Dear Author,

IJEAB Research Journal has sent your manuscript for review.

ISSN: 2456-1878, Digital Object Identifier DOI: 10.22161/ijeab, Impact Factor: 3.118.

Your paper details are as below for future communication

**Paper Title:** Optimizing The Irrigation Water Needs of Lebak Semendawai Swamp in Increasing Agricultural Production

**Corresponding Author Name:** Dinar Dwi Anugerah Putranto

**Email:** dinar.dputranto@gmail.com

**Paper Id:** IJEAB-101202028

Article publication and review process: All manuscripts are reviewed by the core field reviewers. Decisions will be made as rapidly as possible, and the journal strives to return reviewers’ comments to authors within one week.

The publication fee of the paper is 70 USD.

If you have any queries, write in reply to this email or contact to Infogain Publication 0091 7424950531 (save for Whatsapp also).

--

Thanks & Regards

Editor- in- Chief

International Journal of Environment, Agriculture, and Biotechnology (IJEAB)

facebook.com/infogainpublication
Dear Author,

Congratulations.......! We are glad to inform you that your manuscript has been selected for publication in the International Journal of Environment, Agriculture, and Biotechnology (IJEAB).

**Paper Title:** Optimizing The Irrigation Water Needs of Lebak Semendawai Swamp in Increasing Agricultural Production

**Corresponding Author Name:** Dinar Dwi Anugerah Putranto

**Email:** dinar.dputranto@gmail.com

**Paper Id:** IJEAB-101202028

To register your approved manuscript for publication, please send Copyright form which is attached to this e-mail, in the scanned format with publication fee transaction details on before 07 February 2020. IJEAB publishes the accepted manuscript in the current issue within 2 days after submission of copyright form and publication fee details.

**Publication Charges are as below:**

- **70 USD** (DOI, Online Publication and soft copy of certificates to each author of the paper)

- **90 USD** (DOI, Online Publication, Soft copy and Hard copy of certificates to each author of the paper)

It is included of all Government Taxes and the cost of CrossRef for DOI generation.

**Payment Information:** After making the payment, send us transaction details or scanned copy of the receipt.

**Pay online through Paypal:** [https://ijeab.com/payment-option-ijeab/](https://ijeab.com/payment-option-ijeab/)

If you want to transfer publication fee through Bank transfer, then please find the Bank account details below.

**Bank Name:** Axis Bank

**Account Name (Beneficiary Name):** INFOGAIN PUBLICATION

**Account No:** 916020037731597

**SWIFT CODE:** AXISINBB433
IFCS CODE: UTIB0000433

Bank Address: Sanganer, Jaipur, India

If you wish to make payment through Money Gram and the Western Union then find the receiver details below.

Receiver Name: KIRAN   (First Name- KIRAN   Last Name- No Last Name)
City: Jaipur
Country: India
Contact No. +91-9166093655

If you have any query or requirement, write in reply to this email or contact with Infogain Publication (save for Whatsapp also) - 0091 7424950531.

--

Thanks & Regards

Editor-in-Chief

International Journal of Environment, Agriculture, and Biotechnology (IJEAB)

facebook.com/infogainpublication

Copyright form-ijeab (1).docx

62K
IJEAB(10.22161/ijeab) is a member of CrossRef(DOI)
(http://www.crossref.org/01company/06publishers.html)

Qualis-CAPES indexed (AGRICULTURAL SCIENCES I) (Brazilian system for the evaluation of periodicals, maintained by CAPES) (https://ijeab.com/qualis-capes-indexed/)

JournalToc (UK) (http://www.journaltocs.ac.uk/index.php?action=search&subAction=hits&journalID=37971&userQueryID=21995&high=1&ps=30&page=1&items=University Library (Denmark) (http://journaltocs.aub.aau.dk/2456-1878), WorldCat (https://www.worldcat.org/search?q=ijels&fq=yr%3A2017&se=desc&sd=desc&dblist=638&start=1&qt=page_number_link), Scilit MDPI AG (Basel, Switzerland) (https://www.scilit.net/journals/515888), Tyndale University College & Seminary (http://www.tyndale.worldcat.org/search?q=2456-1878&qt=results_page&dblist=638&scope=0&oldscope=0&fq=), Indiana University (http://iupui.worldcat.org/search?q=2456-1878&qt=results_page&scope=0&oldscope=0&fq=),

All papers will be Indexed in Google Scholar (https://scholar.google.co.in/citations?user=j02ad0UAAAAJ&hl=en)

Neliti (https://www.neliti.com/journals/ijeab) - Indonesia’s Research Repository

Under Review for Scopus Indexing (Ref.: BFC7C1C0F97E1DDC)

Refereed/ Peer Reviewed International Environment Journal | Agriculture Journal | Biotechnology Journal.

Thomson Reuters ResearcherID: E-2759-2017 (http://ijeab.com/)

Impact Factor: 3.118 (http://rootindexing.com/journal/international-journal-of-environment-agriculture-and-biotechnology--2/)

DOI: 10.22161/ijeab (https://dx.doi.org/10.22161/ijeab)

Publication Frequency: Bi-Monthly/6 Issue Per Year

International Journal of Environment, Agriculture and Biotechnology (IJEAB)(ISSN: 2456-1878) is an international open access peer reviewed online journal in the field of Environment, Agriculture and Biotechnology. It’s main aim is to give quality research papers. It covers all sub-fields of above mentioned fields. It provides platform to academicians, students and professionals. It publishes only original research papers and review papers. Submitted paper should meet some criteria like, It should be original, unpublished and not submitted to any other journal.

