

PROMOTING RIVER-BASED INFRASTRUCTURE DEVELOPMENT: INTERGRATING LANDSCAPE COMPONENTS IN URBAN RIVER DEVELOPMENT IN MALAYSIA

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Abstract: The main concern of river development was to facilitate future development of a river in a way they can preserve and conserve the river environment naturally. Since the river areas was one of the most valuable assets in sustaining urban development, the river mitigation measures formulated should not discourage the development to take place. However it must be strictly safeguarded by proper controlling and monitoring mechanism by the relevant approval authorities. Therefore, the objective of the paper is to review the general features of urban river development and urban river landscaping by local authority in implementing the river infrastructure mitigation projects. This paper also made suggestions on how the relevant authorities can play their roles for a friendly monitoring of river development particularly in urban property development.

Keywords: River development, infrastructure provision, tourism development, land-use planning

Introduction

Malaysia is moving towards achieving a developed nation status by the year 2020. This evidenced by its rapid socio-economic growth in the last two decades. Urban and industrial areas have grown in many parts of the country. The pressures have caused significant consequences to the environment, such as hydrological and ecological changes. Various aspects contribute to urbanization increases the population density and the expansion of urbanized areas by creating a higher building density and thus became the most prominent influence on changes in hydrological processes. In some urban centres, internal migration grows annually and take place from rural areas to established urban centers and industrial zones where these to established urban centers and industrial zone where are good infrastructural facilities. Most urban areas are normally found on alluvium plain and coastal/estuarine zones. In the year 2020, the Malaysia population is expected to escalate to 30 million and, with further urban and industrial growth, cities and towns may reach 55-60% of the total population.

The increase in population through the urbanization brings about the rise of water demand and this gives rise to the necessity of water resources development. This is the first of the major hydrological problems. The increase of population density and increase the building density also increase the quantity of waterborne wastes. This contributes to the deterioration of storm water quality. Malaysia has experienced various problems due to rapid industrialization and urbanization, particularly through a period of high economic growth. During that period, actions for intensified countermeasures by respective authorities

commenced regarding each problem. Today appropriate adjustments and combinations of such various measures are required to efficiently achieve the urban water management through the approach of 'Integrated Urban Water Management'. Major problems related to urban water management were shortage of water, pollution of water bodies, deterioration of environments surrounding rivers, lack of available water for emergencies and urban flood disasters.

Throughout the paper, emphasis was given on the strategies outlined by respective authorities in Malaysia in managing urban water management by integrating planted components (landscaping programs) into river based infrastructure development plans. The discussions in this paper also explain the Malaysia's experience as a case study, outlines development of urban water management and the efforts by respective authorities towards preparing integrated water management in the country.

Urbanisation and River and Development

The profiles of River

Malaysia is part of the South Asian Community. It occupies a total area of approximately 330,000 sq. km and is divided by the South China Sea into West Malaysia (the Peninsula) and East Malaysia (Sabah and Sarawak), about 1000 km apart. Being located between longitudes 1 – 7 North and latitudes 100 – 120 East, Malaysia is influenced by the equatorial environment and is well outside volcanic, tornado, and severe drought belt. Strategically, the country is located to various international air and sea transport and communication routes.

Malaysia is formed by 13 states varying in size from 244 sq. km (Federal Territory Kuala Lumpur) to 124,449 sq. km (Sarawak) (see Figure 1). With a present estimated total of 21 million people, the Malaysia population is becoming more concentrated into cities, towns and industrial zones (over 50%), with the highest figure in Kuala Lumpur at 1.4 million. Kuala Lumpur started as a village in 1860, became capital of the United Malaysia State in 1896, and was turned into capital of Malaysia in 1863. It was subsequently upgraded to a city status in 1974 and now stands as the most urbanised and populated zone in Malaysia with a projected population of 1.85 and 2.4 million in 2020 and 2050, respectively (EPU, 2000).



Figure 1: The Location of Malaysia

Like many other developing countries, Malaysia is striding to upgrade its social well-being by alleviating ever-increasing flash-flood, water and pollution problems. In mitigating the flood problem, river features was identified as one of the vital elements to mitigate flood

problem. It has some of 150 rivers in Peninsular Malaysia and 50 rivers in Sabah and Sarawak. Rivers have played an important role in shaping and influencing Malaysia's development and almost towns in the country are located beside a river. It offers tremendous recreational opportunities to the local communities by sharing a wide variety of flora and fauna. From the viewpoint of the urban storm water management or water resources, this situation means that planning for the future in Malaysia must envisage a continued increase in population growth in urban areas.

Development and River Infrastructure

Urban growth creates demands for various development projects as accelerated by strong growth in industrial sector and reinforced by dynamic property market sectors. The concentration of urban population and expansion of existing development areas requires rapid implementation of various types of infrastructure projects. The large scale development project has produced greater challenge to local authorities to balance the issues regards to river basin environmental sustainability and livability. However, improper execution of the projects, especially those located in sensitive development areas, would be harmful to river basins. Various countermeasures have been identified to monitor urban river basins. Meanwhile, the adequate provision of infrastructure has to be provided and at the same time it has to protect the natural and built environment.

