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UDC : 626.8

Chusnul Arif, Budi Indra Setiawan, Slamet Widodo, Rudiyanto, Nur Aini Iswati Hasanah, Masaru Mizoguchi**DEVELOPMENT OF ARTIFICIAL NEURAL NETWORK TO PREDICT GREENHOUSE GAS EMISSIONS FROM RICE FIELDS WITH DIFFERENT WATER REGIMES****Abstract**

The paper proposes the artificial neural networks (ANN) model to predict methane (CH₄) and Nitrous Oxide (N₂O) emissions under different irrigation system based on easily measurable environmental biophysics parameters such as soil moisture, soil temperature and soil electrical conductivity. To verify the model, two experiments were conducted in the pot experiments in two different locations. The first location was in the greenhouse of Meiji University, Kanagawa Prefecture, Japan from 4 June to 21 September 2012, and the second location was in water resources engineering laboratory, Department of Civil and Environmental Engineering-IPB from 2 July to 10 October 2014. In each location, there were three different irrigation systems adopted with the System of Rice Intensification (SRI) principles. We called the experiment as SRI Basah (SRI B1 and SRI B2 for the first and second locations, respectively), SRI Sedang (SRI S1 dan SRI S2) dan SRI Kering (SRI K1 dan SRI K2). Each treatment has different water level during growth stages. As the results, the developed ANN model can predict CH₄ and N₂O emissions accurately with determination coefficients of 0.93 and 0.70 for CH₄ and N₂O prediction, respectively. From the model, characteristics of those greenhouse gas emissions can be well identified. For the mitigation strategy, SRI B1 and SRI B2 treatments in which the water level was kept at nearly soil surface are the best strategy with highest yield production and lowest GHG emission.

Key word : **artificial neural networks, environmental biophysics, irrigation system, greenhouse gas emissions, paddy fields**

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Marasi Deon Joubert, Aditya Prihantoko**USER ACCEPTANCE ANALYSIS ON IRRIGATION OPERATION MANAGEMENT SYSTEM USING TECHNOLOGY ACCEPTANCE MODEL (TAM)(Case Study Boro Irrigation Area, Purworejo)****Abstract**

Irrigation Operation Management System (SMOI) is an irrigation operating system developed by the Experimental Station For Irrigation. This system is an irrigation operation application based on website that put forward the concept of the paperless or replace the irrigation operational role in the paper. SMOI technology is designed to be able to process operational data transmission with automatic irrigation network utilizing internet communications services. This SMOI technology testing needs to be done to test trials of the system and the benefits of using this system.

The location of the SMOI application done in Boro Irrigation Area, Purworejo District. The methodology used in this study is using the Technology Acceptance Model (TAM), which is done by taking data about the level of acceptability of the use of the application on a population in Boro Irrigation Area, Purworejo by means of questionnaires. Furthermore, the data were statistically analyzed to gain acceptance rate local irrigation management. The analysis showed Ease variable has an influence on the attitude of users SMOI by 78.6% of respondents answered agree and have a significance level of 0.790, while the benefits of the variables have the support of 82.2% of respondents answered agree and 0.044 significance level. This indicated that the irrigation operation management system (SMOI) of the side benefits to be used more affect than the ease of irrigation management.

Keywords: **irrigation, Irrigation Operation Management System, Technology Acceptance Model, paperless, web based**

UDC : 626.8

Sudirman Sirait, Satyanto K. Saptomo, M. Yanuar J. Purwanto**DESIGN OF AUTOMATIC PIPE IRRIGATION SYSTEM IN PADDY FIELD BASED ON SOLAR POWER****Abstract**

Design of optimum irrigation equipped by an automatic control system can keep the water level in the soil at a certain level according to the needs of plants, It can increase the productivity and efficiency of irrigation water use in paddy fields. Automatic control system was constructed by utilizing digital technology, microcontroller and sensor networks. Arduino Uno ATmega328P microcontroller was used as an automatic controller to operate electrical valve Valworx 561086 based on soil moisture conditions and water level in paddy fields determined by sensor. Water level of the field was set at a range of 0 to 5 cm set point reference to operate electrical valve Valworx 561086. System microcontroller limits the duration of time for setting the opening and closing electrical valve Valworx 561086 for 300 seconds with a rotation of 90° that can reduce battery consumption. The system is operated by solar energy, which consists of solar panel, charge controller and battery, and can be operated for 24 hours without operators attending. Irrigation system test was operated by applying intermittent irrigation and water did not flow continuously in paddy field. The result shown that the automatic irrigation system can keep the water level in paddy fields between the desired setpoint range.

