The Study of Water Allocation in Klong Yai Basin

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ABSTRACT

Klong Yai Basin is sub-basin of east coast basin, and watershed area is 1,830 sq. kilometers in Rayong and Chonburi Province. The existing Dokrai reservoir and Nongpralai reservoir are main reservoirs and Klong Yai reservoir was suggested to support more water usage.

A mathematical model, Acres Irrigation Support Package (AISP) was selected to simulate water allocation in Klong Yai basin at normally case (in 2000) and forecasting case (in 2009). AISP will calculate results from 1970 to 2000 to decide the operating rule curve and evaluation water delivery from external indicator was selected for water allocation in Klong Yai Basin.

It was found that, the effective rainfall in dry seasons is more than wet season, at the same time the irrigation efficiency in dry season is 60 % and wet season is 55 %. Normally case in 2000, inflow rule and reservoir rule curve of Dokrai reservoir and Nongpralai reservoir will be used to operate the reservoirs in each year. In forecasting case in 2009, Reservoir rule curve of Klong Yai reservoir will be used to forecast water allocation in Klong Yai basin. The evaluation of water delivery found that, irrigation supply is 0.449 from industry supply, at the same time industry supply is 0.459 from reservoir capacity and irrigation supply is 1.697 from net irrigation demand which irrigation supply in dry season more than wet season.

Key word: water allocation, Klong Yai Basin

INTRODUCTION

As the result of agricultural, industrial and consumption expansion, the demand of water in Thailand is increasing rapidly. It is, however, difficult to use any constructions such as dams or opening new irrigating area dealing with water management because of shortage of capital and being fought against by disadvantageous groups. In stead of constructing, water allocation and water delivery system are likely to be the efficiently measures.

To fulfil water allocation from cost water source, the relevant offices must completely share their responsibility. The basin consisting of many cost water sources and varieties of water use activities needs good water management, suitably for its activities and avoiding water shortage. Accordingly, to the National Economic and Social Development Plan, the development was designed to utilize for economy, society and the people's life folk.

The reason for choosing Klong Yai Basin as the demonstrated area is that there are varieties of water use in this area- agricultural, industrial and consumption as well as water delivery between existing water supply and cross-cost water source. It is essential to allocate water in order to avoid shortage of water in this area. Water allocation in Klong Yai Basin has been model by applying the

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Acers Irrigation Support Package (AISP) as a measure in water allocation and water use from existing cost water source.

The purposes of the study are to:

1. investigate the activities of usage water in Klong Yai Basin

2. model the water allocation condition in Klong Yai Basin using the Acres Irrigation Support Package (AISP) Approach and adjust the model suitably for water usage in study area.

3. suggest how to allocate water suitably with existing cost water source and water supply system for efficient water allocation

4. suggest the future water allocation after the construction of Klong Yai Reservoir.

Klong Yai Basin is a sub-basin in the eastern coast of Thailand. Its basin code is 18.03, establishing at 13^0 15' – 12^0 45' N. and 101^0 00' – 101^0 30' E. Within 1,830 sq. km., in area, 1,454.43 sq. km. is in Rayong Province and 349.59 sq. km. in Chonburi Province. Rivers and canals in the basin flow into Rayong River and consequently to the gulf of Thailand. (RID 2000, illustrated in Fig. 1)

At present, water supply in this area consists of 2 reservoir – Dokrai reservoir and Nongpralai reservoir is the main reservoir to supplying water for varieties of activities. Water release of the main reservoir was drained to Dokrai Canal and Nongpralai Canal, and flowing to Rayong River. In the middle of Rayong River, the water level was risen by Ban Khai weir and the water from Ban Khai weir will be released to the both sides of the river for agricultural demand for 30,000 Rai of Ban Khai Irrigation area and water supply in Rayong Province.