Urbanisation results in diversification of landuse practices with respect to the hydrological and environmental terms. Urban and industrial areas in Malaysia typically comprise of residential, markets, institutional, construction, industrial, resort development or golf course, parks and greenways, commercial/business, roads, streets and highways. Urbanisation can takes place in many different ways. They are formed such as towns, cities, ports, commercial or business centres, new development areas or even on linearly along road, highway or coastal roads. The recent trend in local property sector was bringing new image to some urban rivers in Malaysia.

Many of the planned residential development was given hope to river environment with the concept of river become the main focus of the development. By integrating the river features (*fauna* and *flora*) into the match-design of mitigation measures (*man-made structure*) of the river, river nowadays have been part of the river component functioning as infrastructure to mitigate any uncertainty within river basin. This can be rephrased in environmental terminology as landscaping exercises. Where the man-made structure used to mitigate the river bank from erosion, landslide or sedimentation consequences must be symbioses with the surrounding. At the designing stage, all related professionals currently engaged in such development should therefore accept the new concept and challenge roles of not only designing satisfactory of flood mitigation structures but they have also to look forwards of how this river infrastructure (*man-made structure*) can be integrated to the river basin development.

Issues in River Development

Since 1957, Malaysia which is evolving from an agricultural and raw commodity economy such as timber, rubber, tin and palm oil into an industrialised and manufacturing is driven by Vision 2020. The economic growth of the country was strongly stimulated by manufacturing and construction sector which makes up some 46% of GDP. The rapid growth through land development, urbanisation and industrialisation has created a considerable consequence to the environment. Rivers however, have directly received such negative impacts from development. Some of rivers which located in many major urban centres in the country are now at an alarming stage, due to improper monitoring by relevant authorities. As reported by Department of Irrigation and Drainage (2000), the problems being encountered by some of the river in the country are; flash flood, mud flows due to construction activities, water pollution and

ecological damage, river bank failures, sedimentation, surcharges and overflow from wastewater facilities and garbage and floating litters. The areas which are prone to experience these problems include urbanised and urbanising centres in the Klang Valley, Kuala Lumpur International Airport (KLIA), Penang, Linggi River Basin and other new socio-economic growth areas which most then located in West Coast of Malaysia. Based on a study conducted by Department of Irrigation and Drainage (2003), summarised the problems associated with rivers are:

i. Water Shortage - Rapid economic growth coupled with prolonged drought has brought the problems of water imbalance into development which is concentrated in 'water-stress' regions. The main problem in this particular scenario, the number of population is not-proportionate with the capacity of what a river basin can support in that region. By the year 2020, it was projected that the number of water use is increase from 15.5 BCM 20 million BCM (DID, 2003).

ii. Flooding - With the rapid growth of industrialisation and with improper monitoring of urbanisation, was led to the increase of flash flood problem in some major urban areas. Malaysia is estimated that around 9% (or 29 000 sq. km) of it total area is prone to flooding, with some 2.7 million people would affected. Some flood disaster in developed areas was caused by improper control and monitoring. Since then many newly developed areas which had no previous flood records were subjected to severe flooding. Two primary reasons can be identified as the causes of urban flood disasters, likely the expansion of urbanization areas and flooding of downstream areas caused by the increase of flood discharge due to upstream urbanization.

iii. River and Water Pollution - In the most cases, the river water polluted and becomes discoloured after human use. The deterioration of river water quality is synonymous with development. The main source of pollution was discharged from domestic and industrial sewage, rubber factories, effluent from palm oil mills and animal husbandry activities. Mining, property development and new roads construction, logging and clearing of forest are major causes of high concentration of suspended sediment in downstream stretches of rivers.

iv. River Sedimentation - The sedimentation of river normally occurred in the lower stretches with heavy silt loads especially after heavy rains. Whereas in urban areas, the sedimentation take place as the direct consequence of extensive land clearing for projects such as housing, industry and highways and the subsequent severe erosion caused by heavy rains. In urbanised areas, land clearance for construction project contributes 90% of sediment load to river.

v. Squatters - Another major contributor to urban river pollution came from the presence of squatters settlements. The problem is detrimental to the river in a number of ways. The settlement was not adequately provided with sewerage and rubbish disposal facilities. Most of the sewage and water generated within the area find their way directly into rivers. As an example in the Klang Valley, it was estimated that between 20,000-40,000 squatters population still living on the river reserves. The area was poorly managed and rubbish is generally disposed to a common dumping area on the banks of the river, which invariably gets washed down to the river.