Keywords: **automatic irrigation, paddy field, pipe irrigation, set point, water level, water productivity**

UDC : 626.8

Soekrasno S.

ELEVEN CONSIDERATIONS TO DETERMINE IRRIGATION WEIR SITE

Abstract

Irrigation weir failure beside caused by inaccurate survey and investigation, not thoroughly design, poor construction implementation, poor operation and maintenance, but also caused by wrong irrigation weir site selection. Initial factor influencing irrigation weir performances is irrigation weir site selection. Weir would strong enough against external force, flood impulse, local scouring, river degradation in case of accurate weir site selection. This paper discusses eleven conditions in selecting irrigation weir site in order to obtain better weir performance, i.e. : topographic condition, geotechnical consideration, hydraulic, river regime, primary canal, weir site space, irrigation service area, catchment area, assesment, economic justification, stakeholder acceptance. Analyse of correlation between weir site selection during design and weir performance, to be combined with weir observation by means of directly site inspection and communication with weir operator has been carried out to justify those eleven conditions weir site selection. Generally weir site mis-selection caused by among others are: irrigation engineer's incapability, less budget, time and manpower, and less professional engineer.

Keyword: **irrigation weir failure, eleven conditions weir site selection, initial factor, weir performance, weir site mis-selection**

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Rizki Maftukhah, Erni R., Benito H. P., Sri R., Sigit S. A

SHALLOW WATER DEPTH MANAGEMENT TO ENHANCE RICE PERFORMANCES UNDER SYSTEM OF RICE INTENSIFICATION (SRI) FRAMEWORK

Abstract

Nowadays, the issues of water scarcity, high fertilizer cost, and negative environmental impacts due to high agrochemicals use are escalating so that the improvement of resource efficiency on rice cultivation is necessary. Based on many studies, SRI is a very promising approach. Pot experiment was conducted under SRI framework with continuous flooding (CF), shallow water depth (SWD), and field capacity (FC) irrigation; together with four different doses of organic fertilizer (F100, F50, F0, and LF). The aim of this study is to figure out the effect of water and organic fertilizer managements on rice performances. Our experiment showed soil Eh was significantly different between three water management treatments ($p < 0.05$) where FC gained the highest soil Eh, followed by SWD and CF. Whereas, organic fertilizer management gave insignificant effect on soil EH. Under SWD management, number of tillers was significantly higher than CF and FC. On the other hand, water management and organic fertilization had no significant effect on plant height. SWD significantly increased yield and biomass followed by CF and FC. Organic fertilizer caused significant reduction on number of tiller, yield and biomass. In conclusion, SWD provided better environment for rice growth and enhance the rice performances, while the effect of organic fertilizer was not clearly seen.

Keywords: **water management, organic fertilizer, rice, soil Eh, biomass, yield**

UDC : 626.8

Aditya Prihantoko, Marasi Deon Joubert, Dadan Rahmandani

THE USE OF COMPOSITES MATERIAL AS AN ALTERNATIVE WATER GATE COMPONENT

Abstract

Irrigation network operation is an important part of the irrigation management system. Operating on an irrigation area (DI) requires the performance of human resources (juru pengairan) and divider building infrastructure, in this case irrigation water gate, in a good performance. Water gate material is mostly made up of steel or wood which is susceptible to damage and theft. As alternative material of sluice, can be considered the use of composite material which has an advantage can save cost and makes the lighter material is used as an opportunity for alternative irrigation water gate. So it is necessary to research on material other than steel or wood. The methodology that used in this study was test several alternative types of composite material to be used as irrigation water gate in the laboratory and then conduct an analysis of water gate loading. Results of laboratory testing and analysis of the load for a water gate with 50 cm width and maximum height of water about 60 cm showed that type 1, 2 and 3 are able to withstand the load of more than 1000%, 440 % and 320 %, respectively of the load. These results indicate that a composite is strong enough if used as an alternative material for water gate.