IJEAB is a refereed / Peer Reviewed International Journal. It has high impact from a reputed society and DOI (Digital Object Identifier) from CrossRef.
We publish papers on a variety of topics, contexts and analysis strategies that examine the quickly evolving relationship between Agriculture and knowledge technology. We have a tendency to encourage a large range of submissions, including, but not restricted to:

**Topics of Interest:**

**Environment Research Paper Topics:** Researches in the field of environmental science such as Aquatic Sciences, Energy Resources and Conservation, Environmental Chemistry, Environmental Biology, Environmental Economics, Environmental Engineering, Environmental Physics, Pharmaceuticals in the environment, Environmental Health - Public Health, Environmental Law - Policy - Eco Justice, Risk assessment, Environmental Management, Environmental Toxicology, Global Change, Climate Change, Monitoring, Environmental Analysis - Monitoring, Nature Conservation - Biodiversity, Pollution and Remediation, Soil Science, Sustainable Development.

**Agriculture Research Paper Topics:** Agricultural Diversification, Agricultural Economics, Agricultural Engineering, Forestry, Agricultural Biotechnology, Agricultural Technology, remote sensing agriculture, Natural Resources, Agro climatology, Agricultural Entomology, Agricultural Production, briquetting machine design, Energy Agriculture, Tissue Culture, Plant Culture, Aquaculture, farming, Toxicology and Waste management, Veterinary medicine, Irrigation and water management

Crop Production: Cereals or Basic Grains: Oats, Wheat, Barley, Rye, Triticale, Corn, Sorghum, Millet, Quinoa and Amaranth, Oilseeds: Canola, Rapeseed, Flax, Sunflowers, Corn and Hempseed, Pulse Crops: Peas (all types), field beans, faba beans, lentils, soybeans, peanuts and chickpeas, Hay and Silage (Forage crop) Production, Crop Protection Chemicals, Organic fertilizers, Vegetable crops or Olericulture: Crops utilized fresh or whole (wholefood crop, no or limited processing, i.e., fresh cut salad); (Lettuce, Cabbage, Carrots, Potatoes, Tomatoes, Herbs, etc.), Tree Fruit crops: apples, oranges, stone fruit (i.e., peaches, plums, cherries), Tree Nut crops: Hazlenuts. walnuts, almonds, cashews, pecans, Berry crops: strawberries, blueberries, raspberries, Sugar crops: sugar cane. sugar beets, sorghum, Potatoes varieties and production

Livestock Production: Animal, husbandry, Ranch, Bovine, Equine, Camel, Yak, Pigs, Sheep, Goats, Poultry, Bees, Dogs, Exotic, species, Chicken Growth, Animal science: Animal breeding, Animal nutrition, Agronomy: Plant science, Theoretical production ecology, Horticulture Research, Plant breeding, Plant fertilization, Medicinal Plants

Biological engineering: Genetic engineering, Microbiology, Environmental science: Agricultural Biodiversity, Ecology, Basic biology concepts, Food science: Nutrition, Safety, Storage, Management and Preservation,

Soil science: Soil physics, Soil chemistry, Soil biology, Agrology, Plant Breeding, Plant soil, Soil and Environmental Sciences, Agricultural genetic,

Milk Production (Dairy): Dairy goat, Dairy cow, Dairy Sheep, Water Buffalo, Moose milk, Dairy product.

**Biotechnology Research Paper Topics:** Researches in the field of biological science such as Animal Sciences, Botany, Bio Chemistry, Biotechnology, Bioinformatics, Cell biology, biochemical, biogas production, Cryobiology, Ecology, Ethno-biology, Food technology, Forestry Sciences, Fishery Sciences, Fish farm, Shrimp farm, Forensic Sciences, Genetic Engineering, Home Sciences, Life Sciences, Molecular Biology, Microbiology, Medical Sciences, Nanotechnology, Pathology, Pharmaceutical Sciences, Toxicology, Veterinary Sciences, Zoology etc.

**Popular Indexing and Abstracting of Journal**

Google Scholar
Academia
WorldCat
scinapse
SlideShare
Pol-Index
Microsoft Academic Search
PBN-Polish Scientific Bibliography
The university Library-Aalborg University (Denmark)
Scilit MDPI AG (Basel, Switzerland)
Tyndale University College & Seminary
Indiana University
Internet Archive
JournalTOC (UK)
Index Copernicus
ResearchBib
Bibonomy
CiteSeer
Thomson Reuters ResearcherID-Author Profile
WikiCFP
Root Indexing
Infobase Index
PdfSR
ISSUU
Scribed
Dimension-ai
Jurn-Academic Articles, Chapters and Theses etc.....
Optimizing the Irrigation Water Needs of Lebak Semendawai Swamp in Increasing Agricultural Production

Dinar DA Putranto¹, Sarino², Agus Yuono³, Agus Karsa Yudha⁴

¹,²,³Department of Civil Engineering and Planning, Faculty of Engineering, University of Sriwijaya, Indonesia
⁴Department of Public Works, OKU Regency, South Sumatra, Indonesia

Abstract—East OKU Regency, South Sumatra Province, Indonesia, is a region that has great potential in the agriculture and plantation sectors. Utilization of swamps and tidal swamps is used as an alternative to increasing agricultural yields despite extreme changes in river water flow downstream during the dry season. This study aims to analyze the magnitude of the potential discharge mainstay, and the influence of the magnitude of the flow of the Komering river flow to the availability of water and the availability of optimum discharge in the Lebak Semendawai irrigation area. The total area of 1,218.83 hectares of rice fields, 374.9 hectares is a shallow swamp. Based on rainfall data for the last ten years, it shows that the potential for discharge is 2.67 m³/sec, while the required water needs is 2.16 m³/sec. (excess water is 0.51 m³/sec). The results of the analysis show that the planned cropping patterns that can be applied are Paddy - Paddy – Secondary Crop. The Komering river water discharge which affected the first cropping rice planting pattern was 62.877 m³/sec, the second rice planting period was 43.41 m³/sec and during the cropping period the water demand could be fulfilled, if it was achieved through pump system with a capacity 1.657.6 liters/sec because the water level of the river from June to November are under the baseline elevation of floodgate on retrieval buildings. Water requirements for the entire irrigation network system in the Lebak Semendawai marsh swamp are 37.22 m³/sec.