Figure 2 indicates the mains issues that have been discussed and each main issue has been contemplated further with several sub issues. Besides the above discussed problems facing by many rivers in the country, further analysis shows that some of the three sub issues are inter related with several other issues like poor land use management which connects to the

inadequate protection of forest and green area or poor monitoring as well as improper land conversion or expansion of urbanisation. By referring to the same figure, the sub issue of improper land conversion was much related to the three main issues such as poor land use management, flood problem and depletion of biodiversity and water quality deterioration. This scenario was further supported for the reason why integrated approach is the favourable step toward for the country for river management. The establishment of an authority to manage the river basin would further strengthen the overall river basin development in particular the planning and implementation of the appropriate infrastructure and landscaping programmes.

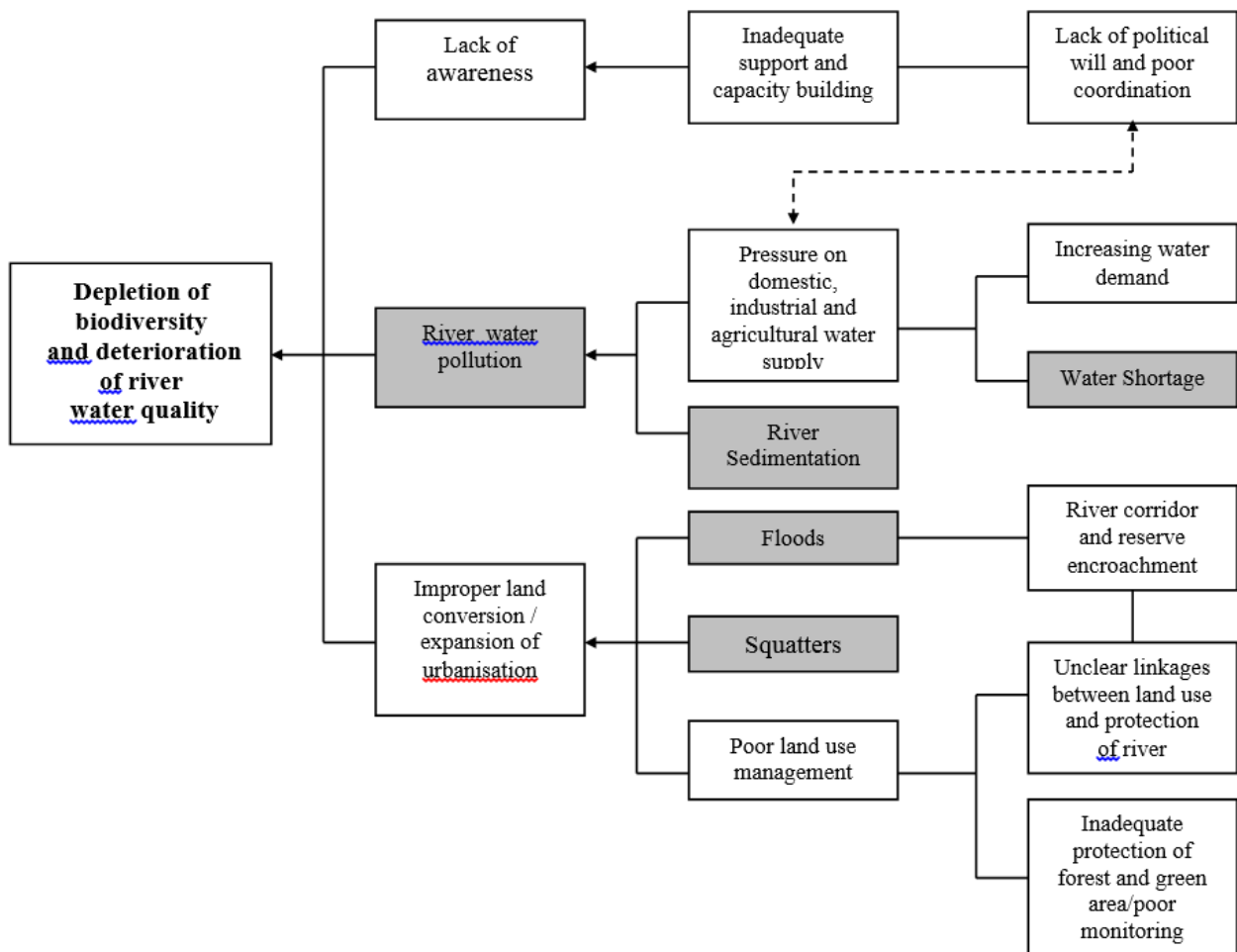


Figure 2: Issues in Urban River Development, source: Adopted from Noh (2003)

River Infrastructure and River Landscape

The expansion of existing development areas together with high migration into urban areas and have become global phenomena in the latter half of the last century. Malaysia in particular has experienced a rapid and intensified urbanization since its independence, through a period of high economic growth. The fast urban growth accompanied by the country's good economic has resulted in strong demand for development projects as well as the urgent need for rapid implementation of various huge sizes of infrastructure projects. Such urbanisation makes changes the hydrological regime of river basins. This requires various countermeasures to monitor the urban water management.

