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SECONDARY CHANNEL PLANNING TECHNICAL ANALYSIS BATANG ALAI, BARABAI, SOUTH KALIMANTAN

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ABSTRACT

The Batang Alai Irrigation Area has a potential area of ± 8000Ha, located to the left and right of the Batang Alai river, where 5000Ha is to the left 3000Ha to the right of the river. In this area, a study was carried out on the Analysis of Calculation of Water Needs in fields on the Secondary Profile of the Tanah Alang Habang Channel. Research and calculation will be carried out on the secondary channel profile. This research and analysis are done to determine the performance of secondary channels in irrigating water needs in paddy fields. Whereas in the current era, the government has a goal for food self-sufficiency. So research and calculations are carried out so that agriculture can know the discharge of the channel that can rinse, and the solution so that the flow of water in the channel can irrigate rice fields to the maximum.

The research method used was the Irrigation Planning Criteria published by the Ministry of Public Works of the Republic of Indonesia and the Penman Method to obtain evapotranspiration value. The initial step in writing this thesis is the analysis of Rainfall Hydrology from Batang Alai and Batu Tangga Station with 29 years of data from 1978–2006, evapotranspiration calculations calculating irrigation water requirements to determine the dimensions of irrigation channels.

Based on the analysis of the calculation of water requirements for Group I Planting Patterns (Penman Method), the following results were obtained: Water demand for the biggest corn plant in June was 0,722 lt/sec/ha while the smallest in April was 0,254 lt / sec / ha . The biggest water demand for Variety I Rice in October was 1,302 lt/sec/ha while the smallest in February was 0,165 lt/sec/ha. The highest water demand for Rice Variety II in May was 1,120 lt/sec/ha while the smallest in August was 0,671 lt/sec/ha. Secondary Channel Tanah Habang: 1) B.BT.2–BTh.1, Wet Cross-sectional Area (Ao) = 3,04 m2, Wet Section Cross-Section (P) = 4,78 m, Hydraulic Radius (R) = 0,64 m and Channel Discharge (Q) = 1,393 m3/s. 2) BTh.1–BTh.2, Wet Cross-sectional Area (Ao) = 2,93 m2, Wet Cross Section (P) = 4,70 m, Hydraulic Radius (R) = 0,62 m and Channel Discharge (Q) = 1,336 m3/s. 3) BTh.2–BTh.3, Wet Cross-sectional Area (Ao) = 1,14 m2, Wet Section Cross-section (P) = 2,89 m, Hydraulic Radius (R) = 0,39 m and Channel Discharge (Q) = 0,345 m3/s. 4) BTh.3–BTh.4, Wet Cross-sectional Area (Ao) = 1,04 m2, Wet Section Cross-section (P) = 2,77 m, Hydraulic Radius (R) = 0,38 m and Channel Discharge (Q) = 0,313 m3/s. 5) BTh.4–Kehakan, Wet Cross-sectional Area (Ao) = 0,76 m2, Wet Section Cross-Section (P) = 2,36 m, Hydraulic Radius (R) = 0,32 m and Channel Discharge (Q) = 0,217 m3/s.

***Keywords**:* Irrigation, irrigation channels in Batang Alai Barabai, irrigation water needs.

1. INTRODUCTION

To support food security improve-ment through increased agricultural production of food crops, rice, efforts are made to manage and evaluate water availability. The Batang Alai Irrigation Area location in the Central Hulu Sungai Regency. Geographically, Central Hulu Sungai Regency is the location at ± 02° 27 'latitude - 02 ° 46' latitude and 115° 5 'east longitude - 115° 31' east longitude. Administratively, Central Hulu Sungai Regency has 1,770 km2 consisting of 11 (eleven) districts. The Batang Alai Irrigation Area has a potential area of ± 8000Ha, located on the left and right of the Batang Alai River, where 5000Ha are on the left 3000Ha, the right of the river. From the potential mentioned above, the irrigation field irrigated by water availability is ± 5000Ha, namely 3000Ha on the left of the river and 2000Ha on the right. For the Irrigation Area, a weir building on the Batang Alai river, located in Batu Tangga Village, Batang Alai Utara District, Central Hulu Sungai Regency. The Batang Alai Irrigation Area has Primary, Secondary, and Tertiary Channels. In this area, he conducted a study on the Analysis of the Calculation of Water Needs in Rice Fields in the Secondary Profile of the Habang Batang Alai Soil Canal. On the secondary channel, carried the profile research and calculations. Carried study and analyses to determine secondary channels' performance in irrigated rice fields and determine channel discharge and solutions so that the water discharge in the channel can maximally irrigate rice fields.

