the core of biodiversity that provides us water, nutrients and livelihoods. The rich biodiversity of rivers reflects the diversity of environments they flow through. "Biological diversity" is defined as the variability of living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part of, including diversity within species, between species and of ecosystems (Convention on Biological Diversity, 1992).

Biological diversity plays a critical role in underpinning ecosystem services. The direct causes of biodiversity loss and ecosystem service changes are habitat change (such as land use changes, physical modification of rivers or water withdrawal from rivers, loss of coral reefs, and damage to sea floors due to trawling), climate change, invasive alien species, overexploitation, and pollution.

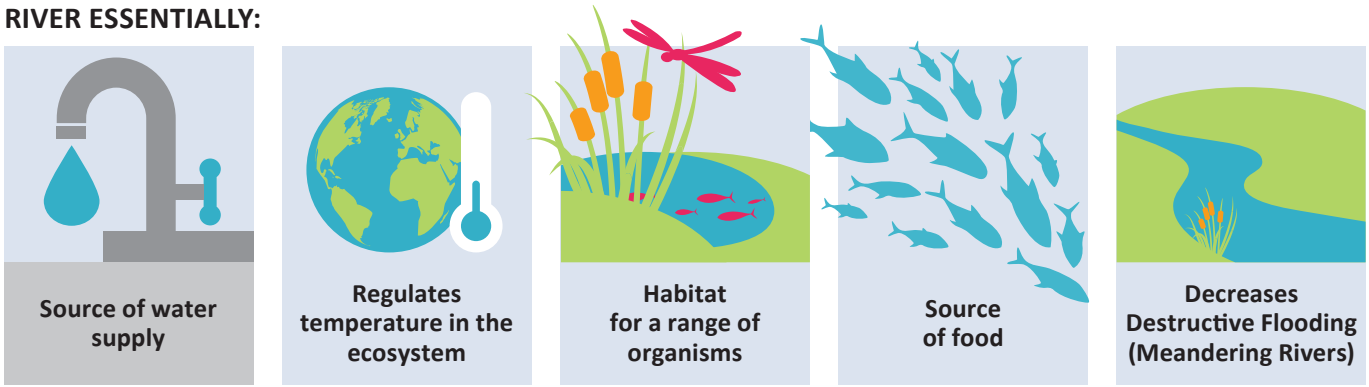
If we fail to account for ecosystem services — invest in them, protect them and sustain them — we will no longer be able to rely on them for our water security and sustainable development.

If we invest in nature and its services, it will offer us solutions for water security and other development challenges.

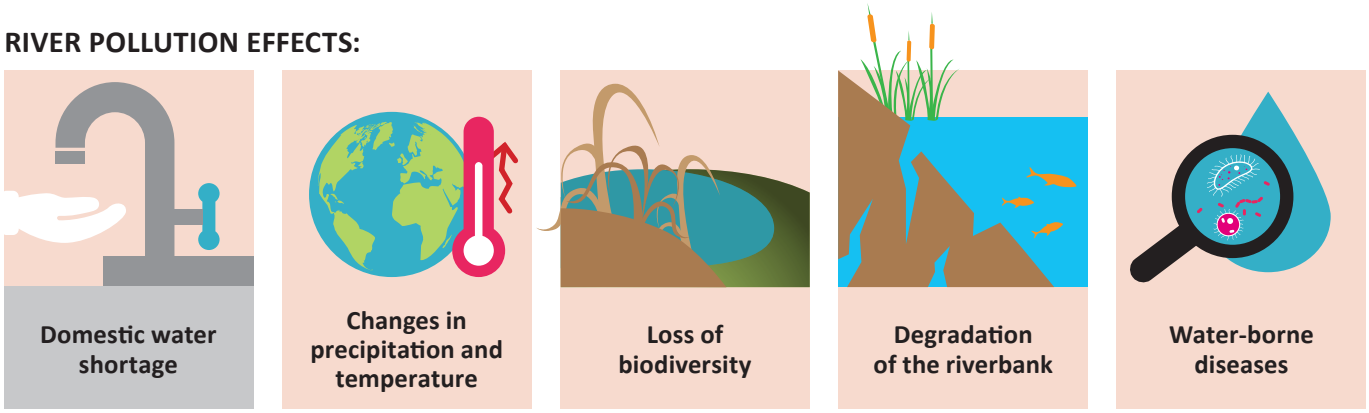
Quoted from International Union for Conservation of Nature (IUCN) 2013

The deteriorating biodiversity significantly impacts the health of rivers, climate change resilience, disrupts functions of the riparian zone in maintaining the balance in nutrient cycling, water quality, bank stability with the added anthropogenic pressures from loss through rapid industrialisation and urbanisation. At the upper basin, the remaining catchment forests are impacted by highway constructions, land clearing, and development schemes which also lead to pollution and siltation of the river system. Meanwhile, the lower river basin is impacted by pollution, port, and housing development which affect the mangroves and the estuarine ecosystem.

RIVER ESSENTIALLY:



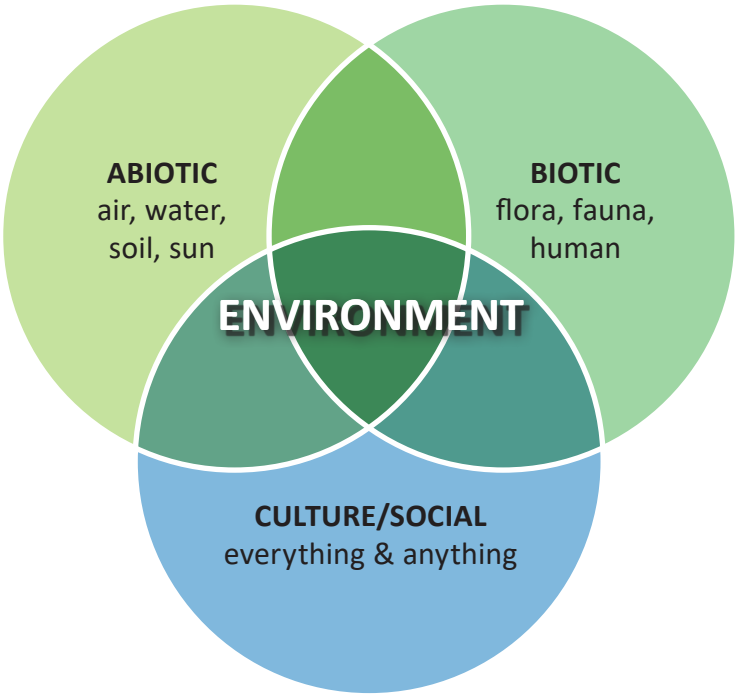
RIVER POLLUTION EFFECTS:



In summary, the increase in clean water demand, overuse, and unmanaged water services will lead to various environmental pollution issues such as water quality, climate change, and anthropogenic effects. Rivers and biodiversity are two major components which are interdependent whereby disruption on either of these components will lead to the disturbance of the environmental services. Giving the significance of Biodiversity, there is an utmost need for it to be re-streamed into the field of river management as this component has been largely disregarded in the current model/operation of river management. The adoption of the component of Biodiversity into the current model/operation of river management will ensure the sustainability of the ecological cycle in the long run.

1.2 Environmental Components

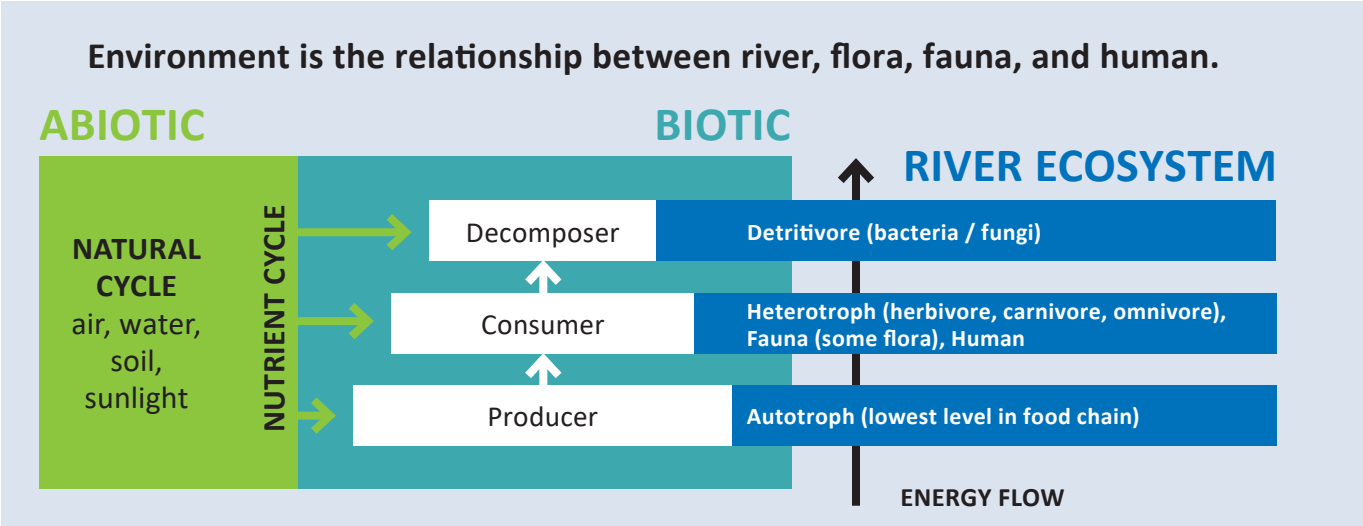
Environment is a general term that describes all of our surroundings, including natural forces, conditions, and the whole interrelations and interactions that affect the growth, health, as well the progress of someone or something. Elements that make up the environment components consist of physical and biological attributes. These attributes and elements are also referred to as the ABC of the environment:



A (Abiotic): limiting factors which, their quantity and quality determine the survival of living things in an ecosystem, i.e., water supply, land form, and soil types etc.

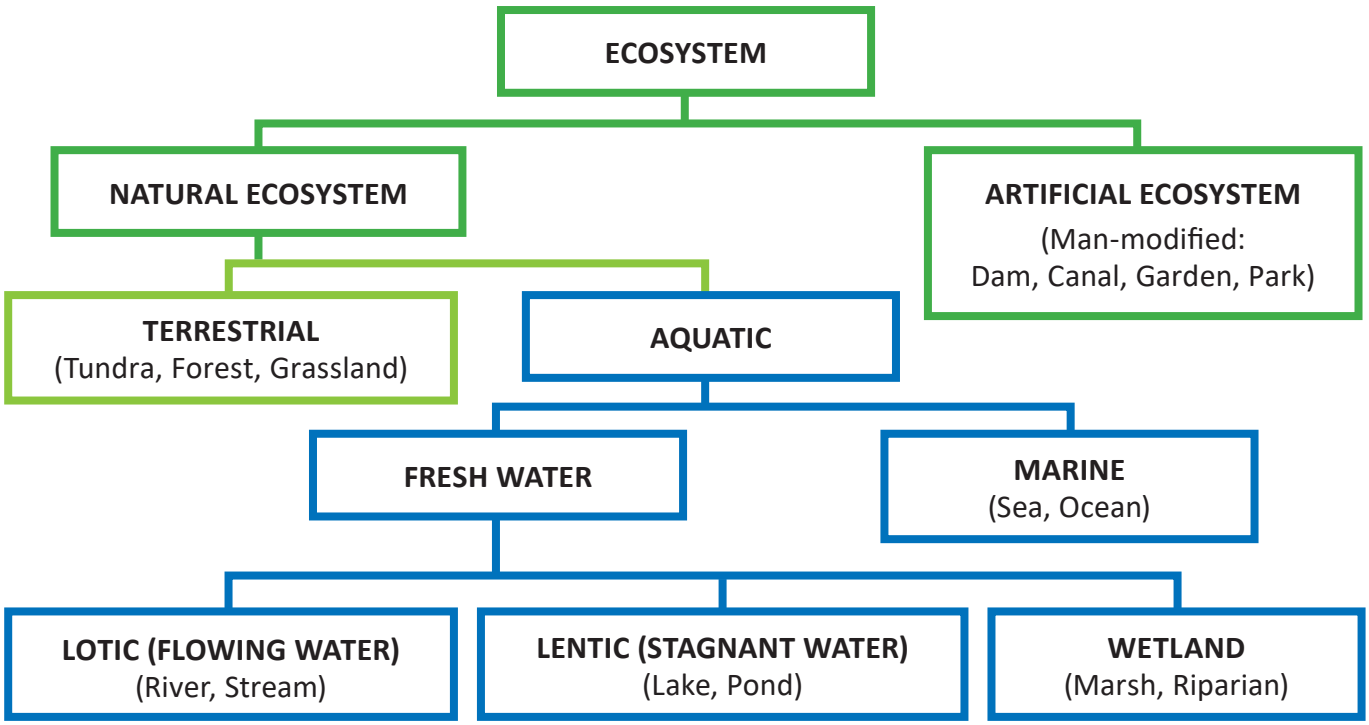
B (Biotic): biological concepts as communities, populations, diversity, competition, prey-predator relationships, and energy transfer - food chains, webs, pyramids.

C (Culture/Social): the surrounding - focusing on anything and everything. An example of Culture includes how people utilise their environment: land use, resource consumption, transportation, waste management, pollution, environmental planning and design.



1.3 Ecosystem and its Services

The Convention on Biological Diversity (1992) defines an ecosystem as "a complex of living organisms and the abiotic environment with which they interact in a specified location." Ecological functions are the interactive physical, chemical, and biological processes that contribute to the natural maintenance of ecosystems. Ecosystems vary enormously in size: from a temporary pond in a tree hollow to an ocean basin. Ecosystems can also be grouped into two categories, namely natural and artificial or manmade as shown below:



Aquatic ecosystem is an ecosystem in and surrounding a water body, and is the largest of all the biomes, covering about 75% of the Earth's surface. The aquatic ecosystem is divided into two categories: freshwater and marine. Typically, freshwater habitats are less than 1% salt. The freshwater ecosystems includes the lentic (slow moving water, e.g. ponds and lakes), lotic (faster moving water, e.g. streams and rivers) as well as the wetlands (areas where the soil is saturated or inundated most of the time). The freshwater ecosystems are quite diverse and support a variety of animals, plants, fungi, protists, and prokaryotes.

The gravitational movement of materials in drainage waters from terrestrial ecosystems to aquatic ecosystems is the major land-water linkage in the biosphere, thus both the ecosystems are interlinked. Disturbed humid terrestrial ecosystems lead to losses of water, nutrients, and particulate matter of the aquatic ecosystem. Each organism has a role to play and contributes to maintaining the health and productivity of an ecosystem. Through observation, it is evident that the deterioration of the environment is caused by human and their activities such as rapid and unsustainable development which lead to the disruption of natural ecological cycles (e.g. hydrological, carbon and nitrogen cycles, biogeochemical cycle).