Generally urban water management is strongly affected by climatic, socio-economic and institutional arrangement and these may vary among countries, or even regions. In

Malaysia, the increase in population as a result from urbanisation brings about the increase in water demand and this gives rise to the necessity of water resources development. This is the first of the major hydrological problems. The increase of population density and increase the building density also increases the quantity of waterborne waste. This contributes to the deterioration of storm water quality. Among the factors contributing to flood disaster in Malaysia are i). Increase of inundation caused by insufficient drainage capacity, ii). Increase of flood damage density due to the high concentration of population and new development projects and iii). Unregulated or improper supervision during construction stage causes sudden landslide which effect normal runoff of the nearby rivers or drainage system. In order to minimise the negative impacts, various mitigation measures have been formulated and put forward in line with urban water management through the approach of 'Integrated Urban Water Management'. Therefore various counter measures have been taken in mitigating the environmental consequences. Hence, planting was identified as an effective, economic and environmentally friendly method available to be incorporated in river based infrastructure development in managing urban river water infrastructure development.

The main purpose of river based infrastructure development is to control flooding as efficiently as possible by incorporating the plants as the main components. The growing public concern demands the utilisation of plants (*fauna and flora*) for recreational purposes. In response, a development concept themed 'Development Facing River' which using plants as the main component was welcomed by most local planning authorities in the country. Social and economic growth has long been associated with river water control by means of mitigation of flood damage to people's lives and diversification of river water utilisation. In recent years, the environmental function of the river in urban areas has been recognised as equally important.

The Function of River

Generally river has three main functions for flood mitigation, water utilisation and environmental aspects.

i. *Flood mitigation* - The function of flood mitigation is for safeguarding and preventing flood disasters and this is more fundamental function of the river to be held. However, in some cases flood has been often occurred while town and settlements has obliged to settle within flood prone areas. Under these circumstances, flood mitigation has been always considered as a social necessity. As for river water control, it mitigates the flood damage to people and their life. Diversified utilisation of the river water, have been recognized quite importantly from old days along with growing and high expansion of social and economic activities.

ii. *Water utilisation* - During rapid economic growth, witnessed a large scale population migration to cities (e.g. industrial areas) from rural areas causing rapid urbanization and sparks heavy demand on existing water supplies. In Malaysia, State Water Authority was established in every state to manage and control the water supply to each state in the country and also to step up a comprehensive and interdisciplinary development and legitimate utilization of water resources. The function of water utilization is for an effective utilization of river water, and this is not only the utilization of water resources as water supply and irrigation purpose but also involving a category of water transportation and fishery.

iii. *Environmental aspects* - In recent years, the environmental function of the river in urban area has become relatively to recognize its importance. For instance, pollution level of river water was increase resulted from improper control of economic and urbanisation activities, and the river itself faces over saturation in self-purification capacity. Pollution of natural waterways through effluent discharges from factories and businesses began to be noticed in

during the rapid industrialization period. The function of environment is more wide range of aspects such as acquiring spaces for recreational, sports activities and walkways, amelioration of microclimate condition, inhabitation of aquatic fauna and flora. Some rivers have characters which influenced by topographic and climatic condition.

River Improvement and River Landscaping

Landscaping of river is somewhat results of human motivation with background of social value and consensus to the river, and this idea becomes to reality of landscaping. The function of river could be more conceptual and flexible in form of design. Therefore, the landscaping of the river should be integrated with surrounding elements such as the urban conditions and the character of social demand and activities to be performed.

Meanwhile, the main purpose of river improvement is to control flood as efficiently as possible. These measures generally gave rise to straight and lined river channels, which were not aesthetically pleasing. At the same time a growing public concern demanding utilisation of public water bodies for recreational purposes was initiated some local authorities in the country to promote a river development concept termed 'Development Facing River' which well received by most local planning authorities in the country. These include expanding greenery and beautification of urban rivers.

Another aspect of urban water requirements made it necessary to integrate urban water management strategies. During the last decade public concern for environment issues has included demands to revert the rivers back to their natural look. In this context the river beautification programmes have been expanded to cover the full length of the river. Under these projects preservation and improvement of river are given a high priority in any large property development related projects in the country. Major urban river management measurements had taken place during the last decade. These measures include the Water Pollution Control law, Comprehensive Flood Control Measures plan, River Friendly Projects etc. The direction of these measures over the years is towards the management of both flood and ordinary flow in rivers, by integrating planning and management of urban development.

The study of river landscape by local authorities during the preparation of development plans (Structure Plan and Local Plan) would be a part of the whole contents of development plans also comprises the landscaping programme of river. The objective of landscaping program in the study was;

To review of the existing river landscape condition schemes and aesthetic aspects of the river system by incorporating the flood mitigation and drainage, master plan and feasibility study.

ii. To review the conceptual landscape improvement concerning with the river channels and retention ponds, and relevant measures to enhance aesthetic value of these surrounding areas.

