International Workshop Working Group on Modernization and Revitalization of Irrigation and Drainage Services

24th ICID International Congress
73rd IEC Meeting
3rd OCT - 10th OCT 2022
ADELAIDE | SOUTH AUSTRALIA

National Water Balance Study for Bernam River Basin, Malaysia

- A Case Study on Paddy Irrigation Efficiency at the Pasir Panjang Irrigation Block of the Barat Laut Selangor Irrigation Scheme (BLSIS), Bernam River Basin

Dato' Ir Hanapi Mohamad Noor - Project Director, National Water Balance Study for Bernam River Basin, Malaysia

Ir Yong Siew Fang - Director, Global Water Consultants Sdn Bhd, Malaysia

1

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.

2

2

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)

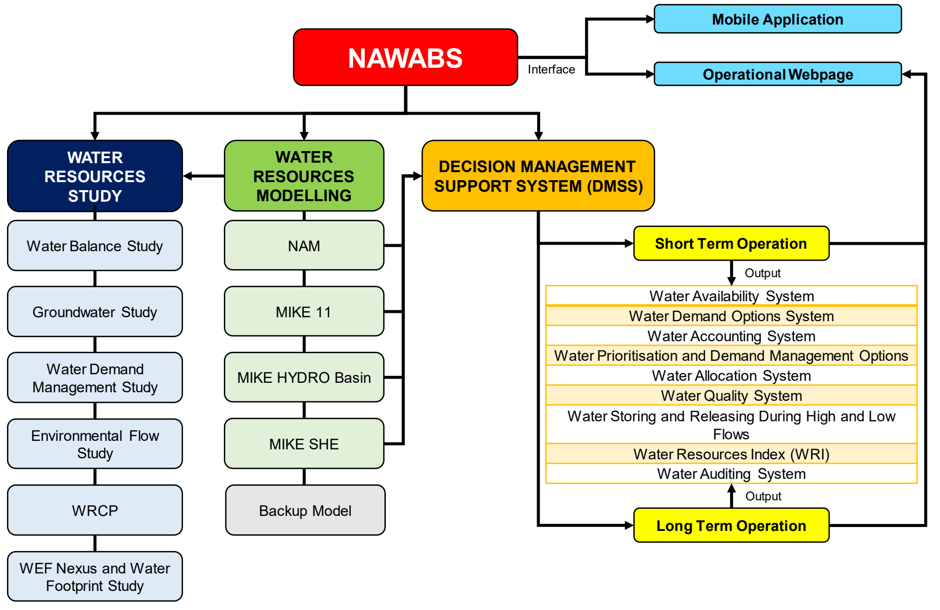
to assist the

Water Resources Manager

in

Managing the Water Resources of the Sg. Bernam Basin

Overall Framework of NAWABS Study

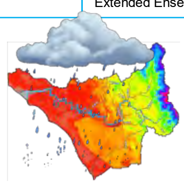


The NAWABS Bernam DMSS

DATA INPUT

Short Term
Forecast Rainfall
Day 1-7: NWP
Day 8-14 GFS

Long Term
Forecast Rainfall
Day 1-90: NCEP
Day 91-12th Month: Extended Ensemble



Forecast Potable Demand

Forecast Non-potable Demand

MODELLING

Short Term Modelling Packages
NAM
MIKE HYDRO Basin
MIKE 11

Long Term Modelling Packages
NAM
MIKE HYDRO Basin

RESULTS

Short Term
14 days
Forecasted Catchment Runoff
Forecasted River Flow
Forecasted Water Level

