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UDC : 626.8

Azmeri, Hairul Basri, Devi Sundary, Yusni Eva Cus Endang, Faris Zahran Jemi**HYDRODYNAMICS AND SEDIMENT PRODUCTS TOWARD KEUMALA IRRIGATION WEIR, IN KRUENG BARO RIVER, ACEH PROVINCE** Oleh: Abstract

Abstract

Keumala Dam is built on Krueng Baro River which is one of the strategic rivers in Aceh Province to irrigates the farmland and supplies drinking water for the community downstream. However, this river has a considerable issues due to its long path and passing through various geological formations, causing a high concentration of sediments in the river. Therefore, this study aimed to analyze the river hydrodynamics employing the HEC-RAS 5.0 software. The results of the study revealed that the flow capacity of sediment transport along the riverbed varies directly with the difference between the shear stress at the bottom sediment and the critical shear stress allowed for moving particles. Sediment transport occurred in all sediment samples from the upstream and downstream of Keumala Dam. The flow reduction due to the damming changed the channel and flow regime, while the decrease in water release reduced the floating and bottom sediment transport to the the downstream. The total sediment around the weir area at the normal discharge is 6,325,698.93 tons/year. Sedimentation around the weir is a severe problem as it can affect the function and performance of the weir and irrigation channel. Siltation due to sedimentation also closed the intake of Keumala PDAM. Thus, periodical dredging and transporting sediments from the bottom of the weir are necessary to overcome this problem. Dredging and transporting sediments will improve the Keumala weir performance to irrigates the Krueng Baro Irrigation Area. Thus, the discharge capacity of othe weir intake can be maintained to irrigate the farmland following the planned area.

Keywords: **irrigation, sediment yield, hydrodynamics, Krueng Baro River, HEC-RAS**

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Denik Sri Krisnayanti, Elsy E. Hangge , Tri M.W. Sir, Eugenius Nino Mbauth, Alvine C. Damayanti**WAE LERONG SMALL DAM DESIGN TO FULFILL IRRIGATION WATER NEEDS IN THE WAE LERONG IRRIGATION AREA OF RUTENG IN EAST NUSA TENGGARA PROVINCE**

Abstract

Wae Lerong Small dam is located in Ruteng City, Manggarai District which has a catchment area of 0,606 km² and the annual rainfall ranges from 2,500-3,000 mm/year. But in some locations still having water shortages, so it needs rainwater harvesting to get increase agricultural potential during the dry season. This study aims to design the Wae Lerong Small dam as a rainwater reservoir during the rainy season and used in utilization to fulfill the needs of irrigation water. The method used is a quantitative method with empirical data analysis. The rainfall analysis used the Log Pearson III method and flood discharge analysis using the rational method. Evapotranspiration calculations using the Penman Modification

method and the dependable discharge analysis using the F.J. Mock method. The analysis of slope stability using the Limit Equilibrium Method aided by the GeoStudio Slope / W 2007 Program. The results showed that the average monthly rainfall ranged from 28.87 - 511.99 mm/month. The rainfall for 50-year return period of 249.28 mm, and flood discharge for 50- year return period of 12.094 m³/s. The design of Wae Lerong dam is height of 13.5 m, a width of 5 m, length of 81.50 m, the upstream slope of 1:3, and downstream slope 1:2.25. For the stability of the reservoir body safety value > 1.10 so it is still in a safe condition. Wae Lerong Small dam storage capacity is 86,540.96 m³ with an inundation surface area of 19,855.69 m² at a normal water level of 1,204.00 m. The value of dependable flow is 0.001 - 0.793 m³ /s and the water requirements for planting pattern I (Paddy-Paddy-Palawija) increase up to 0.176 m³/s. The water balance values deficit in May - September which ranged from 0.017 to 0.13 m³/s.

Keywords: **small dam design, slope stability, irrigation water, GeoStudio Slope/W, dependable flow**

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Dadan Rahmandani, Hanhan A. Sofiyuddin, Ratna Adiana, Abid Hendri Indarta, Hayatuddin Tuasikal**DESIGN AND PERFORMANCE EVALUATION OF MICRO-IRRIGATION IN HARUKU ISLAND, MALUKU**

