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Integrated River Basin Management (IRBM) in Malaysia

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Abstract: Malaysia is still experiencing a vigorous and rapid land development process. Land development requires a careful and comprehensive planning process to ensure that a development can be implemented without significant negative impact on humans and the environment. With rapid urbanisation and industrialisation, problems and issues related to rivers and the river environment are expected to intensify. River basins need to be managed in an integrated and holistic manner. The integrated river basin management (IRBM) approach is through the process of coordination, management, development and conservation of water, land and related resources covering various sectors regardless of administrative boundaries within a river basin. Failure of water resources planning in land development will cause huge impact on the environment such as water scarcity, water resources pollution, floods and environmental destruction. This will directly or indirectly affect the economy, investment and the well-being of the people.

Keywords: land development, River Basin, floods

1. Introduction

Since the beginning of civilization, rivers have played a huge and important role in shaping and influencing the development of the nation and the culture of its people. Almost all major cities in Malaysia are located by the river. The city of Kuala Lumpur itself was founded at the confluence of the Klang and Gombak rivers. The rivers in Malaysia, sharing a wide variety of flora and fauna, also offer incredible recreational opportunities.

Malaysia has 2,986 river basins of which 189 are major river basins while the rest are minor river basins. Of the total major river basins, 74 are located in the Peninsular Malaysia, 75 are located in Sabah and 40 in Sarawak. The main river basin is a basin with an area of more than 80 km2 while the small basin has an area of less than 80 km2.

River basins in Malaysia can be divided into three categories as stated in Table 1.

Table 1: River basins categories in Malaysia

Category	Description	Total No.River Basin
1	River wholly in a state	167
2	River shared with more than one state	17
3	River shared with other country	5

1.1 Issues and Challenges Related to Water

Malaysia is fast evolving from what was primarily an agricultural or raw commodity economy i.e. timber, rubber, tin and palm oil into an industrialised and manufacturing economy. The manufacturing and construction are currently become the main stimuli for the economic growth of the country. Continuing rapid growth through land development, urbanisation and industrialisation has invariably had its toll on the environment. Rivers have not been spared from such impacts of development. The problems normally associated with rivers are flooding, water shortage, river pollution and environmental destruction.

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1.2 Flooding

Over the last two decades, as a result of economic growth, there has been a rapid growth in urban centres and expansion in the development of land, property and infrastructure in the suburban areas. This has resulted in the potential for greater flood damage as well as increased incidences of occurrence of flash flood, which result in a lot of disruption to socio-economic activities.

The Updating of Flooding and Flood Damage Assessment Study (DID, 2012) conducted by the Department of Irrigation and Drainage (DID) found that 33,298 km2 or equivalent to 10.1% percent of the country's area are floods prone areas. Of late the flood occurrences have escalated due to a combination of high and uneven of rainfall and rapidly increased impermeable area from concrete to tarmacs. Development is too fast in result of not coordinated with current drainage capacities and capabilities in highly dense populated areas are some of the significant causes of current flash flood escalations after heavy rainstorms. Besides, indiscriminate disposal of solid wastes and transport of sediments from land clearance and construction areas into waterways constricts the flow of water also is one of the major causes to flooding. The increase in runoff from developed areas results in higher peak discharges and shorter time to peak. The decreased capacity of the waterways and higher runoff contribute to frequent flood occurrences of larger magnitude (Zakaria & Sharip, 2007). There is also the possibility of newer development initiatives, not taking into consideration the negative impacts it brings to the existing surrounding environment. The floods damages are estimated to involve an average loss of RM36 billion a year and involve a population of almost 5.7 million, which is 21% of the Malaysian population.

1.3 Water Shortage

Located in the tropical humid region, Malaysia is generally endowed with abundant rainfall in the order of 2940 mm annually. The total water resources of Peninsular Malaysia are dominated by the amount of water that flows in surface streams after rainfall. The source of all water is rainfall, which falls on the Peninsula in response to two monsoonal seasons. Of the total average annual rainfall of about 2,940 mm, some 51% (1500 mm/year) runs off as surface flow, 43 % (1250 mm/year) is evapotranspiration back to the atmosphere and the remaining balance of 7% (1592 mm/year) enters into groundwater and eventually finds its way to oceans without entering surface streams (DID, 2011). Water is used for a variety of purposes. Consumptive water use is largely for irrigation, industrial and domestic water supply and to a minor extent for mining and fisheries. In stream water uses, which are non-consumptive in nature, include hydropower, navigation, recreation and fisheries. The projected water demand for Malaysia has increased steadily from years to years and is expected to reach 18,228MCM or 55.1 mm by year 2050 (DID, 2011). It is expected that five states in Peninsular Malaysia will experience water deficits, i.e. Selangor, Penang, Melaka, Perlis and Kedah. Currently, these states start experiencing the water shortages during the dry season.