River systems comprised of many small rivers with some tributaries originated from the hill range and it's foothill with respect to landscape condition of the riverside area of most rivers that are in urbanized area is lacking of aesthetic quality due to water pollution, solid wastes and condition of grown sedge and vegetation on the banks. River reserves areas are often have inadequate outlooks of surrounding areas. In many cases, river reserves are illegally developed by squatter settlements.

The development plans has issued policies for the river development. The policy imposes strict gives very strong requirement in improving the river and its corridors. Among these requirements are;

- i. To improve the environmental quality of the river and its corridor.
- ii. To improve access and circulation to the river and its corridor
- iii. To realise the potential of the river and the corridor for recreation and amenity.

Landscape Components of River

The river has many aspects of landscape components in relation with human activities and the nature. The natural characteristics of the river are usually having quite diversified forms and dynamics within the riverine spaces (Cals and Drimmelen, 2001). By referring to Figure 3, the landscape components of the river are generally divided into two categories which are attributed the space within the river and surrounding space of the river.

Towards Integrated Urban River Development

The major problems related to urban river development include, the pollution of water bodies, urban flood hazards and deterioration of the environment surrounding rivers. To date a piecemeal approach has been adopted to solving the problems. The previously piecemeal and segmented efforts are needed in order to achieve efficient and environmentally sustainable function of urban river. However, the efforts must be appropriately integrated, especially by integrating land use planning to achieve multiple uses for urban land.

The concept of 'Integrated Urban Water Management' consists of two main components, which are structural and plant component. The concept creates a wide range of aspects such as acquiring spaces for recreational, sports activities and walkways, amelioration of microclimate condition, inhabitation of aquatic fauna and flora. Rivers in some states in Malaysia have characteristics affected by topographic and climatic conditions; historically floods have often occurred when towns and settlements are established within flood prone areas. Under these circumstances, flood mitigation has always been considered a social necessity. The river has many aspects of landscape components in relation to human activities and nature. The natural characteristics of rivers are diversified form and dynamics within the riverside areas. The landscape (plants) components of the river are generally divided into two categories which are attributed to the area within the river and the area surrounding area of the river.