2. LITERATURE REVIEW

2.1 Definition Of Irrigation

Irrigation is generally an effort to bring in water by making buildings and channels to drain water for agricultural purposes, distributing water to rice fields or fields in an orderly manner, and removing what is no longer needed after water is required. With the best possible. According to (Endah Pipin T. Dan Ir. Soetjipto, 1992: 4 'in Eka Yuliana, 2011: 7'), Irrigation is generally defined as the use of water in the soil to provide the fluids needed for the growth of plants.

2.2 Irrigation Network

The irrigation network is channels, buildings, and supporting structures that become a unit required for the provision, distribution, provision, use, and disposal of irrigation water (PP No. 20 of 2006 'in Eka Yuliana, 2011: 7').

Tabel 2.1 Classification of Irrigation Networks

Jaringan Irigasi	Klasifikasi Jaringan Irigasi		
	Teknis	Semi Teknis	Sederhana
Bangunan utama	Bangunan permanen	Bangunan permanen atau semi permanen	Bangunan sementara
Kemampuan dalam mengukur dan mengatur debit	Baik	Sedang	Tidak mampu mengatur/mengukur
Jaringan saluran	Saluran pemberi dan pembuang terpisah	Saluran pemberi dan pembuang tidak sepenuhnya terpisah	Saluran pemberi dan pembuang menjadi satu
Petak tersier	Dikembangkan sepenuhnya	Belum dikembangkan atau densitas bangunan tersier	Belum ada jaringan terpisah yang dikembangkan
Efisiensi secara keseluruhan	Tinggi; 50 - 60%	Sedang; 40 - 50%	Kurang; < 40%
Ukuran	Tak ada batasan	Sampai 2.000 ha	Tak lebih dari 500 ha
Jalan Usaha Tani	Ada keseluruh areal	Hanya sebagian	Cenderung tidak ada
Kondisi O & P	- Ada instansi yang menangani - Dilaksanakan teratur	Belum teratur	Tidak ada O &P

Source: Irrigation Planning Standards KP-01 Chapter I page 6 2.3

2.3 Irrigation Water Needs

The need for irrigation water (IR) is an estimate of the amount of water for irrigation based on factors of the type of plant, type of soil, method of providing water, method of soil cultivation, depth of rainfall, planting schedule, climate, and loss of water in the range of plant growth processes. The amount of water for irrigation in rice fields/bunds formula as follows:

$I_R = (P + L + U) - R_e$

or $I_R = NFR = W - R_e$

$W = (P + L + U)$

Where:

IR = Need for irrigation water (mm)

P = water loss due to percolation

L = Providing water during tillage

U = Consumptive Use, necessity water for plants

Re = Effective Rainfall

NFR = Net Field Requirement

1) Consumptive Water Needs

Water demand is related to the problem of available water on the surface and in the ground.

H.L. Penman working for the Rothamsed Experimental Station, Harpenden, England, wrote the free water evaporation theory in 1948. The combination theory is base on conditions energy balance (radiation balance) and vapor gradient, which states that it requires heat with a slope to move steam after evaporation is generating. In many representations of the Penman Method (in Cuenca and Nicholson, 1982), the original form of the equation converted into SI (metric) units into the following equation:

$$ET_t = \frac{\Delta}{\Delta + \gamma}(R_n - G) + \frac{\Delta}{\Delta + \gamma} f_{(u)} \Delta_e$$

Where:

ETt = reference evapotranspiration for grass plants,

$\frac{\Delta}{\Delta+\gamma}$ = elevation weighting function and temperature

Δ = slope of the vapor pressure curve saturation & temperature at Tmean

γ = psychometric constant

Rn = net radiation, equivalent to mm / day

G = ground heat flow, equivalent mm / day

f(u)= function of wind speed, km/day at measuring height

Δe = deficit vapor pressure = (es - ea), in mb

2) Monthly Crop Coefficient

The crop coefficient (Kc) can also refer to as the Seasonal Consumptive Use Coefficient. The consumptive use coefficient is measured and associated with temperature data and seasonal plant growth.

3) Percolation (P)

Percolation is the downward movement of water from the aeration zone (not saturated with water) towards the water-saturated zone's surface. If the percolation continues for a long time, an unsaturated layer will initially change to a temporary semi-impermeable layer, causing extra storage in the aeration zone.