1.4 River and Water Pollution

Section headings should

Malaysia has been divided into 189 river basins. Many of the river water quality are degraded by sediments from land clearance and solid wastes. Most problems originated mainly from the extensively altered flow regimes and clearing of riparian vegetation, development too close to the river banks, can cause streambank erosion that can negatively impacts the morphology of the river channels and their habitats. The Environmental Quality Report for 2019 (DOE, 2019) states that there are 59 rivers, which is 9% of the 672 monitored rivers have been classified as polluted rivers. Major pollution source were sewerage, industries and pig farming. Pollutants included solid waste, debris, chemicals, minerals, sewage and sediments. Solid wastes, such as plastics and rubbish from households and industry, are not only major aesthetic nuisance and can harm aquatic fish and plants, but can be critical and dangerous during heavy rains as it can create flash floods very rapidly. Diffuse source from agriculture practices are mainly from residuals of agro-chemical, fertilizers and pesticide. In the report, the Department of Environment (DOE) has identified biological oxygen demand (BOD), ammonic nitrogen (AN) and suspended solid (SS) as the main pollutants in the river. High BOD in rivers is associated with inefficient sewage treatment and as a result of effluent discharge from manufacturing and agro-based industries. Meanwhile, high AN is associated with livestock activities and domestic sewage. Besides, indiscriminate disposal of solid wastes and transport of sediments from land clearance and construction areas into waterways is also one of the major causes contributing on high SS in the rivers.

1.5 Environmental Destruction

The environment should be taken care of as best as possible because the nature and human beings are interdependent. There are various benefits that human beings can obtain as a result of good care and conservation of the environment,

In Malaysia, there are numerous of environmental pollution cases reported every year. Among them, the air pollution incident happened in Pasir Gudang, Johor in 2019. The pollution is believed due to the dumping of toxic waste planted in the ground by irresponsible people. The illegal planting of toxic waste into the soil can cause not only the air pollution but also the water pollution. The groundwater drainage in the area may be infiltrated by the volatile toxic waste. Over the time, it will slowly seeping through the soil and through evapotranspiration process and activation by the air, the toxic gases is formed and released to the environment. As a results of the air pollution, it impacts the health of the nearly communities, especially children, disrupted learning due to school closures and the socio- economy.

1.6 Integrated River Basin Management (IRBM)

Integrated River Basin Management (IRBM) is defined as "the coordinated management of resources in natural environment (air, water, land, flora, fauna) based on river basin as a geographical unit, with the objective of balancing man's need with necessity of conserving resources to ensure their sustainability". IRBM is geared towards integrating and coordinating policies, programmes and practices. It addresses water and river related issues. It requires improved professional capability and increased financial, legislative, managerial and political capacity.

To control the negative impact, DID began to introduce the concept of IRBM since the mid-90s. The IRBM concept

approach is through the process of coordination, management, development and conservation of water, land and related resources covering various sectors regardless of administrative boundaries within a river basin. The implementation of IRBM aims to maximize the economic and social benefits derived from water resources equitably while maintaining and restoring the water resources ecosystem in accordance with the four main objectives of IRBM as shown in Figure 1, namely :

- Ensure Adequate Water
- Ensure Clean Water
- Reduce Flood Risk
- Enhance Environmental Conservation