MATERIALS AND METHODS

Acres Irrigation Support Package is designed to perform planning and operations for large irrigation systems. Systems with multiple reservoirs, irrigation projects and channels, and conflicting water supply demands can be analyzed. To provide this functionality, the package includes a set of computer programs that are designed to give the user several degrees of freedom to perform a system analysis. The user can set up different configurations of an irrigation system to perform studies of different development plans. As well, the analysis programs can work with monthly or weekly time steps. The package also provides access to the tools required for management of the input and output data of the computer programs. (ACRES,1979, 1999)

AISP was the mathematical model to provides several modules which are as follows:

• Main Control program (MC)

• Database Module for Time Series Data (DBM)

• Reference Evapotranspiration Module (ETM)(developed by International Institute for Land Reclamation and Improvement (ILRI))

• Irrigation Demand Module (IDM)

• Water Balance Module - Acres Reservoir Simulation Package (ARSP)

• Editing Modules for ARSP, IDM, and ETM

• Backrouting Module (BRM)

• Tools (Utilities) Module which provides access to PKZIP for file backup and to Microsoft Office for statistical analysis and data reporting.

The process of study is to

1) collect the data on meterology, hydrography and physical feature of the Basin and other data of water use for agriculture, industry and consumption, compared with the mode, accordingly to the factual conditions,

2) calculate the rain supply in the Basin,

3) analyze water balance module in the Basin used for other water use activities (Illustrated in picture No.1)

Setting measures and analysis of the result

1. The calculation of average annual water supply and multi-saved water statistically to set up the measure of water supply- dry, wet and normal level, flowing into the Dokrai, Nongpralai and Klang Yai Reservoir. The data were drawn from the
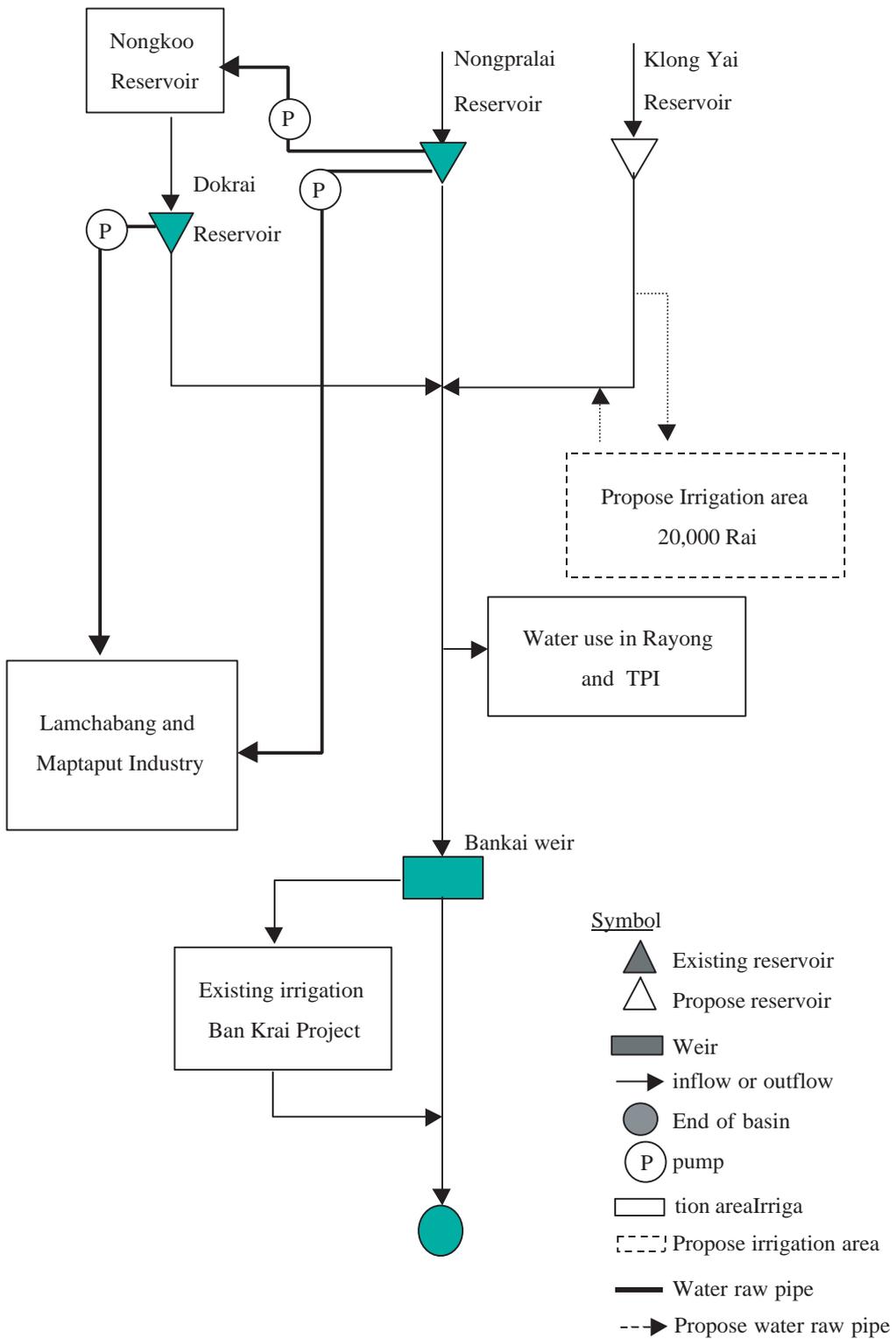
Figure 1 Schematic diagram water allocation in Klong Yai Basin.
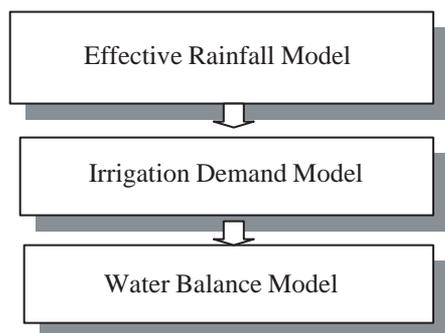
Figure 2 Schematic diagram to calculation for AISP Model.