Abstract

The development of irrigated agricultural land on small islands faces many obstacles due to the very limited water availability. The development of irrigated land is often constrained by the relatively high need for water for agricultural land, resulting in competition with domestic water needs. Thus, the development of irrigated land needs to be carried out by applying waterefficient irrigation technologies such as micro irrigation. The research was conducted to test and identify the impact of applying micro irrigation technology on small islands. The research was conducted conditions in Haruku Island, Central Maluku through testing the application and measurement of network performance. The results of the application showed that network installation, irrigation operations, fertilization work, pest control and weeding on the application of micro irrigation were easier and faster. Conventional irrigation using watering pot requires a long time and a lot of labor to meet the water needs of plants. Thus, at the research location, water needs could not be fulfilled by nearly 47% of the period during the growing season and crop production was not optimal. Another case with micro irrigation where water can be given at the right volume and time. Soil moisture can be maintained at optimum levels through short irrigation intervals and of longer duration. From the socioeconomic aspect, there is a good performance in the economic aspect of the farmers, which is shown by an increase in income and being able to set aside a portion of their income for savings. Meanwhile, from the social aspect, the application of micro irrigation technology is required by farmers on Haruku Island. These results indicate that micro irrigation could be an alternative technology to support the management of water resources in small islands, especially on Haruku Island.

Keywords: **water saving irrigation, micro irrigation, Haruku Island, irrigation network, performance**

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Regina Amalia, Roh Santoso Budi Waspodo, Budi Indra Setiawan

THE DESIGN OF EVAPORATIVE IRRIGATION SYSTEM FOR PEPPER PLANTS

Abstract

One of the obstacles in providing irrigation water is the difficulty in determining the right parameters to be used in the controlling of timing and amount of irrigation water according to crop needs. One of the alternative parameters that could be considered in order to meet the water needs of plants is the irrigation control based on evaporation. This study aims to produce an evaporative irrigation system design and determine the crop coefficients of pepper. The drip irrigation network consists of a supply tank and distribution pipes that provide water to the plant pots. The network valve opening and closing arrangements are made based on the evaporation in the supply tank. This research was conducted in a plant house for 5 months by observing the observations made on the water balance components, including the rate of evaporation which is measured based on changes in the water level in the water supply tank. The results showed that the evapotranspiration outside the houseplant was greater than that in the plant house. At the beginning of planting pepper, the evapotranspiration was 5.2 mm/day in the plant house and 4.9 mm/day outside. The average evapotranspiration during observation inside the plant house was 4.1 mm/day and 3.8 mm/day outside. Meanwhile, evaporation outside the plant house is smaller than that inside the plant house which ranges from 2-5 mm/day. Provision of water with this evaporative irrigation system of 5.2 mm/day has been able to meet the needs of 4.1 mm/day of evapotranspiration water for pepper plants. The provision of water has been able to encourage the growth of primary branches and flowering. Normal pepper plant growth during this study with calculated crop coefficients ranging from 0.1-0.7.

Keywords: **evaporative irrigation, crop coefficient, greenhouse, Piper nigrum L., drip irrigation**

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Ansita Gupitakingkin Pradipta, Murtiningrum, Niko Windy Dwi Febriyan, Fathi Alfinur Rizqi, Ngadisih

PRIORITY OF THE DEVELOPMENT AND MANAGEMENT OF THE TERTIARY IRRIGATION NETWORK IN D.I. YOGYAKARTA USING THE MULTIPLE ATTRIBUTE DECISION MAKING

Abstract

There are five pillars in the irrigation network management, one of them is the improvement of irrigation network facilities and infrastructure. The improvement of irrigation network facilities and infrastructure is divided into two activities, namely development and management. Related to these activities, there are many locations in the irrigation area that require prior handling. This study purposed to analyze the priority of ten irrigation systems of district authority spread over D.I. Yogyakarta for optimizing the implementation of

management of irrigation networks. The analysis used (Multiple Attribute Decision Making) MADM which consists of SAW, WP, TOPSIS, Electre and AHP methods. Five parameters used in the analysis, including main irrigation network infrastructure, tertiary irrigation network infrastructure, water availability, service area, and crop productivity. The study proved that the tertiary irrigation network in 10 irrigation systems of district authority in D.I. Yogyakarta suffered moderate to severe damage in a number of 65 locations. There were 11 locations that always appear at the top of each MADM, which were priority proposals for irrigation network development and management activities. In addition, there was a tendency that the higher the priority of development or management of a location. If there are several proposed locations with similar conditions, the determination of priorities can be determined based on the irrigated area.

