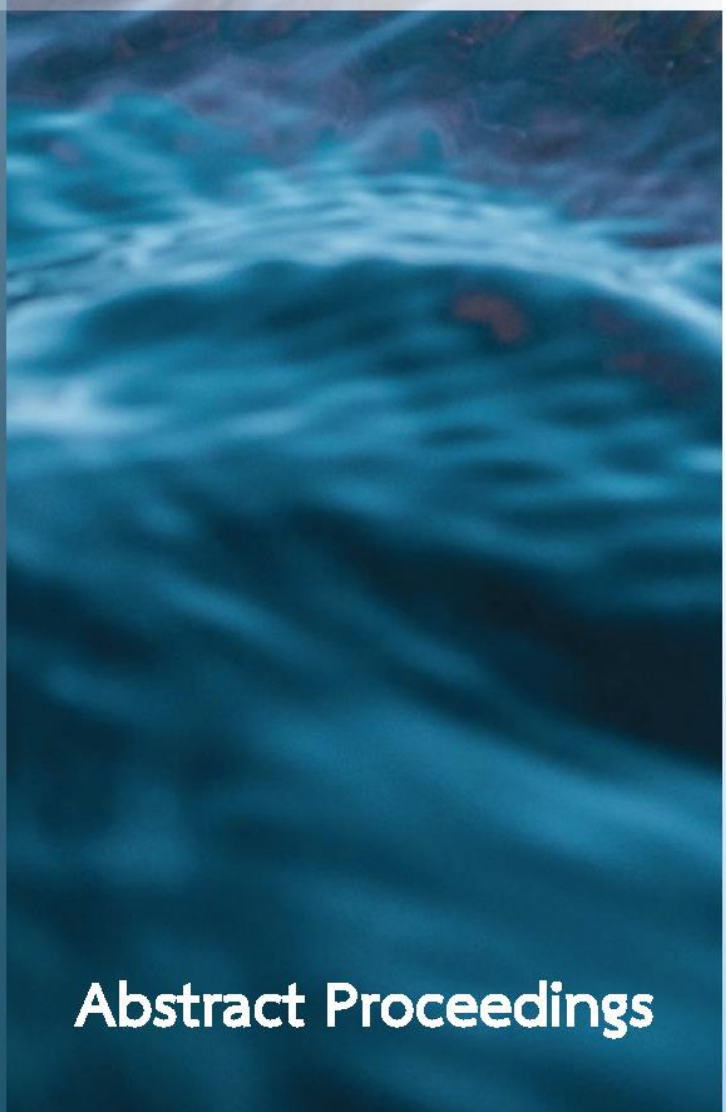
5th International Conference on Water Resources Engineering

"Water Resources Management under Risk and Uncertainty"



26 November 2021

Online Conference

Abstract Proceedings

ABSTRACT PROCEEDINGS

The 8th National Conference on Water Resources Engineering & The 5th International Conference on Water Resources Engineering

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WATER RESOURCES MANAGEMENT UNDER RISK AND UNCERTAINTY

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26 NOVEMBER 2021

ORGANIZED BY

DEPARTMENT OF IRRIGATION ENGINEERING, FACULTY OF ENGINEERING AT KAMPHAENGSAEN, KASETSART UNIVERSITY

SUB-COMMITTEE ON WATER RESOURCES ENGINEERING UNDER THE ENGINEERING INSTITUTION OF THAILAND

IRRIGATION ENGINEERING ALUMNI ASSOCIATION UNDER H.M. THE KING'S PATRONAGE

IRRIGATION COLLEGE

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MESSAGE FROM THE DEAN OF THE FACULTY OF ENGINEERING AT KAMPHAENG SAEN, KASETSART UNIVERSITY

The 8th National and 5th International Conference on Water Resource Engineering under the topic "Water Resource Management under Risk and Uncertainty" were academic conferences organized by the cooperation between the Engineering Institute of Thailand under HM the King's Patronage; Faculty of Engineering at Kamphaeng Saen, Department of Irrigation Engineering, Kasetsart University; Irrigation College; Engineering Alumni Association under H.M. the King's Patronage. This conference aims to provide a great opportunity for both national and international researchers, and general people to participate and exchange their knowledge and experiences for enhancing and improving water management practices in the future.

It is an honor to host the 8th National and 5th International Conference on Water Resource Engineering. As the chairman of the committee for organizing, I would like to express my sincere appreciation to all authors for their contributions to this conference. Also, I would like to thank all the organizing committees, the technical committees, the public agencies, and the private agencies for their excellent support. Also, I sincerely hope that everyone will benefit from this academic conference.

Assoc. Prof. Dr. Chouw Inprasit

Dean of the Faculty of Engineering at Kamphaeng Saen

Kasetsart University

MESSAGE FROM THE PRESIDENT OF THE IRRIGATION ENGINEERING ALUMNI ASSOCIATION UNDER THE ROYAL PATRONAGE

The National Water Resources Engineering Conference is considered as another national forum that allows academics, researcher, teachers and education personnel, students, and engineers from various organizations to demonstrate their potential through presentations that have been assured the quality by qualified persons as the Irrigation Engineering Alumni Association under the Royal Patronage, the organization aims to be the center of the relationship among the members, promote education and dissemination of science. Right now, it is time to be grateful and welcomes the Subcommittee of Water Resources Engineering, Engineering of Thailand under the Royal Patronage of Thailand, Department of Irrigation Engineering, Faculty of Engineering, Kasetsart University, Kamphaeng Saen and College of Irrigation Department of Irrigation, Associate Institute, Kasetsart University, which co-hosted the 8th National Water Resources Engineering Conference.