Ecosystem services are a set of ecosystem functions that directly or indirectly benefit the well-being of human or enhance their social welfare. The Millennium Ecosystem Assessment (MA), a major UN-sponsored effort to analyse the impact of human actions on ecosystems and human well-being identified four major categories of ecosystem services: provisioning, regulating, cultural,and supporting services. An example of the ecosystem services is illustrated in **Figure 1** while the localised ecosystem of the Upper Kinta River Basin is as per **Figure 2.**

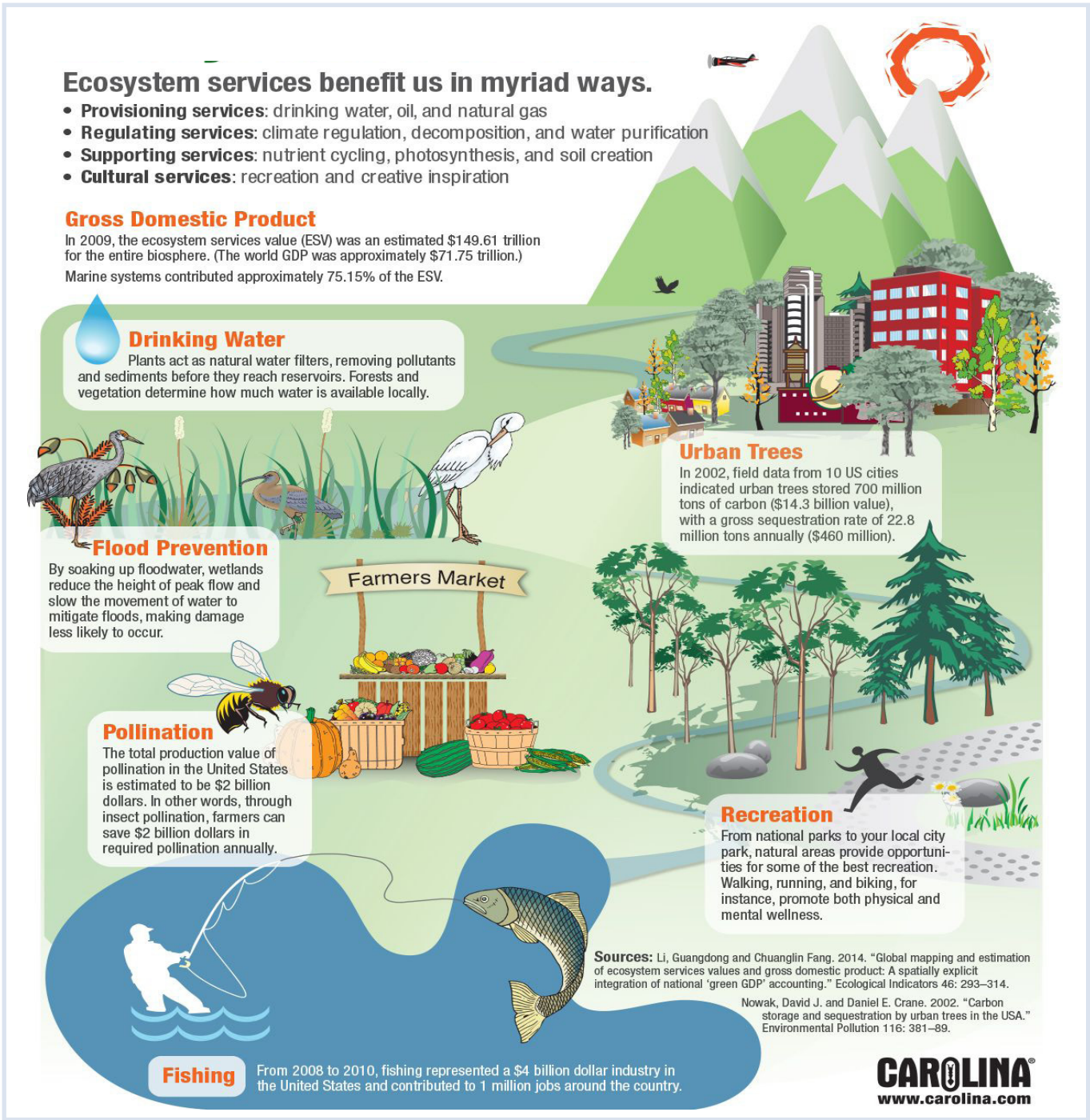


Figure 1: Ecosystem services in Carolina.

Drinking water protection

Additional natural filtration and enhanced accessibility to potable water supply for 8 villages.

Slope protection for soil erosion, biodiversity enhancement, and protection

Climate regulation

Community-based rehabilitation efforts through tree planting activities at Kampung Makmur and Simpang Pulai Highway (selected stretches).

Capacity building in river and biodiversity protection

Communities are able to relate and well-versed on the importance of river health, biodiversity protection, and monitoring.

Community-based ecotourism/recreation

i. i. Enhancement of ecotrail from Kampung Tonggang to Mount Korbu.

ii. Training of the Indigenous (Orang Asli) community members as tour guides and porters (Malim Gunung) and to manage facilities and activities.

ii. Establishment of a mountain bike ecotrail and an ecotourism outdoor recreational space along the Seno'oi riverbank.

Food security

Alternative livelihood for KRT Klebang Selatan through community-based business model.

Figure 2: Ecosystem services adapted at the Upper Kinta River Basin.

The symbiotic relationship between water, environment, and sustainable economic growth are now part of the conventional water wisdom. Water, unlike any other natural resources, impacts every aspect our lives be it in the domain of society, environment or even our wellbeing. Water is embedded in all aspects of natural resources management for inclusive and sustainable growth, in energy, agriculture and other productive activities as well as in sustaining the ecosystems that everything depends on (GWP, 2012).

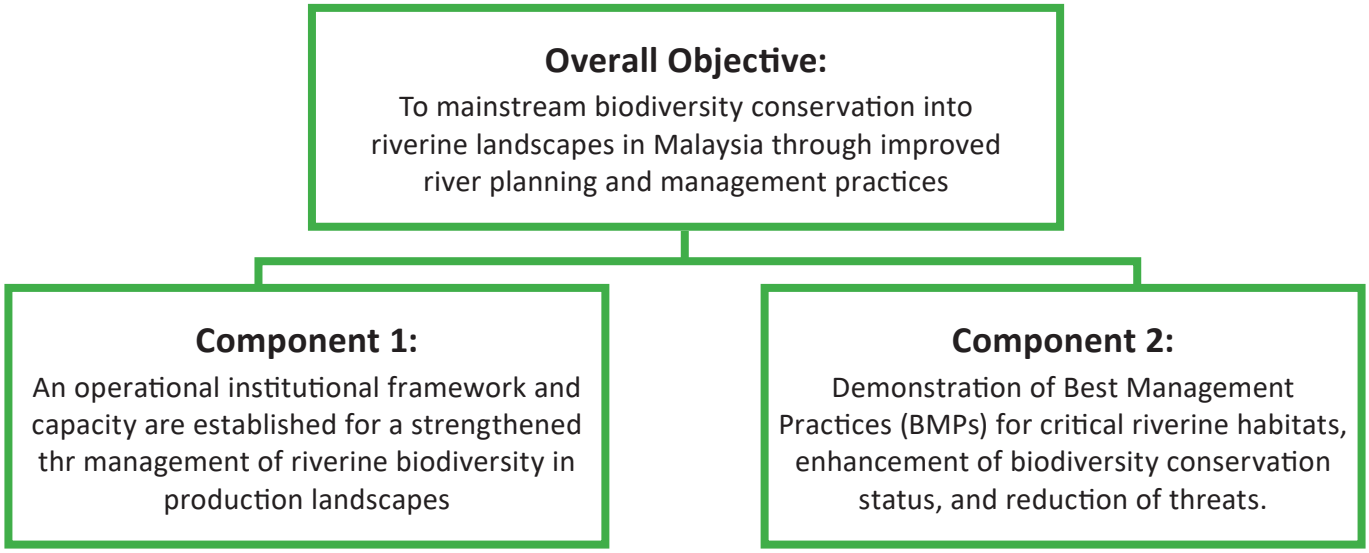
1.4 Gaps identified in River and Biodiversity Management

There are very limited works or available scientific case studies that promote to mainstream biodiversity conservation into river management. This is mainly due to the central focus on national policies, local plans, individual business practices, and cross-cutting development plans. The mainstreaming of biodiversity conservation into river management must include approaches that optimise resources - enable economies of scale, stakeholders role and commitment, production of common information materials, and joint activities across all sub-catchments rather than conducting separate initiatives. The Integrated Approach will enhance the quality of results and help ensure sustainability by enabling the development of long-term multistakeholders partnerships. Some of the gaps identified in the riverine biodiversity management include:

- Poor management of water resources continues to threaten the vitality and viability of ecosystem, biodiversity, communities, and cities today.
- Biodiversity and river management are seen as two separate components and divided between different government portfolios.
- The component of biodiversity is not given enough coverage and importance as compared to water supply due to human pressures and policy measures.
- Lack of sustainability mechanisms (financial, human resource, institutional).
- Tendency in assuming that mainstreaming is a top-down hierarchical process (by government initiation and ownership).
- Inconsistant key messages and principles on mainstreaming biodiversity conservation into river management.
- Smart Partnership or collaboration is not prioritised when developing partnerships between key organisations - both governmental and non-governmental as well as other stakeholders.
- The contribution of mainstreaming biodiversity to the SDGs is disregarded and downplayed in the developed policies or in the government initiatives implementation.
- Cost ineffectiveness - similar programmes are carried out through various agencies instead of collaborating.
- No significant data or resources available on invasive fishes and trees in Malaysia. Remote sensing images, phytosociological methods, mapping using ground-based methods need to be implemented.
- Limited capacity building and training for target groups; government officers, communities as well as the public to address management gaps.

1.5 Mainstreaming Biodiversity Conservation Into River Management

Mainstreaming Biodiversity Conservation into River Management in Malaysia is a project under the Malaysian Government with the aim to achieve two main outputs: A focus on the institutional framework and the Best Management Practices (BMPs) in different environmental settings in Malaysia. This approach and the action plan are in line to address the gaps identified in mainstreaming river and biodiversity management in Malaysia.



Source: Mainstreaming of Biodiversity Conservation into River Management in Malaysia Project Introduction by DID Malaysia

The project received support and fostered cooperation with several committees, policies and legislation cooperation from several committees, policies and legislation related to biodiversity in Malaysia such as:

- National Biodiversity Council (NBN)
- Biodiversity Technical Committee of the National Biotechnology
- National Policy on Biological Diversity (NPBD 2016-2025)
- Access to Biological Resources and Benefit Sharing Act (2017)
- Access to Biological Resources and Benefit Sharing Regulations 2020.

"Biodiversity mainstreaming", a process defined as "embedding biodiversity considerations into policies, strategies and practices of key public and private actors that impact or rely on biodiversity, so that it is conserved, and sustainably used, both locally and globally" (Redford *et al.*, 2015). It is designed to change those practices that influence land uses outside of protected areas by demonstrating the importance of conserving biodiversity for achieving development outcomes (IIED and UNEP-WCMC, 2013).

CHAPTER 2:
MAINSTREAMING BIODIVERSITY CONSERVATION INTO RIVER MANAGEMENT

2.1 River Management

River is a living entity and plays a significant role in our daily life. It is entitled to its right to be managed responsibly as humans benefit tremendously from it. The values of river to human well-being extend well beyond its role in supporting life-sustaining functions including mental health, emotional balance, and happiness. In Malaysia, rivers play important roles in the economic, social, cultural, and spiritual life aspect of the people. It serves as a complex balance of the social-economic-ecological system, serving the cultural and religious beliefs, fulfilling the recreational needs, the livelihood dependencies as well as the ecological services of the riverine ecosystem.

However, with the vast development and urbanisation as well as human demand, the rivers are being disconnected from the valley and are losing its natural state. This has led to various pivotal issues such as the deterioration of river water quality, quantity, and biodiversity as well as its aesthetic value. The rivers which was primarily regarded as sources of water is now known as pollution sinks. **Figure 3** shows the transformation of rivers to its current state with a need for rehabilitation.

Figure 3: The adapted and localised conceptual flow of urban river taken originally from Cengiz (2013) & Timur (2013).

Early Settlement

Settlements along the riverbank, promoting agriculture, livestock farm, and transportation mode.

Civilisation

Formation of cities, with proper settlement plans, drainage system, water sources, and economic growth.

Urbanisation

The growth of transportation within industrial cities, population, social, and economic, caused the river to become the nearest dumping and pollutant discharge points.

Downfall of settlement

Deterioration of river water quality leads to the downfall of settlement as surrounding businesses relocate for a better surrounding. The deterioration of the drainage system can cause flash floods incurring causing financial losses.

Upgrading the riverbanks/waterfronts

With the increasing knowledge, to protect the water ecosystem and to promote ecomonic growth through tourism, upgrading efforts and rehabilitation of riverbanks/waterfronts are being proposed and implemented.

Rivers possess the natural capacity to remedy itself through natural self-purification. This capacity enables it to combat pollution as well as to sustain benthic organism within the area. With the increase in population, development, and demands, rivers are losing its natural conditions and are slowly disconnected from the valley. Although the rivers in Malaysia are being restored and rehabilitated, there is a need for the river management to balance the grey components with green infrastructures. Currently, there are more emphasis on hard approach in river management — grey infrastructures compared to green infrastructures. Restoration efforts focusing only on the engineering structures will only lose the natural condition of rivers. River management should be in line with Nature-based Solutions (NbS) for rivers to protect and revitalise it into its natural status.

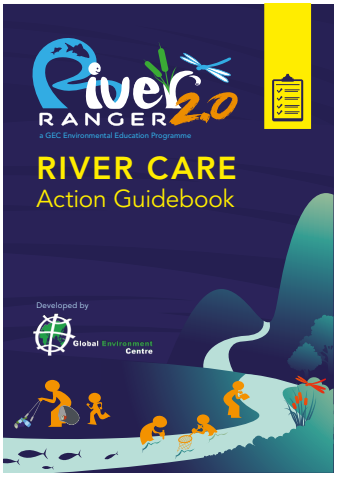
NbS are defined by IUCN as "actions to protect, sustainably manage and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits". NbS is globally recognised for its work with nature, instead of against it, providing platform for ecosystem improvement besides hydrological efficiency, and improving both quantity and quality of water (for issues or management related to the hydrology issues). By infusing NbS into environmental management, it can improve both ecological and cultural values of the ecosystem. Thus, by partnering people with nature to manage our water resources, we are able to empower and engage all stakeholders to be more proactive in protecting and conserving watershed through ownership.

2.2 River Health

River health is the assessment of the river condition (physical, chemical, biological components) in relationship with the environmental variables that affect aquatic biota, such as habitat structure, flow regime, water quality and biotic interactions and biological condition (Norris & Thoms, 1999). This is interrelated as physical and chemical features of the environment affect the biotic indicators, due to human activities. River water qualities are directly attributable to the hydrological variability and in-stream processes as reaeration, nutrient and carbon cycling, which cause daily and seasonal fluctuations in water quality (Aazami *et al.*, 2015; Merz, 2013). Physical and biological characteristics of a river are connected, whereby the pollution loads from the anthropogenic activities, lead to changes in the physical characteristic of the river changes and this affects the chemical balance (Yadav *et al.*, 2014; Chapman, 1996).

In order to monitor the health of a river, there is a need to have a proper monitoring method that captures the physical, chemical, and biological components of the river heath as well as the biodiversity connectivity at the site. One of the proven and widely used citizen science

Scan this QR code to download the RIVER Ranger 2.0 Module.



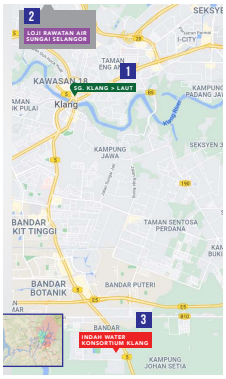
Scan this QR code to download the RIVER Ranger 2.0 Action Guidebook.

monitoring programme in Malaysia is called the RIVER Ranger, developed by Global Environment Centre (GEC) in 2004. The RIVER Ranger is a comprehensive programme on water resource management which focuses on rivers and river basin management. It emphasises not only on water pollution, but every aspect of freshwater ecosystems including the functions, values, biodiversity, and benefits to humankind. With new features and scopes for improvements identified for 15 years, the RIVER Ranger programme has been upgraded to RIVER Ranger 2.0 (RR 2.0) in 2019.

2.2.1 RIVER Ranger 2.0

The RIVER Ranger 2.0 programme emphasised on 4R2P Approach towards a sustainable river management. The Approach focuses on River Address, River Mapping, River Hydrology, and River Monitoring as well as action plans that the emphasis on Protection and Proactiveness. The approach enables the RIVER Rangers (custodian of the river) to learn the river address, conduct river mapping, carry out river hydrology and river monitoring to identify river problems. The content of each programme focus is as per the below description:

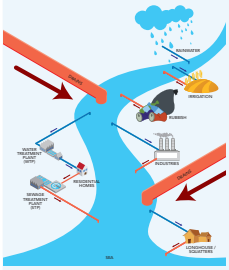
RIVER ADDRESS



River address is as important as knowing our home address as it provides information on the location of the source of water, treated river water supply and where the wastewater is being treated. The questions formulated to obtain these details are as below:

1. What are the nearest river to your home/school/establishment? Which part of the river basin?
2. Where are the source of the water supply/drinking water of your home/ school/establishment (Water Treatment Plant) from?
3. Where the wastewater produced from home/school/establishment being treated (Sewage Treatment Plant)?

RIVER MAPPING



Focuses on mapping the river to include the river address component, identify the physical attributes of the river and its surroundings as well as the issues; possible pollution source, how it impacts the area mapped and possible action(s) to mitigate the impact.

RIVER HYDROLOGY

A study to obtain the health of our rivers and the quality of the river/stream water. The components of this study include the depth and width of the river/stream, velocity, and volume of water (discharge).

RIVER MONITORING

Involves three components - physical, chemical, and biological assessment of the river health monitored to calculate the RIVER Ranger Index (RRI). The RRI is then used to evaluate the riverine biodiversity recorded from the site-based monitoring.