Keywords: **irrigation network operations, water gate, composite, fibre, honeycomb**

UDC : 626.8

Nur Aini Iswati Hasanah, Budi Indra Setiawan, Chusnul Arif, Slamet Widodo

CROP COEFFICIENT EVALUATION AT VARIOUS WATER TABLE TREATMENTS OF PADDY

Abstract

Paddy is the main agricultural commodity in Indonesia that needs a large amount of water. Accurate prediction of crop water use is essential to have an efficient irrigation system. The actual evapotranspiration (ET_c) is an important factor for estimating water use. Moreover, crop coefficient (K_c) is one of the important parameters in ET_c calculation. In this study, K_c of paddy is estimated by using experimental pots under various water tables treatments. The water table is controlled by using mariotte tube and set at -12 cm, -7 cm, -5 cm, -3 cm, 0 cm, and +2 cm from the soil surface. From the experimental sets, the value K_c is calculated by using modified water balance equation and Kalman Filter. The result shows that water table treatment in paddy farming influences soil moisture (θ) and soil temperature (T_{soil}). Soil physic parameter fluctuation due to water table treatment affects the plant growth and potential evapotranspiration. K_c value at each water table treatment is different, and varies with plant growth phase. The average K_c for all water table treatments are 0.77-1.27 (initial season), 0.90-1.11 (crop development), 1.10-1.39 (mid-season), and 1.17-1.40 (late season).

Keywords: **crop coefficient, evapotranspiration, paddy, water balance, water table**

UDC : 626.8

Susi Hidayah, Suhardjono, Very Dermawan

DISCHARGE PROPORTIONALITY TEST OF NUMBAK DIVISOR

Abstract

Water distribution structure is the main distribution facility and has been an important part in the operation system of irrigation networks. Numbak configuration lay the secondary water distribution structure, tertiary water tapping structure, and control structures in a parallel position, so it is suitable to be applied for the proportional system. This type of water distribution structure has been recommended in Irrigation Planning Criteria-04 (revision 2013), however, the planning information is still inadequate. The placement of sill on the proportional water distribution structure that has been tested is placed before the peer's divisor. This makes the position of the distributed flow located not in a critical condition so that the distributed flow is also not proportional. A series of physical tests to assess variations in the placement of sill by the pillars dividing position conducted on a model that has been created by the Experimental Station for Irrigation, Research Center for Water Resources, Ministry of Public Works, is the type of the proportion of 1:2:1. The test results show that the average proportion of the distribution of discharge at all the scenarios for the right channel, center, and left respectively was 0.82:2.4:0.78. Recommendations of use and placement of sill by the pillars divisor as input for the planning and building of this type are also found in this study.

Keywords: **divisor, proportional, numbak, physical model, irrigation**

UDC : 626.8

Yani Suryani, Syamsul Bahri

REUSED OF EFFLUENT OF MILK PROCESSING INDUSTRY AS IRRIGATION WATER FOR PADDY PLANT

Abstract

Reuse of wastewater with no heavy-metal contains is potential in irrigation water supply, for example, effluent of milk processing industry. The aim of this study is to analyze the effect of milk industry effluent concentration to paddy growth (*Oryza sativa* L.). For case study, Ciherang variety with water-saving irrigation system scheme is used in an experimental plot with factorial design of 2 x 4. Several scenarios are applied: two treatments fertilization (with and without fertilization) and four variations of wastewater concentrations (0%, 50%, 75% and 100%). This study shows that the variation of wastewater concentrations with fertilization is not significantly affect the plant height, growth rate, number of tillers, and number of panicles. However it is significantly affect the wet grain weight and dry grain weight. The above result might be affected by the excessive nitrogen compound in the effluent, as the dry grain weight decreases to about 16% to 31%.