Keywords—Agricultural, discharge, irrigation, swamp, water level.

1. INTRODUCTION

The Indonesian Government's efforts to increase rice productivity include building a swamp irrigation network. Irrigation area of Lebak Semendawai is a rainfed rice field developed by the Indonesian government in South Sumatra Province with an area of approximately 2,244 ha. But in its development, in one year, farmers plant rice between one and two times, but in the second planting season the possibility of failure is more dominant because it has entered the dry season, making it difficult to get water. Water sources are located around the irrigation area. The reliable Lebak Semendawai is the Komering River.

This study aims to analyze the magnitude of potential discharge mainstays in the Lebak Semendawai area, and analyze the magnitude of the Komering river flow discharge to the availability of water as a source of Lebak Semendawai irrigation water, as well as analyze the availability of optimum discharge for the Lebak Semendawai irrigation flow.

2. METHODOLOGY

2.1 Research Area

The Lebak Semendawai irrigation area is administratively located in Campang Tiga Ulu village, Sukaraja village and Gunung Jati village, Cempaka District, East OKU Regency, South Sumatra Province with geographical coordinates of east longitude 104º10'1.2” - 104º41’49.2” and 4º27’32.4” - 4º27’32.4” south latitude.

2.2 Research Methods

To analyze the availability and demand for water resources in the study area, several equations are used to perform calculations

2.2.1 Rain plan

Calculation of rain plan is done using several distribution methods, namely the Normal Method, Normal Log, Gumbel, and Pearson Type III log [1]

Normal distribution method,

\[ X_T = \mu + K_T \sigma \]  

with

\[ XT \]  : Rain plans with a T year return period;
\[ Y_T = \bar{Y} + K_T S \] ..............................(2)

With,
\[ Y_T \]: Estimated value expected to occur with a T-annual return period;
\[ \bar{Y} \]: The average value of the variate count;
\[ S \]: Standard deviation of variate values;
\[ K_T \]: Frequency factor.

Pearson Log Type III distribution method,
\[ \log X = \log \bar{X} + G* S \] ..............................(3)

Gumbel distribution method,
\[ X = \bar{X} + \frac{y_T - y_n}{\sigma_n} \] ..............................(4)

With,
\[ X \] : Extreme value;
\[ \bar{X} \] : average value;
\[ y_T \] : reduced variate;
\[ y_n \] : reduced variate mean;
\[ \sigma_n \] : standard deviation

To find an appropriate design, the Chi-Square Test was conducted to test the suitability of the distribution. Chi Square Test \((X^2)\) was carried out using the following equation,
\[ X^2 = \sum \frac{(F_{e} - F_{t})^2}{F_{t}} \] ..............................(5)

\[ X^2 \text{ count it} \]: price Chi-Square count it;
\[ F_{e} \] : Frequency of observation j class;
\[ F_{t} \] : Frequency of Frekuensi teoritical j class;
\[ k \] : Class Total.

2.2.2 Calculation of peak discharge

To design the amount of peak discharge in the study area is carried out using the following approaches, Nakayasu HSS formula for Flood Peak Discharge,
\[ Qp = \frac{c.A.R_{O}}{3.6(0.3T_{p} + T_{0.3})^3} \] ..............................(6)

with
\[ Qp \] : Qmaxs, is the peak flood discharge (m³ / sec);
\[ c \] : flow coefficient (= 1);
\[ A \] : Watershed area (until to outlet) (km²);
\[ R_{O} \] : unit rain (mm);

\[ T_{p} \] : the grace period from the beginning of the rain to the peak of the flood (hours);

While the Rational method function is used to determine the design flood discharge, namely by the equation[2],
\[ Q = 0.278 \text{ C.I.A (A in ha) } \] ..............................(7)

With,
\[ Q \] : Design flood discharge (m³/sec);
\[ C \] : Flow coefficient;
\[ I \] : rain intensity (mm/hour);
\[ A \] : Watershed area (km² or ha).

While the flood discharge equation according to Haspers [3]
\[ Q = \alpha. \beta. q. F \] ..............................(8)

with,
\[ f \] : chatment area (km²);
\[ \alpha \] : drainage coefficient;
\[ \beta \] : reduction coefficient;
\[ q \] : maximum rainfall (m³/km²/sec).

And the flood discharge equation according to Mononobe [4]
\[ Q = \frac{\alpha.r.f}{3,6} \] ..............................(9)

With,
\[ \alpha \] : drainage coefficient;
\[ r \] : rainfall intensity (mm/hour);
\[ f \] : chatment area (km²);
\[ Q \] : Flood discharge (m³/sec).

While the flood discharge equation according to Melchior [5]
\[ Q = \alpha.x.I.x.A.x. \frac{r}{200} \] ..............................(10)

With,
\[ r \] : Maximum daily rainfall (mm).

To find out the intensity of rain with a specific period design used the Mononobe method rainfall intensity equation [6]
\[ I = K_{24} / 24 \times [24 / I]^n \] ..............................(11)

\[ I \] : The intensity of rainfall (mm/hours);
\[ t \] : rain concentration time (hours), for Indonesia 5~7 hours;
\[ R_{24} \] : maximum rainfall of 1 day (mm/hours);
\[ n \] : constants (for Indonesia estimated n~2/3).