Irrigation engineering and water resources are the basis of everything, especially driving both agricultural and industrial economies. However, changing the context of society from an agricultural society to an industrial society, climate change and the risk of flooding and drought has put Thailand's water management under risk and uncertainty. Therefore, irrigation science and water resources have become the cornerstone to ensure efficient, appropriate, and equitable water management.

On behalf of the Irrigation Engineering Alumni Association under the Royal Patronage. Hopefully, this symposium will achieve its objectives and strengthen the network of irrigation science and water resources for the benefit of Thailand hereafter.

Dr. Thongplaew Kongchang
Deputy Chief, Ministry of Agriculture and Cooperatives
President of Irrigation Engineering Alumni Association
under the Royal Patronage

MESSAGE FROM THE DIRECTOR OF IRRIGATION COLLEGE

Irrigation college of Royal Irrigation Department (RID), affiliated to Kasetsart University is celebrating its 84th year of our on-going commitments to educate and promote expertise in irrigation and water engineering. Irrigation College also aimed to support scholarly academic events to advance our research and teaching in sustainable ways including being part of this 8th National Water Resources Engineering Conference which provide opportunity to build more academic collaborations. This conference also offers the expansion of irrigation and water resources academic networks ranged from domestic to international via their qualified academic work presentations and publications to generate more knowledge exchanges. This conference is also organized in response to Thailand's water resource management under climate change risks and uncertainties. Consequently, the integration of academic knowledge with practical in field experiences were taking place to modernize technologies toward more responsive and informative overall decisions makings starting from pre-incident to post-incident stages.

Irrigation College would like to thank you and acknowledge the Department of Irrigation Engineering, Faculty of Engineering, Kamphaeng Saen, Kasetsart University, the Subcommittee on Water Resources Engineering, and the Engineering Institute of Thailand Under H.M. The King's Patronage, for allowing Irrigation College to take part of this academic conference which we aimed to cooperate and comply academically with our full efforts.

Chaiya Phoungphotisop

Director of Irrigation College

Royal Irrigation Department, Pak Kret

MESSAGE FROM THE PRESIDENT OF THE ENGINEERING INSTITUTE OF THAILAND UNDER H.M. THE KING'S PATRONAGE

Water is vital for life. Human beings use water directly, in their daily lives, and indirectly, e.g., in agriculture, industry, transport, etc. Water is a reusable resource but climate change in various countries, including Thailand, is leading to floods, drought and other problems. Many factors will lead to unavoidable damage, either naturally or from the management of water and other resources, if management of them is not good enough.

The Engineering Institute of Thailand under H.M. The King's Patronage in collaboration with educational institutions, including government and private agencies, have organized the 8th National and 5th International Conference on Water Resource Engineering, under the theme “Water Resource Management under Risk and Uncertainty”. It will serve as a forum for academics, researchers, students and operators concerned in water resource engineering in both the public and private sectors across the country to exchange knowledge, experience and ideas, relating to research, professional expertise and state-of-the-art modern technology transfer.

This conference has been organized successfully because of the cooperation and support of numerous parties. I would like to take this opportunity to express my sincere thanks to the Sub-committee on Water Resource Engineering, the Engineering Institute of Thailand under HM the King's Patronage (EIT); the Faculty of Engineering at Kamphaeng Saen, Department of Irrigation Engineering, Kasetsart University; Irrigation College; Irrigation Engineering Alumni Association under H.M. The King's Patronage; and all parties of the Central Organizing Committee, who devoted time to the conference to enable it to achieve its objectives, as well as the public and private sectors, whose support makes it successful. The conference will help to develop the professional field of water resource engineering, and to make progress and benefit society in the future.

Dr. Thanes Weerasiri

President of The Engineering Institute of Thailand

under H.M. The King's Patronage

MESSAGE FROM THE CHAIRMAN OF THE SUB-COMMITTEE ON WATER RESOURCE ENGINEERING, THE ENGINEERING INSTITUTE OF THAILAND UNDER HM THE KING'S PATRONAGE (EIT)

The Sub-committee on Water Resource Engineering by the Engineering Institute of Thailand under HM the King's Patronage (EIT) was established with the objectives of providing academic services to meet EIT's goals and regulations, and focusing on the development, promotion and support of the water resource engineering profession to further enhance its progress in Thailand.

The 2021 Sub-committee on Water Resource Engineering has a one-year term. On the whole, its policies and action plans emphasize academic affairs.

The 8th National and 5th International Conference on Water Resource Engineering – "Water Resource Management under Risk and Uncertainty" – have taken the combined efforts of local and international academics, water engineering operators and students, who have shared their knowledge and experience, and presented their research, which benefits those concerned, including those interested in water resources. The conference would not be possible without the cooperation of all relevant parties, for example, the 2021 advisory and sub-committee members; the Central Committee for Organizing the 8th National and 5th International Conference on Water Resource Engineering; the Faculty of Engineering at Kamphaeng Saen, Department of Irrigation Engineering, Kasetsart University; Irrigation College; Irrigation Engineering Alumni Association under H.M. The King's Patronage; and public and private agencies; as well as the companies who provided budgetary support, coordination and other operations to enable it to be carried out successfully. Finally, I would like to thank all parties concerned for supporting the smooth operation of the 2021 Sub-committee on Water Resource Engineering and the Central Committee for Organizing the 8th National Conference and 5th International Conference on Water Resource Engineering.

