



# STI solutions for dam, irrigation and community management to ensure safe water and sanitation for all (Thailand case study).

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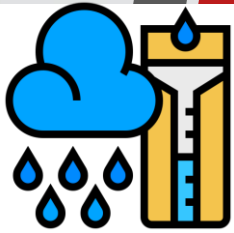
March 28, 2023

"High level Panel and Ensuring Safe Water and Sanitation for all: a solution by science, technology and innovation, UNCSTD, Geneva.

# Background

- Water Resources Act (2018)
- National Strategic Development Plan (2018)
- Water Resources Development Master Plan (2018)
- Research and Development Master Plan (2018)
- Spearhead Research Program in Water Management (2018)  
(appointed Ass. Prof. Dr. Sucharit Koontanakulvong as Program Chair)

# Smart Dam Operation System Development



**Rainfall Data**

- Observed Rainfall (Long Term)
- Predicted Rainfall (14 Days Ahead)

Provided by HAI



**Runoff Data**

- Observed Runoff
- Modeled Runoff (Hydrological Model)

Provided by KU



**Satellite-based Demand Data**

- Cultivated Area
- NIR&GIR

Provided by KU

Grid-based Rainfall

Point Rainfall

## Automated System for Dam-Reservoir Operation (Phase3-Plan3)



Supported by RID&EGAT&MET

**Reservoir Inflow Prediction Model**

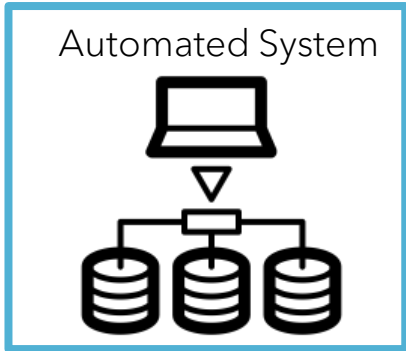
- LSTM/XGBoost Algorithm
- Python Language