Note: the reset factor factor is entered in \( R_{24} \).
2.2.3 Irrigation Water Needs
Estimation of irrigation water requirements is carried out by taking into account the guidelines of the Department of Public Works[7],

(1) The need for clean water in the rice fields
\[ \text{NFR} = \text{Etc} + \text{P} - \text{Re} + \text{WL} \]

(2) Irrigation water needs for rice, WRD
\[ \text{IR} = \frac{\text{NFR}}{\text{e}} \]

(3) Need for land preparation for rice
(4) Irrigation water needs for secondary crops, WRP
\[ \text{IR} = \left( \frac{\text{Etc} - \text{Re}}{\text{e}} \right) \]

Where,
\begin{align*}
\text{Etc} & : \text{Consumptive Use} \\
\text{P} & : \text{Water loss due to percolation (mm/day)} \\
\text{Re} & : \text{Effective rainfall (mm/day)} \\
\text{E} & : \text{Overall irrigation efficiency} \\
\text{WL} & : \text{Water layer replacement (mm/day)} \\
\end{align*}

The amount of evapotranspiration is used by the Penman modification method [8]

\[ \text{ET} = C \left[ \text{w} \cdot \text{Rn} + (1-w) f(U) (\text{ea} - \text{ed}) \right] \] \hspace{1cm} (12)

With,
\begin{align*}
\text{ET} & : \text{Evapotranspiration (mm/day)} \\
C & : \text{Correction factors due to climate conditions day/night} \\
\text{Rn} & : \text{Net radiation is equivalent to Evaporation (mm/day)} \\
\end{align*}

Director General of Irrigation Department of Public Works[9] states that in general water losses in irrigation networks can be grouped into:
(a) Between 15% to 22.5% in tertiary plots, between tertiary tapping buildings and rice fields;
(b) Between 7.5% to 12.5% in the secondary channel, and;
(c) Between 7.5% to 12.5% in the primary canal.

Calculation of irrigation needs during land preparation can use the method of Van De Goor and Zijlstra[7] (Directorate General of Irrigation Department of Public Works, 1986), namely:

\[ \text{IR} = \frac{M_e^k}{(e^k - 1)} \] \hspace{1cm} (13)

where
\begin{align*}
\text{IR} & : \text{Irrigation water needs at the level of rice fields (mm/day)} \\
M & : \text{Water needs to replace water losses due to evaporation and percolation in saturated fields} \\
M_e & : \text{Water needs to replace water losses due to evaporation and percolation in saturated fields per unit area} \\
e & : \text{Efficiency coefficient} \\
k & : \text{Exponent} \\
\end{align*}

\[
M = M_o + P \text{ (mm/day)}
\]

\[
E_o : \text{Open water evaporation taken 1.1 Eto during land preparation (mm/day)}
\]

\[
P : \text{Percolation}
\]

\[
k = \frac{MT}{S} \]

\[
T : \text{Time period for land preparation (days)}
\]

\[
S : \text{Water requirements, for saturation are added with a layer of water 50 mm, ie 200 + 50 = 250 mm.}
\]

Consumptive use is calculated using equations [8]

\[ \text{Etc} = K_e \cdot \text{Eto} \] \hspace{1cm} (15)

with,
\begin{align*}
\text{Etc} & : \text{Plant evapotranspiration (mm/day)} \\
\text{Eto} & : \text{Reference crop evapotranspiration (mm/day)} \\
K_e & : \text{Crop coefficient.}
\end{align*}

The rate of percolation is very dependent on the properties of the soil. In clay soils, with good processing characteristics, percolation rates can reach 1-3 mm/day[10]

Effective rain is rainfall that can be effectively utilized by plants. For irrigation in rice plants, monthly effective rainfall is taken 70% of the average monthly rainfall with a possibility of not meeting 20%

\[
\text{Re} = 0.7 \times R_{\text{80}} \] \hspace{1cm} (16)

With,
\begin{align*}
\text{Re} & : \text{Effective rainfall (mm/day)} \\
R_{\text{80}} & : \text{Mid average monthly rainfall with a 20% chance of not being met.}
\end{align*}

Planting patterns in one year must see the presence or absence of water (water availability) in irrigated areas[11]

Conventional discharge measurements can be done by:
(1) Determine the wet cross-sectional area of the river (A), i.e. by measuring the estimated water;
(2) Measuring water velocity (V) with a speed meter (current meter) or buoy (the speed is measured with a Stop watch).

Then the discharge calculation (Q) is performed as follows[12]

\[ A_1 V_1 rata^2 + A_2 V_2 rata^2 + ... + A_n V_n rata^2 = Q \] \hspace{1cm} (17)

with,
\begin{align*}
Q & : \text{River discharge (m}^3/\text{sec)} \\
A_n & : \text{N-river cross-sectional area (m}^2) \\
V_{\text{rata}} & : \text{Average speed on n-cross section (V}_{\text{rata}} \text{ point 0.2 h and 0.8 h).}
\end{align*}
Mainstay debits are debits available throughout the year with a certain risk of failure. Mock introduced a simple model of simulation of monthly water balance for flow which includes rainfall data, evaporation and hydrological characteristics of drainage areas[8]

\[ E_a = E_{To} - \Delta E \rightarrow (E_a = E_t) \]  
\[ \Delta E = E_{to} \times (m/20) \times (18 - n) \rightarrow (E_t = \Delta E). \]  

with:

- \( E_a \): Actual evapotranspiration (mm/day);
- \( E_t \): Unlimited Evapotranspiration (mm/day);
- \( E_{to} \): Potential evaporation of the Penman Method (mm/day);

Basic planning with regard to land units is tertiary plots. These compartments receive irrigation water that is flowed and measured in tertiary off take structures. The secondary plot consists of several tertiary plots, all of which are served by one secondary channel. The primary plot consists of several secondary plots which take water directly from the primary channel.