Long Term
12 months
Forecasted Catchment Runoff
Forecasted River Flow

5

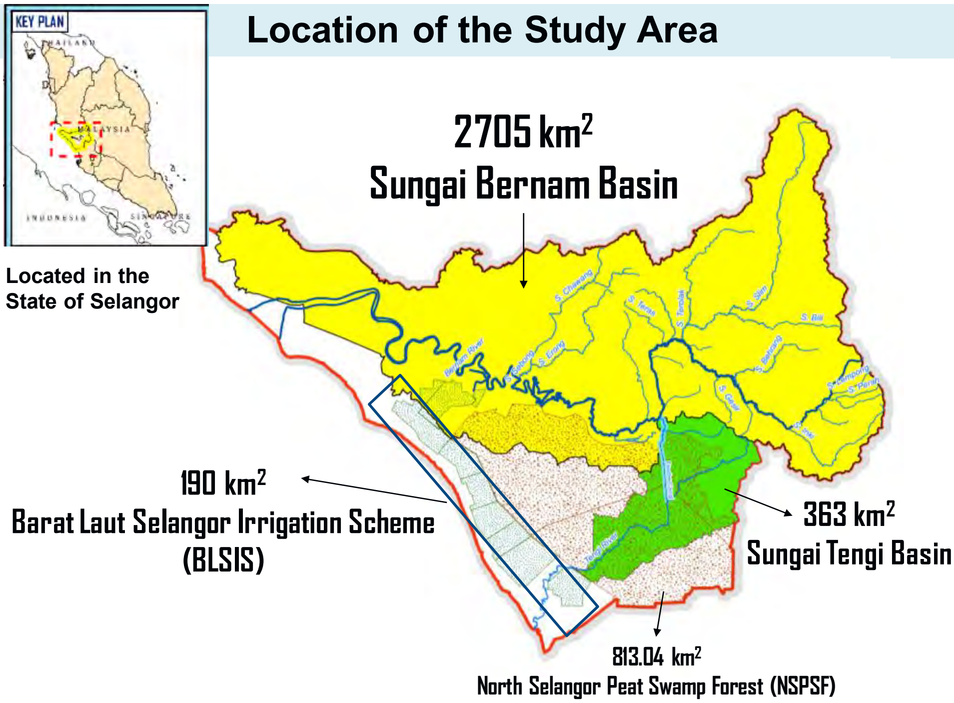
5

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.