Physical Monitoring uses our senses to observe and test the physical characteristics of a river as a guide to indicate the river's health.

Chemical Monitoring uses the Water Quality Test Kit* containing the tools and chemicals to accurately assess and analyse the river water quality at that point of time.

**not suitable for scientific study, only for education purposes.*

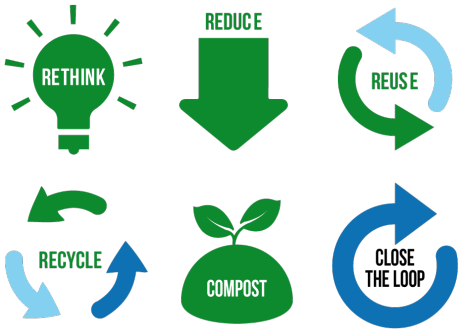
Biological Monitoring observes the life in the river to analyse the river and its basin's health. The macroinvertebrates' presence is used as the river water quality indicator, to show short-term pollution effects.

Biodiversity Monitoring focuses on localised observation during the monitoring period on the presence of any biodiversity which falls in the group of terrestrial and aquatic flora and fauna. The presence of certain species indicates the condition and the ecosystem of the river basin at the monitoring site.

The Protect and Proactive action plan focuses on the action(s) taken to mitigate the impact on the river and its biodiversity. Each action leads to an outcome and the type of action taken indicates whether the outcome is in line to protect the biodiversity or endanger them. For example, a focused action on pollution control can be undertaken at a source and along the river bank. However, proactive action in prevention is more significant as compared to adaptive actions to mitigate the impact. Pollution reduction and proactive actions are part of the mitigation measures encouraged under this approach.

POLLUTION REDUCTION

At the source:



Along the drains and riverbanks:

- Drain/river clean-up
- Plogging
- Pollution Monitoring

PROACTIVE

Ownership
Reconnect with Nature, Stakeholders, River Address, Gazetting

Conservation
Protection, Restoration, Biodiversity Conservation

Rehabilitation
Water Quality Improvement, Habitat Creation/ Enhancements, River Flow/ Hydrology

Waste/Pollution Management
Pollution Prevention, Zero Waste

River Health: Monitoring/ Enforcement
River Condition, Pollution Management

Scan this QR code for more Information on the RIVER Ranger Programme, module, and guidebook.

Information on the RIVER Ranger Programme, module, and guidebook is accessible at www.riverranger.my.

2.3 Stakeholders Role

"As human is the cause of the problem, the solutions also lie with them – through various cap as stakeholders".

Stakeholders are actors who depend on freshwater services from a river basin or are involved in decision making that affect these services. It includes individual citizens, community groups, municipalities, corporations, religious groups and politicians that have a de facto right to the benefits of water as well as non-governmental organisations that have an interest in, and influence over, decisions that affect the basin although not directly benefiting from the ecosystem services at a particular location. They are also the drivers of the environmental management, defined as the individual, people, and organisations who are able to take action or involved in the policy and can be directly or indirectly included in the decision making process.

Figure 4 illustrates different players in different level with varying agendas or interests, with one thing in common - the ultimate player is human (people) with flora and fauna acting as their beneficiaries.

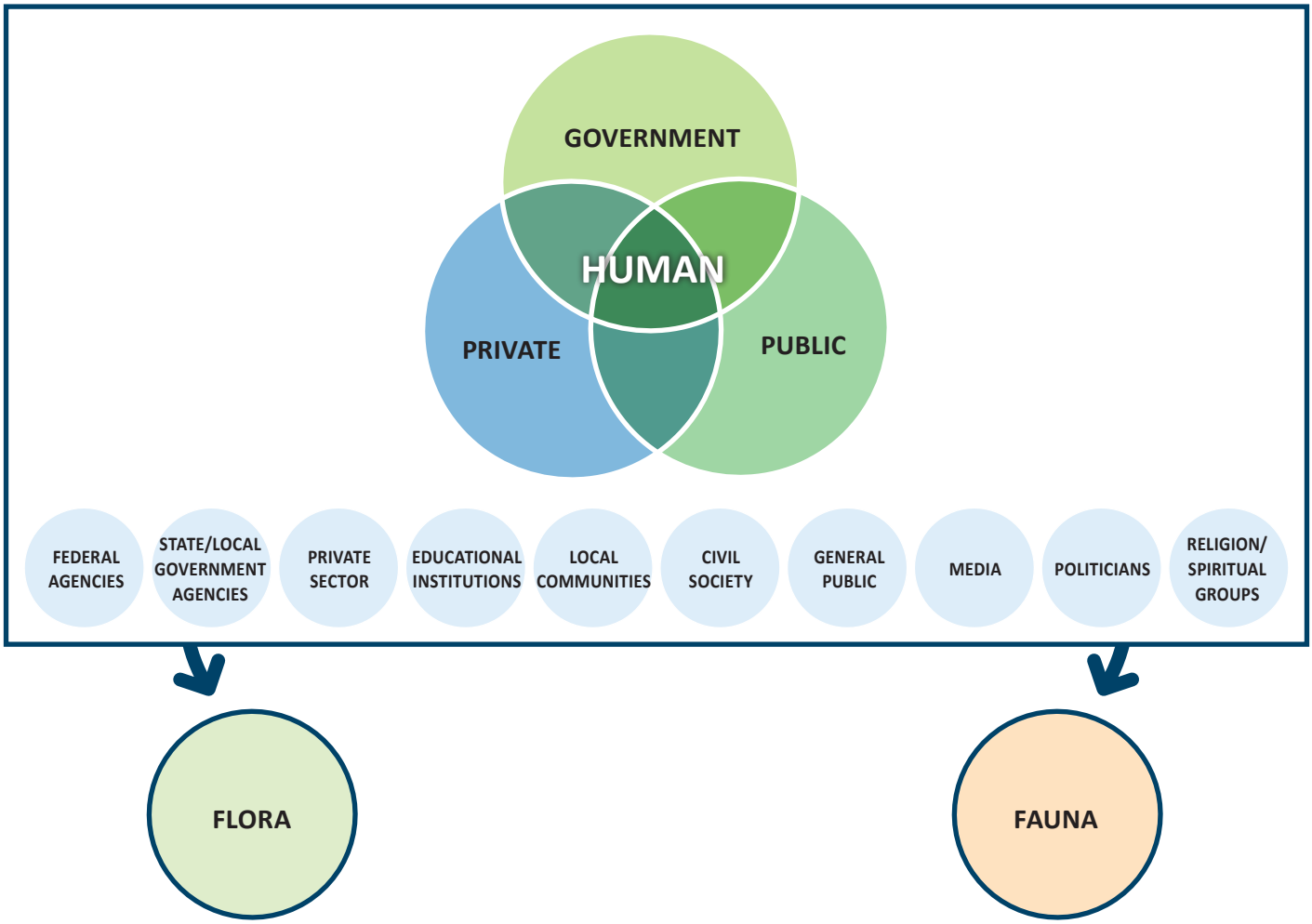


Figure 4: Stakeholder components.

The stakeholders who are connected directly to the environment are the local communities. Communities living along the rivers need to be the key agents for action to mitigate problems related to river pollution. No matter which cap they are wearing in the social and career path, the local communities are the majority, i.e., the receiver and those impacted mainly due to mismanagement of the environment. Therefore, the engagement needs to be interpreted into local conditions or designed through the community involvement with other stakeholders at all times and levels. Empowering the local communities with the awareness, knowledge, and skill will significantly help to mitigate the biodiversity losses that differ according to the specific basin challenges, priorities, and conditions.

The success of the implementation and approaches is strongly related to the support and participation of a large group of stakeholders. Participation of interested partners and supporters will be helpful in terms of publicity and engagement of volunteers to implement the proposed activities to reach a bigger target group. Moreover, involvement of different groups of partners and supporters will provide a good understanding of the contexts and the importance of stakeholder involvement and community ownership. Overall, it leads to a better and more lasting results, where the integrated approach will enhance the quality of results and help ensure sustainability by enabling the development of long-term multistakeholders partnerships.

2.4 Stakeholders Integrated Framework

Each stakeholder will bring an important resource to promote the activities that will lead to a healthy river. For example: the local governments contribute in creating a healthy river policy and governance system; universities and research institutions take charge in monitoring to keep the river healthy; private sector companies revisit and manage their production processes and sponsor programmes that promote healthy rivers. NGOs/CBOs essentially are needed to initiate activities and create groups within and among communities to campaign and volunteer for a healthy river. In addition, it is important to highlight and guide the stakeholders to venture different participation platforms, i.e., education, information dissemination, public advocacy, public hearings and submissions, and litigation. Furthermore, strategic shift from consultation to shared decision-making with respect to environmental management plans at the local level also promotes and encourages multistakeholders's involvement.

Continuous engagements on environmental management is only possible when the stakeholders are interested and accept the partnerships existence within the components of environmental management **(Figure 5)**. This is possible when the information on environmental management needs are attained and the roles and responsibilities of public agencies/local communities and private partners are identified. stakeholders' involvement in all levels of the programme - programme development and implementation, report on implementation progress, involvement in monitoring and evaluation process indicate their commitment and willingness to be a game changer.

Figure 5: Factors that increase multistakeholders participation. Source: GEC.

2.4.1 Mainstreaming Biodiversity by Agencies

In watershed rehabilitation and restoration, government agencies play a significant role not only at the policy level, but also at the on-the-field implementation level. Technically, the governmental agencies focus mainly on the "Hard Approach" i.e. the engineering approach to deal with watershed management and issues through building infrastructure. However, such approach alone is not sufficient as the root cause of the remaining part of the problem after the building of the infrastructure is due to human behaviour and practices.

Smart Partnership mechanism was established and promoted as a focal platform to increase awareness and understanding to establish and share strategies to enhance involvement of various governmental agencies, other relevant stakeholders with local communities, public and media in rehabilitation and monitoring activities, linking on-going programmes among different agencies, information exchange, and technical supports. The partnership emphasises on the engagement of the governmental agencies to significantly contribute ideas and resources towards project implementation to complement their technical expertise with other agencies, with knowledge and skills required to manage watershed in a more natural way. Therefore, the agencies will be able to better understand what is required to manage rivers sustainably and are given ideas about how to initiate and participate effectively in stakeholder participation in watershed management, allow/expose the government officers to the issues faced by communities and provide them with the opportunity to develop solutions for these problems by means that are available to them. It is also an opportunity for the officers to establish network with the stakeholders and therefore, the relevant stakeholders will have direct access/contact with government officers in their relevant agencies. The stakeholders need to be acknowledged and given the recognition and ownership to protect the environment and surroundings while blending well with urbanisation and development in hand with the government/agencies' goal.

Government agencies can also extend their support and acknowledge the ongoing programmes or activities as well as work hand in hand in providing technical support or participate as collaborative partners. Acknowledgement, recognition, and support for the initiatives undertaken by any of the stakeholders especially the public, local communities, and volunteers need to appreciated, acknowledged, promoted, and recognised. Platforms such as River Care Award, Sekolah Lestari, SGDs Awards, World Water Day Award – National Level etc. are examples of recognitions that should be sustained and continued to recognise the efforts of these target groups (players). In addition, financial support, network building among stakeholders and communities are equally important, where platforms such as National River Care Fund (NRCF) by GEC, Local Agenda 21 (LA21) Community Initiatives by the local Authorities, Urban Community Garden Technical Support by the Department of Agriculture (DoA), Friends of Rivers (FoR) being seen as the best available case studies that show the different roles of the governmental agencies in supporting various initiatives undertaken.

Key components of stakeholder engagement by agencies focus on the following processes within **Figure 6** which significantly leads to successful community engagement.

Figure 6: Steps of engagement by agencies.

a) Site Assessment

Conducting an assessment of a particular area is important to identify an issue that needs community engagement. This process also helps to identify the relevant stakeholders to be engaged.

b) Appointment of Desk Officer

Appointing a dedicated desk officer who is not only knowledgeable but highly experienced in working with community groups is important.

c) Identify a Localised Issue

Identifying an issue at targeted project area and providing possible solutions are important. To identify a localised issue, a pre-assessment study, a survey, and research via internet or by observation on the issues raised by the mass media and by any other means of communication is required. Community mapping is also helpful in identifying localised issue.

d) Pre-Consultation Process

It is important to have separate consultations with stakeholders and with community leaders. The relevant stakeholders must be identified, enlightened, and involved at the early stage of implementation phase. It is important to obtain community's consensus before project implementation begin.

e) Compilation of Information and Analysis

Keep record of and compile information obtained during the pre-consultation process with communities and other stakeholders, a short and long-term action plans developed and presented to the targeted group to kick-start the initiatives.

f) Establish Working Group

To kick-start an initiative, establish a formal working committee. The committee members are responsible to plan and implement the actions. All stakeholders need to be involved (government agencies, private organisations, local politicians and leaders as well as communities).

g) Identify Potential Stakeholder

Engage potential stakeholders/partners group(s) by identifying those who are most willing to participate and work together in the project.

h) Consultation with Potential Stakeholders Group(s)

Consult, share, and highlight the issues to the identified potential group as well as enlighten them on the benefits (short and long-term) to get their consensus.

i) Local Facilitator

Appointing a local leader is important as the person will become the focal point of communications. The leader will ensure all activities within the project are accomplished.

j) Empowerment of Local Leaders

Once a local leader has been identified, empower the leader via capacity-buildings (e.g. trainings, workshops, and site visits).

k) Support the Stakeholder-based initiative

Support initiatives being carried out by providing both technical and financial resources.

l) Recognition and Acknowledgement

Recognising the efforts through community-based awards and competitions as well as publicising their efforts by inviting media to cover the events.

m) Incentive Scheme

The government agencies could also look into developing an incentive or award scheme particularly to support and recognise their efforts. Acknowledge the short-term successes as these will indirectly boost stakeholders' confidence and commitment.

n) Monitoring

Project monitoring ensures the effectiveness and sustainability of the efforts. Post-project monitoring indicates that the department/agency has genuine interest in the project and the stakeholders.

o) Reporting

Establish and maintain communications to report the project implementation to the funders/donors as well as the stakeholders/communities, and public through progress or annual reports. Another form is through the publication of books/guides featuring project findings, pamphlets, posters, manuals, and audio-visual materials. Social network platforms like Facebook can be used to share the project's progress.

2.4.2 Mainstreaming Biodiversity by Local Communities

Local community is a major group of stakeholders within a river basin and if mobilised efficiently, they could play a key role in the management of rivers especially in monitoring activities in the river basin. Community action refers to the process of building social relationships in pursuit of common community interests and maintaining local life. Community action is seen as being the foundation of the community development process that represents multiple and diverse interests in the locality, and consequently provides a more comprehensive approach to community development arising from an emotional or social need. Community monitoring can stimulate the interest of public and would help induce ownership of river basin especially in their local catchment area.

Local community engagement is vital to ensure sustainability of the activities and initiatives initiated within the project site. They are the key to safeguard the environment. Human, as the superior being among all living things should protect the environment as it belongs to all. Civic Science Approach which emphasises on the heart approach, recognises the need of awareness, knowledge, and skills for relevant target groups to take actions, which is currently lacking. Therefore, to address and solve the issues at their root causes, localised engagement i.e. among the local communities is promoted. It is important to factor in the humanistic approach, such as the power of the community in alleviating issues for instance, solid waste pollution and river pollution monitoring. The Civic Science Approach (**Figure 7**) highlights the importance of awareness, knowledge and most importantly, the skill to enable communities to take action. For the communities to take action, they need to be empowered and equipped with sufficient information and skills.

The approach enables local actions by reconnecting people back to nature and instil a sense of ownership. In previous generations, the health of the river, the plants or the soil (environment) can be identified by physical observations as there was no required laboratory test or technology available. It is known as traditional knowledge (or backyard science) which was practiced but forgotten over the time mainly due to no scientific explanation or justification given to support the 'theory' or 'concept'. Thus with the components of the civic science, the action can be justified and can now be easily implemented and explained to all.