The discharge plan for a channel is calculated by the formula [11]

\[ Q_t = \frac{NFR \times A}{1000 \times e_t} \]

Where,

- \( Q_t \): Discharge plan (m³/sec);
- \( NFR \): The need for clean water in the fields (lt/sec/ha);
- \( A \): The area of water is irrigated (ha);
- \( e \): Irrigation efficiency in tertiary plots.

Overall efficiency (total) is calculated as follows:

Tertiary network efficiency \( (et) \) x Secondary network efficiency \( (es) \) x Primary network efficiency \( (ep) \), and between 0.65 - 0.79 [7]

3. RESULTS AND DISCUSSION

3.1 Data Discharge Input (Inflow)

The initial data sources used in the analysis are rainfall distribution data and Komering river water discharge data. Rainfall data used to forecast rainfall is daily rainfall data for the years 2005 - 2014 obtained from the Seed center Directorate General of Agriculture BK 10 Gumawang Station, East OKU Regency.

The maximum average rainfall between 2005 and 2014 based on Figure 3 below occurred in January of 364 mm while the minimum rainfall between that year occurred in July and August of 81.1 mm.
3.2. Plan Rain Analysis
The return period that will be calculated in each method is the return period of 2, 5, 10, 25, 50 and 100 years. The rainfall data used is the maximum daily rainfall data.

Figure 4 above provides information that the highest maximum daily rainfall data occurred in 2005 of 199 mm and the lowest occurred in 2010 of 71 mm.

Table 1. Results of calculated rainfall plans

| T (Years) | Normal R (mm) | Log Normal R (mm) | Log Pearson III R (mm) | Gumbel R (mm) |
|-----------|---------------|-------------------|------------------------|---------------|
| 2         | 113.45        | 107.89            | 110.92                 | 108.11        |
| 5         | 146.68        | 141.91            | 140.61                 | 155.26        |
| 10        | 164.09        | 164.06            | 166.34                 | 186.55        |
| 25        | 181.02        | 188.79            | 201.37                 | 226.04        |
| 50        | 194.54        | 210.86            | 229.62                 | 255.36        |
| 100       | 205.82        | 231.21            | 259.42                 | 284.44        |

The rainfall plan (R) in the table above can be displayed in the graph below.

3.3. Chi Square Test
Chi Square Test Results of Pearson Type III Log distribution and Gumbel distribution obtained the parameter Chi-Critical Square (X₂cr) = 7.815 for degrees of freedom (df) = 3 and the level of confidence (α) = 5% so that the price of Chi Square is calculated (X₂ count) = 0.4. Because X₂ counts are smaller than X₂cr, it means that the data corresponds to both distributions. Because the Variance Coefficient (CV) of the Pearson Type III Log distribution is smaller than the Gumbel distribution, the Pearson Type III Log distribution will be used.

3.4. Mainstay Rainfall
The rainfall distribution method that can be used from the distribution test results is the Log Pearson III method. The result is obtained a reliable rainfall of 80% (R80) 183.65 mm. Thus it can be concluded that the 80% reliability opportunity occurs at a probability of 30%, i.e. between 180 mm and 191.9 mm of rainfall.

3.5. Rainfall Intensity
The intensity of rainfall (I) and daily maximum rainfall (R24) of the calculation results can be explained in the graph below.

Distribution test results can be seen that the distribution that meets the criteria is the Pearson Log Type III Distribution and Gumbel Distribution.
amount of rainfall intensity (I) that is influenced by daily maximum rainfall (R_{24}) can be seen in the graph below.

![Fig. 7: Intensity of rainfall Mononobe method](image1)

The intensity of rainfall (I) that occurred in the 2-year return period is shown in Figure 6 above 10.994 mm/hour and the 100-year return period of 27,093 mm/hour.

3.6. Mainstay Discharge
Analysis of rainfall with the probability method is known that rainfall data and the number of rainy days (HH) that can be used is rainfall data in 2008. From the calculation results obtained by the reliable discharge as follows.

![Fig. 8: Mainstay Discharge Method F.J. Mock](image2)

The magnitude of the mainstay discharge stated in Figure 8 above is the highest mainstay discharge occurred in January which is 2.67 m³/sec and the lowest occurred in September of 0.61 m³/sec. This means that the decline in reliability occurs from January to September.

3.7. Nakayasu Synthetic Hydrograph Unit
The results of the calculation of the Nakayasu Synthetic Hydrograph can be obtained from the magnitude of flood discharges of the return period of 2 years to 100 years. The Nakayasu method flood discharge at Table 3 can be outlined in the form of a hydrograph model shown in the following Figure 9.

![Fig. 9: Nakayusus Synthetic Hydrograph Lebak Semendawai irrigation](image3)

Table 3. Nakayasu Method Flood Peak Discharge

| Re Period T (years) | Flood peak discharge (Qp) (m³/sec) |
|---------------------|-----------------------------------|
| 2                   | 200.974                           |
| 5                   | 269.489                           |
| 10                  | 318.290                           |
| 25                  | 385.200                           |
| 50                  | 438.759                           |
| 100                 | 495.500                           |

3.8. Flood Peak Discharge
Calculation of peak discharge (Qp) with the Rational method obtained through spatial analysis can be displayed in the figure below.

![Fig. 10: Peak Discharge (Qp) Rational method](image4)

Data processing from the spatial analysis results above shows that the highest peak discharge (Qp) at the location of the study was 7.389 m³/s and the lowest was 0.04499 m³/s. The total peak discharge (Qp tot) that occurred was 10,415 m³/sec.

3.9. Peak Flood Discharge Plan with the Empirical Method
The calculation of flood discharge plan is calculated by empirical methods including Haspers, Mononobe and Melchior methods, the following results are obtained.