Last but not least, I do hope that the conference participants will gain benefits in accord with their expectations.

Dr. Kasem Pinthong

Chairman of the Sub-committee on Water Resource Engineering,
the Engineering Institute of Thailand under HM the King's Patronage

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Conference Program

The 8th National Conference on Water Resources Engineering
&
The 5th International Conference on Water Resources Engineering
November 26, 2021

Opening Ceremony	
09.00-09.30	**Welcome Remark** by **Dr. Kasem Pinthong** Chair of the sub-committee on water resources engineering under the Engineering Institute of Thailand under H.M. The King's Patronage by **Assistant Professor Dr. Thanes Weerasiri** President, The Engineering Institute of Thailand under H.M. The King's Patronage
	Opening Remark by **Associate Professor Dr. Chow Inprasit** Dean of Faculty of Engineering at Kamphaengsaen campus Kasetsart University
Keynote Address	
9.30-10.00	Keynote address I **Mr. Lalit Thanomsing** Secretary-General of the Office of the Royal Development Projects Board
10.00-10.30	Keynote address II **Dr. Surasri Kidtimonton** Secretary-General of the Office of the National Water Resources
10.30-11.30	Keynote address III **Professor Gary P. Merkley** Senior Supervising Engineer Natural Resources Consulting Engineers, Inc. California, US.
Parallel Sessions	
13.00-16.00	**International conference :** Session 1: Water Management / Water Quality Management and Ecosystem Session 2: Meteo-Hydrological and Climate Change / Water Supply and Sanitary / Risk and Disaster /Hydroinformatics
	National conference: Session 1:Water management, meteo-hydrological and climate change Session 2: Irrigation and Drainage Session 3: Water Quality and water supply engineering Session 4: Emerging technology and decision support
16.00-16.30	**Closing Remark**

LIST OF ARTICLES PUBLISHED IN JOURNALS

FAST TRACK: MAHASARAKHAM INTERNATIONAL JOURNAL OF ENGINEERING TECHNOLOGY

CC6 ASSESSMENT OF ROYAL RAINMAKING PERFORMANCE WITH GROUND-BASED RAINFALL IN PHETCHABURI RIVER BASIN

RD3 CATCHMENT-SCALE FLOOD HAZARD MAPPING IN THE LOWER AREAS OF LAM PAO RIVER BASIN, THAILAND

WQ1 SIMULATION OF WATER LOSSES FOR THE 1D SALINITY FORECASTING MODEL IN CHAO PHRAYA RIVER

NORMAL TRACK: NARESUAN UNIVERSITY ENGINEERING JOURNAL

WM7 LOW-FLOW ASSESSMENT FOR UNGAUGED SUB-BASINS IN THE UPPER PING RIVER BASIN, THAILAND

WM15 EVALUATING HYDROELECTRICITY PRODUCTION RE–OPERATING WITH ADAPTED RULE CURVE UNDER CLIMATE CHANGE SCENARIOS CASE STUDY OF BHUMIBOL DAM IN THAILAND

WM21 TRACING CROP WATER REQUIREMENT IN THE PUMPING, GRAVITATIONAL AND INUNDATION IRRIGATION SCHEMES OF THE GREATER CHAO PHRAYA RIVER BASIN USING CLOUD-BASED IRRISAT APPLICATION

RD0 DEVELOPMENT OF A WEB-BASED INTERFACE FOR URBAN FLOOD WARNING SYSTEM IN BANGKOK, THAILAND

RD7 DROUGHT ANALYSIS IN THE EASTERN ECONOMIC CORRIDOR BY USING THE STANDARDIZED PRECIPITATION INDEX (SPI)

WQ2 WQI INDEX ASSESSMENT OF RAW WATER FOR WATER SUPPLY

Water Management

LOW-FLOW ASSESSMENT METHODS FOR UNGAUGED SUB-BASINS IN THE UPPER PING RIVER BASIN, THAILAND

Sokseyla Man[1] and Supattra Visessri[2*]
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ABSTRACT

Water scarcity has become one of the most remarkable problems in Thailand. This is due to several factors both natural processes such as increased rainfall variability and anthropogenic activities such as rapid socio-economic development. An assessment of flow or specifically low-flow may lead to better water resources management and reduce the risk of water scarcity. The assessment of low-flow in gauged basins where the flow time series are available is straightforward. The challenge exists in ungauged or poorly-gauged basins where the flow data are unavailable or of low quality. Due to the studies of low-flow assessment methods for ungauged sub-basins in Thailand including the Upper Ping River basin are of limited and most of those studies focused on the baseflow index (BFI), this study aims to address the low-flow assessment in the ungauged sub-basins in the Upper Ping River basin in Thailand by defining a regionalization method for extrapolating beyond the limitations of observed flow data focusing not only the BFI but also other two indices namely 95th percentile-flow (Q95) and the annual minimum 7-day moving average streamflow with a 10-year recurrence interval (7Q10). Performance comparison of two widely used regionalization methods namely the regression and climate adjustment methods in estimating low-flow is performed. The study framework is demonstrated through the case study of 25 sub-basins of the Upper Ping River basin with available data from 1995-2014 since it has a relatively good number of gauging stations with smaller missing data. The regression method is applied to investigate the relationship between the basin properties and three low-flow indices. The climate adjustment methods consist of two main steps which are donor site selection and record augmentation. The accuracy of the methods is assessed by comparing the predicted with the observed low-flow indices. The performance of methods is tested by R^2, RMSE, and NSE. The results of the regression method indicate that the method performs best for predicting 7Q10 compared to Q95 and BFI. On the other hand, the results of the climate adjustment method show that the method with a comparatively long overlap period is found to improve over the regression method.