current flowing into the reservoirs starting in January yearly per multi-saved water at the end of each month yearly, ranked respectively from high to low then calculate for percentage at 10, 30, 50 70 and 90% of the time.

2. Evapotranspiration (ETO) was calculated from weathers data of the Rayong Weather Station, Department of Meteorology, (Station Code No. 48478) by Penman-Monteith Method.

3. Analyze the quantities of effective rainfall within Bankai Irrigation Project and Klong Yai Irrigation Project (suggestion). The data were collected in daily rainfall format by the Station No. 48022 established in Bankai District, Rayong Province as representative for rainfall in both Irrigation Projects. The evaluation of effective rainfall was calculated by Effective rainfall Module of AISP mathematical model. The specification of capacity in the paddy field can be identify in 3 types capacity, accordingly to their water height in the paddy field – high (120 mm), medium (90 mm) and lower (45 mm) in two periods- dry season (January to June) and wet season (July to December).

4. The calculate of water demand in Irrigation Area

4.1 Demonstrated area was divided into 2 blocks – existing area in Bankai Irrigation Project and the propose area in 20,000 Rai of Klong Yai Irrigation Project. Case study was drawn from the surveying results, collected by Rayong Irrigation

Project. The suitable conditions of Klong Yai Reservoir were reported by the Resource engineering and Macro-Consultant Engineering Ltd (1996).

4.2 In the calculation of the Evapotraspiration Module, Coefficient of plants (Kc) from Cropwat mathematical model (version 7.0) applied to plants being grown in the irrigation area which were classified into 5 groups- grains, crops, vegetables, long-life trees and fishing pond.