Keywords: **priority, development, management, irrigation network, Multiple Attribute Decision Making, D.I. Yogyakarta**

UDC : 626.8

Chusnul Arif, Budi Indra Setiawan, Hanhan Ahmad Sofiyuddin

ANALYSIS OF POTENTIAL EVAPOTRANSPIRATION BY VARIOUS EMPIRICAL MODEL AND ARTIFICIAL NEURAL NETWORKS WITH LIMITED WEATHER DATA

Abstract

On the determination of crop water requirements, climate data are essential but are often limited due to the farm field's lack of weather station. For this reason, it is necessary to consider plant water requirements with various potential evapotranspiration (ETp) models with various weather input parameters, including Artificial Neural Network (ANN) models. The objectives of this paper were 1) to develop ANN models to estimate ETp, 2) to compare various ETp models (empirical models) including ANN models with the FAO standard models, 3) to analyze crop water requirements by the models, and 4) to determine the recommended input parameters for estimating ETp. The analysis was performed based on the measurement of weather parameters data in the two rice planting seasons, i.e., April - August 2017 and January - May 2018. There are 8 ETp models (empirical models) and 3 ANN models with a combination of input parameters. The results of this study indicated that the ANN-2 model with solar radiation input parameters was the best ANN model with R2 values 0.91-0.92 and RMSE 0.284 mm and 0.287 mm for the 2017 and 2018 planting seasons. ETp Turc model, one of the empirical ETp models with parameters input of air temperature and solar radiation, was the best model with the highest R2 and the lowest RMSE. Therefore, these two models were the best models with total ETp values closed to the ETp FAO standard. In addition, the parameters of air temperature and solar radiation are recommended parameters to be measured in the determination of crop water requirements using the ETp Turc model. But if there is only one parameter that can be measured, it is recommended to measure solar radiation with ANN-2 models to determine potential evapotranspiration.

Keywords: **potential evapotranspiration, artificial neural networks, crop water requirement, empirical model, weather parameter**

UDC : 626.8

Najla Anwar Fuadi, Mohd. Yanuar Jarwadi Purwanto, Afri Fajar

SOYBEAN CULTIVATION PROSPECT BASED ON CROP WATER REQUIREMENTS AND THE AGROCLIMATIC ZONE IN JAMBI PROVINCE

Abstract

Soybean (*Glicine max*) has the potential to be developed because it cannot only be processed into foodstuffs but also become livestock feed. In addition to using technology, enhancement of crop production can be done by looking at water availability and pay attention to the weather factors, especially to increase crop intensity. This research aims to determine the crop water requirements based on the agroclimatic zone. The quantitative descriptive analysis and data processing were conducted using the Cropwat model. This model was created by FAO specialists to provides an opportunity for automation of all the necessary calculations for evapotranspiration determination. Cropwat is an easy-to-operate software that can minimize human error. Climate classification was identified based on precipitation data in Jambi province respectively in Muaro Jambi Regency at Sultan Thaha Station, Jambi Palmerah, and Depati Parbu. The agroclimatic zone for those areas, respectively, are D1, D2, and E2. Based on the rainfall, all three districts are feasible for soybean cultivation with average rainfall between 127.11 mm – 192.51 mm per month. The amount of crop water requirements is also an essential factor for cultivating a plant so that the water can be administered according to the needs of plants and can provide optimal production. Based on water balance, the surplus in Muaro Jambi Regency Jambi Province occurs in January, February, March, April, September, October and December. East Tanjung Jabung Regency surplus is in January, February, March and April. West Tanjung Jabung Regency surplus occurs in January, February, March, October, November and December. The results of this calculation indicate that Jambi Province has the potential to cultivate soybean plants because they have sufficient water availability.

Keyword: **Cropwat model, Oldeman Classification, water balance, evapotranspiration, crop water requirement, water availability**

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UDC : 626.8

Iman Muhardiono, Budi Kartiwa, Adang Hamdani, Nani Heryani

PIPE IRRIGATION NETWORK OPTIMIZATION BASED ON HYDRAULIC AND COST CHARACTERISTIC IN DRY LAND AGRICULTURE

Abstract

In dry lands, limited annual rainfall rate as well as its uneven temporal and spatial distribution causes a heavy constraint on agricultural activities. Utilization of proper irrigation method can overcome these limitations so that water demand can be fulfilled in an efficient and effective manner. Currently, pipe irrigation has been widely used to improve irrigation efficiency and crop productivity. However, in practice, the designs which had been made usually not yet optimum and efficient so that the expected discharge output can be excessive or less than expected. Therefore, design optimization is required by considering hydraulic characteristics and costs. The research was conducted to obtain optimal pipe irrigation network design through scenario analysis of pipe dimensions based on

hydraulic modeling in the EPANET 2.0 application. The research was conducted in South Lampung Regency with a research block area of 1 ha. The analysis was conducted in 15 scenarios of irrigation networks with different combination of pipe diameter. The results showed that the simulated pipe diameter combination scenario can give varying results for the cost component and the hydraulic conditions of water in the pipe. The best combination is Scenario 7 with a combination of main pipe with a diameter of 48 mm and a sub-main pipe with a diameter of 22 mm which can optimally fulfill the plant water requirement at a relatively economical cost.