Keywords: Climate adjustment, Low-flow indices, Record augmentation, Regional regression, Regionalization, Upper Ping River Basin

EVALUATING HYDROELECTRICITY PRODUCTION RE–OPERATING WITH ADAPTED RULE CURVE UNDER CLIMATE CHANGE SCENARIOS: CASE STUDY OF BHUMIBOL DAM IN THAILAND

Khin Muyar Kyaw[1], Areeya Rittima[2*], Yutthana Phankamolsil[3], Allan Sriratana Tabucanon[4], Wudhichart Sawangphol[5], Jidapa Kraisangka[6], Yutthana Talaluxmana[7], and Varawoot Vudhivanich[8]
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ABSTRACT

Hydroelectricity production is being impacted by climate change due to the considerable changes in water availability of reservoir system and dam release. This study aims at evaluating the response of energy production of the Bhimibol dam through the reservoir re–operation system with non–engineering adaptation measures due to climate change. Reoperating the Bhumibol (BB) dam with adapted rule curve and modelling exercise with MIKE11 to predict series of reservoir inflow were conducted under RCP4.5 and RCP8.5 climate change scenarios. The adapted rule curves of BB dam were established by either increasing or lowering the upper and lower rule levels of 0.5 meters from the rule curves which were developed by EGAT in 2012. In addition, the standard operation policy were applied to specify the amount of water release corresponding to the adapted rule curves established. The water balance–based reservoir re–operation model were developed using MATLAB Simulink Toolbox for short–term simulation during 2012–2018. Influence of climate change on the seasonal and yearly reservoir inflows were considerably investigated. In addition, the relation of current and projected inflows, and the response of dam release and hydroelectric production of BB dam were then evaluated. The results of the short–term simulation during 2012–2018 show that dam release is likely to be increased corresponding to the high variability of projected inflows. Therefore, the seasonal and yearly hydroelectricity production are accordingly increased when re–operating dam under RCP4.5 and RCP8.5 inflows. It is found that the yearly hydroelectricity production with RCP4.5 and RCP8 inflows are about 52% and 30% respectively higher than the current inflow. It is also revealed that re–operating dam with the different types of adapted rule curves does not alter the volume of released water and energy production generated from the reservoir radically because the standard operating rules were adopted for all adapted rule curves. Importantly, the study on the adaptation measures to climate change would help increase understanding of necessity of new operational rules for dam and reservoir re–operation to cope well with instability of reservoir water supply for sustainable hydropower production in future.

Keywords: Adapted rule curve, Climate change, Hydroelectricity, Hypothesis testing, Water balance–based simulation model

BMA FLOOD MITIGATION IN RESILIENCE PERSPECTIVE OF FLOOD VULNERABILITY INDEX

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ABSTRACT

Bangkok flooding results from the rain in the area, even if the intensity is less than the design value. It affects populations in different districts with varying degrees of severity, depending on several factors. To address this obstacle, the Flood Vulnerability Index (FVI) method, in which the main parameters consist of Exposure (E), Susceptibility (S), and Resilience (R), was analyzed and implemented. The higher FVI means more inundation risk in the area. On the other hand, the reducing values of E and S or increasing R can generate lower FVI. This study tested the mitigation concerning resilience perspective in seven Bangkok areas, dividing the physical characteristics into three groups according to drainage system performance. The sensitivity analysis of FVI concerning the R parameter by the factor changes of retention pond to the area ratio (P/A) was tested. The FVI analysis using the Fuzzy Inference technique was used in this study. The simulated results showed that the existing conditions of those seven districts have FVI values between 0.60 and 0.90 approximately. After increasing parameter R according to the feasible physical conditions of the areas, it was found that the FVI of Chatuchak, Bangkhen, and Khanna Yao districts could be reduced to 0.70 approximately, while at the Phayathai and Ratchathewi districts could not be reduced due to the limited conditions of residential.

On the other hand, business areas in Bangkhuntien and Prawet districts could not be reduced due to the limited conditions of Pond area ratio with an existing condition. The current condition is already tremendous; adding pond storage could not reduce FVI. Therefore, other measures such as warning systems or groundwater storage in a resilience perspective should be considered in these two districts.