Table 4. Recapitulation of Flood Hydrograph Calculation Results for Empirical Method Planning

| Period T(years) | flood discharge (Q) (m³/sec) |
|-----------------|------------------------------|
|                 | Haspers | Mononobe | Melchior |
| 2               | 97.066  | 64.187   | 71.417   |
| 5               | 130.040 | 85.992   | 95.678   |
| 10              | 153.669 | 101.617  | 113.063  |
| 25              | 185.947 | 122.962  | 136.812  |
| 50              | 211.829 | 140.077  | 155.855  |
| 100             | 239.212 | 158.185  | 176.003  |

Flood discharge (Q) Empirical method in Table 4. above can be poured into the following graph.
3.10 Irrigation Water Needs Analysis
3.10.1 Evapotranspiration of the Penman Method
Calculation of potential Evapotranspiration (ETo) with the Penman method obtained the following results:

![Figure 11: Flood Hydrograph of the Empirical Method Plan](image)

| Month | ET (mm/month) |
|-------|--------------|
| Jan   | 0            |
| Feb   | 0            |
| Mar   | 0            |
| Apr   | 0            |
| May   | 0            |
| Jun   | 0            |
| Jul   | 0            |
| Aug   | 0            |
| Sep   | 0            |
| Oct   | 0            |
| Nov   | 0            |
| Dec   | 0            |

The highest evapotranspiration based on the land use can be shown in the following graph.

![Figure 12: Evapotranspiration of the Modified Penman Method](image)

Figure 12 above explains that the highest evapotranspiration occurred in January, March, October and December amounted to 137.90 mm/month and the lowest occurred in April and June amounted to 109.19 mm/month. The amount of evapotranspiration (ET) based on land use can be seen in the following graph.

![Figure 13: Evapotranspiration based on Land Use Maps](image)

3.10.2 Percolation
The rate of percolation is very dependent on the properties of the soil. The percolation rate used is 2 mm/day with consideration of soil texture in the location area.

3.10.3 Effective rainfall for rice and secondary crop water needs
The probability in determining how much the reliability of the flow is applied using the basic year method. The results of these methods obtained by reliable rainfall of rice plants (R80) using rainfall data in 2011 and reliable crops of crops (R50) using rainfall data in 2014.

![Figure 14: Effective rainfall of rice and secondary crops](image)

Maximum effective rainfall (Reff) for rice analysis results Figure 14 above is estimated to occur in January which is 9.35 mm/day and the maximum reff for secondary crop occurs in December amounted to 14.74 mm/day.

3.10.4 Irrigation Efficiency
The guideline used for irrigation efficiency planning in operation and implementation, namely water loss in Tertiary plots is determined 20% between tertiary tapping buildings and paddy fields with an efficiency factor of 1.25. In the Secondary Channels is determined 10% with an efficiency factor of 1.11 and for the Primary Channels is determined 10% with an efficiency factor of 1.11.

3.10.5 Irrigation Water Needs and Planting Patterns
Irrigation water needs include crop water needs per irrigated land area. Planting patterns that can be applied from the analysis of irrigation water needs are Rice - Rice – Secondary Crop with the provisions that the Rice planting period lasts for 4.5 months, Rice planting period for 4 months and crops for 3.5 months. The results of the analysis of the calculation of Irrigation Water Needs for an area of 1,218.83 Ha can be displayed in the graph below.
The amount of maximum irrigation water requirements for the 1st planting season for 1,218.83 Ha as shown in Figure 15 above is 2.18 lt/sec/ha at the beginning of December, the 2nd planting period 1.90 lt/sec/ha in early April and secondary crop at 1.13 lt/sec/ha in early August.

3.11 River Water Discharge Based on Comparison of Rainfall Occurred

River water discharge (Q) when rainfall is low in October 2014 results of measurements of river flow velocity using Current meters and river cross section using Echosounder is 25.30 m$^3$/sec. River water discharge (Q) during moderate rainfall of 219.97 m$^3$/sec is obtained based on the ratio of river water discharge and rainfall that occurs when rainfall is low in October with moderate rainfall in November.

The results of comparison of river water discharge and low rainfall in October with the prediction of high rainfall in January obtained river water flow (Q) when high rainfall amounted to 426.35 m$^3$/sec.

3.12 Potential Use of the Komering River as a source of Lebak Semendawai Irrigation Water

3.12.1 Water Levels Based On Water Level Fluctuations

The results of data processing of water level fluctuations show that the average water level is 1.156 m, the highest high tide is 1.65 m and the lowest low tide is 0.75 m. Fluctuations that occur are mixed tides ($0.25 < F < 3.00$) based on the Formzahl value $F = 1.18$ above. Of the two types of mixed tides, the tides that occur are the mixed-dominant diurnal tides for $0.50 < F \leq 3.00$.

3.12.2 River water discharge based on prediction of high fluctuations in water

River water discharge is obtained from the multiplication between the total river cross-sectional area (A) and the river flow velocity (V). The measurement results using Echosounder and Current Meter as well as water level from river water level fluctuation data can be seen that,

1. Based on the average height of low water level over a period of 19 years (MLWL) 0.59 m, obtained river water flow (Q) when rainfall is low at 24.37 m3/sec;
2. Based on the average height of the high water level over a period of 19 years (MHWL) 1.57 m, the river water flow obtained during moderate rainfall was 144.7 m3/sec;
3. Based on the highest water level at the tidal full moon (HHWL) 1.86 m, river water discharge obtained during high rainfall amounted to 209.59 m3/sec;

3.12.3 Prediction of availability of average river water discharge per month based on fluctuations in surface water and rainfall occurred

The average river water discharge (Qrt) per month can be displayed in the following graph.

