. **The First Regional Workshop on Development of Eco-Efficient Water Infrastructure in Asia and the Pacific**

COUNTRY PAPER: MALAYSIA

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INTRODUCTION

Located in the humid tropical region, Malaysia is endowed with abundance of rainfall throughout the year. It has an average temperature of 21'-32'C and an average annual rainfall of 3000mm. It has a population of 27.7 million people of multi-racial and multi-religion origin living harmoniously in a country with an area of 330,000sq. km. Because of the warm climate and abundance of rainfall, agriculture and agro-based industry contribute significantly to our national economy.

DEVELOPMENT OF ECO-EFFICIENT WATER INFRASTRUCTURE

During the periods of 1960-1985, Malaysia has embarked on several major Agricultural Development Projects with the objectives of increasing the productivity and standard of living of the farmers. These projects were successfully implemented with financial assistance in the form of loans from the World Bank and Asian Development Bank. The Muda Irrigation Project, the Krian-Sungai Manik Irrigation Project, the Northwest Selangor Integrated Agricultural Development Project and the West Johore Integrated Agricultural Development Project are examples of successful projects which contributed significantly to the national economy and the increased farm income of the rural community.

The construction of modern eco-efficient irrigation and drainage infrastructure for these projects has achieved the objectives of sustainable production of paddy, oil palm, rubber and other crops as well as improved standard of living of the farmers. The design of the irrigation and drainage systems were based on natural gravity conveyance system with minimum use of pumping station, hence avoiding the excessive use of energy which is harmful to the environment. The use of solar-energy in the operation and control of telemetry and local automation has resulted in lower production cost of the commodity.

The strong economy of the country since 1980 has resulted in major urban developments in all parts of the country. The consequence of rapid and uncontrolled urban development has resulted in frequent flooding in both urban and rural areas in Malaysia. In fact uncontrolled housing development and other land clearing activities are responsible for the increased runoff and high sediment loads in our rivers. Rapid industrial development in the country has also contributed to the deterioration of water quality in our river systems due to untreated pollutants from factories. Flooding not only causes severe hardship to the people in terms of flood damage but also loss of lives. The average annual flood damage in Malaysia is estimated at RM100 million per year.

ROLES AND FUNCTIONS OF DID

The traditional roles of the Department of Irrigation and Drainage (DID) has been with the Ministry of Agriculture in the design, construction and subsequent operation and maintenance of irrigation, drainage and flood mitigation infrastructure for the farmers and rural communities since 1932. With the subsequent increase in flooding incidence and the rapid deterioration of water quality in our river systems due to rapid and uncontrolled urban development in the country, DID has been entrusted with new functions and responsibilities such as Urban Storm water Management, Flood Mitigation and Management, River and Coastal Zone Management. The Department of Irrigation and Drainage has been attached to the new Ministry of Natural Environment (NRE) since 2004.

The DID has been entrusted with the responsibility to assist local authorities on urban storm water management since 1970. The early guidelines published by the department on planning and design procedures for urban storm water drainage systems were based on rapid disposal methodology. However this manual was found to be inadequate to cope with the rapid rate of urbanization nowadays which causes frequent flooding in urban areas due to increase in runoff into the rivers. Since 2001 a new revised Manual on Urban Storm Water Management has been introduced to replace the old manual. The new manual is unique in many aspects compared with the old manual. It is eco-efficient, environmentally friendly and is based on control at source methodology instead of the former methodology of rapid disposal which will require the capacity of our river systems to be upgraded from time to time due to urbanization and increase in peak runoff.

Flooding in Malaysia can be categorized into two types, the seasonal monsoon floods characterized by low intensity long duration rainfall and the unpredictable flash floods characterized by high intensity short duration rainfall. Both structural and non-structural measures will be adopted for effective control of floods. Structural measures comprise dam storage, diversion or bypass channel, flood detention storage, river improvement and river bund or levee construction. Non-structural measures comprise stringent urban planning control, rain water harvesting, on-site retention, zero contribution to peak discharge etc. The use of swales and sub-soil drainage system will significantly reduce the sediment load and floating garbage in the rivers.

PROJECTS OF SIGNIFICANT IMPACTS

The Storm Water Management and Road Tunnel or SMART in short is a unique dual purpose tunnel designed and constructed for the purpose of diversion of flood discharge as well as traffic diversion. The primary objective of the tunnel is to divert flood discharge from the Klang River to the Desa Storage Pond during periods of heavy rainfall to prevent flooding in Kuala Lumpur city centre. The secondary objective of the tunnel is to be used as a traffic diversion tunnel when the tunnel is not in use for flood diversion. The SMART tunnel is thus the first dual purpose tunnel in the world. The tunnel is 13.2m

in diameter and is 9.7km in length. It was completed in July 2007 at a total cost of RM1.9 billion. The tunnel has been operated and functioned effectively as a flood diversion channel for over 50 times already since July 2007. The tunnel has also been successfully used for traffic diversion to alleviate traffic congestion in the city centre. The traffic tunnel is a tolled highway which contributes towards partial cost recovery of the project.

The SMART Project is a fine example of the application of structural measures to mitigate flooding in the capital city of Kuala Lumpur. However in order to complement this approach, the use of our new Urban Storm Water Management Manual (MSMA in Bahasa Malaysia) in all future urban development projects will have to be made mandatory in order to control further increase in peak discharge in our river system. The adoption of this new Manual by Local Authorities in several new Housing Projects in Malaysia has shown that it is indeed an Eco-efficient and Eco-friendly Manual because it emphasizes on both quantity and quality control of urban storm water. It has been shown that the application of structural measure alone without the use of non-structural measure will not be adequate to handle or deal with flooding in urban areas effectively.

The Muda Irrigation Project and the Northwest Selangor Integrated Agricultural Development Project are fine examples of the application of eco-efficient and eco-friendly concept in the design of the irrigation and drainage systems. Since the completion of these projects in 1982 and 1987, the average yield of paddy and other crops such as oil palm and rubber has been increased by more than 70% whereas the operation and maintenance cost has been relatively constant because of the adoption of low cost gravity canal system.

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