Keywords: Bangkok Metropolitan Administration (BMA), Flood Mitigation, Flood Vulnerability Index (FVI)

POTENTIAL OF HARVESTED RAINWATER FOR HOUSEHOLD CONSUMPTION: A CASE STUDY FOR RURAL DEMONSTRATION SITES IN THE NORTH-EAST OF THAILAND

Ekarut Archeewa[1], Shotiros Protong[2*]
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ABSTRACT

During past several decades, Thai people in rural areas had used rainwater as drinking water in their households. However, consuming rainwater nowadays is not a normal practice anymore, people changed to drink bottled water owning to aware of rainwater contaminated by air pollution. Bottled water is not only costly, but also the bottles are hardly decomposed, deteriorate environment, and cause global warming and climate change phenomenon. This research has an aim to ascertain that harvested rainwater can be another source of potable water for consumption in households. Two provinces, Nong Khai and Ubon Ratchathani, were selected to be study areas to investigate quantity of rainfall and quality of stored rainwater. Forty-two harvested rainwater samples were collected from water storage containers (Ongs) during the late of rainy season in year 2019. Thereafter, the samples were transported to the Bureau of Research Development and Hydrology, the Department of Water Resources to analyse their qualities. Another parameter is amount of annual rainfall. The future rainfall densities due to climate change are attained from predicted rainfall data from CMIP6 global circulation with MRI-ESM2-0 for both SSP245 and SSP585 future index analysis, performed by Hydro-Informatics Institute. The observed rainfall data from 1970 to 2020 by the Thailand Meteorological Department are used to validate results from CMIP 6. Amount of rainfall can be later determined by interpolation technique of Arc GIS version 10.5. With those aforementioned methods, the amount of rainfall in Nong Khai and Ubon Ratchathani are enough for using it as drinking water in each family. On the subject of rainwater quality, the results from the laboratory reveal that harvested rainwater has its chemical and physical properties passing the Drinking Water Standard issued by Department of Health B.E. 2553. For that reason, it can be concluded that rainwater in rural areas in Nong Khai and Ubon Rachathani can be considered as an alternative source of drinking water in households and as an adaptation measure for climate change during a long drought period

Keywords: Harvested rainwater, Rainwater Quality, Annual rainfall, Observed rainfall, Interpolation and Arc GIS 10.5

THE PREDICTABILITY OF RESERVOIR INFLOW PREDICTION MODEL FOR SIRIKIT DAM USING XGBOOST MACHINE LEARNING ALGORITHM

Pheeranat Dornpunya[1], Areeya Rittima[2*], Yutthana Phankamolsil[3], Allan Sriratana Tabucanon[4], Wudhichart Sawangphol[5], Jidapa Kraisangka[6], Yutthana Talaluxmana[7], and Varawoot Vudhivanich[8]
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ABSTRACT

XGBoost which is a tree–based ensemble machine learning algorithm, was used to predict the daily and monthly reservoir inflows of the Sirikit Dam, Thailand. Training and testing the prediction models were accordingly implemented using observed inflow and climate data during 2000–2020 as the key prediction inputs. The correlation analysis was conducted to seek the strong relations between the observed inflow of the Sirikit Dam and climate data collected from TMD and NASA data sources. Setting up the prediction model structures were performed using observed inflow, precipitation and humidity data at time step t, and the average inflow at the delayed time steps. Consequently, 54 scenarios of XGBoost daily and monthly models were trained and evaluated by altering the model parameters such as ratio of training–training datasets, learning rates, maximum number of iterations, and early stopping rounds. It is found from the validation results that the XGBoost model could present more reliable and robust prediction results especially for the daily prediction model with the highest R^2, R, NSE of 0.8362, 0.9145, and 0.8161, respectively. In addition, small values of RMSE and MSE were considerably found. The predictability of the XGBoost model to predict the daily reservoir inflow with good precision is strongly higher than the monthly inflow. Predicting the average values of the daily and monthly inflows gives the prediction results definitely closer to the observed inflows. However, the capability to characterize and predict the dynamics of extreme values of these two developed models is still weak. Therefore, to improve the quality of machine learning algorithm for hydrological prediction, the model parameters need to be optimized. Moreover, conducting the further study using the technological advancement of machine learning is highly encouraged for the achievement of hydrological forecast on water resources management.

Keywords: Artificial Intelligence (AI), Extreme Gradient Boosting (XGBoost), Machine Learning (ML), Reservoir Inflow Prediction, Sirikit Dam

TRACING CROP WATER REQUIREMENT IN THE PUMPING, GRAVITATIONAL AND INUNDATION IRRIGATION SCHEMES OF THE GREATER CHAO PHRAYA RIVER BASIN USING CLOUD–BASED IRRISAT APPLICATION

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ABSTRACT

Tracing crop coefficient (K_c) at all the stages of crop growth is commonly essential for an accurate estimation of crop water use. This study applied the cloud–based IrriSAT application to trace the dynamic values of crop coefficient in three different sorts of irrigation schemes; pumping, gravitational and inundation irrigation for estimating crop water requirement in the Greater Chao Phraya River Basin. Three selected irrigation schemes; Bang Bal (BB), Thabua (TB), and Yom–Nan (YN) representing pumping, gravitational, and inundation irrigation schemes were selected to trace crop coefficient values of in–season and off–season crops and to estimate long–term crop water requirement (ET_c) from 2015–2020. The results of dynamic values of K_c–IrriSAT were verified and adjusted with average K_c–RID which were calculated as a function of K_c from field observation for the different types of crops and accumulated area size monitored by GISTDA. The results revealed the similar patterns of average K_c generated by IrriSAT corresponding to the average K_c–RID. After the calibration procedure was successfully done, the correlations between K_c–IrriSAT adjusted and average K_c–RID for BB, TB, and YN irrigation schemes are relatively higher with R^2 of 0.8304, 0.8466, and 0.8314, respectively. In addition, it shows the explicit variability on monthly and yearly crop water demands of these three sorts of irrigation schemes when the adjusted K_c–IrriSAT were employed. It would be concluded that cloud–based IrriSAT application can be a very supportive tool in estimating the actual crop water requirement particularly for irrigators to evaluate the current status of irrigation water use and to improve the irrigation efficiency at the field scale.