Keywords: **pipe irrigation, optimization, dry land, cost, EPANET**

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Susilowati, Widya Utaminingsih, Segel Ginting

OPTIMATION OF PLANT AND IRRIGATION PLANNING TOWARD MODERNIZATION OF IRRIGATION IN CILIMAN IRRIGATE AREA

Abstract

Development of an irrigation area were implemented to increase the productivity of agricultural products, especially rice and palawija (secondary crops commodities). The productivity of rice and palawija was influenced by irrigation performance, both by infrastructure and irrigation management. The operation management of irrigation network in Ciliman Irrigation Area is still not optimal due to the absence of an operations to regulate the amount of water that enters each tertiary intake causing excessive water intake upstream while shortage in the downstream. This is also exacerbated by the condition of water availability in the dry season which is lower compared to the need of irrigation water. Therefore, this research is conducted to optimize the cropping pattern and water allocation in Ciliman Irrigation Area by considering the reliability of irrigation water delivery. Research was conducted through water balance simulation according to several scenarios based on group division, changes in the planting schedules, and changes in planting area. Then, optimization of the cropping pattern was done by maximizing the reliability of irrigation water delivery. The recommended cropping pattern is 100% rice planted in planting season I, 100% rice planted in planting season II, and 27.47% palawija (soybean) planted in planting season III. Water delivery should be arranged into 3 groups with the 1st planting schedule starts in 1st period of November, 2nd planting season starts in 1st period of March, and 3rd planting season starts in 2nd period of July. With this scenario, there was an increase in the cropping index from the existing conditon of 199.7 (83% reliability) to 213.7 (100% reliability).

Keyword: **water allocation, irrigation, reliability, optimization, simulation**

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Fathi Alfinur Rizqi, Sri Nuryani Hidayah Utami

WATER FOOTPRINT ASSESSMENT ON RICE, CORN, AND SOYBEAN COMMODITIES IN THE SPECIAL REGION OF YOGYAKARTA AREA TO SUPPORT A SUSTAINABLE AGRICULTURE SYSTEM

Abstract

Indonesia's population is estimated to reach 350 million by 2045, encouraging Indonesia to increase food availability by 3% every year. The Upsus Pajale (Upaya Khusus Padi Jagung Kedelai) program is one of the government's flagship programs in responding to this challenge. On the other hand, environmental pressures provide clear boundaries for implementing a sustainable agricultural process. As the two goals of the Sustainability Development Goals (SDGs) are to zero hunger and ensure access to water, concept of virtual water is present as an alternative concept along with a water counting tool needed in an agricultural production process. This research was conducted to assess water footprint for rice, corn, and soybean in the Special Region of Yogyakarta. The analysis resulted in the term water footprint assessment consist of blue water, green water, and grey water. The results showed that the

annual water footprint of soybean was the highest at 2,589 m³/ton, followed by field rice, corn, and lowland rice at 1,280 m³/ton; 844 m³/ton; 841 m³/ton. The results are due to higher level of productivity resulting lower of the water footprint. The implementation of this research reveals the factors that influence the amount of water needed (Virtual Water) to produce agricultural commodities. Whereas location selection, climatic conditions, types of plants, cultivation techniques, and the use of fertilizers are factors that need to be considered to reduce water use in the agriculture production processes. Thus, the objectives of implementing sustainable agricultural cultivation can be realized.

Keyword: **water footprint, virtual water, Pajale, Special Region of Yogyakarta, sustainable agriculture**

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EDITORIAL

Jurnal Irigasi merupakan publikasi ilmiah yang memuat hasil-hasil penelitian, pengembangan, kajian dan studi kasus terkait irigasi dan drainase. Ruang lingkup Jurnal Irigasi meliputi survei, investigasi, desain, akuisisi lahan, konstruksi, operasi, pemeliharaan di sistem irigasi yang dapat ditinjau dari sisi teknis, ekonomi dan juga kelembagaan. Dengan tetap menjaga mutu dan kualitas penerbitan, mulai tahun 2019 Jurnal Irigasi memuat lima artikel ilmiah dalam setiap terbitannya.