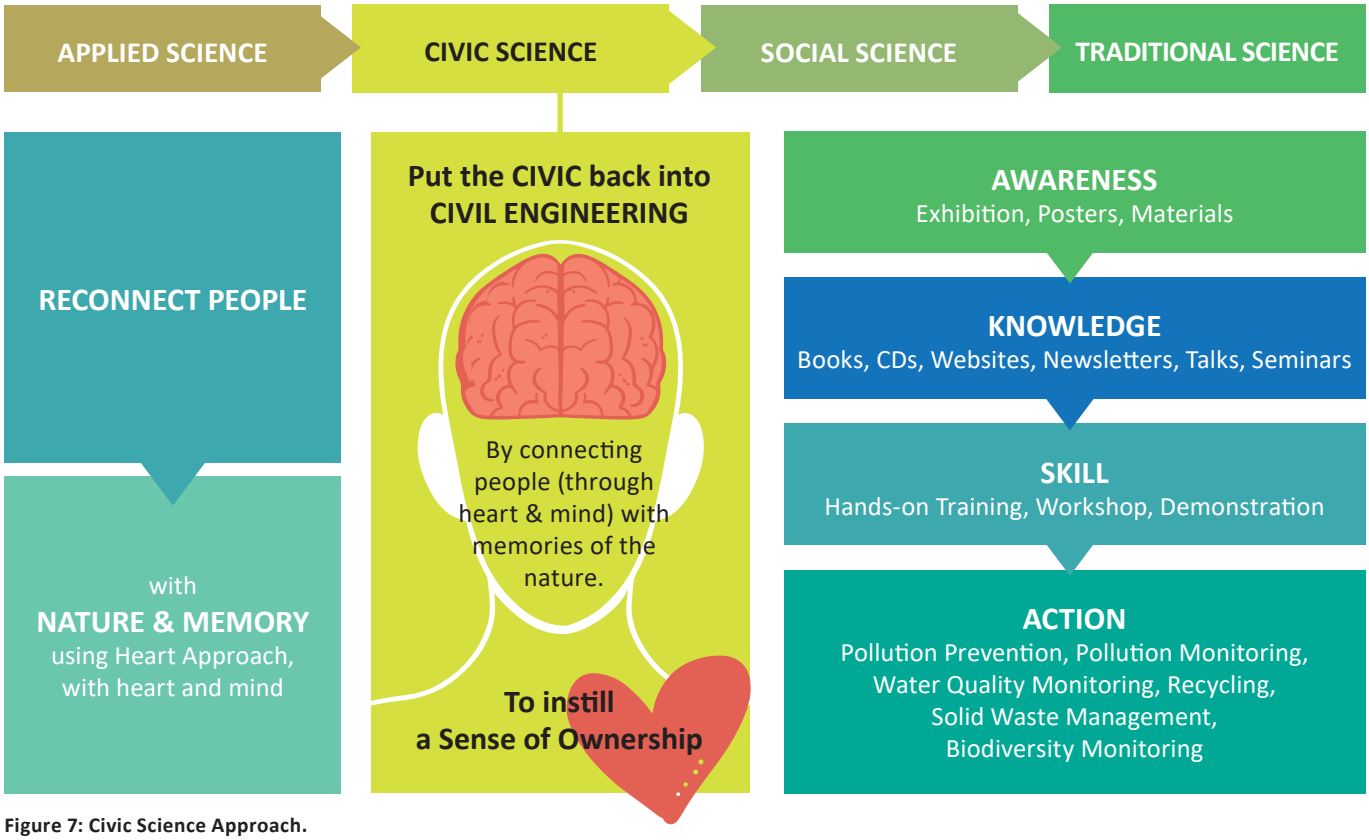


Figure 7: Civic Science Approach.

Balanced “top down” and “bottom up” approaches (**Figure 8**) are the key in ensuring ownership and sustainability. The communities need to be entrusted and given the ownership to adopt and monitor as well as to feel appreciated and needed to play their roles as the stakeholders in watershed protection and management. It is important to address this gap to improve the outcome of any river management project especially on the sustainability aspect.

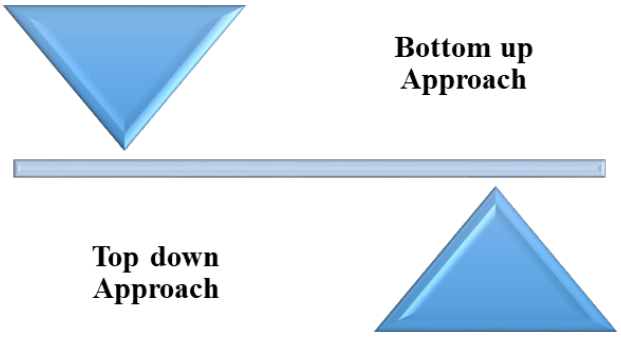


Figure 8: Top down and bottom up approaches.

A good example is the network of Friends of Klang River Basin (FoKRB) and other FoRs which were established under the mechanism. The outcomes include establishing partnership between various local proactive community groups and government agencies for joint adoption, monitoring, collaboration, information sharing, and networking amongst stakeholders as information exchange mechanism to share experience and related lessons learned.

The key components of community engagement for environmental monitoring by community are focused on the following processes which significantly lead to successful community engagements as highlighted in **Figure 9**.

a) Active Consultation

Community engagement is a team work, where a team of like-minded people join hands to address and find solution to the issues. In order to get the support and commitment from fellow community groups, it is important that the targeted groups are well informed and their consensus obtained. The views of the local communities in the targeted area should be taken into consideration before any project implementation while the stakeholders need to be consulted for their consensus and understanding.

b) Rapid Assessment

It is important to prioritise target groups/actions based on the relative pollution contributions. A rapid assessment can highlight and document the key pollution sources. The assessment is crucial in designing a project's initiatives and its implementation plans. The targeted communities can engage and consult with the relevant agencies as well as the polluters to solve key pollution problems and encourage further action. The rapid assessment includes the land use and demographics survey; pollution source rapid inventory; water quality sampling; biological indicator sampling; stakeholder perception survey and the preparation of baseline survey report.

Figure 9: Step-by-step in community engagement.

c) Stakeholder Engagement

Stakeholder consultation of engagement should be an important aspect for collaborations and Smart Partnership among the communities and governmental agencies. Stakeholder consultation helps to understand the interests of the people and analyse the feedback from the local communities, coordinating the needs of the local and relevant issues, and the appointment of the local group leader. Local leader shall be appointed based on the commitment shows to participate in the initiative.

Furthermore, good communications with the stakeholders is vital to:

- ensure all issues concerning/affecting stakeholders are addressed;
- ensure stakeholders understand the efforts being undertaken to resolve the issues;
- ensure that stakeholders' feedback is utilised in improving the management strategies;
- foster a sense of partnership amongst all stakeholders for sustainable approach.

The types of consultation may include (but not limited to):

- Stakeholder workshops
- One-to-one meetings with stakeholders
- Focus group discussions
- Questionnaire surveys

Note: The initiative must be from the communities addressing the issues affecting the environment and to be supported/implemented together with fellow community members. Most importantly, the local leader must be accepted by the community members.

d) Capacity Building

The communities need to be empowered via training and workshop to enhance their knowledge and skills. Such empowerment will enable the communities to identify the issues through the rapid assessment and pollution mapping in developing an action plan. Further to the action plan, the communities will also be able to develop proposed activities and the expected outcome.

Providing the communities with the right monitoring tools is key to community awareness, knowledge, and skills. Community Monitoring Tools (CMT) is designed to allow communities to use their knowledge, skills, and experiences altogether to monitor and record their observations as well as to present pollution-related evidence and complaints to the authorities or identified polluters. WIPSEAS Approach (**Table 1**) developed by GEC is an effective CMT tool to empower communities.

Table 1: WIPSEAS Approach.

W	**Water and river basin education**	Reconnect to nature, river address
I	**Identify and understand the local needs/issues**	Rapid environmental assessment, pollution mapping
P	**Proactive consultation**	At all times and levels
S	**Smart Partnership and stakeholder engagement**	Ownership, public–private partnership
E	**Empowerment**	Training, capacity building, knowledge, skill, tools
A	**Action**	HEART approach, bottom up, NbS, protection, prevention, reduction, rehabilitation
S	**Sharing & Recognition**	Visibility, peer-to-peer sharing, recognition and award

Scan this QR code to access materials developed using the WIPSEAS Approach.

e) Multistakeholders Partnerships

Establishing a Smart Partnership model between government agencies, sectors, and local communities will enable effective implementation of a project as each participating agencies have clear roles to play. This will encourage participation from the public/local community to support the project implementation. Furthermore, the partnership will provide an opportunity for the public/local community to practice their skills and knowledge, stimulate stakeholder contributions, and co-financing. It can also serve as a platform for project stakeholders to share the available resources between agencies. This form of partnership could cultivate volunteerism and outreach partnership.

f) Action Plan (Implementation and Enhancement)

The communities are encouraged to develop small scale and feasible initiatives to minimise the pollution impact on the environment. The action plan should be focused and manageable. There are two forms of engagement; individuals and collective action. Individual action refers to practicable activities to be implemented at home and related closely to the behavioural changes. Examples of individual actions include recycling, composting, used cooking oil collection, rain water harvesting, installation of water thimbles, reduce usage of air conditioning, buy local products and food with lower carbon and water footprint. The same actions can be expanded to community level by encouraging the community members to form a collective action group at a bigger scale.

g) Monitoring and Evaluation

It is important to monitor the actions undertaken by the communities. A joint monitoring programme with the stakeholders and agencies will encourage the communities to enhance their actions and come up with a continuous action plan.

h) Enhancement

Upon monitoring and evaluation, communities can enhance the ongoing action plan to ensure its effectiveness, and sustainability of the initiatives.

i) Visibility

Visibility includes coverage from the mainstream media which involves newspapers, radio and television as well as social media to promote event and feature stories. Project visibility is important to attract attention of the public to join the initiatives. Various platforms can be used to encourage and promote community initiatives.

Scan these QR codes for examples.

Example 1: www.facebook.com/friendsofklangriverbasin

Example 2: www.facebook.com/groups/dagesrid3300

j) Recognition

Recognising the communities' efforts and increasing the publicity of community initiatives are highly important. Several ways to enhance recognition are by inviting the media to prominent events, develop an incentive or award scheme for the community particularly for their support and efforts. It is also important to acknowledge the short-term successes to boost the communities' confidence and commitment.

k) Acknowledgement

Acknowledging that community is the driver of environmental management in Malaysia is pivotal. By encouraging and highlighting their roles and recognising their efforts, more communities will volunteer and significantly play their roles to be part of the actions and solutions to address the environmental management issues.

l) Sustainability

Ensuring the sustainability of a project after its completion is not an easy task. It is paramount in order to ensure the local community's interest remains. The following actions can lead to environmental commitment/sustainability.

- Create a sense of ownership amongst the targeted community members
- Secure sustainable funding through government agencies or private sponsors beyond project's period
- Facilitate the establishment of focused CBOs
- Integrate actions with works of existing groups e.g. Residential Associations (RAs), interest groups etc.
- Associate and collaborate with ongoing activities/programme.

2.5 Partnerships and Key Approaches

Building partnership through the public–private partnership (PPP) or through collaboration with universities and research departments as well as with CBOs, NGOs and other agencies is important and it should be highlighted and given significant visibility to promote the concept to other interested players especially corporate players. The corporate sector plays an important role in addressing the socio-economic challenges in partnership with the governments, through civil society organisations, trusts and private foundations. In an effort to systematically encourage the corporate sector to incorporate environmental sustainability in its operations, various government institutions have issued notifications and guidelines. Some of possible platform or key component to attract business communities to thrive on biodiversity are through:

- Removing direct and indirect subsidies for unsustainable practices - requires a detailed study and review to be included into the policy.
- Creating an enabling framework for sustainable practices by investing in relevant research and development (R&D) - collaboration between biodiversity experts in governments and industry players as well as experts on various production systems and the funding institutions for basic and applied research in a country.
- Ensuring information regarding biodiversity benefits reaches potential users – use institutional links and resources available for sharing and translating relevant research for project uses need to be put in place.
- Creating co-management schemes of multipurpose ecosystems - land use planning process has devised clear rules for land or water usages.

Some of the key approaches applicable on stakeholder’s engagement include hands-on, practical, and close-contact approaches as below:

a) Multistakeholders

- Developing partnership between government agencies, private sector (where possible), NGOs/CBOs, and local communities to address problems and collectively find solutions.
- Enabling effective implementation of the project through clear role of each participating stakeholders.
- Establishing strategic Smart Partnership model between government agencies, private sectors, and local communities.

b) Participatory and Practical Approach

- Encourage participation from public/local community to support the project implementation.
- Focus on practical action for biodiversity protection and conservation rather than theoretical information dissemination approach.
- Provide opportunity for the public/local community to practise their skills and knowledge obtained from the project activity.

c) Involving the Mainstream Media and Social Media

- Involve (where possible) news agencies to promote and cover events and/or feature stories.
- Encourage the use of social media such as Facebook, Instagram, and TikTok to spread message and share success.

d) Active Consultation Process

- Public dialogues and continuous progress section to share the project implementation/feedback from the targeted groups regarding the project.
- Consulting the stakeholders for their consensus and understanding.
- Actively engage responsible government agencies and other key stakeholders in working groups.
- Outreach to public areas.

e) Integrated River Basin Approach

- Initiate actions at the top of the basin and work downwards using source-to-sea and connectivity concepts.
- Prioritise target groups/actions with biodiversity.
- Balance the need of others residing and utilising the resources in the project site.

f) Biodiversity Protection and Conservation

- Identify, document, and highlight key existing natural biodiversity spots.
- Identify and establish new spots of biodiversity within selected Community groups.
- Link and share the information of biodiversity species, areas, and ecosystem within a river basin.

g) Working with On-Going Activities

- Associate and collaborate with any ongoing state/local government/NGO/local communities' activities to help kick-start the project faster and to ensure its success.
- Involve and incorporate activities designed within existing local authorities and other government agencies programmes.

h) Stimulating Stakeholder Contributions

- A platform for project stakeholders to share available resources between agencies which can support the overall project implementation without depending on the project costing.
- Promote Corporate Social Responsibility (CSR) programmes at targeted areas for sustainable approach.

i) Sustaining the Activities beyond the Study Period (Exit Strategy)

- Create a sense of ownership from the targeted community in the project area to enable them to continue protecting the biodiversity and conserve the river.
- Promote establishment of budget line in respective of government agencies.
- Identify options to sustain funding through government agencies or private sponsors to extend activities beyond project period.
- Link with existing funding initiative such as NRCF.
- Facilitate the establishment of focused CBOs at local level to continue the work especially through Friends of River Basins (Friends of Klang River Basin and Friends of Kinta River Basin).

2.6 Expected Outcome

Although the approaches vary according to the localised situation and landscape, it is adaptable to any landscape and can be recreated to be localised and implemented in any other basins as well. The importance and the need to mainstream biodiversity into the river management is vital and need to be promoted in all upcoming initiatives undertaken not only by the government agencies but also by the private sector and civil society in order to promote the diverse and sustainable river management. The followings as tabulated in **Table 2** are some of the expected outcomes anticipated from the stakeholder engagement.

Table 2: Expected engagement or support in Smart Partnership from respective stakeholders.

Type of Stakeholders	Expected engagement or support in Smart Partnership
Institutional Government	• Create private-public synergies • Organise deliberations between stakeholders • Creating linkages and cross-references between environmental (biodiversity-related) standards at different levels. • Governmental support on multistakeholder engagement • Enforcement and institutional capacity building to implement and monitor existing policy
Multistakeholders	• Income opportunities from mainstreaming measures, also from specially-created incentives • Leadership that can emerge from various actors, public-private, local-national-global, based on the interests or values
Output	• Independent scientific research to increase knowledge on biodiversity linkages • Awareness - raising and demonstration of benefits of biodiversity to stakeholders showing cross-sectoral benefits • Solid evaluation, data sharing, exchange visits in pilot mainstreaming projects • Knowledge made available and shared between parties enables open and transparent learning opportunities • Funding for governance on mainstreaming initiatives, building institutional capacity, and implementing action plans • Multistakeholder initiatives seeking funding from international donors for joint implementation • Private sector funding resources

CHAPTER 3:
CASE STUDIES

3.1 Project Introduction

Mainstreaming of Biodiversity Conservation into River Management in Malaysia Project was designed in 2015 and approved by the GEF-5 in 2016. The project's goal is to contribute to the conservation and sustainable use of globally significant biodiversity in Malaysia. The objective is to be achieved by mainstreaming biodiversity conservation into riverine landscapes through improved river planning and management practices in Malaysia with two components as stated below:

Component 1 addresses the need for an operational institutional framework and capacity for strengthened management of riverine biodiversity in production landscapes. The task was assigned to RBM Engineering Consultant by DID Malaysia.