Keywords: Crop Coefficient, Crop Water Requirement, Reference Crop Evapotranspiration, Cloud–Based IrriSAT Application, Normalized Difference Vegetation Index

Water Quality Management and Ecosystem

SIMULATION OF WATER LOSSES FOR THE 1D SALINITY FORECASTING MODEL IN CHAO PHRAYA RIVER

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ABSTRACT
Salinity intrusion is one of a major problem in the Chao Phraya River during dry season. It affects salinity condition for water consumption and other uses. The pumping station of MWA is located at Sumlae station, Pathumthani Province, about 80 km from Chao Phraya River mouth. During dry season when the freshwater is low the salinity can be intruded and affected the salinity level at this station. The salinity concentration becomes higher than the safe range for drinking water. The one-dimensional salinity forecasting model has been developed using 1D Mike11 AD model. The model has been setup operationally providing 7 days salinity forecast. When the salinity is forecasted to be higher than accepted range, freshwater will be released from the reservoir to flush the salt water out of the river. Although the overall accuracy is well satisfied. The water losses due to local abstraction along the river is still causing problem to the computed results. Therefore, the model has been setup to simulate the discharge losses into 4 cases; No loss, 40%, 50% and 60%, respectively. The forcing at the upstream river comprised of the release from main reservoirs and gates while at the river mouth, the boundary was adapted using the salinity forecast from HYCOM. The model results have been validated with the results from salinity survey during spring and neap tides in February 2021. The results were found that 60% loss of discharge provide the nearest results compared to the observation from salinogarpher and salinity at gauge station. This is confirmed that there is water loss along the river that need to be included in water flushing plan as well as in the model. The discharge station is recommended to install at Samelae station to measure the exact river discharge that may vary over time. This will improve the accuracy of salinity forecast model as well as the water management for salinity intrusion in Chao Phraya River.
Keywords: Salinity intrusion, Chao Phraya River, Water losses, Salinity forecast

ESTABLISHMENT OF WATER QUALITY INDEX FOR RAW WATER OF WATER SUPPLY

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ABSTRACT

Over two decades, climate variability has caused a significant change in human well-being, particularly the availability of water resources. The water shortage especially affects the quality of life for various purposes since it affects not only the quantity but also the quality. According to the surface water quality standards of the Pollution Control Department (PCD), thirteen parameters are selected as they are essential in the indication of raw water suitability for MWA water supply production. The recorded water quality of the Chao Phraya River at 18 PCD stations along the 379-km stretch from Chainat to Samutprakarn has been considered. Thus, the Water Quality Index (WQI) was created, including color, turbidity, BOD, DO, pH, NO_3-N, Fe, Mn, TDS, TP, EC, salinity, and hardness. WQI provides a single value for water quality suitability, useful for the MWA in tapwater production. It reflects the constituents that may be harmful to the consumer and the efficiency of production. For example, if the salinity in raw water greater than 0.25 mg/l could not be removed by the MWA system, resulting in tap water with a salty flavor. Therefore, if the deteriorated water quality of raw water has been acknowledged in advance, prior Samlae intake station, the appropriate solutions can be arranged. Using PCD water quality records, the average WQI scores of the Chao Phraya River in the rainy and dry seasons are 74.63 and 78.37 (from a full score of 100), respectively. It indicates the tendency to deteriorate raw water during the low flow period; thus, MWA should be aware and periodically inspect.

Keywords: Surface water quality standard, Water quality index, tap water production, MWA

Meteo-Hydrological and Climate Change

ASSESSMENT OF ROYAL RAINMAKING PERFORMANCE WITH GROUND-BASED RAINFALL IN PHETCHABURI RIVER BASIN

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ABSTRACT

Phetchaburi River Basin is a watershed that connects to the coast. There is a rainy season from May to November. The average rainfall is about 1,000 mm per year, about 200 mm less than the average rainfall in Thailand. Due to the low rain in the area, there is a problem of water shortage for agriculture and consumption. Therefore, the Department of Royal Rainmaking and Agricultural Aviation has carried out Royal Rainmaking operations to increase the amount of rainfall over the basin especially the amount of water flow through the Kaeng Krachan Reservoir. This study assessed the effectiveness of royal rain and terrestrial rain in the Phetchaburi Basin by collecting hourly rainfall data during 09.00-21.00 (12 hrs.) for 14 stations and 4 additional stations studied for installation and radar rain data in the form of a grid obtained from the operation in years 2018-2020. It found that there were 108 days of Royal precipitation during these three years by analyzing the spatial areal using the Invert Distance Weighted technique. The spatial areal rainfall of the two datasets had a correlation coefficient of 0.21, which was a relatively low correlation. Once simulating radar rainfall data, come to the 4 additional stations to find the average daily spatial areal rainfall. The data were then compared with the reference data again. It found that the correlation coefficient increased with correlation coefficient of 0.54. However, it has to wait for the actual measurement results during the Royal Rainmaking Operations Year 2021 from this additional measuring device and use the results obtained to evaluate the achievement of the Royal Rainmaking Operations in the year 2021.