![Fig. 16: Monthly river water discharge (Qrt)](image)

The highest average river water flow (Qrt) based on Figure 16 above occurred in December, which was 246.60 m3/s and the lowest occurred in August 14.36 m3/s. The predicted results of the average water level per month can be displayed in the following table.

| Month | Average Water Level (m) |
|-------|-------------------------|
| Jan.  | 2.60                    |
| Feb.  | 1.84                    |
| Marc. | 2.23                    |
| Apr.  | 2.65                    |
| May   | 1.53                    |
| June  | 1.11                    |
| July  | 0.98                    |
| Aug.  | 0.16                    |
| Sept. | 0.20                    |
| Oct.  | 0.34                    |
| Nov.  | 1.11                    |
| Dec.  | 2.67                    |
The water level above when connected to the condition of the building intake (free intake) can be shown in the following figure

![Fig. 17: Average River Water Level Against Free Intake Conditions](image)

River water discharge in June - July and August - November based on Figure 16 above has an average water level of 1.05 m and 0.45 m from the bottom of the river under the elevation of the Box Culvert base so as to be able to drain the irrigation water source to the location. Paddy fields cannot use box culvert channels to drain water, so a pump system is needed.

3.13 Water Discharge Irrigation Network System

How much water flow (Q) needed to irrigate the irrigation network must be analyzed

3.13.1 Water availability per month based on planned water needs and cropping patterns

How much water flow (Q) needed to irrigate the irrigation network must be analyzed how big is the availability of water available, compared with the required water debit. The results of the calculation of water discharge (Q) needed based on the analysis that has been done is 37,220 m³/sec to flow through 1271.69 Ha of paddy fields.

(a) Paddy planting season 1 (end of November - March when rainfall is high)
River water discharge during high rainfall 209.59 m³/sec; Availability of river water at the intake for irrigation 103.57 m³/sec; Peak water discharge on the surface 10,415 m³/sec; availability of water for irrigation (30% x 209.59) + (70% x 10,415) = 70.17 m³/sec;

(b) 2nd planting season (April - July during moderate rainfall)
River water discharge during moderate rainfall 144.70 m³/sec; Availability of river water at the intake for irrigation 38.68 m³/sec; Water discharge rivers for irrigation in June and July (- 3.48 m³/sec and - 15.3 m³/sec) are met if pumping with a capacity of 1657.6 lt/sec; Peak water discharge on the surface 5,705 m³/sec; availability of water for irrigation (30% x 144.70) + (70% x 5,705) = 47.40 m³/sec;

(c) Secondary crop (August - early November when rainfall is low)
River water discharge when rainfall is low 24.37 m³/sec; Availability of river water for irrigation does not exist - 81.65 m³/sec (Qintake = 0.00 m³/sec); River water discharge for irrigation is fulfilled if the pump capacity is 1,657.6 lt/sec; River water discharge for pumping irrigation resulting from 7,311 m³/sec; Peak water discharge at 4,517 m³/sec; Water supply for irrigation is 11,828 m³/sec (7,311 m³/sec + 4,517 m³/sec).

3.13.2 Excess water in the swamp area and adjustment of the planting pattern plan

The plan to prepare land in swampy swamp area for planting rice 1 is strongly influenced by excess water in the area because it is not possible to plant if the amount of water is too excessive. The excess water for the 1st planting season rice in the swampy swamp areas above based on the analysis of water availability in the plot can be shown in the following table

Table 6. Excess water in the plot and water discharge plots in the swamp area based on water availability for the 1st Planting Rice

| Rice Fields | Excess water plot plan (m³/sec) | Swamp water discharge (m³/sec) |
|-------------|---------------------------------|------------------------------|
| CT4-Ka      | 0.268                           | 0.232                        |
| CT4-Tg      | 0.177                           | 0.286                        |
| C1-Ki       | 0.180                           | 0.169                        |
| C2-Ki       | 0.191                           | 0.239                        |
| C3-Ki       | 0.194                           | 0.282                        |
| C3-Ka       | 0.199                           | 0.235                        |
| Lb.4-Ki     | 0.136                           | 0.194                        |
| Lb.4-Ka     | 0.264                           | 0.293                        |
| Lb.3-Ka     | 0.180                           | 0.225                        |
| Lb.3-Ki     | 0.077                           | 0.071                        |
| Total       | 1.866                           | 2.228                        |

The excess water in the planned plot of swampy swamp area according to Table 6 above is 1.866 m³/sec (161.222.4 m³ / day). Water discharge in the swampy swamp area is 2,226 m³/sec (192.326.4 m³ / day) with a swampy swamp area of 374.9 Ha of the total planned plot of 663.05 ha. The water discharge is predicted to occur at the highest rainfall in December. Thus, monthly water discharge in the swampy swamp area based on comparison of the average rainfall that occurs can be displayed in the following table
Table 7. Prediction of water discharge in the swamp area per month

| Month | Water discharge in swampy area (m³/det) |
|-------|----------------------------------|
| Jan.  | 2.169                            |
| Feb.  | 1.534                            |
| Marc. | 1.854                            |
| Apr.  | 1.748                            |
| May   | 1.013                            |
| June  | 0.734                            |
| July  | 0.649                            |
| Aug.  | 0.483                            |
| Sept. | 0.607                            |
| Oct.  | 1.051                            |
| Nov.  | 1.459                            |
| Dec.  | 2.226                            |

The highest prediction of swamp water discharge based on Table 7 above occurred in December, which was 2.226 m³/sec (192,326.4 m³/day) and the lowest in August was 0.483 m³/sec (41,731.2 m³/day). Planting patterns that can be applied to the swampy swamp area are based on the above water discharge, namely:

(1) The first cropping season in October - February;
(2) The 2nd cropping season in March - early June;
(3) Secondary crop at the end of June - September.