There were four outputs designed and expected from **Component 1**:

Output 1.1: Inter-agency strategy, national action plan, and financing plan to mainstream biodiversity into river management are developed and adopted:

- Review of the existing legal, policy, and institutional set-up for river management.
- Inter-agency strategy to mainstream biodiversity into river management.
- National action plan for the conservation of riverine biodiversity.
- Financing plan to secure Federal and state budget allocations.

Output 1.2: BMPs guidelines are developed and adopted:

- Literature review based on a series of case studies on BMPs.
- BMPs Guidelines on the integration of biodiversity conservation into river management.

Output 1.3: Institutional capacity of KASA, DID, and other related federal and state agencies as well as key non-governmental stakeholders enhanced for riverine biodiversity management:

- Capacity needs assessment of the identified agency units.
- Training programme on riverine biodiversity conservation.
- Training of trainers to conduct the training courses and pilot training.

Output 1.4: Awareness programmes delivered targeting policy makers and practitioners:

- Communications and awareness raising strategy.
- Research study on the economic values of riverine biodiversity and ecosystem services.
- Awareness-raising materials in Bahasa Malaysia and/or English.
- Programmes on awareness raising activities.
- Assessment of knowledge, attitudes, and practices.

Component 2 focuses on demonstrating the BMPs for critical riverine habitats in three different situations and geographic locations including a water supply reservoir catchment area, an urban river, a rural river impacted by plantation development, and smallholder land uses. The implementation of **Component 2** was assigned to local NGOs; Global Environment Centre (GEC) for the Klang and Kinta River Basin and Forever Sabah (FS) for the Segama River Basin. The focus is to enhance biodiversity conservation status and reduce threats through the BMPs implementation with the following four outputs:

Output 2.1: Pilot demonstration of water reservoir catchment in Upper Kinta Basin improves status of riverine biodiversity through strengthened watershed management:

- Demonstrating at least one site of erosion mitigation through a bioengineering approach (bamboo or enrichment planting).
- At least 5-10 communities actively monitoring and participating in related events.

Output 2.2: Pilot demonstration of urban river in Klang River Basin on integrating riverine biodiversity into planning and implementation:

- Physical enhancement of riverine and riparian habitats in the Klang River are benefiting riverine biodiversity.
- Awareness levels concerning the risks posed by aquatic Alien Invasive Species (AIS).

Output 2.3: Pilot demonstration in protected habitat and enhancing partnership with private and local communities in Segama River Basin:

- Length of riparian zone conserved along Segama River.
- Engagement of local communities in river monitoring and conservation.

Output 2.4: Four communities involvement at the demonstration sites provides socio-economic benefits to local communities and proactively engages women in the communities:

- Number of households in target communities involved in implementing project activities (such as tree planting) on a paid basis.
- Proportion of women participating and benefiting from sustainable livelihood groups supported and facilitated by the project.

The **project implementation framework** was divided into three tier as indicated in **Figure 10** where is the Project Steering Committee (PSC) sits on the top followed the Project Management Unit (PMU) and Project Working Committee (PWC). The PSC committee is chaired by the Secretary-General of KASA and serves as the project's coordination and decision making committee. This PSC is supported by the PMU which oversees and is responsible for the day-to-day management of the project. The PMU members include DID Malaysia, UNDP Malaysia, selected State DIDs, Biodiversity division from Ministry of Energy and Natural Resources (KeTSA), Economic Planning Unit (EPU), and Federal and State governments. The PWG is the localised committee group established at the project implementation sites chaired by the DID State e.g. DID Selangor, DID Perak, dan DID Sabah supported by the assigned consultants that implement the assigned components/output at ground level.

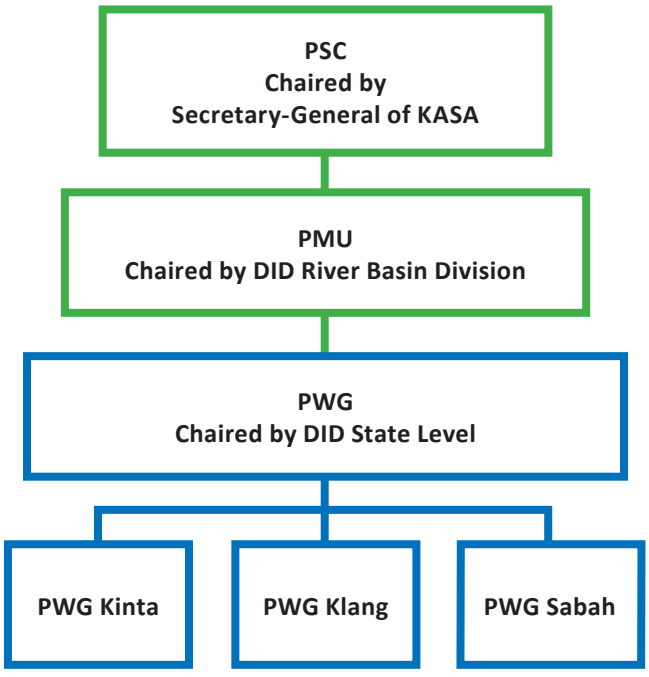


Figure 10: Project Implementation Framework

This chapter highlights case studies at the two pilot sites for **Component 2: Output 1 and 2** which are the Upper Kinta River basin and Klang River basin, as well as from the National River Trail, an initiative undertaken by KASA.

Case Study 1: Upper Kinta River Basin (Perak)

The Upper Kinta River Basin (Perak) covers an area of about 18,000ha within Ipoh city in Perak. The focus is on the management of the upper catchment of Kinta River that is important for biodiversity conservation and water supply. The pilot site aims to (I) improve understanding and the status of riverine biodiversity and improve the conservation of riverine biodiversity through strengthened watershed management, especially on the reduction of sediment loading from highway and agro-tourism developments; (II) strengthen communication between the dam operator, government agencies, private players, and local communities to ensure sustainable land uses.

The sub-component involves a range of local stakeholders with emphasis on *Orang Asli* (OA) communities. The targeted communities were Kampung Chadak, Kampung Tonggang, Kampung Suluh, Kampung Makmur, Kampung Tonggang, and Kampung Choh, located below the Sultan Azlan Shah Dam. These communities are empowered on environmental awareness as well as river and pollution monitoring. In addition, Kampung Pawong, an OA village located near the dam and adjacent to Simpang Pulai Highway were involved to support slope erosion monitoring and control in the upper catchment bioengineering works at Section 45.9, FT 185, Simpang Pulai Cameron Highlands Highway. The Upper Kinta River basin focused on establishing Project Working Group (PWG) that includes all the stakeholders engaged at the Kinta Basin. Detailed assessment of status and distribution of biodiversity within the Kinta River basin catchment area was carried out to develop the strategy and action plans. The initiatives at both pilot bioengineering sites (Section 45.9, FT 185, Simpang Pulai Cameron Highlands Highway) and along the Penoh River were implemented with the support of the OA to implement community-based key mitigation and restoration. Furthermore, to ensure continuous awareness enhancement on the importance of protecting water catchment area beyond project period, the Kinta River Open Classroom was established as the educational and showcasing model on river source of the Kinta River.

Case Study 2: Klang River Basin (Selangor/Kuala Lumpur)

Klang River flows through Kuala Lumpur and Selangor and eventually into the Straits of Malacca. Klang River originates in the highlands, 25km northeast of Kuala Lumpur with headwater catchments still pristine; located between Genting Highlands and the Ampang Hills of the Main Range Ridge; part of the Selangor Heritage Park. There are 11 major tributaries i.e. the Gombak River, Batu River, Kerayong River, Damansara River, Keroh River, Kuyoh River, Penchala River, and Ampang River. It is approximately 120km in length and drains a basin of about 1288km^2. The upper portion of Klang River Basin provides water supply (through two major dams - Batu Dam and Klang Gates Dam) to the people of Klang Valley.

The Klang River Basin focused on identifying the gaps and opportunities to incorporate biodiversity conservation into the River of Life (ROL) and other ongoing river management programmes. The action plan is focused on rapid biodiversity assessment, hands on environmental education, participatory monitoring, small-scale wetland habitat creation, strengthening connectivity to enhance river corridors, and awareness raising activities particularly on the effects of AIS at five demonstration sites: Kampung Taman Warisan - Taman Melawati, AU2 Taman Keramat at Upper Klang River basin, Perumahan Awam Seri Terengganu at Gombak River, Taman Rimba Bukit Kiara at midstream (Penchala River, tributary of Klang River) and downstream of Klang River at Taman Pengkalan Kampar. The stakeholders and communities outreached through the ROLPOP and FoKRB were the key partners to mainstream biodiversity with localised trainings and awareness programmes. The FoKRB is a network comprises CBOs and FoRs within the Klang Basin. A number of awareness and education materials for target groups (communities, educational institutions, NGOs/CBO) were developed and shared through the network. By connecting the communities and the initiatives undertaken, the project focused to benefit both the riverine ecology and people by promoting the connectivity between people and the ecosystem.

Case Study 3: National River Trail

The third case study is focused on the National River Trail - an initiative undertaken by the KASA. The river trail is seen as one of the NbS approaches to address socio-environmental challenges through multistakeholders and Smart Partnership.

3.2 Mainstreaming Biodiversity with Agencies

Government agencies play a vital role in mainstreaming biodiversity into river management. One of the methods that can be implemented into river restoration, slope mitigation, or any other related mitigation projects is NbS. Soil bioengineering is one such endeavour that will be addressed in more details as follows:

3.2.1 Soil Bioengineering

"Soil bioengineering" is a term coined to describe the application of vegetation, either parts or whole plants, specifically on low to moderate risk slopes for sustainability and stability of the slope (Coppin & Richards, 1990; Morgan & Rickson, 1992). Oftentimes, soil bioengineering and biotechnical engineering are used synonymously but the latter, sometimes also known as water and soil bioengineering (Schiechtl & Stern, 1992), involves the use of plant, or plant parts, either alone or in conjugation with inert materials such as steel, concrete and rocks for surface protection or erosion control and to enhance the soil stability (Schiechtl, 1980; Gray & Leiser, 1982). This approach is highly sustainable as vegetation self-regenerates and could adopt and adapt to its environment. This environmentally friendly approach has low capital costs compared to civil engineering structures and low in maintenance since the local population can be involved in the management and maintenance of the works (Giupponi *et al*., 2019).

General Procedure

There are various procedures to undertake soil bioengineering project at a slope or eroded riverbank. Here is an example of a soil bioengineering procedure diagram. A total of six main steps need to be considered when designing soil bioengineering project.

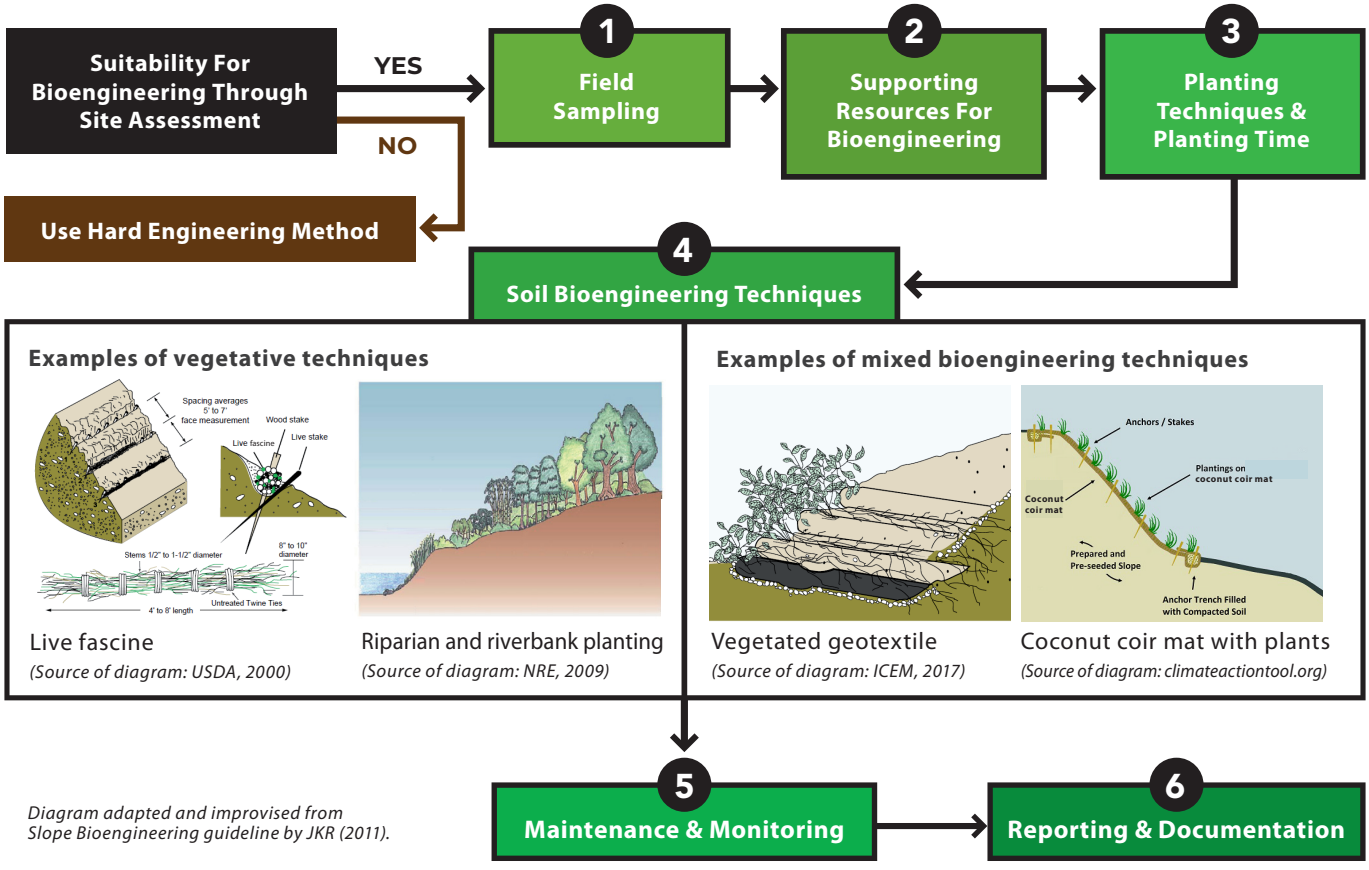


Diagram adapted and improvised from Slope Bioengineering guideline by JKR (2011).

a) Site Assessment

Not all sites are suitable for soil bioengineering project. For a slope, slope risk and class need to be determined and access route also needs to be identified to ease maintenance and long-term monitoring works (Normaniza *et al.*, 2021). For riverbank revegetation, characteristic of the floodplain and riparian area need to be assessed before kick-starting a project.

c) Supporting resources for bioengineering

Plants, non-plant materials, and human resources are regarded as main supporting resources for bioengineering initiative. All existing plant species in slope areas and surrounding areas should be listed. The existing plant species classification table in the study area will be used to make the selection of suitable plant species to be planted in the slope area. Among the details needed are (PWD, 2011):

i. Species name
ii. Native or invasive
iii. Suitability with soil/rocks
iv. Size/structure
v. Type of root
vi. The ability of roots to grow after cutting

The identified plants can be sourced from the wild while seedlings can be grown in nurseries (**Figure 11**). Seedlings can also be purchased from external markets. Human resources is a vital component for a successful soil bioengineering initiative. Local communities or OA can be the main human resources as they know the site and the plants best. They need to be empowered during the initiative and must be guided. Nursery can also be established as part of the preparation for soil bioengineering project where the ownership can be given to the community. Seedlings can be sourced from the community-based nursery as it will also provide additional or alternative income for the communities.

Non-plant materials also need to be infused. Areas of steep slope and without sufficient surface soil layer (**Figure 12**) need to use non-plant materials such as 'coil-rolls', 'fibre-mat' or coconut fibre. The use of this support material is important as an agent to help and ensure the survival of a plant species that is growing (PWD, 2011).

b) Field Sampling

Upon deciding the suitable site for soil bioengineering, field sampling which includes data collection as well as baseline sampling need to be carried out. Slope geometry, geology, geotechnical properties, soil characteristics, and existing vegetation details are some of the potential deciding factors for a successful bioengineering technique.

Community nursery at Kampung Pawong.

Chrysopogon zizanioides **(Vetiver) and other plant saplings stored at the nursery.**

Germination of *leucaena leucocephala.*

OA community collecting wild bamboo saplings.