Keywords: **effluent , milk processing industry, irrigation, fertilization**

UDC : 626.8

Nurfaijah, Budi Indra Setiawan, Chusnul Arif, Slamet Widodo

CONTROL WATER LEVEL SYSTEM FOR PADDY FIELD CULTIVATION

Abstract

This research aims to design a control system to keep the water level and soil moisture at a level that is suitable to the plant requirement and determines the optimum water level and soil moisture in each growth phase of paddy field cultivation. The water level control system was formed based on on-off controls system using Arduino Uno ATmega328P microcontroller. When the sensor gives input that the water level is below the set points, then microcontroller will command the irrigation valve to open and the drainage valve to close. The volume and time of irrigation and drainage control are dependent to set point. Set point was controlled based on water regime treatment. Water regime consisted of three treatments, which are wet regime (RB), slightly wet regime (RAB), and dry regime (RK). The research result showed that control system was very effective and efficient in controlling the water regime according to the control algorithms. Besides, the research result showed that the water regimes affected the plant growth, land productivity, and water productivity. Treatment of wet regime (RAB) gave the highest number of tiller (138 tillers), yield 194.7 g/hill (equal to 21 ton/ha with assumption of 30 cm x 30 cm spacing) and water productivity 3.16 kg/m³.

Keywords: **paddy, water regime, control system, water level, set point**

UDC : 626.8

Eko Winar Irianto

ECOHIDRODYNAMIC ANTICIPATION FOR EUTROPHICATION CONTROL TO SUPPORT THE SUSTAINABILITY OF JATILUHUR IRRIGATION SYSTEM

Abstract

Eutrophication is one of the serious problems in a reservoir which may disturb the water supply system in the downstream. Jatiluhur Dam is the reservoir with eutrophication problems. One of the methods to control water quality in Jatiluhur Reservoir is ecohydrodynamic method by utilizing Hollow Jet Valve (HJV). A comprehensive HJV operations is required to maintain the already-planned reservoir operation. This paper informs how to analyzes the effect of HJV operation to water quantity and water quality in the downstream of Jatiluhur Reservoir. Analysis result shows that the water level decreases in Jatiluhur Reservoir and increases in Curug Barage while HJV gate operation is still in line with water supply plan and reservoir operation, especially for irrigation sector. Furthermore, the result also shows that HJV operation increases BOD, Total N, and Total P pollutants and still complies with Class-3 of Indonesian National Standard of Water Quality for irrigation water. DO is the most sensitive parameters and 67% increase of BOD might develop an anaerob condition in the hypolimnion layer after the reservoir restoration. Therefore, sinergyc programs between reservoir restoration and water conservation in irrigation network are still required.

Keywords: **Hollow Jet Valve, ecosystem, reservoir, trophic status, oligotrophic, eutrophic, hidroynamics**

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UDC : 626.8

Popi Rejekiningrum, Satyanto Krido Saptomo

FINANCIAL FEASIBILITY ANALYSIS FOR DEVELOPMENT OF SOLAR POWER AUTOMATIC IRRIGATION WITH DISC IRRIGATION SYSTEM IN WEST NUSA TENGGARA

Abstract

This study evaluates the result of implementation of water-efficient irrigation technology by using an automated round-shaped emitter, powered by solar cell. In order to determine investment feasibility of the automated system, Net Present Value (NPV), Internal Rate of Interest (IRR) and Benefit Cost Ratio (BCR) analysis have been conducted. An investment is feasible if the project fulfill the following criteria: (1) NPV is

greater than zero, (2) IRR is greater than the discount rate which are applicable, (3) BCR greater than 1. The analysis shows that in general, the application of the automated system for mango, sugar apple, grapes, and chili plantation is very feasible. NPV of the investment ranges from Rp 1,533,423 to Rp 21,995,452; BCR value ranges from 1.337 to 3.775, and IRR value ranges from 17.38% to 34.10%. Implementation of the automated system for the development of mango and sugar apple plantation are the most feasible, with highest NPV, BCR and IRR. Whereas, implementation of the automated system for chili plantation is not feasible, since the value of $NPV < 0$, $BCR < 1$, and $IRR < 14\%$ interest rates. The average payback period of the automated system is about 4 year.