Keywords: Phetchaburi River Basin, Royal rainmaking operation, Radar rain, Spatial areal rainfall, Terrestrial rain

Water Supply and Sanitary

RISK AND VALUE-BASED ANALYSIS IN WATER DISTRIBUTION SYSTEM: CASE STUDY OF MWA'S LADPLAO BRANCH

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ABSTRACT
Water loss has been the main challenge of the Metropolitan Waterworks Authority (MWA) for over a decade; 31.25% loss took place in 2020. To address this challenge, MWA has paid attention to investing in a pipe replacement scheme. However, the recent projects cause a high expenditure while the water loss still has a trend to increase significantly. The difficult obstacle is how to efficient use of limited budgets with the appropriated need of pipe replacement. This study aims to prioritize pipeline replacement based on two indices, Risk Index (RI) and Infrastructure Value Index (IVI), and to describe the relationship of those indices in specific areas of different characteristics. Moreover, the analysis of pipe replacement in the last three years was investigated its effectiveness of selection in this study. The Ladplao branch was employed as a study area. Its water distribution system (WDS) has a polyvinyl chloride pipe (PVC) with a length of approximately 2,350 kilometers in 64 district metering areas (DMA) and with average pipe aging of 35 years. Five different characteristic DMAs depending on their specific data were selected for the study.
To analyze RI, three crucial parameters, namely, length, age, and historical leakage data, were considered via fuzzy logic inference. For asset valuation, the approach of asset-oriented technique was implemented to evaluate the infrastructure value. First, the unit costs were used to determine the existing asset replacement costs, then the current infrastructure values and its replacement cost was calculated for the IVI. Finally, a modified Risk-Value Index (MRVI) was adapted to prioritize pipe routes. It was found 17,669.84 meters of pipe length in 29 pipe routs that RI is over 50 % by indicating high risk of distribution pipeline, and 25,901.29 meters of 200 pipelines that have IVI value lower than 0.4 from 10 DMAs. It means that many poor condition pipes had not been yet arranged in replacement priority. However, discussing these indices regarding the various conditions points to critical issues that still require to be addressed.

Keywords: Asset valuation, District metering area, Fuzzy inference system, Infrastructure value index, Risk index.

Risk and Disaster

DEVELOPMENT OF A WEB-BASED INTERFACE FOR URBAN FLOOD WARNING SYSTEM IN BANGKOK, THAILAND

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ABSTRACT

Climate change, combined with rapid urbanization in Asia's major cities, has resulted in a number of extreme events over the last two decades. Urban floods have become one of the major challenges in the urbanization process. Bangkok flood is a barrier to the city's development because Bangkok is located in low-lying area of Chao Phraya Delta; as a result, Bangkok floods frequently especially in rainy season. There are many physical and meteorological factors that influence urban flooding, such as drainage systems, infrastructures, precipitation, and so on. In this study, urban flood warning system has been developed by integrating the flood guidance threshold with the 1hr now-casting rainfall from the weather radar. The threshold is calculated using historical rainfall data from rain gauge stations located throughout the province that have been in operation for at least ten years. The system is implemented by overlaying the 1hr now-casting rainfall and the threshold. When the now-casting rainfall reaches the threshold, a warning area appears. The web-based interface warns of urban flooded areas, and the operating system displays them every six minutes based on the frequency of the weather radar. The sensitive Bangkok flood area and sub-district are described in detail in the warning area. There are radar data quality control process, accuracy of radar rainfall nowcasting, and rainfall thresholds calculations in different time periods in our urban flood warning system. Finally, we examined the performance of the urban flood warning system using standard statistics based on actual urban flood events. Furthermore, urban flood warning via web-based interface can be used to enhance the work of flood managers and technical staff in areas such as drainage system operation and flood mitigation. As a result of its quick warning and high performance, the warning interface is critical for Bangkok's urban flood prevention.

Keywords: Bangkok, Flood warning, Urban flood, Weather Radar, Web-based Interface.

CATCHMENT-SCALE FLOOD HAZARD MAPPING IN THE LOWER AREAS OF LAM PAO RIVER BASIN, THAILAND

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ABSTRACT

Floods have resulted in the reduction of agricultural production in Thailand. Flood hazard mapping in the lower part of Lam Pao River Basin is a challenging task because its upper part is controlled by the Lam Pao Reservoir. The present study aims at developing flood hazard maps using an integrated approach based on the SWAT hydrological model and satellite data. The SWAT model was used to transform observed daily meteorological data between 2008 and 2017 into runoff hydrographs. The results indicated that the SWAT model had capability to reproduce extreme flood hydrographs according to Nash-Sutcliffe Efficiency, R2 and percent error in peak. The simulated discharges were found to be satisfactorily fitted to the Gumbel distribution based on the Chi-square test. The flood peaks with return periods of 5, 10 and 20 years at each sub-catchment were classified into four levels of flood hazards, namely low, medium, high and very high flood hazards based on the frequency of flood occurrences acquired from the satellite data. It was found that six sub-catchments along the main river had very high degrees of flood hazard. The results of the sub-catchments S15 and S16 located downstream were verified by the satellite data. There were three flood events occurred in the two sub-catchments during the study period. Moreover, some sub-catchments of tributary streams were found to have high degrees of flood hazard. We conclude that flooding spatial information of satellite data can help to improve hydrological prediction and to prioritise flood protection areas in ungauged sites.