Figure 11: OA community nursery in Kampung Pawong, Perak. (Source: GEC, 2021)

d) Planting techniques and planting time

Microclimate plant propagation technique with modified soil depth can be used as a suitable planting technique (Normaniza & Barakbah, 2011). The planting (**Figure 13**) as well as cultivation technique should have the following characteristics (Normaniza *et al.*, 2021):

i. Hole diameter: 5 inch / 12.7 cm

ii. Depth of hole (soil depth) - depends on the level of soil acidity (seek advice from consultants/ experts)

iii. Soil supplements: 15 g sphagnum moss, 15 g NPK fertiliser, and 15 g rock phosphate

iv. Height of pioneer plant species during planting: 0.3 m to 1 m (depending on the type of pioneer plant species).

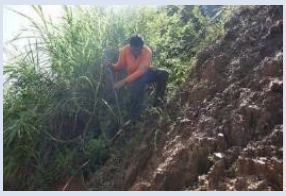
The planting work should be carried out according to the appropriate time period for the area. Weather data such as previous annual rainfall distribution should be used as a guide for selecting the appropriate planting duration. Planting work is done when there is a moderately high rainfall while the site preparation work is done during the dry season. However, this influence can be overcome with intensive watering programme measures and arranged according to its needs (PWD, 2011).

e) Watering and fertiliser

Water is the main element needed by plants to grow and ensure its survival. Proper water drainage can be constructed to carry water from high terrain to low terrain using gravitational system. Watering process is very important especially in the early stages of the cultivation period. Organic fertilisers or chemical fertilisers (only if needed) should be mixed with fertile soil once a month to promote tree growth and flower production. To facilitate the maintenance of the fertilisation process, bags of organic fertiliser are placed at the top of the slope and arranged parallel to the 'coil-roll' position. Small holes can be drilled to allow the fertiliser to leak out when it rains, which helps to ensure the source of fertiliser to the plants perfectly. The organic fertiliser or chemical fertiliser (urea, NPK) to be supplied with slow release taken in account (PWD, 2011).

Figure 12: Coconut coir mat as supporting resources (Source: GEC, 2021)

Planting techniques: planting



Dig hole up to 45cm deep.

Place soil supplements before placing plant.

Smoothen surface with addition of NPK fertiliser on surface.

Planting techniques: seeding

Seeding legumes on coconut coir mat and direct distribution (*Calopogonium mucunoides* and *Centrosema pubescens*).

Figure 13: Planting techniques. (Source: GEC, 2021; Normaniza & Barakbah, 2011)

f) Monitoring and maintenance

Monitoring and maintaining the soil bioengineering work is crucial as it is key to long-term sustainability. The first six months of the project is very important where plants need to be continuously monitored. Soil characteristics, plant growth, survival rate, the effect of sun slopes, species influx, and sediment trapped at silt trap are some of the key monitoring parameters to measure the success of this initiative. During succession, planted trees will begin to assimilate with the surrounding area and further enrich existing ecosystem.

3.2.2 Soil Bioengineering Techniques

There are lot of soil bioengineering techniques used worldwide. The techniques are divided into two main categories for the purpose of this guideline. Vegetative and mixed bioengineering techniques are the two categories which will be discussed further in the following sections:

a) Vegetative Techniques

Vegetative techniques of slope protection are appropriate when a slope is prone to erosion or very shallow slope collapse. To decrease erosion and shallow-seated instability on slopes, living plants or cuttings are used. While there are some slope stabilisation in these applications, the primary focus is on slope surface protection through strengthening. Plants and their roots protect the slope surface while strengthening the soil. The three examples of vegetative techniques which are hydroseeding, live fence, and shrub/tree planting will be discussed further.

i) Hydroseeding

Hydroseeding which involves distributing seed under pressure with a water carrier is an efficient method of plant establishment on a ground surface. The basic notion of hydroseeding is to spray seed that has been blended with water or dry over a previously prepared surface. Hydroseeding (**Figure 14**) is a process that involves utilising a hydroseeding equipment to apply a mixture of seeds, adhesives, mulch, fertilisers, and water to soils (Emeka *et al.*, 2021).

Figure 14: Hydroseeding Technique
(Source: *https://www.hydroseeding.com.my/photoalbum/index.html*)

ii) Live fences/fascines

The live fences technique involves planting hardwood cuttings in lines across a slope with live branches woven horizontally between the verticals, creating a living fence (**Figure 15**). The fence collects material travelling downslope and delays surface runoff at first, then provides root reinforcement with vertical cuttings and some horizontals (ICEM, 2017).

- Live fences can be used to stabilise riverbanks and prevent minor or shallow erosion.
- They can be easily installed and maintained on a wide variety of sites.
- Can improve the aesthetic appearance and provide wildlife habitat.
- Low in cost where materials are available.
- Creates favourable conditions for natural colonisation of vegetation from the surrounding plant community.
- Stabilise intervening areas between other soil bioengineering techniques.

Installing live fences on a riverbank.

Three months after planting live fences on a roadside embankment.

21 months after planting live fences on a riverbank.

Figure 15: Live fence/fascine installation (Source: ICEM, 2017)

iii) Shrub and tree planting on riverbanks/riparian corridors

Besides slope, vegetative techniques also can be applied on wetlands including ponds, riverbanks, and riparian areas. Native plants can be planted to promote riverine biodiversity besides mitigating slope and bank erosion. There are six zones identified when it comes to riparian and riverbank planting (DID, 2012) as per **Figure 16**.

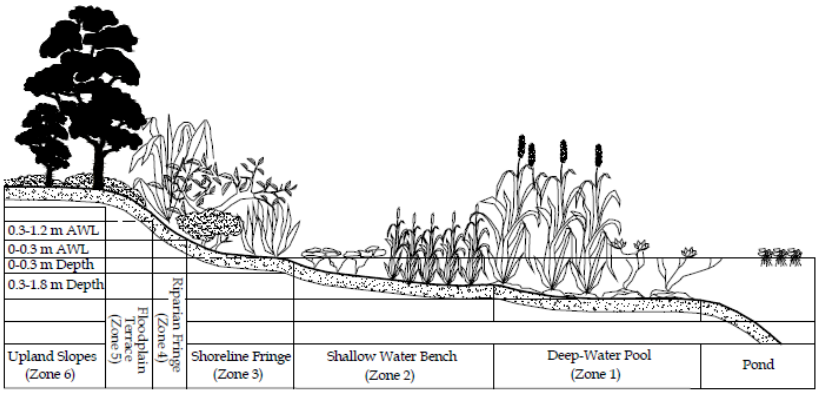


Figure 16: Planting zones for typical pond or wetland (Source: DID, 2012)

Figure 17 highlights some of the plants that can be planted in each zones:

Zone 1 (Deep Water Pool): Tube sedge *(Lepironia articulata)*

Zone 2 (The shallow water bench): *Simpoh Air* *(Dillenia suffruticosa)*

Zone 3 (Shoreline fringe): Mexican primrose-willow *(Ludwigia octovalvis)*

Zone 4 (Riparian fringe): Common bamboo *(Bambusa vulgaris)*

Zone 5 (Floodplain terrance): *Senduduk* *(Melastoma malabathricum)*

Zone 6 (Upland slopes): Camphor tree *(Dryobalanops aromatica)*

Scan this QR code for a detailed list of plants.

Figure 17: Suitable plants according to planting zones.

b) Mixed Bioengineering Techniques

In some cases, hard measures can be useful if they are combined with vegetation as part of the engineering solution. "Mixed bioengineering" is referring to a combination of hard, soft, and mixed techniques to deal with slope or eroded riverbank. In terms of how to deal with a slope, or a group of slopes, the best solutions are often a mix of hard, soft, and mixed techniques to deal with different parts of the slope. Three examples will be discussed further on the mixed bioengineering techniques.

i) Vegetated gabions

Gabions are stone-filled wire baskets as shown in Figure 18. There are a lot of different ways gabions can be used as they have different strength and weight and flexibility. Revetments can be used to help protect the riverbed and riverbank. They can also be used to build retaining walls and bridge abutments. If the wire on the gabions is stolen or rusts early, grass, trees, or shrubs can be planted to provide extra strength (ICEM, 2017).

ii) Vegetated geotextiles

Vegetated geotextiles are synthetic or organic geotextiles wrapped around lifts of soil with a mix of live branches placed between layers (**Figure 19**). There are numerous opportunities of blending geotechnical-engineered systems with soil bioengineering. It retards rill and gully erosion, stabilises fill banks. It is also less expensive compared to other retaining walls like gabion (USDA, 2000).

iii) Vegetated concrete frames

Surface erosion protection is provided by concrete frames that are covered with grass panels (**Figure 20**). Stone or unreinforced concrete frames may be used to construct the structures. Reinforced concrete may be utilised in some circumstances, such as when the slope needs to be strengthened more than usual. Because the hard engineering and soft bioengineering steps require very different skills, they need two different groups of people to work on them. During the dry season, the concrete frame must be built, and the grass planting must be done during the wet season. (ICEM, 2017).

Constructing vegetated gabions.

Vegetated gabions wall, one month after construction.

Vegetated gabions wall, one year after construction.

Figure 18: Vegetated gabions (Source: ICEM, 2017)

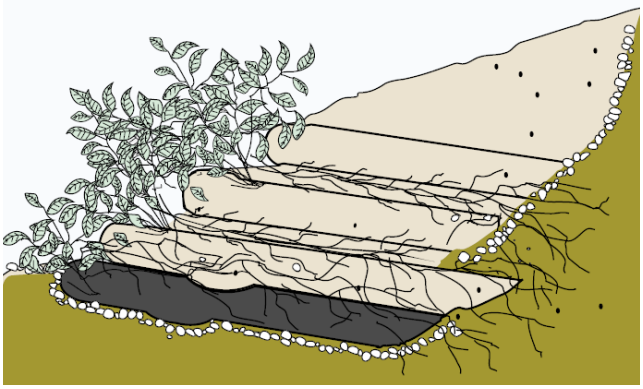
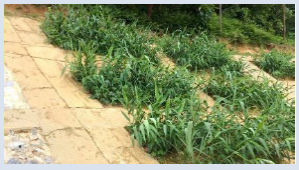


Figure 19: Vegetated geotextile (Source: USDA, 2000)

Concrete frame with newly planted grass.



Vegetated concrete frame, three month after construction.

Vegetated concrete frame, 9 month after construction.

Figure 20: Vegetated concrete frame (Source: ICEM , 2017)

3.2.3 The Case Study of Upper Kinta Basin, Perak

The Upper Kinta River Basin (Perak) covers an area of about 18,000 ha above Ipoh city in Perak. The focus is on the management of the upper catchment of Kinta River that is important for biodiversity conservation and water supply purposes. The pilot initiative through the Mainstreaming Biodiversity Conservation into River Management Project is to use NbS, i.e. bioengineering techniques to reduce soil erosion and subsequently to prevent sedimentation downstream, as well as improving the livelihoods of indigenous communities in the area. With vegetation being a central element in soil bioengineering, this project was initiated with the aim to rehabilitate and revegetate intensively a section of eroded highland slope located at Section 45.9 FT185 Simpang Pulai – Cameron Highlands Highway. In general, the soil type of the slope area is sandy textured soil that is highly susceptible to erosion. Mixed soil bioengineering techniques is used during this pilot initiative. Hence, the suitable slope pioneers, namely *Melastoma malabathricum* (*senduduk*), *Dillenia suffructicosa* (*simpoh air*), bamboo, vetiver, and cover-crop (legumes) were grown on slope with different planting designs. Coconut coir mat, vegetated geotextiles, and brush layering are the three bioengineering techniques used with slope pioneers. A total of five trial plots were set up in two phases; Phase 1 consists of four trial plots (Plot 1 - 4) in year 2020 and Phase 2 in 2022 consists of one treatment plot (Plot 5). Positive progress on the species influx was also observed especially in Plot 1, which was an important indicator as an early successional stage and improvement of soil conditions.

Besides bioengineering techniques, the pilot initiative also used OA Kampung Pawong as key human resource to implement the project. Their involvement was very vital for the success of project where the exchange of traditional knowledge occured besides providing alternative livelihood for them. The trial plots of bioengineering site successfully demonstrated an effective combination of plant attributions and composition designs as a way forward in slope restoration programme on highland slopes. The promising observations can be regarded as a baseline data for the current status and future prospects of the slope mitigation and management programme (**Figure 21a** and **Figure 21b**). The initial success of pilot demonstration site can be taken as a case study to extend more soil bioengineering initiatives at various eroded slopes in the country.

Figure 21a : Before (7th September 2021)

Figure 21b:After (20th October 2021)

Scan this QR code for further details on the project.

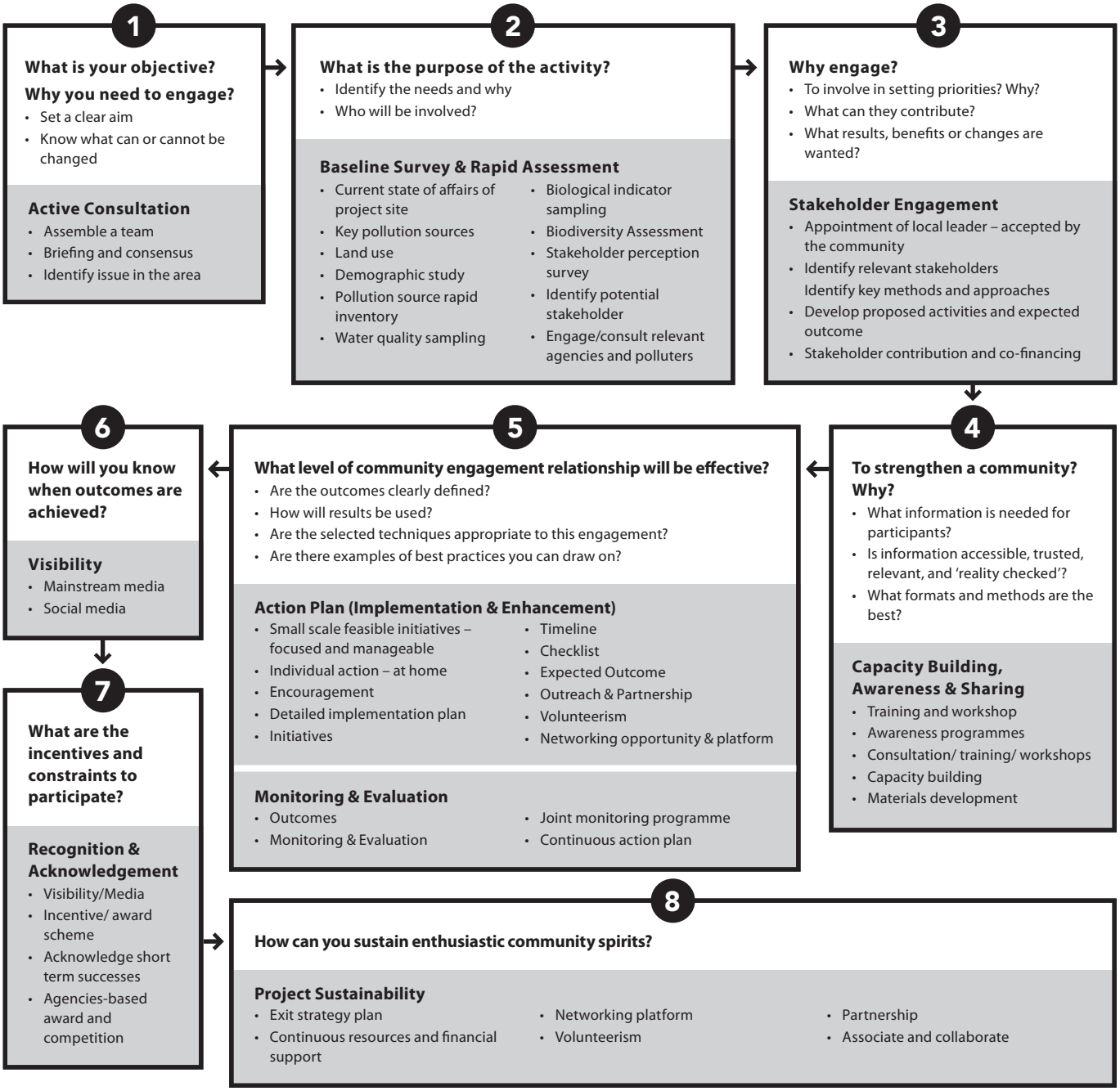
Soil bioengineering is not new in Malaysia but it is still in its early stages. With climate change impacts rising, soil bioengineering is a way forward to tackle all the impacts through one solution, NbS. Mixed techniques can be applied in places where vegetative techniques alone is not sufficient. Involvement of local or OA as key human resources for soil bioengineering project not only will add value to the initiative, but will also provide an additional or alternative income for them.