**Dam-Reservoir Operation Model**



**Constraint Programming Model (CP)**

- Python Language



End Users

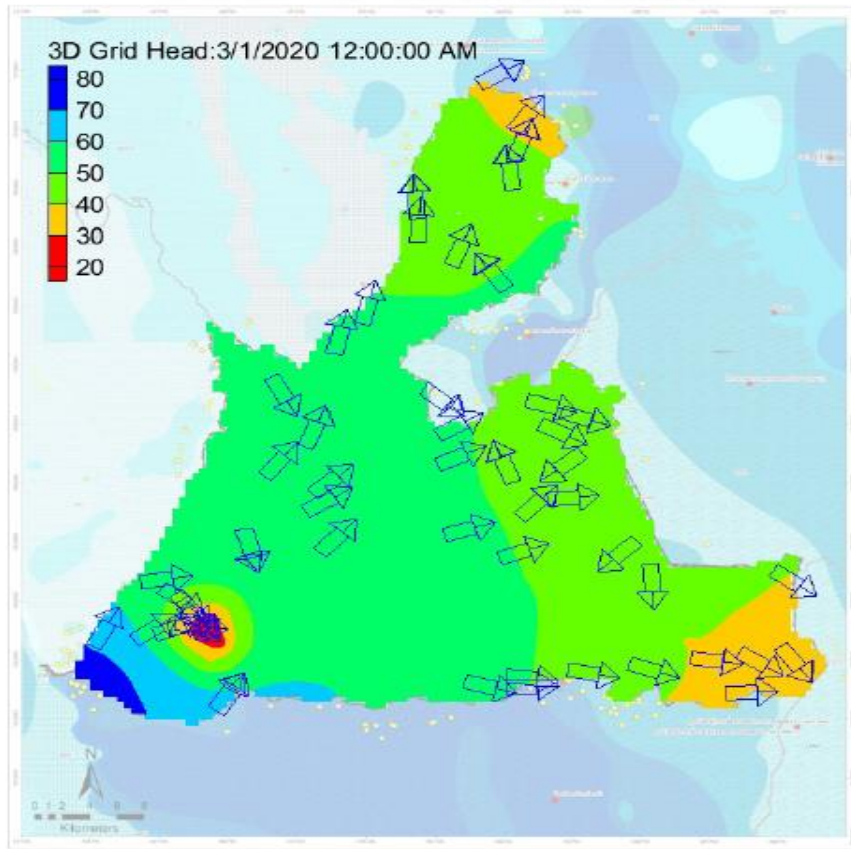


# GW water balance and yields in an irrigation project (in M cum. 2020)

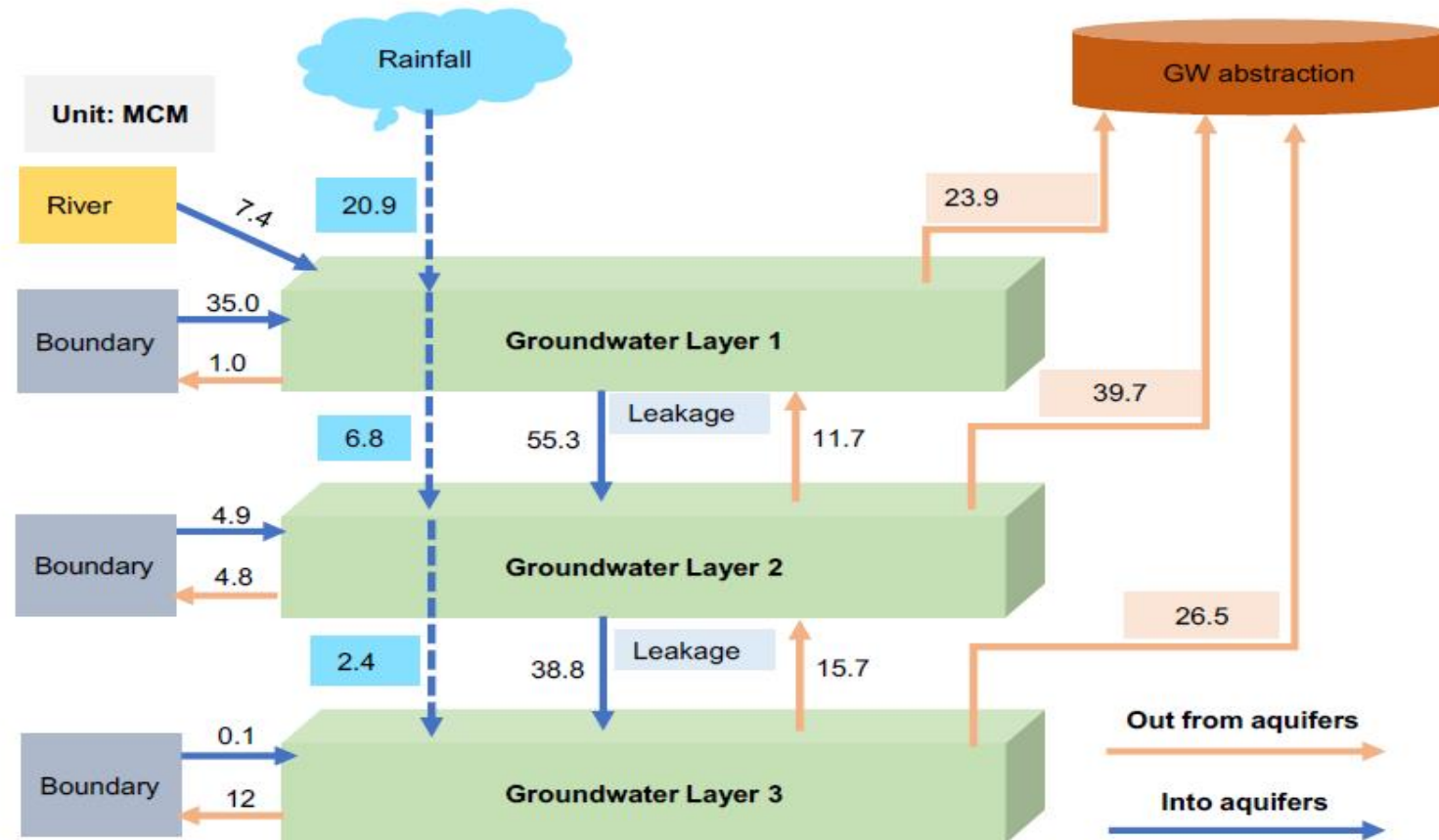
## 3. RESULTLS

Current situation ◆

### ➤ GW level distribution in March 2020



### ➤ GW balance analysis in 2020



# Simulation results

## Storage increase in the four main dams in the Central Plain of Thailand

Model used	Dam Storage Increase at October 31 ( M cum per year) <sup>1/</sup>				
	Bhumipol	Sirikit	Kwaenoi	Pasak	average
CP model type 2: considered travelling time to demand nodes in each zone (Demand-Based Model)					
case : Water Demand from Royal Irrigation Plan					
2.8 Yearly Constraint_URC_WithSF_LagTime <sup>4/</sup>	-44.36	+962.14	+206.38	+97.06	+1,221.23
2.14 Yearly Constraint_URCBBSK_85%ReducedKNBP S_20SFBB_10SFSK_LagTime <sup>3/</sup>	-195.99	+868.49	+114.92	+3.30	+790.71
With upper rule curve control					

Remarks : compared with actual data during the year 2000-2020.

GW potential yields were assessed and used as a backup resources in dry season.

# Automation/GW in an irrigation project/results

## AI Based Mathematical Model integrated with Sensor

### LINKAGE OF SENSOR TECHNOLOGY AND AI MATH MODELING

#### AI Based Mathematical Modeling

- Monitor Water level and Soil Moisture Changed via Website and Line Application
- Evaluate Crop Water Demand in respect to real-time Soil Moisture Monitoring
- Forecast and Simulate Water Flow through Canal under existing situation of Water Supply
- Suggest Water Allocation Plan
- Recommend Water Operation Plan
- Link to Automatic Gate Controlling via Website