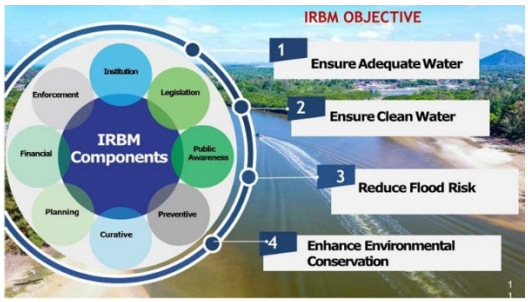

Figure 1: IRBM concept and objectives

The IRBM Plan plays a very important role in the eight key components of National Water Resources Management. It explains how existing water resources can be exploited to their potential, dam planning and development, development of river's corridor, flood management and its plains, environmental friendly local drainage, agricultural irrigation and drainage and estuary and coastal zone conservation. The components of the IRBM Plan as depicted in Figure 1 include planning, rehabilitation, awareness, prevention, enforcement, financial, institutional and legal components. For each component, activities are planned to achieve four (4) objectives that have been set for a river basin. For example, in the rehabilitation component, studies are done first before formulating strategies to reduce flood risk, reduce pollution as well as improve the quality and quantity of rivers. Rehabilitation strategies, whether in the form of structural or non-structural solutions, are subject to and as appropriate within the basin. Some river basins require structural solutions, such as construction of flood reservoir ponds but some river basins are more suitable to use non-structural approaches through population evacuation schemes and gazetting floodplains as for example in Sg Kemaman Basin. Ideally, the preparation of the IRBM plan is building with nature, where the focus is on preserving the natural state of the river.

1.7 Planning

Planning for development should be done in an holistic manner. Masterplans and Zoning Plans must adopt an integrated approach in addition to being proactive and preventive. There should also be appropriate standards which conform to best practices. Comprehensive manuals and guidelines must also be available to ensure quality and ease in implementation. The introducing of Malaysian Stormwater Manual (MaSMA) is one such example.

1.8. Preventive

For sustainable solutions, the objective must necessarily be one of prevention, very much in line with the adage "prevention is better than cure". Such approaches would invariably require the removal of the sources and causes. Even issues like erosion can be controlled or avoided. Each river has its optimum "carrying capacity" and to keep demands within this capacity, the problems should be addressed and treated at source (or source control). It often requires regulatory action and hence the need to ensure enforcement, when necessary, through appropriate legal instruments. Preventive measures are cost-effective and offer long term solutions.

1.9. Curative

Curative measures that include physical cleaning of the river and providing sewerage treatment works have been implemented and will continue to be undertaken to rehabilitate and improve river water quality. At the same time, mitigation works against flooding are also should be implemented. However, the pace in implementing such measures, which at times are unending, often lag behind the rate of degradation of river water quality and the increase and extent of occurrence of floods. Needless to say, such curative measures are costly and time consuming, which the limited public sector coffers can ill-afford considering other more urgent priorities that need to be addressed.

2. Enforcement

There are numerous laws with gaps and overlaps, there are also many agencies and departments involved dealing with fragmented sectoral functions. There is invariably lack of resources to carry out the enforcement. The penalties are inadequate and political will is often lacking.

2.1 Finance

Finance is a critical resource common for all the elements mentioned above. Water is both a social and economic good. In addition, it is also a public and private good. All programmes would entail both direct and indirect costs and benefits. Financial instruments, especially those with a view to enable cost recovery, requires that there is transparency and accountability in all processes and transactions. Polluter/user pay principles are currently widely used in many countries and are relevant also for adoption in Malaysia. Privatisation is not new in Malaysia. It is an option to consider for service provision in the implementation of both development and recurrent operation and maintenance programmes.

2.2 Public Awareness

The participatory approach and involvement of all stakeholders in the entire project/programme cycle is a key element to ensure success and sustainability in the long term. Strong and smart partnerships are essential to create win-win solutions, with the community and other stakeholders (as corporate citizens) accepting their share of responsibility. Such participatory management mechanisms need time to develop for which appropriate public awareness campaigns and education programmes would need to be put in place early. Non-governmental organisations (NGOs) can play an important and facilitating role in such programmes.

2.2 Legislation

There are some 40 Federal laws related to land and water. In addition, there are 3 or 4 enactments in each state. Adding

all the related laws, Malaysia has more than 100 laws related in one way or other to water or rivers. These laws generally govern the use rather than the protection of the resources. Conflicts and overlaps are therefore common. There are also the contentious issues of Federal and State jurisdiction to be dealt with. Hence, there is a need for a more comprehensive and contemporary river/water law and this process admittedly is time consuming.

2.3 Institution

As described earlier, fragmented laws and institutions and the lack of well-defined jurisdiction has become a definite obstacle to sustainable resource development and management. There is a clear need for an institution, like a river basin authority (RBA) that can integrate and co-ordinate activities within a river basin. Efforts towards this end have already been initiated by the State of Selangor with the recent passing of a contemporary water law, which applies IRBM concepts for the management of rivers. As a consequence, most of the earlier fragmented laws have also been repealed. Under this enactment, the Selangor Waters Management Authority or "Lembaga Urns Air Selangor (LUAS) has since been established, charged with the responsibility to plan and regulate land and water development and activities in an integrated manner at the river basin level. In managing individual sectors, the need to distinguish the regulatory and service provider roles is essential for effectiveness and greater efficiency.