3.3 Mainstreaming Biodiversity with Local Communities

The focus is to connect the communities and the initiatives undertaken where both the riverine ecology and the people will be the beneficiaries by promoting the connectivity between people and the ecosystem. Community engagement in the Klang River basin kick-started during the ROLPOP Phase 1 and Phase 5 between 2014 to 2019 and the community engagement continous during the implementation of the Mainstreaming Biodiversity Conservation into River Management Project at the selected pilot sites.

3.3.1 General Procedure

Chapter 2 highlighted in detail the approaches and the concept involved in the stakeholder engagement. The similar approaches were localised to adapt for the local community engagement. The fundamental steps of local community engagement process as highlighted below is about providing opportunities for the community to participate in the decision-making process. It is important to scale the community engagement process to the size, scope, and significance of the issue/decision at hand.



a) Baseline Survey and Rapid Assessment

Baseline survey is significant to obtain an overall understanding and appreciation of the current state of affairs and stakeholders' sentiments within the project site. A baseline survey provides information on potential sources of pollution and current pollution mitigating measures/projects as well as the current biodiversity distribution at the site. The data obtained is used to design a proposed action plan to be shared with the stakeholders for consideration. This step will also help to identify possible expected outcome by implementing the action plan.

b) Stakeholder Engagement

The types of consultation used for the project include, but not limited to, one-to-one meetings with stakeholders and focus group discussions. The consultation process has to be done with stakeholders and separately with a community leader(s). Identifying, enlightening, and involving the relevant stakeholders at the early stage of identifying the issue will help in the implementation phase. This is because it is crucial to have a committed groups supporting the implementation activities. The key group of stakeholders that needs to be consulted includes but not limited to the followings:

- Federal and state government agencies
- Local authorities and district offices
- Private sector
- Non-governmental organisations
- Community-based organisations
- Special interest groups
- Local communities
- Public

c) Capacity Building, Awareness, and Sharing

Civic Science Approach was implemented to enable the communities to understand the importance of biodiversity and how it can be mainstreamed into the river management. Series of individuals follow-ups, consultation, trainings, localised programmes, training of trainers as well as competition and virtual series of workshop/training is an important component under the community engagement. This needs to be conducted continuously in stages to create awareness, empower them with knowledge, and provide the communities with skills to enable them to mainstream biodiversity conservation into the river based initiatives. In addition to trainings, awareness materials in the form of posters, video clips, signboard, guidebooks will also be helpful to raise awareness. Furthermore, the materials developed can be shared and adapted to other basins.

d) Action Plan

As indicated by the Civic Science Approach – awareness, knowledge, and skill will lead to actions. The next step is to brainstorm initiatives which can be implemented to achieve the project objective(s). The action plan is localised to the area, the environmental ecosystem, and its needs. Suitable activities is key to attract interest among stakeholders and target groups. The proposed activities will be discussed with the stakeholders, where the detailed plan, possible hurdle, shortcomings, mitigation plans, and implementation plan are shared. At this level, a timeline for the implementation will be drawn and the communities among their team members will be leading the initiatives.

Implementation of the action plan at the respective sites within the project involves empowerment of the local communities on the biodiversity element within their ongoing and existing initiative include and not limited to the following:

- **River Health**: **Physical**: River landscape assessment; **Chemical**: Testing water quality parameters using a monitoring kit; **Biological**: River health based on the type of benthic macroinvertebrate; and **Biodiversity** monitoring along the riverbank based on observation.
- **River Education and Empowerment**: Monitoring and data collection of biodiversity with reference to the Community-based River Biodiversity Handbook.

- **Community Garden**: Promotes a win-win approach in growing vegetables, fruits, flowering and non-flowering plants focused to local plants/trees species, and promote elimination or reduction of the invasive species of plants and trees.
- **Awareness on AIS**: Community monitors and eliminates invasive species (fishes and plants) from the water bodies.
- **Riverine Rehabilitation**: Tree planting and awareness programme among the local communities and public. Local tree plants were planted along the riverbank to reduce the impact of erosion, and reintroduce the riverine trees.
- **National River Trails:** Connect through the NbS approach along the riverbank by turning the site into river health and biodiversity monitoring as well as river education, and care hub.
- **River Monitoring:** Actively monitor the impact of pollution, connect with the relevant agencies to mitigate issues on wastewater discharged into the river.
- **River Open Classroom:** An open river education corner established with the support of the stakeholders through Smart Partnership.
- **PPP**: Promote to increase participation of the stakeholders as volunteers and also to support through CSR initiatives.

e) Monitoring and Evaluation

Monitoring the initiatives during and after implementation period will ensure the action plan is on the right track. It sheds a positive light on the community members during evaluation through the mitigation actions which showcases the quality and project's result performance.

f) Recognition and Acknowledgement

Recognise the efforts and increase the publicity for the community group through media coverages, competition, and award is important to boost self- esteem and also to motivate communities to continue their efforts. Furthermore, communities will be motivated and encouraged if they participate in the national and agencies-based award or competition schemes.

g) Sustainability

The action undertaken during the implementation phase should enable the target group and stakeholders to take ownership of the project and run the initiative beyond the implementation phase. Sustainability ensures the ongoing initiatives have sufficient resources and financial support for the long run.

3.3.2 The Case Studies of Klang River Basin, Selangor and Federal Territory of Kuala Lumpur

The pilot demonstration sites under the Klang River Basin was identified from the uniqueness of the sites (**Figure 22**). All five sites within the Klang Basin have different criteria of river condition, the surrounding area, and variables that are effecting the biodiversity of the area as tabulated in **Table 3.**

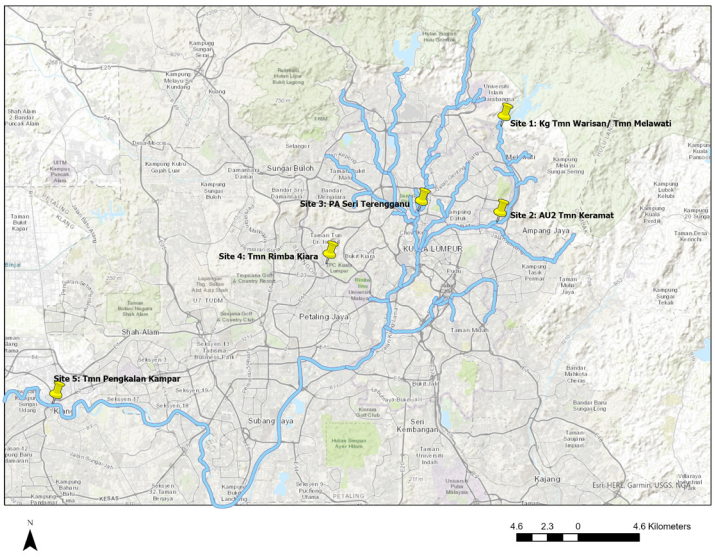


Figure 22: Pilot sites within the Klang River basin.

Table 3: The stakeholders and local governments involved at the Klang River basin.

Sites within the Klang River basin	List of Stakeholders
Site 1: Kampung Taman Warisan to Taman Melawati (Klang River) The stretch near the Klang Gates Dam before Kampung Taman Warisan is the most pristine stretch of the Klang River as it originates directly from the out-flow of the Klang Gates Dam. Habitats surrounding this area consist of a small patch of relatively intact secondary forest bordering the perimeter boundary (fence) of the dam compound, an open (formerly a camping) area with scattered large trees and mature trees growing on both sides of the river bank.	• *Persatuan Penduduk Taman Rekreasi Kampung* Taman Warisan • Friends of Sg Klang Tmn Melawati River Tree (FoSK TMR3) • *Majlis Perbandaran* Ampang Jaya (MPAJ) • *Lembaga Urus Air* Selangor (LUAS) • DID Gombak / Selangor and Malaysia
Site 2: Rumah Pangsa AU2, Taman Keramat (Klang River) The riverine areas at this site is of a more disturbed habitat. Tall grasses and shrubs covered most of the riverbanks. Small-scale community garden can be found along the bank on the Rumah Pangsa AU2 side. The opposite river bank is lined up with commercial buildings of an industrial area. The water level during the survey was quite low but moderately fast flowing.	• *Kelab Kebun Rumah Pangsa* AU2, Taman Keramat • MPAJ • LUAS • DID Gombak/Selangor and Malaysia • Depatment of Agriculture (DoA) Selangor • Private and Corporate Support
Site 3: PA Seri Terengganu (300m) (Gombak River) This site appeared to be the most disturbed, urbanised river and is within the Gombak Basin. It is located in a high-density urban and commercial area in Sentul. The habitats here consists of tall grasses, shrubs, secondary growth, and reed beds lining both banks of the Gombak River. Part of both sides of the riverbanks at the lower reaches have been strengthened with concrete structures.	• *Kawasan Rukun Tetangga (KRT) Perumahan Awam* Seri Terengganu • RA Perumahan Awam Seri Terengganu • Dewan Bandaraya Kuala Lumpur (DBKL) • DoA Kuala Lumpur • DID Federal Territory of Kuala Lumpur (FTKL) and Malaysia
Site 4: Taman Rimba Bukit Kiara The vegetation along the water stream and river ridges is mainly made of regenerated forests and planted park trees (Figures 5 and 6). The diversity of trees planted in the assessed park area is rich in local forest species with many iconic *Dipterocarpaceae*.	• Friends of Sungai Penchala (FoSP) • DBKL • DID FTKL and Malaysia • Indah Water Konsortium (IWK)
Site 5: Taman Pengkalan Kampar This is the downstream of the Klang river. The river bank becomes wet and muddy. Large areas of muddy flats or gentle slopes without vegetation are exposed during river water level variations.	• RIVER Ranger Kampung Sungai Pinang Bandar Klang • Majlis Perbandaran Klang(MPK) • DID Klang/Selangor and Malaysia

Upon conducting the rapid assessment and stakeholder mapping, the consultation process formed the Project Working Group (PWG) among the key stakeholders especially the federal and state agencies. The members of the PWG includes:

- DID Malaysia
- DID Selangor
- DID Gombak.
- DID Petaling
- DID Klang
- DID Federal Territory of Kuala Lumpur
- Youth and Community Department, MPAJ
- Infrastructure Planning Department, DBKL
- DBKL Cawangan Segambut
- Department of Fisheries (DoF) Malaysia
- Department of Agriculture (DoA) Selangor
- Town and Country Planning Department, MPK
- Park and Recreational Department, MPK
- LUAS
- UNDP
- GEC

The local communities also act as the immediate guardian and the focal point to connect to the general public and communities to the site initiatives. Under the project, the immediate local community stakeholders are:

- Persatuan Penduduk Taman Rekreasi Kampung Taman Warisan: Mr. Mazelan Jamaluddin
- FoSK Taman Melawati River Three: Mr. Kennedy John A/L Michael Anbumani
- Kelab Kebun Rumah Pangsa AU2, Taman Keramat: Mr. Mohamad Halim Mohamad Said
- Kawasan Rukun Tetangga Perumahan Awam Seri Terengganu: Mr. Richard Poh Soon Seng
- Friends of Sungai Penchala (FoSP) Ms. Yusnita Dollah
- RIVER Ranger Kampung Sungai Pinang Bandar Klang: Hj Hamdan bin Hj Yusof
- FoKRB - Klang River Network

Throughout the project implementation within the Klang River basin, 15 virtual sharing and talks were conducted as part of capacity building (**Figure 23)**. In addition to trainings, awareness materials in the form of posters, video clips, signboard, guidebooks were also developed. All materials can be accessed via RIVER Ranger website (www.riverranger.my). The objective of these materials were to raise awareness on initiatives undertaken via the community engagement and biodiversity observed along the urban Klang River Basin. In addition, talks on the AIS; fishes and plants along the Klang River and in Malaysia were conducted with the support of DoF Malaysia and DoA Selangor.

Figure 23: Capacity Building for local communities within Klang River basin

As highlighted in the Civic Science Approach, actions can be implemented when there is awareness, knowledge, and skill. Some of the actions undertaken at the respective pilot sites within the Klang River Basin are as per the description:

Site 1: Kampung Taman Warisan to Taman Melawati (Klang River)

Activities carried out on sites include biodiversity monitoring, native tree planting with tagging, establishment of the eco-trail as well as community herbs and pollination garden at both Kampung Taman Warisan and Taman Melawati. Refer to F**igure 24 (a) and (b)**.

Figure 24 (a) Ecotrail at Kampung Taman Warisan and (b) pollulation Garden at Taman Melawati.

Site 2: Rumah Pangsa AU2, Taman Keramat (Klang River)

Initiatives undertaken on site are biodiversity monitoring, native tree planting and tagging, pollution reduction through zero waste initiative, water quality improvement through wetland cell filtration at drains directly feeding into the river. Refer to **Figure 25 (a) and (b)**.

Figure 25 (a) Community Garden and (b) wetland cell filtration at AU2 Taman Keramat.

Site 3: Perumahan Awam Seri Terengganu (Gombak River)

The community initiatives include biodiversity monitoring along the Gombak River, riverbank beautification, establishing eco-trail, mural painting, native tree planting and tagging as well as awareness programmes with the locals and general public utilising the area through signages. Refer to **Figure 26 (a) and (b)**.

Figure 26 (a) Ecotrail along Gombak River and (b) awareness signage along the pedestrain bridge across Gombak River connecting to LRT Titiwangsa.

Site 4: Taman Rimba Bukit Kiara (Penchala River)

The focus at this site was narrowed to address the pollution due to the sewage pollution from the Perumahan Awam Bukit Kiara feeding into the Penchala River. With the Smart Partnership and engagement with various agencies, the respective agency; DBKL addressed the issues to mitigate the impact of the sewerage system to the river health and its biodiversity. Refer to **Figure 27 (a) and (b)**.

Figure 27: Overflow pollution from the Sewage Treatment Plant at the Perumahan Awam Bukit Kiara (a) into the drainage and (b) leading to Penchala River.

Site 5: Taman Pengkalan Kampar (Klang River)

Figure 28 (a) Urban River Open Classroon at Taman Pengkalan Kampar and (b) RIVER Ranger Sungai Pinang Bandar Community Garden.

Under the project, an Urban River Education Centre or Pusat Pembelajaran Sungai Bandar, Sungai Klang was established where the community is the main custodian of the Centre. Other activities taking place within the site are biodiversity monitoring and riverbankbeautification. The RIVER Ranger Sungai Pinang Bandar community have also established a community garden around 1 km from the Centre. Refer to **Figure 28 (a) and (b)**.

The project also encourages, promotes, and cheers for the communities that participated, shortlisted and won competitions, awards, and recognition as below:

Home River BioBlitz Activity during World River's Day 2021 (Figure 29)

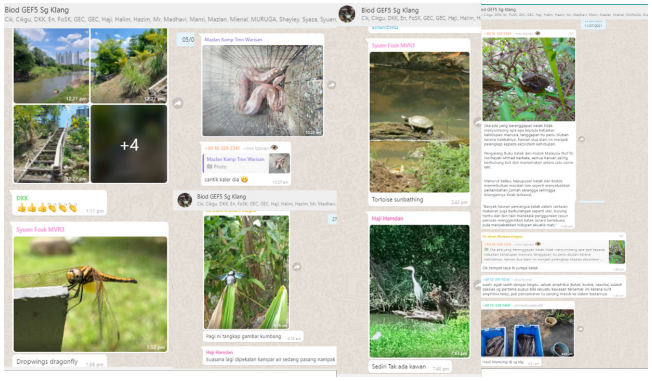


Figure 29: Snapshot of the Home RIver Bioblitz Activity at Klang River basin.

PERKISS SWCorps Competition 2020/2021 (Selangor State Level)

SK Ampang won the main category - Highest Collection of Recycled Plastic (**Figure 30**).

Figure 30: Certificate received by SK Ampang under the PERKISS SWcorps Competition

Anugerah Khas Sumber Air 2021

Nomination involved Sungai Batu Community - KRT Kampung Kasipillay, Sungai Keroh - Kebun Komunti Mutiara Magna, Sungai Gombak - KRT Perumahan Awam Seri Terengganu and Sungai Klang - Kebun Komuniti AU2 Tmn Keramat, and FoSK TMR3.

RIVER Care Award 2021

The 2021 RIVER Care Award under the NRCF was an initiative to recognise community initiatives and their roles in river management. (**Figure 31)** The winners for the Local Community Category were AU2 Flats Garden Club, Friends of Sungai Klang Taman Melawati River Three, KRT Buntong 3 & 4, Inspirasi Kawa and SS20 Central Zone Residents. While the winners for Educational Institutions were Water Warriors UM, Friends of Sungai Pusu, IIUM, and KL Krash Pad, Chow Kit Foundation.