#### Automatic Gate Controlling



#### Soil Moisture Monitoring



#### Water Level Monitoring



## Dry Season NOV to APR

Efficiency in saving water Supply to irrigated area	Dry Season 2017	Dry Season 2018
<b>❖ EXISTING operation</b>		
Observed Water Irrigation Supply (mcm)	93.62	270.50
Area of rice cultivated (rai)	344,948	373,799
<b>❖ RESEARCH improve</b>		
Simulated Water Irrigation Supply (mcm)	78.20	202.33
Percent of Water Supply Saving for Irrigation	<b>16.47%</b>	<b>25.20%</b>
Volume of Water Supply Saving for Irrigation (mcm)	15.42	68.17

# outputs

- Community water plan
- More distributed water sharing
- Save time monitoring
- More service area
- Reduce water conveyance loss
- Increase water productivity



# Alternative agriculture cultivation (paddy plus)

## Establish social enterprise after water secured and confident

น้ำใสใจจริง



### Tungpo Talae Dis.

Lime plantation after paddy in rainy season  
With sprinkler

Revenue after cost reduction  
935 USD/acre

### Nong Mai Klong Dis

Herb plantation (Andrographis paniculate)

Revenue 1000 USD/acre  
Become water management model





# Conclusions

- The action research, granted from TSRI/NRCT Spearhead Research Program on Water Management (2019-2023), could induce the **new view and modes of IWRM with STI and GW resources included** to ensure more safe water and sanitation. Under the **National Water Resources Masterplan (2018-2037)**, **more new technology in IWRM** will be introduced based on the urgency and readiness of the area to counter with new water demand, fluctuating climate and to reach SDG 6 goals. The case study can be **learned, shared and applied** to other countries through **regional and international promotion and cooperations with common information infrastructure** needed in the **international level**.