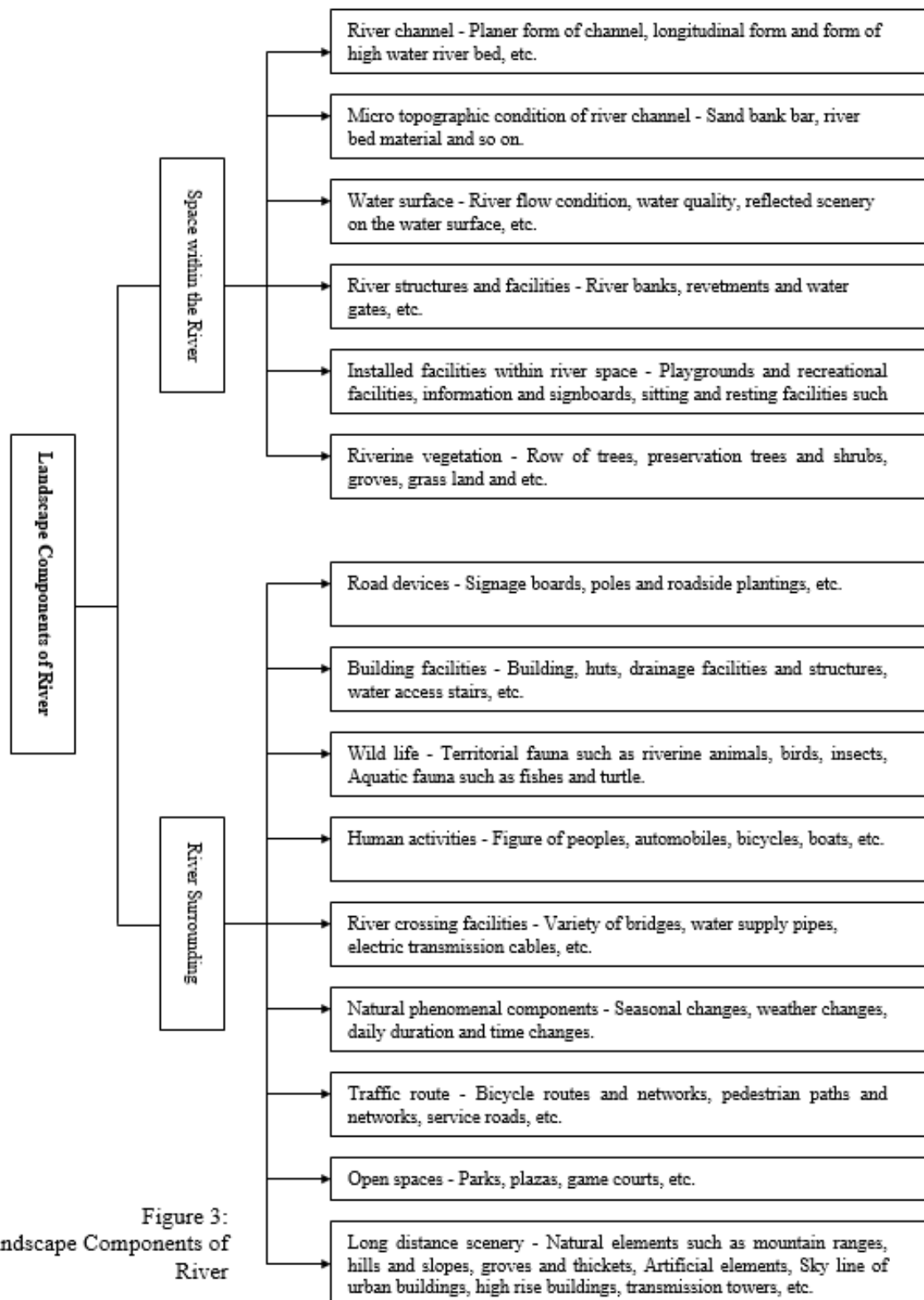


Figure 3:
Landscape Components of
River

River Improvement Guidelines

Together with the future riverside park areas, spaces of the river reserve it are become valuable open space as utilized recreational cores with pedestrian walks. These series of space along the river can be made well-harmonized environment to represent effective façade of the urban area. Functional services of these spaces are pedestrian walks, rest place and plazas with

landscaping, and these new environmental function of the riverside spaces is quite effective. The existing landscape condition will be changed to be more attractive environmental situation through these improvements of the riverside development works (see Figure 4).

An idealised goal for urban water management would be the restoration to its natural level. To achieve this goal, the objectives of urban river management should take into consideration some important components; i). to enhance the urban landscape, ii). to optimise the land available for urbanisation, and iii) to minimise the environmental impact of urban runoff on water quality. Riversides development is one of the most viable types of river development enable to mitigate river bank from slope-slide. Most local authorities were promoting a river development concept termed *Development Facing River*. By integrating the river features (*fauna* and *flora*) into the match-design of mitigation measures (*man-made structure*) of the river, river nowadays have been part of the river component functioning as infrastructure to mitigate any uncertainty within river basin. This used to mitigate the river bank from erosion, landslide or sedimentation.



Figure 4: Riverside development is one of the most viable type of river development enable to mitigate river bank from slop-slide

Considering the riverside improvement schemes of river systems, following improvement guidelines may be suggested for the river corridor landscaping.

- i. Qualitative improvement of river revetments as means of improving the riverside landscape.
- ii. Efficient projection of riverside walkway improvement in conjunction with nearby development of some strategic commercial and business.
- iii. Keeping a clean condition of the river reserve.
- iv. Improving the river reserve and establishing recreational open space usage of the river reserve.
- v. Providing some attractive observation places and plazas, resting core areas at strategic riverside points.
- vi. Providing the sequential walkways system along river side and establishing aesthetic space for each bridge brinks.
- vii. Conservation of valuable natural vegetation along environmentally sensitive areas.

The management of the river environment should be included with other responsible agencies because management of the river environment could be closely related to other functions. The range of river management actually covers the following functions;

- i Promotion of river environment project; To meet various river environmental requests, river environment improvement projects (water quality, recreation, etc.) should be promoted.
- ii. Integrated control by river management agency; Integration of flood control and water utilization policies

- iii. Long-term and wide-ranging management; Present and future generations in the river basin
- iv. Regulation and utilisation; Disaster prevention in urban area, rivers should be utilised as the natural recreational zones with water and the precious urban open space.
- v. Management for individual river basin; among other components to be considered includes; natural environment, human habitat, industrial and economic activity, social and cultural conditions.

Stakeholders involvement

An effective urban river management requires efficient coordination among the different stakeholders with legitimate role and responsibilities within the river catchments (Andersen *et al.*, 2001). These stakeholder are often in unique positions to solve particular parts of the problem, and if each contributes what they are best positioned to do, the most effective and efficient results will be achieved. Institutional arrangement and management programs need to be developed in such a way as to ensure that responsibility for the development and implementation of river management solution is shared equitably and efficiently.

Integrated approach in planning

While development projects generate economy activities production, services and commerce, the increasing number of people, motorised vehicles and factories within them will strain the capacities of their road, built-up areas and natural environment such as the atmosphere, rivers and streams. Improper monitoring of such activities would contribute to the deterioration of environmental quality due to the high building density, traffic-flow, increase soil/land erosion, underground erosion. (e.g. site project water-waste, domestics, hill erosion etc.). Hence, environmental aspects of planning and monitoring of development projects requires a comprehensive development control mechanism to guide development. In order to fulfil this requirement, Town and Country Planning Act 1976 (Act 172) imposed several requirements to guide such projects become more 'environmental friendly development projects'.