Program 5 pilar modernisasi irigasi di Indonesia, salah satunya adalah adanya sistem pengelolaan irigasi yang ditujukan untuk pengoperasian yang lebih praktis, efektif dan efisien. Pada tingkat yang lebih teknis, suplai air irigasi harus diberikan sesuai dengan kebutuhan air tanaman aktual. Data cuaca sangat diperlukan dalam penentuan kebutuhan air tanaman, namun sering kali ketersediaan stasiun cuaca di lapangan masih terbatas. Artikel pertama edisi ini akan menganalisis evapotranspirasi potensial pada berbagai model empiris dan jaringan syaraf tiruan dengan data cuaca terbatas dengan beragam parameter input, termasuk juga model Jaringan Syaraf Tiruan (JST) sebagai pertimbangan dalam penentuan kebutuhan air tanaman.

Ketersediaan air merupakan faktor yang paling menentukan dalam kegiatan pertanian khususnya di lahan kering. Artikel kedua edisi ini akan membahas prospek budidaya kedelai berdasarkan kebutuhan air tanaman dan zona agroklimat di Provinsi Jambi. Penelitian ini bertujuan untuk mengetahui kebutuhan air tanaman berdasarkan zona agroklimat. Apakah Provinsi Jambi cukup berpotensi untuk dibudidayakannya tanaman kedelai? Hal ini akan dianalisis secara deskriptif kuantitatif dengan pengolahan data model Cropwat. Klasifikasi iklim diidentifikasi berdasarkan data curah hujan di Provinsi Jambi yaitu di Kabupaten Muaro Jambi di Stasiun Sultan Thaha, Palmerah Jambi, dan Depati Parbu.

Pengembangan sebuah Daerah Irigasi (DI) dilakukan untuk meningkatkan produktivitas hasil pertanian khususnya komoditas padi dan palawija. Pengelolaan operasi jaringan irigasi di DI Ciliman masih belum optimal akibat tidak adanya operasi dalam mengatur jumlah air yang masuk di setiap sadap, sehingga menyebabkan air masuk berlebihan di hulu sedangkan di hilir sering kali tidak mendapatkan air. Hal ini diperparah dengan kondisi ketersediaan air pada musim kemarau yang lebih rendah dibandingkan dengan kebutuhan air irigasinya. Artikel penelitian selanjutnya bertajuk optimasi rencana tanam dan pemberian air irigasi menuju modernisasi irigasi di DI Ciliman, yang bertujuan untuk mengoptimasi rencana tata tanam dan alokasi air irigasi DI Ciliman dengan mempertimbangkan keandalan pemberian air melalui simulasi neraca air pada beberapa skenario pembagian golongan, perubahan jadwal tanam, dan perubahan luasan tanam.

Pola pertanian lahan kering di Indonesia hingga saat ini masih banyak mengadopsi sistem pemenuhan air tanaman yang bersumber dari air hujan. Tanpa menggunakan teknologi penerapan irigasi hemat air, sistem pertanian di lahan kering beresiko tinggi terhadap kegagalan produksi akibat kekeringan. Dewasa ini, teknologi irigasi perpipaan pada lahan kering sudah banyak dimanfaatkan untuk meningkatkan efisiensi irigasi dan produktivitas tanaman. Namun dalam pelaksanaannya, desain yang dibuat masih belum optimal dan efisien sehingga keluaran debit yang diharapkan dapat berlebih atau sangat kurang dari yang diharapkan. Artikel selanjutnya akan mengulas desain jaringan irigasi pipa optimal melalui pemodelan hidraulis jaringan irigasi menggunakan perangkat lunak EPANET 2.0. Pada penelitian ini jaringan pipa optimal adalah nilai biaya total yang paling minimum dan memenuhi nilai hidraulis yang aman.

Salah satu kebijakan pemerintah Indonesia untuk menghadapi permasalahan ketersediaan pangan adalah dengan peningkatan swasembada beras, produksi jagung, kedelai, gula, daging, cabai dan bawang merah. Program Upaya Khusus (Upsus) Padi Jagung Kedelai (Pajale), menjadi salah satu program unggulan pemerintah dalam menjawab tantangan ini. Sebagaimana dua tujuan dari *Sustainability Development Goals (SDGs)* yaitu menghentikan kelaparan dan kepastian akses terhadap air. Konsep air virtual (*virtual water*) hadir sebagai salah satu alternatif konsep berserta alat hitung air yang diperlukan dalam sebuah proses produksi pertanian. Artikel terakhir edisi ini mengangkat tema *Water Footprint Assessment* yang mengidentifikasi air virtual untuk komoditas padi, jagung, dan kedelai di wilayah Daerah Istimewa Yogyakarta. Analisa dalam penelitian ini menghasilkan nilai tapak air yang terdiri dari *blue water*, *green water*, dan *grey water*.

Semoga naskah-naskah yang kami sajikan dapat bermanfaat dan memperkaya ilmu pengetahuan. Akhir kata Redaksi mengucapkan selamat membaca.

Redaksi