4.3 The evaluation of Irrigation Demand Module, the water provided for paddy plant is 250 mm. and the average soaking water ratio per day is 1.5 mm.

4.4 1.5 mm of Investigation of Klong Yai Basin

Three main reservoirs - Dokrai, Nongpralai and Klong Yai Reservoir (currently constructed) are utilized in supplying for consumption, agricultural and industrial demand within the Basin. Water Balance Module in AISP was evaluated into 2 study cases:

1. The evaluation in the present case, it consist of existing water supply water and water demand conditions in 2000 – Dokrai reservoir and Nongpralai reservoir, water demand within planting area of Bankai Irrigation Project and non-agricultural demand in 2000.

2. The evaluation in the future case, it consist of existing water supply and water demand conditions in 2009- Dokrai reservoir, Nongpralai reservoir, Klong Yai reservoir is the main reservoirs. The water demand in Klong Yai Basin consist of water demand within planting area of Bankai Irrigation Project and Klong Yai irrigation project (currently constructed by the 2004-2006) and water usage for non-agricultural demands in 2010.

RESULTS AND DISCUSSION

Measure of the backrouting module

The Backrouting Module to Dokrai and Nongpralai Reservoir could be divided into 2 periods- dry season and normal season. (Figure 3)
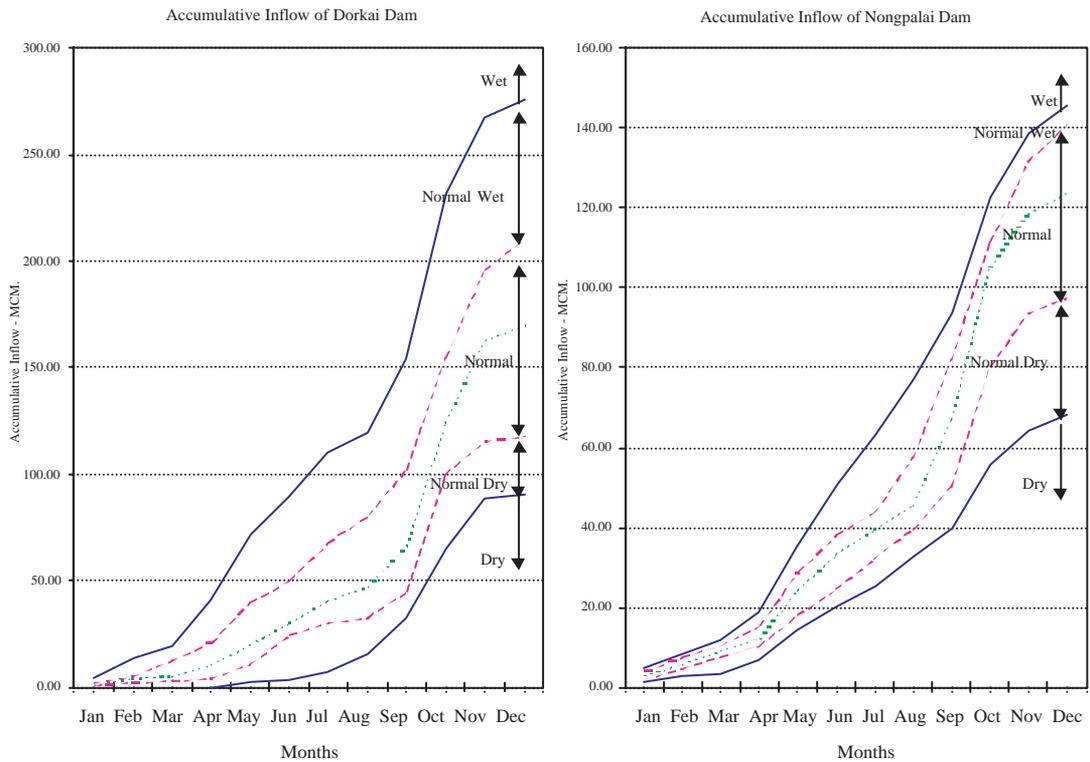
Figure 3 Inflow rule of Dokrai and Nongpralai Reservoir.