In Malaysia the related legislatives in urban planning and environmental planning has been formulated in order to regulate the balance development in public interest. Therefore it has a positive role to play towards the achievement of an orderly urban development pattern by guiding appropriate development. It must make adequate provision for development of housing, employment, infrastructure and recreational need and at the same to protect the natural and built environment.

Now, how to relate the role of planning system in river infrastructure development? The existing and future condition of rivers is closely associated with the existing and future landuse patterns. The different density of landuse will significantly influence the volume and rate of runoff and the quantity and quality of river pollutants carried from the land surface to the rivers system. River related development must be guided by the deep understanding of the interdependence of landuse planning exercise and the nature of river system. Integrated development plans must be geared towards taking river system as a significant component of the landuse planning system.

Development must be guided by a coordinated approach associated with catchment-based planning and management, integrated urban landuse planning, infrastructure provision and also last but not least these components must be *furnished* with appropriate landscaping plan just to symbioses the natural feature and the man-made structure.

Scope and Function of River Management

With the combination of the above functions, various aspects are required to be incorporated in the formulation of proper management of the river environment (see Figure 5).

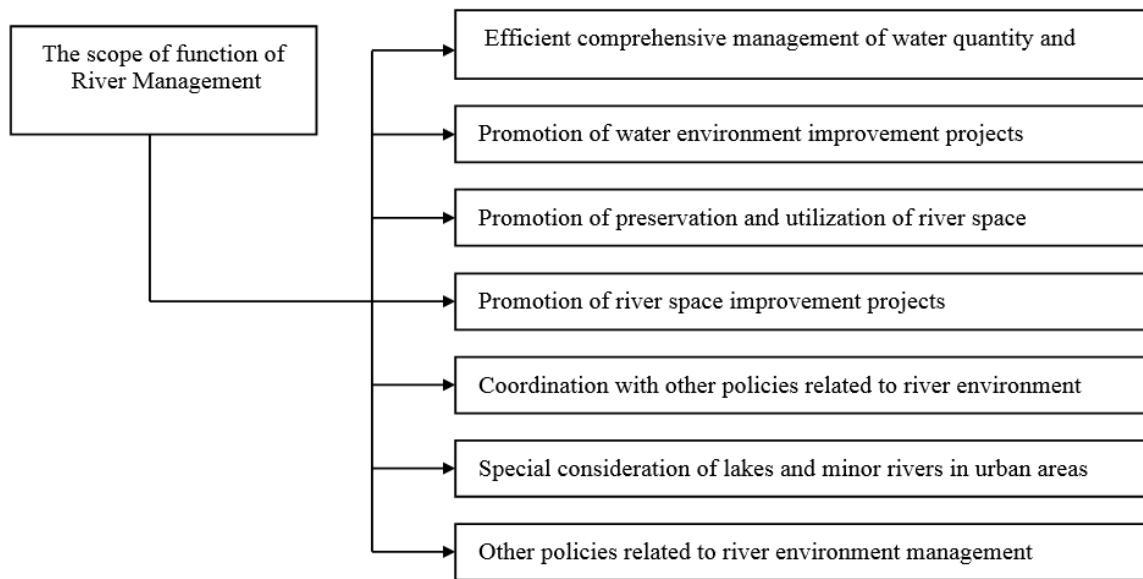


Figure 5: Proposed Scope of Function of Urban River Management

Setting up of Integrated River Infrastructure Development

The rapid urban development causes many wetlands were reclaimed for residential development, forests cut down for highland resorts development, or new highways. Some of virgin rivers diverted or impounded for construction huge scale of hydropower plants and the most obvious practice where rivers used as industrial or domestic waste discharge points. For many years the cumulative effects of the practice being felt much to the detriment of the environment. To prevent further deterioration, efforts for more innovative and integrative approaches aimed at bringing nature back to rivers have to be formulated and promoted by respective approval authorities.

To proceed with, an integrated development and management of river identified the most efficient approach. Since quite number of new development projects was and will take places nearby to river basin, the construction of river infrastructure to mitigate the consequences impacts must be address accordingly to the environmental measures. In the figure 6, the recommendation was made to elaborate further the idea of how the development of river basin should be carrying out by identifying elements connected to each element in Figure 5.