6

Location of the Study Area

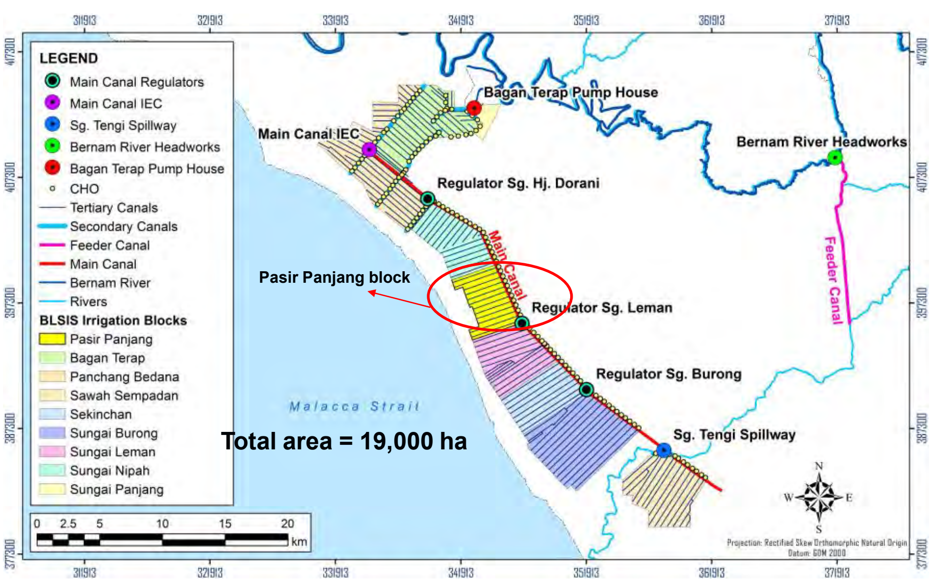


7

7

Barat Laut Selangor Irrigation Scheme

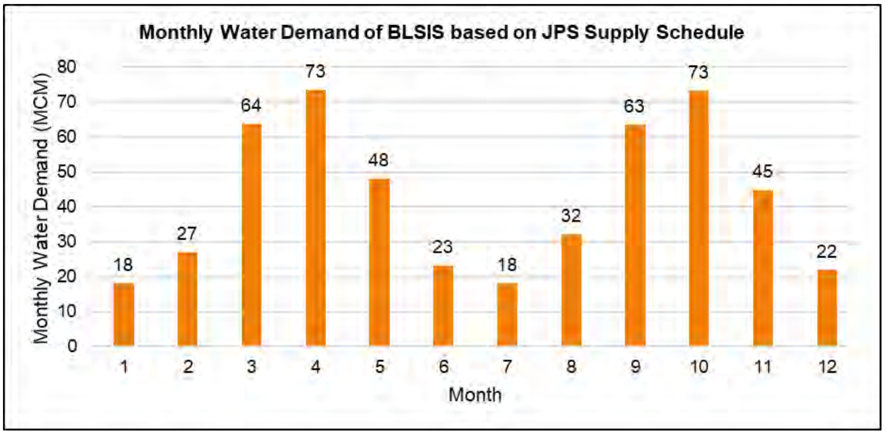
The fourth largest and highest yield granary area in Malaysia



8

8

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.***

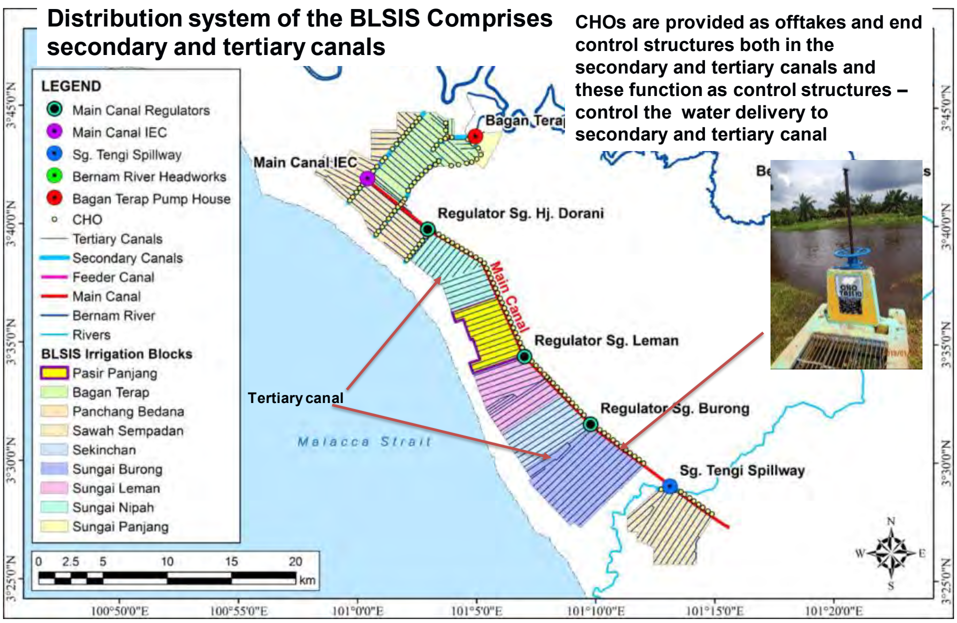
Type of Irrigation Efficiency

- **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

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

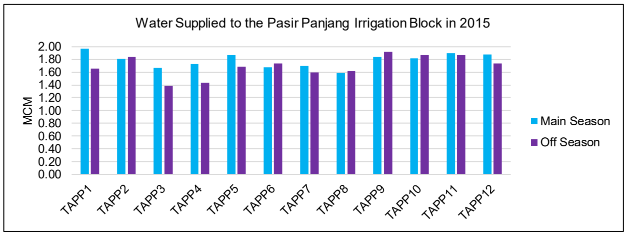
Main Season commences from September to November and the Off Season from March to May.

