Introduction

- The case study was part of the findings from the *National Water Balance Management System (NAWABS) study for the Bernam River Basin, Malaysia*.

- The NAWABS Study was initiated by the Department of Irrigation and Drainage Malaysia (DID) in year 2017 with the objective to develop a comprehensive water balance study and water resources modelling utilising the forecasted rainfall to form a water resources decision management support system (DMSS) for the selected river basins. As per today, a total of 7 NAWABS Study for the river basins comprising Sg. Muda, Sg. Kedah, Sg. Melaka, Sg. Kelantan, Sg. Bernam, Sg. Klang and Sg. Similajau has been completed.
Objective of NAWABS Sg Bernam

Carry out Water Resources Study hand in hand with Water Resources Modelling to implement a Decision Management Support System (DMSS) to assist the Water Resources Manager in Managing the Water Resources of the Sg. Bernam Basin

Overall Framework of NAWABS Study

NAWABS Interface

WATER RESOURCES STUDY
- Water Balance Study
- Groundwater Study
- Water Demand Management Study
- Environmental Flow Study
- WRCP
- WEF Nexus and Water Footprint Study

WATER RESOURCES MODELLING
- NAM
- MIKE 11
- MIKE HYDRO Basin
- MIKE SHE
- Backup Model

DECISION MANAGEMENT SUPPORT SYSTEM (DMSS)

Short Term Operation
- Output
  - Water Availability System
  - Water Demand Options System
  - Water Accounting System
  - Water Prioritisation and Demand Management Options
  - Water Allocation System
  - Water Quality System
  - Water Storing and Releasing During High and Low Flows
  - Water Resources Index (WRI)
  - Water Auditing System

Long Term Operation
- Output
Objective of the Case Study

• To examine the irrigation efficiency of a paddy field parcel at the Pasir Panjang Irrigation Block which is one of the irrigation block in the main granary area of Barat Laut Selangor Irrigation Scheme (BLSIS) located in the Sg Bernam basin.
Location of the Study Area

- Sungai Bernam Basin: 2705 km²
- North Selangor Peat Swamp Forest (NSPSF): 813.04 km²
- Sungai Tengi Basin: 363 km²
- Barat Laut Selangor Irrigation Scheme (BLSIS): 190 km²

Located in the State of Selangor

Barat Laut Selangor Irrigation Scheme

The fourth largest and highest yield granary area in Malaysia

Total area = 19,000 ha
Paddy Irrigation Water Use

Annual total Irrigation Water Demand = 496 MCM

Definition Irrigation Efficiency

- Efficiency of an irrigation scheme can be defined as the ratio of the amount of actual water required for land preparation and crop growth to the amount of water supplied via the scheme.

- For a paddy scheme with no losses in the irrigation water delivery system, the irrigation efficiency will be close to 1.0.

- The higher the losses, the lower is the irrigation efficiency.
**Type of Irrigation Efficiency**

- **Conveyance efficiency** of the main conveyance system - efficiency of canal and conduit networks channelling water from the supply source such as pumping station, river diversion or reservoir to the offtakes.

- **Distribution efficiency** in the secondary and tertiary canal system - on-farm system used to store and distribute water to the various fields

- **Application efficiency** in the farm lots – ratio of the amount of water supplied to the paddy roots to the amount of water supplied to the field.

- In this case study, only the **distribution efficiency for the Pasir Panjang Block** was computed.

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**Distribution System of BLSIS**

Distribution system of the BLSIS Comprises secondary and tertiary canals

CHOs are provided as offtakes and end control structures both in the secondary and tertiary canals and these function as control structures – control the water delivery to secondary and tertiary canal
Scenario for Assessment on Irrigation Efficiency

- The distribution efficiency for the Pasir Panjang Irrigation Block was computed using the ratio of the actual paddy water demand to the amount of irrigation water supplied through the constant head orifices (CHOs) of the distribution system.
- The amount of irrigation water arrived at the CHOs is estimated based on the records of flow measured at the CHOs.
- The availability of field data collected at the CHOs of the Pasir Panjang Irrigation Block allows the determination of the actual distribution efficiency.
- Two scenarios were examined in this study: distribution efficiency without and with the contribution of effective rainfall.