Figure 31 : RIVER Care Award 2021

Green Neighborhood Award (Anugerah Kejiranan Hijau) 2021

Among the communities involved and the recognisation received (**Figure 32)** were:

Figure 32: Recognition received by the local communities under the PLANMalaysia Green Neighbourhood Award 2021.

Scan these QR codes to know more.

Desa Mentari Blok 3: www.facebook.com/PLANMalaysia/photosa.169071899845440/435983555410236

RIVER Ranger Kampung Sungai Pinang Bandar, Klang: www.facebook.com/PLANMalaysia/photos/a.169071899845440/435983852076873

TTDI Edible Garden: www.facebook.com/PLANMalaysia/photosa.169071899845440/436007304407861

MPAJ Community Garden Competition

Second place was won by AU2 Flats Garden Club Community Garden. (Second place in the MPAJ 2021 Community Garden Award and first place in the Cheerful Garden Award Category).

In addition to the competition, a number of media coverage also highlighted the community initiatives:

Scan these QR codes to know more.

Sungai Klang Urban River Open Classroom takes off (25 October 2021) – involving River Ranger Kampung Sungai Pinang Bandar: www.thestar.com.my/metro/metro-news/2021/11/10/learning-all-about-river-care

Kebun Komuniti dan Pusat Sumber – involving Friends of Sungai Klang AU2 Keramat: www.thestar.com.my/metro/metro-news/2021/04/19/library-in-communitygarden

www.malaymail.com/news/life/2021/07/14/after-over-a-year-of-mco-klang-river-shows-signs-of-improvement-with-less-w/1989819

Smart Partnership was promoted and facilitated through FoKRB's network platform via knowledge sharing, peer-assisted support and collective action with a clear goal of protecting and restoring riverine ecosystems. This network facilitated the mobilisation of resources from the various stakeholders which allowed access to a variety of approaches ranging from zero waste concepts, riverbank clean-ups, community gardening to NbS. This is the sustainability model that is currently active and recognised in ensuring all the initiatives undertaken are shared and replicated to other sites within the Klang Basin.

In order to promote and encourage more participation of the partners into the FoKRB network, the membership of the Network is not only promoted among the local communities, but also to educational institutions, NGOs, governmental agencies, research institutions as well as corporate players. This is to create a diverse network of Smart Partnership and PPP mechanisms. In addition to the support in the form of information, the project also supported the communities in need of tree saplings to be planted along the riverbank, tree tagging to tag local and pollinator species, guidance, and technical support. The communities that supported the tree tagging and seedlings activities were PPR Beringin (Jinjang River), Mutiara Magna (Keroh River) and Friends of Sungai Ampang. Throughout the project period, the membership of FoKRB increased from 30 members from 20 groups in 2020 to 70 members from 32 groups in 2022. There are 26 FoRs within the Klang River basin which are empowered and supported under the FoKRB Network. **Figure 33** highlights the distribution of the FoKRB members.

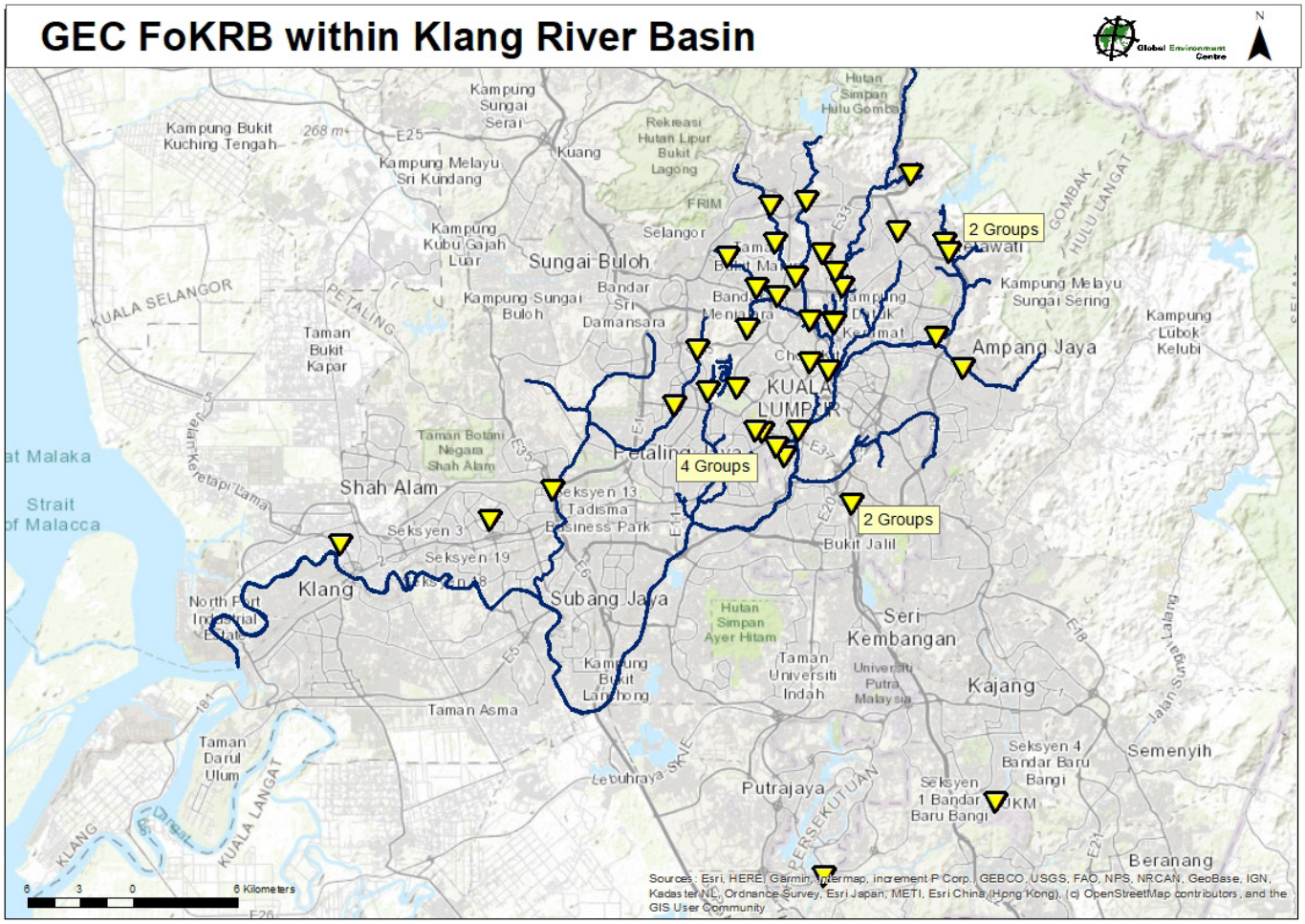


Figure 33 : Distribution of the FoKRB members in Klang RIver basin.

3.4 Mainstreaming Biodiversity through Government-Initiated Public Programmes

KASA in its effort towards Sustainable Malaysia 2030 has committed to 30 initiatives which are built upon four thrusts; empowered governance, green growth, strategic collaboration, and social inclusiveness. It covers the atmosphere (air), hydrosphere (water), lithosphere (land), and biosphere (living things). The National River Trail of 10,000km is to be achieved through strategic collaboration by 2030. Various actions connected to river and biodiversity conservation are carried out by government-sponsored public programmes. KASA's National River Trails is one of them, as it instils a sense of ownership in the public's attitude toward the river.

3.4.1 Malaysian National River Trails (DSK) Programme

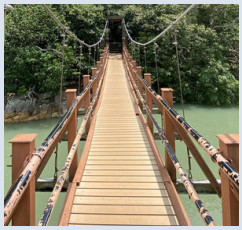
KASA created the National River Trail Programme or better known as DSK (Denai Sungai Kebangsaan) as a NbS to ensure the sustainability of river basin. Through the DSK programme, river reserve areas are aimed to be developed as a recreational site through trail construction and beautification activities (**Figure 34**). This will indirectly encourage nature-based activities such as picnic, fishing and cycling among the local communities, besides stimulating the economic activities of local communities such as river ecotourism. The presence and focus of the crowd in the trail area will prevent the actions of irresponsible parties from making rivers as waste disposal sites or polluted (KASA, 2021a). KASA is targeting the construction of 10,000km long river trail nationwide by 2030 to address socio-environmental challenges, ensuring the sustainability of the river basin and thus, protecting from pollution risk.

3.4.2 Stakeholder Participation in DSK Programme

KASA welcomes stakeholders' participation in this national programme. The targeted stakeholders are local communities, local leaders, NGOs, and private sectors. KASA also encourages interested groups to be formed as FoRs. The selection criteria for the National River Trail covers the following aspects (KASA, 2021b):

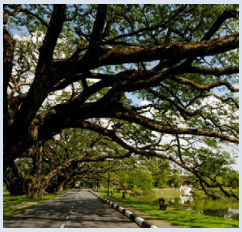
- Willingness of local community
- Suitability of physical and geographical site
- Nearby to residential area
- Nearby to water intake
- Nearby to industrial area
- Nearby to sea and beach
- Low construction costing
- Seek proper consensus and agreement from relevant agencies
- Does not involve private land/ land with Temporary Occupation License (TOL).

Traditional trail



Hanging trail

Hut trail



Roadside trail

Scan this QR code to download Guideline on *Denai Sungai Kebangsaan*.

Figure 34: Type of trails (Source: KASA, 2021a)

3.4.3 Infusion of Biodiversity Components within River Trails

Biodiversity components can be infused and promoted within the National River Trail Programme in many ways. Constructing river trails closer to waterways will not only bring the people closer but also provide opportunity to create healthy ecosystem. The following are some of activities that were carried out by stakeholders to promote biodiversity within river trails:

- Use native plants for beautification
- Create river community garden
- Establish river park
- Monitor riverine biodiversity
- Organise biodiversity hunt
- Story-telling activities for kids

3.4.4 Case Studies

Currently, there are good examples of river trails as shown in **Figures 35a, 35b** and **35c** constructed in Malaysia with good public participation.

Figure 35a: Sungai Langat River Trail, Selangor (Source: DID Malaysia, 2021)

Figure 35b: 25km Sungai Perak bike trail, Perak (Source: DID Malaysia, 2021)

Figure 35c: 720metre Sungai Pengkalan Datu trail, Kelantan (Source: DID Malaysia, 2021)

CHAPTER 4: **CONCLUSION**

Mainstreaming Biodiversity Conservation into River Management is a wide and expandable area of work. Holistic Approach towards Integrated River Basin Management (IRBM) is highly recommended to include science-based understanding of riverine resources, inter-agency coordination, strategy towards harmonised development and environmental goals, adequate technical capacity, and resources with community as the driver. Based on the two pilot studies, these can be done through the followings:

- Develop common methods for stakeholders' engagement and participation - flexible to accommodate to different scenarios/ landscapes within the conservation intervention.
- Adopt Citizen Scientist Approach - both quantitative and qualitative approach. Qualitative evidence as narrative reporting, which explains context and allows for culturally sensitive interpretation, as it can play a valuable part in explaining on the impacts of interventions.
- Integrate the biodiversity conservation initiatives with social-economic-spiritual component.
- Integrate community-based biodiversity with food security (when effective, can be an indicator of project success)
- Promote community ownership to create a sense of ownership to care, monitor, and protect their riverbank.
- Promote biodiversity as the ultimate beneficiaries in the PPP concept.
- Protect the source and rehabilitation/ conservation if needed through NbS.
- Establish river health targets and monitoring plans.
- Promote and support alternative livelihood for communities.

4.1 Recommendation

The initiatives undertaken to Mainstream Biodiversity into River Management should also able to mitigate and address issues related to habitat fragmentation and destruction, exacerbated impacts of floods, droughts and climate change. The following are some of the recommendations:

a. Develop Strategic Biodiversity Framework

It is recommended that key agencies develop the strategic framework for the selected basin catchment. Specifically, the framework should assist the government to ensure that the mainstreaming biodiversity projects are focussed, interlinked, integrated, and well-coordinated. It should balance both Hard and Soft Approach as well as the "top down" and "bottom up". The main aim of prioritising process is to ensure that the resources are allocated to where it will generate the greatest impact/benefit as well as reducing the pressure and problem.

b. Establish a Project/Programme-based on Corporate Partnership

Engaging the corporate sector in the outreach programme is important as it enables additional resources (personnel, finance, network, etc.) to be tapped into. Many corporations in Malaysia already have CSR initiatives that can be tapped further to achieve the aims of the programmes. More importantly, creating a sense of ownership among private companies will be very beneficial to sustain the programme in the long run.

c. Capacity Building for targeted Government Agencies

It is crucial that all relevant government agencies develop the skills and capacity to continue with the Mainstreaming Biodiversity Conservation into River Management Project. The capacity building activities should include (but not limited to) training courses, participatory planning and visits to community-project sites. The agencies should also initiate activities/events/programmes that inform and educate relevant government agencies on the Mainstreaming Biodiversity Conservation into River Management Project and seek their active participation.

d. Programme Ownership

Some of the activities that go beyond the jurisdiction of DID Malaysia are the control and action regarding invasive alien fish/species, prioritisation of NbS bioengineering, and Community Action Plan to name a few. However, these programmes are vital as the rivers are affected due to the respective activities such as encroachment of the riverbank, weed poisoning, and domination of invasive species.

e. Community Engagement

Smart Partnership and stakeholder engagement is vital for project sustainability. Local community participation and gender mainstreaming are equally important too. Gender balance and youth involvement at all times and levels also should be encouraged, promoted, and monitored.

f. Promote, Establish and Support Friend of River Basin Network

To encourage and give voice to the participating communities in river management, it is recommended that a network of these similar organisations is established so that they can learn and inspire each other, as well as being the reference point in facing challenges and solving issues.

g. Establish a Community-based River Care Fund

It is important to establish a funding platform specifically for community-based groups to initiate or sustain the activities. As per the finding of this project, it is found that a lot of local communities are willing to participate in river care and monitoring.

h. Resources and Continuity

There is a need to promote and enhance the skills on the key initiatives stakeholders/officers on the role of communities and the component of mainstreaming biodiversity into riverine management. The trust and relationships built with local communities and other stakeholders throughout the project need to be maintained. Each time a new officer comes onboard, relationships have to be established afresh and trust regained.

4.2 Way Forward

a. Overall

- Streamline, coordinate, and manage the programmes/activities to ensure their effectiveness as cross-agency involvement and support among multiple agencies is crucial for impactful and sustainable results.
- Ensure sustainability of project through an integrated approach (linking structural and non-structural measures including Heart Approach).
- Building and maintaining a relationship and trust with the government, private sector, and community stakeholders require a significant amount of time and a personal approach.

b. Community as main DRIVER

- Empower and provide the right platform for the community to plan and play their proactive role.
- Traditional knowledge/skill and historical information is vital for the success and sustainability of any initiatives.
- NbS could be the pulling factor to get ownership from community.
- Involve key government decision-makers in discussion to change the rules and policies that often constrain community engagement in biodiversity observation.

c. Communication

- Reduce potential conflicts and enhance communication and partnership with the stakeholders.
- Enhance the coordination and communication effort at basin (or sub basin) level to provide visibility, integration, and cohesiveness.
- Create a communication framework to promote mainstreaming biodiversity conservation into river management.
- The framework should serve as a forum accessible to stakeholders: communities, NGOs, governments, private sectors, education institutions, and the general public. The framework too should provide an easy access for communities to post experiences, outcomes, lessons, interests, and needs.

d. Sustainability

- Even after the project ends, initiative need/will/should to be continued.
- Involvement and support from DID Malaysia and other partners must be continually active especially to local communities.

The project implementation partners strongly feel that Mainstreaming Biodiversity Conservation into Riverine Management Project is vital and significant for the country. Therefore, there is a need for such projects to be initiated/continued, either through new project or infused within respective agencies' ongoing or upcoming projects/programmes. It is important to work hand-in-hand with the environment and relevant agencies where more benefits can be achieved instead of focusing at department or agency level. By incorporating Smart Partnership and recognising all relevant partners, agencies as well as community, the impact will be in a larger scale and more significant.

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- Friends of Sungai Klang AU2 Taman Keramat
- Friends of Sungai Gombak Perumahan Awam Seri Terengganu
- Friends of Sungai Penchala
- Friends of Klang River Basin Network

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