2.4 Institution

IRBM is a subset of Integrated Water Resources Management (IWRM). IRBM is a process of coordination, management, development and conservation of water, land and related resources covering various sectors regardless of administrative boundaries in a river basin. Considering the river basin as a single block, regardless of district or state boundaries in planning and coordinating water resources within the basin. IRBM's role is to integrate and coordinate policies, programs and practices related to water and water issues.

DID has started preparing the IRBM Plan since 2003. This is in line with the decision of the 2nd National Water Council Meeting on 29 July 2003 which agreed that closer cooperation be established between the Federal Government, State Government and Local Authorities to manage river basins in an integrated manner.

To prepare an IRBM plan, input from various expertise is required to evaluate from various angles
e.g. hydrological and hydraulic engineering expertise, water quality expertise, biodiversity, socio- economic experts and many more. The preparation of this IRBM plan requires us to think broadly and macro to ensure benefits from all angles of a river basin. The preparation of the IRBM plan involves three main processes:-

1) Data management
2) Analysis through the process of numerical modeling
3) Produce of short, medium and long term action plans

To ensure the produced IRBM plan is workable, having effective communication amongst all involved stakeholders at various stages is essential preparation. These stakeholders include state governments, district offices, PLANMsia, state water regulatory bodies, Fisheries Board, agricultural agencies, local residents and others.

The IRBM plan, which has been prepared, explores a two - pronged solution to the problem. For example, we receive a high rainfall distribution, but not all the time. There are times, we do not have enough water because the prolonged dry season causes the water level in the dam to decline and forces water supply rationing to be implemented to ensure the continuity of water supply throughout the drought period. This has happened in the Klang Valley about 5 to 6 years ago.

The need for the implementation of awareness programs such as public outreach programs as an initiative for river conservation and preservation that have been outlined in this IRBM plan. The IRBM plan prepared also examines the legal aspects based on the geographical position of the river basin, in an effort to strengthen the processes and procedures that affect the river either directly or indirectly.

A lot of data and analysis results have been collected and generated in preparing this IRBM plan. All data and analysis results that have been collected including geospatial data will be stored in one geospatial database.

Figure 2 shows the implementation IRBM plans that have been carried out throughout Malaysia. In total, DID has completed 34 IRBM plans covering at least 70% of the area of Peninsular Malaysia up to the 11th Plan. Meanwhile, in the 12th Plan, DID has planned to conduct 25 more studies for the preparation of IRBM plans for river basins covering Peninsular Malaysia, Sabah and Sarawak.

Figure 2: The implementation of IRBM plans in Malaysia

2.5 Action Plan

In the IRBM Action Plan preparation, relevant issues are listed. From the results of the analysis, strategies have been formulated through the approaches that need to be taken to achieve the IRBM objectives that have been outlined. This strategy is detailed with an action plan that needs to be implemented and the actions to be taken by the lead agencies within a period of one year, 3 years, 6 years and 10 years, namely for short term, medium term and long term. The Action Plan also provides the involved cost estimates in implementing these actions. Figure 3 shows the example of IRBM Action Plan format.

2.6 Benefit

The implementation of the IRBM Plan in the State will benefit in the identification of water supply sources where this will generate and increase state revenue. River basin planning is requires allocations and this IRBM Plan will become the basis

in the application of allocation from the State Economic Planning Unit (UPEN), meanwhile at the local government level, the IRBM Plan is one of the planning basis for implementing development in a more holistic river basin solution under Local and Structures Plans.

Figure 3: An example of IRBM action plan format

The proposal for the applying the IRBM Plan as the basis for Land Development Planning at the State, District and Local Government Levels was presented in the National Water Council meeting for consideration on 25 March 2021 and the meeting agreed with the DID's recommendation. It is hoped that this IRBM plan will be easily adopted by stakeholders in planning development in the river basin with the aim and goal of making the water sector as a catalyst for the national economy.

3. Conclusion

The country's water resources is a national heritage to be preserved and passed on to the future generations in a good and sustainable condition to ensure long term sustainable development. Water is a critical element for consumption and food production. Without proper management, conservation and efficient use, serious water-related problems like floods, droughts and pollution of the environment will reoccur. Recognition of water as a finite and vulnerable resource will help contribute towards efforts in maintaining sustainable development among all stakeholders.

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