Keywords: Flood frequency, Gumbel distribution, Flood hazard assessment, Return period, SWAT

THE FLOOD WARNING INDICATORS ASSESSMENT USING STREAM FLOW AND SATELLITE IMAGE DATA

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ABSTRACT

Sisaket and Ubon Ratchathani provinces are in a downstream of the Mun river. There is often a big flooding in these provinces, especially Ubon Ratchathani province as in 1977, 2002, 2010, and 2019. Then, it is important to consider flood warning because these provinces have not the flood warning. The purpose of this study is to evaluate water levels and discharges in the runoff stations for the flood warning indicators in Sisaket and Ubon Ratchathani provinces based on the 137 satellite images. To access the purpose, all satellite images are in the process of image processing to determine a flooding area by using the ERDAS imagine software. Water mask is generated by using the digitization technique. Thresholding technique is considered to segregating the water area and non-water area from satellite images during flooding time. Then, the flood mapping is done by overlaying the inundated layer on the sub-district boundary map. Thereafter, each satellite image is classified flooding area by sub-district in each province. On the other hand, water level and discharge in the same day with all 137 images are matching to determine the maximum, mean, and minimum of water level and discharge. The minimum values are the beginning of flooding. The mean values present a serious flood situation. The maximum values are a very serious of flooding or a big flooding. The runoff stations where can evaluate the flood warning include M5, M9, M182, M7, M179, M170, E.20A, and E.98. The advantages of flood warning indicator are (1) using original tools at runoff station, (2) low-cost operation and management (3) easy for understanding and using, and (4) that new data is not collected. The disadvantages are (1) a static flood warning and (2) that rainfall is not input data.

Keywords: Flood warning indicator, Stream Flow, Satellite Image, Ubon Ratchathani, Sisaket

DROUGHT ANALYSIS IN THE EASTERN ECONOMIC CORRIDOR BY USING THE STANDARDIZED PRECIPITATION INDEX (SPI)

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ABSTRACT

The objective of this research was to analyze the severity level of drought by using the Standardized Precipitation Index (SPI) in the area of Eastern Economic Corridor (EEC) with the 6 meteorological stations consisting of the stations of Bangkok Metropolis, Chanthaburi, Chonburi, Koh Sichang, Phatthaya, and Khao E-To, during the years of 1988 to 2017. The three patterns of moving cumulative rainfall of 3, 6, and 12 months were used to estimate the indices of SPI3, SPI6, and SPI12, respectively. As the result, the averaged values of 3 patterns of SPI indices were ranged between -0.0052 and 0.0084, which was interpreted as the level of near normal. The maximum and minimum values of the SPI index could experience drought conditions at both extreme drought and wet. However, the results demonstrated that more than 65 (%) of the SPI index were ranged in the level of near normal, the chance of drought was approximated about 1 – 12 (%). The results of this research could be a part of the information to support water management in the study area in order to develop a suitable plan to mitigate the effect of drought on the management in the future.

Keywords: Drought, Eastern Economic Corridor, Rainfall, Standardized Precipitation Index.

Hydroinformatics

ASSESSMENT OF WEAP MODEL IN SIMULATING RAINFALL-RUNOFF RELATION IN THE PING AND WANG RIVER BASINS, THAILAND

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ABSTRACT

This study aimed at developing the physically–based rainfall–runoff model using the Water Evaluation and Planning system (WEAP) with the simplified coefficient method. The Ping and Wang River Basins in the northern region of Thailand were selected as study area to explain the hydrologic dynamics and responses of the implemented watershed system through rainfall–runoff relation. The monthly hydro–meteorological data during 2000–2020 was used as dataset for hydrological modelling by WEAP. To reflect the lumped hydrologic response, the study area in Ping and Wang River Basins were subdivided into 3 sub–basins; (1) Sub–Basin 1 (Upper Ping Basin), (2) Sub–Basin 2 (Lower Ping Basin), and (3) Sub–Basin 3 (Wang Basin). In addition, the land area was fractionally classified into 16 land use classes to identify the relevant inputs such as crop coefficient, areal rainfall, and reference evapotranspiration. Key model parameters; runoff coefficient, infiltration coefficient, and percent of effective rainfall, were estimated and adjusted manually to improve the model performance statistics. The model calibration and validation were implemented through comparison between monthly observed and simulated streamflow measured at 3 gauging stations; P.12C, P.17, W.4A on the Ping and Wang Rivers as well as the monthly inflow of Bhumibol Dam. The long–term simulation results showed that WEAP model could provide the reasonably good agreement of R^2 of 0.75–0.81 at all gauging stations except P.12C station where the hydrologic response has been strongly affected by the influence of regulated dam release. Based on the overall model performance statistics, predominant capability of WEAP model to simulate behavior of hydrologic responses was found particularly at the outlet of sub–basin (P.17 and W.4A gauging stations) and outflow point (reservoir inflow of BB Dam) where the impact of regulated flow on the model performance has been diminished.

Keywords: Ping River Basin, Wang River Basin, WEAP model, Rainfall–Runoff simulation


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