Keywords: **automatic irrigation, solar power, disk irrigation system, Net Present Value, Internal Rate of Interest, Net Benefit Cost Ratio, irrigation efficiency, water productivity**

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EDITORIAL

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Penentuan kebutuhan air irigasi agar sesuai dengan kebutuhan tanaman sangat ditentukan oleh nilai Evapotranspirasi (ET_c). Nilai ET_c akan berubah sesuai dengan nilai koefisien tanaman (K_c) yang berubah sesuai dengan tahapan pertumbuhan tanaman. Edisi kali ini diawali dengan penelitian untuk penentuan nilai K_c tanaman padi menggunakan metode neraca air yang dimodifikasi. Nilai K_c padi ditentukan dengan pemberian perlakuan muka air yang berbeda.

Salah satu bagian dari jaringan irigasi yang merupakan bagian penting dalam pelaksanaan operasi irigasi adalah bangunan bagi. Penelitian yang dilakukan pada artikel kedua dilakukan terhadap bangunan bagi tipe numbak. Rangkaian pengujian pada model fisik dilakukan dengan menguji variasi penempatan bangunan dengan ambang dan tanpa ambang tipe 1:2:1. Penelitian ini merupakan lanjutan dari penelitian bangunan bagi numbak yang telah dilakukan oleh Balai Irigasi dengan melakukan perubahan pada jenis ambang dan penempatan pilar pembagi terhadap ambang.

Padi merupakan tanaman yang membutuhkan air dalam jumlah banyak selama masa pertumbuhannya. Salah satu cara untuk menyiasati penghematan air adalah dengan pemanfaatan air limbah yang tidak mengandung bahan berbahaya dan beracun menjadi sumber air irigasi tanaman padi. Salah satu jenis air limbah yang berpotensi untuk dimanfaatkan sebagai air irigasi adalah efluen industri pengolahan susu dengan produk susu cair. Artikel ketiga membahas mengenai pengaruh takaran efluen dan pemupukan terhadap pertumbuhan padi varietas Ciherang dengan sistem irigasi hemat air yang dilakukan di dalam rumah kaca.

Pemberian air irigasi sesuai kebutuhan tanaman merupakan salah satu cara dalam penghematan air. Untuk menjaga pemberian air irigasi yang efisien, tepat waktu dan jumlah salah satu caranya adalah dengan menerapkan sistem kendali pengaturan muka air tanah. Penelitian yang dilakukan pada artikel kelima bertujuan untuk merancang sistem kontrol untuk menjaga tinggi muka air dan kelembaban tanah pada level yang dibutuhkan tanaman dan mengkaji tinggi muka air dan kelembaban tanah optimum pada setiap fase pertumbuhan budidaya padi dengan Metode *Sistem of Rice Intensification* (SRI).

Pengkayaan waduk oleh akumulasi senyawa nutrisi menyebabkan masalah serius yang harus ditangani. Selain menimbulkan bau, berkurangnya oksigen dalam waduk, juga akan menjadi masalah pada saat dilakukannya pengoperasian irigasi. Untuk itu, perlu dilakukan perbaikan kualitas air waduk tersebut dengan pengoperasian *Hollow Jet Valve* (HJV). Artikel pada artikel keempat bertujuan untuk menginformasikan cara menganalisis pengaruh pengeluaran lapisan *hipolimnion* waduk untuk perbaikan kualitas air dan mengantisipasi pengaruh pengoperasian HJV.

Beberapa daerah di Indonesia, khususnya Indonesia bagian Tengah dan Timur memiliki permasalahan keterbatasan air. Hal tersebut menjadi salah satu kendala dalam upaya pengembangan dan peningkatan produktivitas pertanian. Hasil penelitian yang disajikan dalam artikel keenam, menjelaskan alternatif pemberian air yang lebih efisien menggunakan irigasi cakram yang dilengkapi pemberian air irigasi otomatis bertenaga surya. Untuk mengetahui kelayakan investasi sistem irigasi cakram untuk pengembangan pertanian, maka dilakukan analisis kelayakan finansial investasi sistem irigasi cakram otomatis bertenaga surya untuk pengembangan pertanian menggunakan kriteria investasi.

Akhir kata kami sampaikan ucapan terima kasih kepada Kepala Pusat Litbang Sumber Daya Air, Dr. Ir. Wiliam M. Putuhena, M. Eng selaku Pembina kegiatan ini serta semua pihak yang telah membantu proses penerbitan Jurnal Irigasi ini.

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