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

Tertiary Canal / CHO	Irrigation Area (ha)
TAPP1	176
TAPP2	156
TAPP3	136
TAPP4	134
TAPP5	135
TAPP6	134
TAPP7	140
TAPP8	138
TAPP9	136
TAPP10	134
TAPP11	159
TAPP12	159
Total	**1,737**

Water Supplied vs Water Demand

Water Supplied to the Pasir Panjang Block

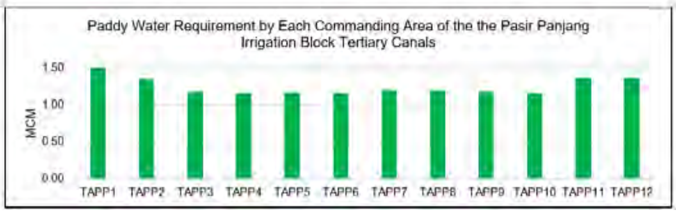


Remarks:
The flow was measured at the CHOs of the tertiary canal

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 3015 to 31st May 2015).

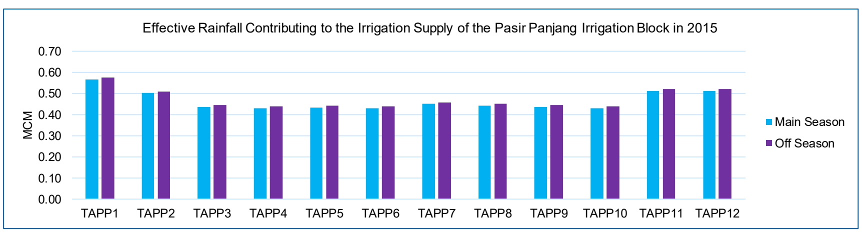
Water Demand by the Pasir Panjang Block



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

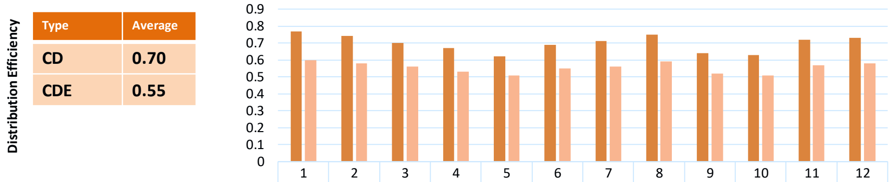
5.58 MCM effective rainfall contributed during the Main Season

5.68 MCM effective rainfall contributed during the Off Season.

Distribution Efficiency

Main Season (September to November 2015)

Type	Average
CD	0.70
CDE	0.55

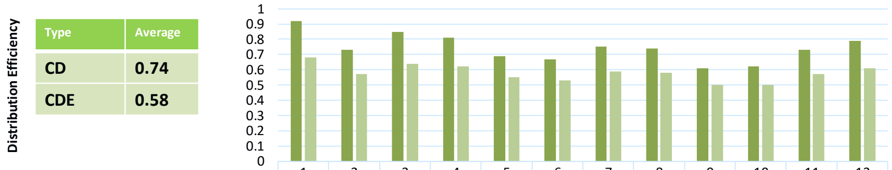


Tertiary Canal	1	2	3	4	5	6	7	8	9	10	11	12
*CD Efficiency without Effective Rainfall	0.77	0.74	0.7	0.67	0.62	0.69	0.71	0.75	0.64	0.63	0.72	0.73
*CDE Efficiency with Effective Rainfall	0.6	0.58	0.56	0.53	0.51	0.55	0.56	0.59	0.52	0.51	0.57	0.58

Tertiary Canal

Off Season (March to May 2015)

Type	Average
CD	0.74
CDE	0.58



Tertiary Canal	1	2	3	4	5	6	7	8	9	10	11	12
*CD Efficiency without Effective Rainfall	0.92	0.73	0.85	0.81	0.69	0.67	0.75	0.74	0.61	0.62	0.73	0.79
*CDE Efficiency with Effective Rainfall	0.68	0.57	0.64	0.62	0.55	0.53	0.59	0.58	0.5	0.5	0.57	0.61

Tertiary Canal

17

17

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.

18

18

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