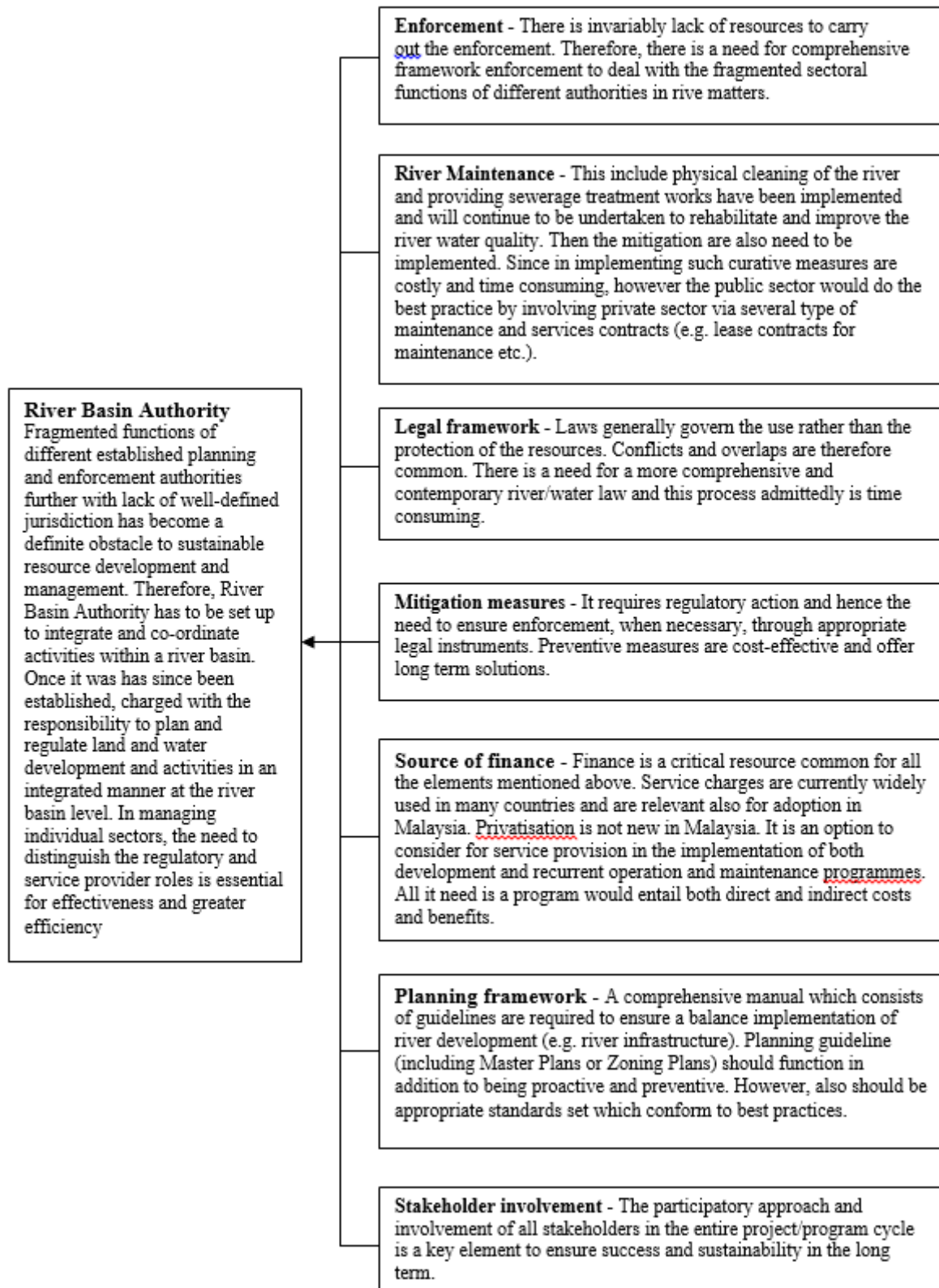


Figure 6: Towards the Integrated Infrastructure Development

Integrated River Management is the coordinated management of resources in natural environment based on river basin with the aim to ensure the environmental sustainability. The concept is geared towards integrating and coordinating professional capability and increased the capacity and implementing all the key elements. 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 a holistic approach by integrating and incorporating all the components as illustrated in Figure 7. However, corresponding authorities and legal changes are needed, coupled with an effective administrative framework.

Conclusion

The main concern of river development was to facilitate future development of a river in a way they can *preserve* and *conserve* the river environment naturally. Since the river areas were one of the most valuable assets in sustaining urban development, the river mitigation measures formulated should not discourage the development to take place. However, it must be strictly *safeguarded* by proper controlling and monitoring mechanism by the relevant approval authorities. Hence, the systematic preservation and restoration of urban rivers environment, the responsible agency for river management should play a main role in establishing the plan for river environment management. With better planning and urban management, with greater creativity, innovativeness in environmental aspects of planning, our dream of making our future cities truly environmentally friendly will one day be realised.

There is a need to ensure that the planning input must be considerably undertaken to resolve issues surrounding urban river management. Urban river systems need to be integrated into the urban system with other relevant river environment components to avoid potential negative consequences. Design guidelines could be developed for problematic land use and development activities. Development must be guided by a coordinated approach associated with catchment-based planning and management, integrated urban land use planning, infrastructure provision and also last but not least these components must be *furnished* with appropriate landscaping plans just to symbioses the natural feature and the man-made structure.

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