The study of water system in Klong Yai Basin

The study of water system in Klong Yai Basin by AISP Approach measuring the relationship within the Basin for water allocation from the existing water supply. The result of existing case in 2000, it can be set Operating rule curve of Dokrai reservoir and Nongpralai reservoir from early of the year (January 1), illustrated in Table 1.

The case study for measuring water use from Reservoirs and delivery system in Irrigation area in 2009 could be estimated for the suitable condition in Klong Yai Reservoir Project using AISP Approach. (Table 2)

Water supplied evaluation

Water Supply Indicators was used as an approach to evaluate the consumption and industrial demand within the Basin. (Table 3)

CONCLUSION

The study of water allocation in Kong Yai Basin was found that irrigation demand ratio in 2000 was about 50 % of industrial and consumption demand. When comparing to industrial water demand per reservoir capacity in Dokrai and Nongpralai Reservoir, industrial water demand was as much as an half of reservoir capacity. It was shown that water allocation in the Basin, principally, depends on industry and consumption.

Net irrigation demand in Bankai Irrigation Project in the dry season is not different from the wet season. However, net irrigation supply in dry season was shown less than in wet season. When comparing to water delivery capacity, It was formed that irrigation demand is higher than any other demand (both sides of Bankai Irrigation Project). In 2000, Water delivery capacity can be delivered at

Table 1 Operating rule curve in Dorkrai and Nongpralai reservoir.

Unit: Million Cubic Meters (MCM)

Month	Volume	
	Dokrai reservoir	Nongpralai reservoir
January	73.0	164.0
February	60.0	144.0
March	50.0	133.0
April	49.0	122.0
May	47.0	116.0
June	49.0	110.0
July	53.0	105.0
August	54.0	103.0
September	59.0	122.0
October	68.0	159.0
November	72.0	164.0
December	73.0	165.0

Table 2 Operating rule curve in Klongyai reservoir.

Unit: Million Cubic Meters (MCM)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Volume	40.0	30.0	28.0	25.0	24.0	22.0	23.0	27.0	32.0	37.0	39.0	40.0

Table 3 Water supplied evaluation in Bankai irrigation project.

Index	Variable	Volume of variable (MCM)	Result of eveuation
1. Water delivery capacity (%)	Canal capacity to delivery	122.52	3.389
	Peak irrigation demand	36.15	
2. Dry season RIS.	Irrigation supply	28.34	1.665
	Irrigation demand	17.02	
3. Wet season RIS.	Irrigation supply	19.61	1.731
	Irrigation demand	11.33	
4. Annual RIS.	Irrigation supply	47.95	1.691
	Irrigation demand	28.35	
5. Industrial water delivery	Industrial supply	109.16	0.459
	Reservoir capacity	238.00	
6. Ratio to water use	Irrigation supply	48.97	0.449
	Industrial supply	109.16	

Remark: The Result of evaluation was calculated from water usage conditions in 2000

RIS.= Relative Irrigation Supply

3.398 time of irrigation demand. (The data in this study were yearly total amount with Bankai Irrigation Project. It is essential to consider water delivery during the crisis time as well as efficient value in a period of time.)

The amount of water flowing into the Reservoirs each year during the wet season is one of the most important factors to be considered (dry, wet or normal level) for water delivery and water draining. To prevent water shortage and flooding in the wet season, agricultural and consumption demand is also a factor to evaluate amount of water in the reservoirs and operating rule curve. In present, if we change the habitual way of water use and cost water supply within the irrigation area, for example, the construction of a new reservoir changing insteaded of good water allocation (kinds of growing plants, planting area, duration of planting, and an amount of water use in Industrial demand ,etc.), we will reduce the cost for planting development and social problems.

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