# References

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Online resource : [http://project-wre.eng.chula.ac.th/watercu\\_th/sites/default/files/EBOOK/Water%20Management%20Transform.pdf](http://project-wre.eng.chula.ac.th/watercu_th/sites/default/files/EBOOK/Water%20Management%20Transform.pdf)
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- Chaiyapong Thepprasit et al., An Estimation of Water requirement and Surface Runoff for Water Resources Management in Chao Phraya River Basin, Research Report submitted to the National Research Council of Thailand, September 2022 (in Thai).
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- ONWR, National Water Resources Masterplan (2018-2037) <http://www.onwr.go.th/en/?p=4791>.
- Introduction clip on TSRI/NRCT Spearhead Research Program on Water Management, Thailand  
<https://www.youtube.com/watch?v=r9m621kOPn0&list=PL2qBZChb2KWJFr48dIK12gzJav0W6RikO&index=1>

## **Remarks on STI solutions for dam, irrigation and community management to ensure safe water and sanitation for all (Thailand case study).**

By Assoc. Prof. Dr. Sucharit Koontanakulvong, Distinguished Scholar in Water Resources Engineering, Chulalongkorn University and UNESCO Chair on Water and Disaster Management and Climate Change.

Even though, water supply in the village level reaches to 93 % with suitably sanitation facilities coverage in 2017, Thailand still has issues on drought, floods and water productivity and water quality in the SDG6. With the high demand in urban and industrial sectors and the recent climate fluctuations, water management needs more precise and quick response to prepare for emergency preparedness and long term water resources planning to cope with such environments especially in the Chao Phraya Central Plain (about 2.0 M hectares) including Bangkok where most of the socio-economic activities exist. Under the National Strategic Plan and Research Masterplan, water is a national important issue.

In the basin level, the introduction of combined STI modules (of satellite data on soil moisture, rainfall forecast, monitored water levels and storage, groundwater potential and AI technologies) bring a new mode of water infrastructures (dams, gates, pumps) control based on future weather scenarios. The modules simulated proved to lessen drought and floods phenomena and save more dam storage in the rainy season (about 900 M cubic meter in average) to be used in the next dry season which ensure more water supply for both domestic, agriculture and environmental uses in the study area.

In the Irrigation Project level, the automation system with grounded water level and soil moisture sensor were installed in an irrigation project (with the area of about 48,000 hectares) with data linked with above dam operation. The data of water level in the canal, soil moisture, groundwater level in the paddy field were monitored and transferred to irrigation staff and water user group to be used for water/crop planning. The joint decision on water allocation/delivery among irrigation staff and water user groups based on the monitored data helped to reduce water conveyance loss in the irrigation project and ensure irrigation water (both quantity and timing) for farmers to gain more confident to plan for crop cultivation of both paddy and other cash crops which increased farmers revenue and water productivity of irrigation project simultaneously via data driven irrigation operation and water sharing among water users.

This pilot staged mode of STI modules were tested and will co-run with real operation for a while. The scheme will be used as a schooling to train irrigation staff and water user group to adapt the way of cultivation and water use for a period. Under the National Water Resources Masterplan (2018-2037), more new technology in water infrastructure management will be introduced based on the urgency and readiness of the area to counter with new water demand, fluctuating climate and to reach SDG 6 goals. The possibility of new financing mechanisms including PPP will also be explored in the Masterplan.

The action research, granted from TSRI/NRCT Spearhead Research Program on Water Management (2019-2023), could induce the new view and modes of IWRM based on STI to ensure more safe water and sanitation. The training and preparedness of irrigation staff/water user group, to understand and be ready to adapt to the new mode, are basically essential for successful implementation. The case study can be learned, shared and used to other countries through regional and international promotion and cooperations with common information infrastructure needed in the international level.

<https://www.youtube.com/watch?v=r9m621kOPn0&list=PL2qBZChb2KWJFr48dlK12gzJav0W6RikO&index=1> : Introduction clip on TSRI/NRCT Spearhead Research Program on Water Management, Thailand.

(Note for United Nations Commission on Science and Technology for Development Twenty-sixth Session, Geneva, March 28, 2023 in the session: High-level Panel on Ensuring safe water and sanitation for all)