The cropping plan for the 1st planting season is planted with special local species, namely surung rice (alabio, tapus, nagara and hiyang) because the water discharge is still quite high. For the second planting season rice can be planted with rice types in Indonesia (IR 42, IR 64, IR 66, and local species as Cisokan, Ciperang, Cisanggarung and Mekonga rice types). Secondary crop can be planted with a mound system (elevated section). Rice fields in the form of rice fields in general (not swamp) can follow the previous cropping plan, namely:

(1) The first cropping season at the end of November - March;
(2) Rice planting period 2 in April - July;
(3) Secondary crop in August - early November.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

(1) Potential magnitude of mainstay discharge based on the swamp area based on the flowing pattern limit in the Lebak Semendawai area which is affected by the Komering River is 2.67 m³/sec with the required water demand of 2.16 m³/sec so that there is excess water (water surplus) of 0.51 m³/sec (sufficient);

(2) The magnitude of the influence of river water discharge is able to support the availability of water for irrigation activities based on the planned Rice - Rice – secondary crop cropping pattern, namely:

(a) The 1st planting season (end of November - March) takes place during high rainfall, river water discharge (30%) which can be used for irrigation of 62,877 m³/sec;

(b) The 2nd planting season (April - July) takes place during moderate rainfall, river water discharge (30%) which can be used for irrigation of 43.41 m³/sec with the irrigation network water requirement of 32.62 m³/sec (sufficient). Irrigation network water needs in June and July can be fulfilled if a pumping system with a pump capacity of 1,657.6 lt/sec is implemented, given the river water discharge is below the elevation of the floodgate;

(c) Secondary crop (August - Early November) takes place when rainfall is low, river water discharge that can be used for irrigation is absent (~ 81.65 m³/sec below the elevation of the floodgate at the intake). Surface water discharge is 4,517 m³/sec. Irrigation system water needs can be met if pumping is carried out with a pump capacity of 1657.6 lt/sec so that 30% of river water debit obtained is 7,311 m³/sec. Thus the crop water needs are fulfilled (7,311 m³/sec> 3.74 m³/sec).

(3) The amount of optimum availability of Lebak Semendawai Irrigation is:

(a) Paddy planting period 1 availability of optimum discharge is 70.17 m³/sec. The availability of water in the plot of rice for 6,472 m³/sec with plant water needs 2,167 m³/sec;

(b) In the 2nd planting period, the optimum discharge availability is 47.40 m³/sec. The availability of water in the planned plot of rice is 5,027 m³/sec with plant water needs 1,897 m³/sec;

(c) the availability of optimum discharge Secondary crop 11,828 m³/sec. Availability of water in planned plots for secondary crop 1,817 m³/sec with plant water needs 1,128 m³/sec.

4.2 Recommendations

Further research is needed regarding the efficiency and economic value of the use of pumps to irrigate the irrigation network system.

ACKNOWLEDGEMENTS

Acknowledgments were conveyed to the Research and Community Service Institute of the University of
Sriwijaya University, which provided research funding for Higher Education Competitive Grants based on Agreement / Contract 0149.032 / UN9 / SB3.LP2M.PT / 2019 with the chairman of LPPM, on 27 June 2019

REFERENCES

[1] Oregon State University, “Analysis Techniques: Flood Analysis Example with Daily Data (Log-Pearson Type III Distribution),” Streamflow Eval. watershed Restor. Plan. Des., pp. 2002–2005, 2005.

[2] S. Stanchi et al., “Soil erosion in an avalanche release site (Valle d’Aosta: Italy): Towards a winter factor for RUSLE in the Alps,” Nat. Hazards Earth Syst. Sci., 2014.

[3] A. Jordán et al., “Wettability of ash conditions splash erosion and runoff rates in the post-fire,” Sci. Total Environ., vol. 572, 2016.

[4] D. D. Prayuda, “Temporal and spatial analysis of extreme rainfall on the slope area of Mt. Merapi,” Civ. Eng. Forum, vol. XXI, no. September, pp. 1285–1290, 2012.

[5] C. A. Bana e Costa, P. Antão da Silva, and F. Nunes Correia, Multicriteria evaluation of flood control measures: The case of Ribeira do Livramento, vol. 18, no. 3. 2004.

[6] J. Liu, W. Liu, and K. Zhu, “Throughfall kinetic energy and its spatial characteristics under rubber-based agroforestry systems,” Catena, vol. 161, 2018.

[7] Department of Public Works, > SPECIFICATIONS For: I STANDARD, no. September. 1986.

[8] A. Amazirh et al., “Modified Penman–Monteith equation for monitoring evapotranspiration of wheat crop: Relationship between the surface resistance and remotely sensed stress index,” Biosyst. Eng., vol. 164, no. September, pp. 68–84, 2017.

[9] P. Panagos et al., “The new assessment of soil loss by water erosion in Europe,” Environ. Sci. Policy, vol. 54, 2015.

[10] C. D. Cheng, S. J. Cheng, J. C. Wen, and J. H. Lee, “Time and flow characteristics of component hydrographs related to rainfall-streamflow observations,” J. Hydrol. Eng., vol. 18, no. 6, pp. 675–688, 2013.

[11] S. Ali et al., “Planting patterns and deficit irrigation strategies to improve wheat production and water use efficiency under simulated rainfall conditions,” Front. Plant Sci., vol. 8, no. August, 2017.

[12] S. Sulianto, M. Bisri, L. Limantara, and D. Sisinggih, “Performance of The Dispin Models with Automatic Parameter Calibration on The Transformation of Rainfall to Runoff Data,” Civ. Environ. Sci., vol. 002, no. 02, pp. 084–094, 2019.