Computation of Distribution Efficiency

- Ratio of the actual paddy water demand to the amount of irrigation water supplied through the CHOs of the distribution system

<table>
<thead>
<tr>
<th>Tertiary Canal / CHO</th>
<th>Irrigation Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAPP1</td>
<td>175</td>
</tr>
<tr>
<td>TAPP2</td>
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<td>TAPP10</td>
<td>159</td>
</tr>
<tr>
<td>TAPP11</td>
<td>169</td>
</tr>
<tr>
<td>Total</td>
<td>1,737</td>
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</tbody>
</table>

Main Season commences from September to November and the Off Season from March to May.

Water is distributed to the paddy field via 12 tertiary canals each controlled by a CHO at the intake head.
Water Supplied vs Water Demand

Water Supplied to the Pasir Panjang Block

21.42 MCM was supplied to the field during the Main Season (from 1st September 2015 to 30th November) and 20.32 MCM during the Off Season from (1st March 2015 to 31st May 2015).

Remarks:
The flow was measured at the CHOs of the tertiary canal.

Water Demand by the Pasir Panjang Block

14.97 MCM of water is required per season.

Based on unit water demand 2.32 l/s/ha (pre-saturation) 1.304 l/s/ha (normal demand) From the “Feasibility Study on the Tanjong Karang Irrigation Development and Management Project” by Japan International Cooperation Agency (JICA) in 1987.

Effective Rainfall

Effective rainfall according to FAO (2008) computed using the formulae as follows:

ER = 0.8 RF - 25 if RF > 75 mm/month
ER = 0.6 RF - 10 if RF < 75 mm/month

5.58 MCM effective rainfall contributed during the Main Season
5.68 MCM effective rainfall contributed during the Off Season.
**Summary of Findings on Irrigation Efficiency**

- Distribution efficiencies of the Pasir Panjang Irrigation Block were determined to be **0.70 and 0.55** for scenarios without and with effective rainfall respectively for the **Main Season** (September to November) and; **0.74 and 0.58** respectively for **Off Season** (March to May).

- The findings without effective rainfall shows consistency with the JICA 1987 Study value of 0.75.

- Owing to the rather uniform rainfall between the Main and Off Season, the irrigation efficiencies computed are similar between the two seasons.
Summary of Findings on Irrigation Efficiency

- The significant difference between the efficiency without and with effective rainfall demonstrates the importance of taking effective rainfall into account during the operation of the irrigation system.

- With higher rainfall, the irrigation water supply can be reduced and thus the irrigation efficiency will increase.

- A distribution efficiency within the range of 0.7 shows that there are improvements that can be made to the current irrigation practice at the field.

Recommendations to Improve Irrigation Efficiency

- Better control and regular adjustment of off-takes, monitoring of spilling from the field bunds, capturing of rainfall in paddy fields and control of management loss through regular monitoring of end spills, followed by adjustment of water diversion from the main canal.

- Upgrading and repairing of the tertiary canal conduits, off takes and regulating structures to reduce the losses due to the leakages.
Recommendations to Improve Irrigation Efficiency

• The rehabilitation of the existing SCADA system for flow measurement, water level and rainfall monitoring is recommended for better irrigation water management and consideration of the effective rainfall during the operation of the irrigation system.

Recommendations to Improve Irrigation Efficiency

• Faster pre-saturation that has been conducted as pilot project in the Study (Study on the Performance of Tertiary Canal for the BLSIS by the Ministry of Agriculture and Food Industry (MAFI)) showed a great potential of meeting the objective of improving water delivery management in tertiary canal for modern commercial rice cultivation, managed by individual farmer.

• Faster pre-saturation delivery to individual field was achieved with the newly developed high-water delivery capacity structure of flexible field off-takes. Faster pre-saturation must be supported with efficient orderly mechanization for land preparation commenced immediately after achieving pre-saturation. The saving comes from the reduction of daily losses in paddy fields due to seepage, percolation losses combined with the evaporation losses.
THANK YOU