4) Soil Processing (L)

Soil processing (L) from the word land preparation – puddling work means that the surface of the dry rice field is making so that it becomes a mud puddle. Requires a certain amount of water depending on the soil layer's depth to be wetted, the soil's porosity, the water level to soak the soil, evaporation from surface water, and the center of per-collation.

5) Effective Rainfall (Re)

Adequate rainfall is the amount of rain (R80) from the recorded monthly rainfall with an 80% probability of being matched or exceeded. That means that eight events and ten events are equaled or exceeded.

6) Irrigation Efficiency (e)

The efficiency value for various distribution conditions is to consider the water loss factor during water construction operations and water transportation in tertiary, secondary, and main channels. Loss of water in canals and tertiary structures: ± 10%, efficiency (e1) = 0.90, Loss of water in channels and secondary structures: ± 10%, efficiency (e2) = 0.90, Loss of water in the canal and main building: ± 20%, efficiency (e3) = 0.80.Loss of water in canals and tertiary structures: ± 10%, efficiency (e1) = 0.90 Loss of water in channels and secondary structures: ± 10%, efficiency (e2) = 0.90 Loss of water in the canal and main building: ± 20%, efficiency (e3) = 0.80.

7) CROPPING Patern

The cropping pattern is an arrangement of agricultural land use (in this case, rice fields or all of the area planted with one, two, or three variants of plant types within the available period of 12 months.

2.4 Channel Planning

1) Discharge Plan

$Q = V \cdot A$ or $Q = \frac{NFR}{e} \cdot A$

Where:

Q = Discharge Plan (l / s)

V = flow velocity (m / s)

A = Area to be diary (ha)

NFR = The need for clean water in the fields (l / sec/ha)

e = overall efficiency (65%)

2) Channel Calculation

Channel Calculation For irrigation water, trapezoidal section channels are the most commonly used and economical. Ground drains are widely used for irrigation channels because they are usually much cheaper than concrete or concrete channels.

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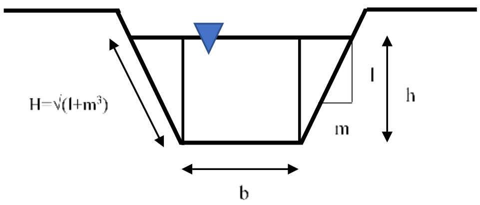


Figure 2.1. Channel cross-section

According to the Guidelines and Criteria for Irrigation Technical Planning, 1980, minimum velocity V = 0.2 m / s, the minimum bottom line width is 30 cm.

Table 2.2 Guard Height -Freeboard

Q (m3/det)	F (m)
0,0 – 0,3	0,3
0,3 – 0,5	0,4
0,5 – 1,5	0,5
1,5 – 15	0,6
15,0 – 25,0	0,75
> 25,0	1

Source: Pedoman dan Kriteria Perencanaan Teknis Irigasi, 1980

Hydraulic calculation of trapezoidal filler;

$Q = V \cdot A \Rightarrow A = Q/A$

$\Rightarrow A = (b + m \cdot h) \cdot h$

$P = b + 2h\sqrt{1 + m^2}$

$R = A/P$

$V = k \cdot R^{2/3} \cdot I^{1/2} \Rightarrow I = \left(\frac{k \cdot V}{R^{2/3}}\right)^2$

Where:

Q = Channel discharge (l / s)

V = flow velocity (m / s)

A = Wet cross-sectional area (ha)

P = wet circumference (m)

R = hydraulic radius (m)

I = slope of the channel

k = Koef. Stickler roughness

3) Stability Calculation

Stability against erosion can be control using the drag force on the bottom and ducts of the channel, that is:

a) Basic channel

$(\tau_d = \rho \cdot g \cdot R \cdot I) < \bar{\tau}_d$

Where :

$\bar{\tau}_d$ = allowable shear force on basic channel

τ_d = shear force that occurs on channel

ρ = density of water = 1000 kg/m^3

R = hydraulic radius (m)

I = slope of the channel

b) Talud channel

$$\bar{\tau}'_t = \tau_d \cdot \cos\varphi \sqrt{1 - \frac{\tan^2\varphi}{\tan^2\theta}}$$

$(\tau_t = 0{,}75 \cdot \rho \cdot g \cdot R \cdot I) < \bar{\tau}'_t$

Where:

$\bar{\tau}'_t$ = allowable shear force on talud

τ_{dt} = shear force that occurs on talud τ_d = shear force that occurs on basic channel

φ = slope of the talud

θ = inner sliding angle

c) Embankment

Controlled against the seepage line on the embankment

3. RESEARCH METHODOLOGY

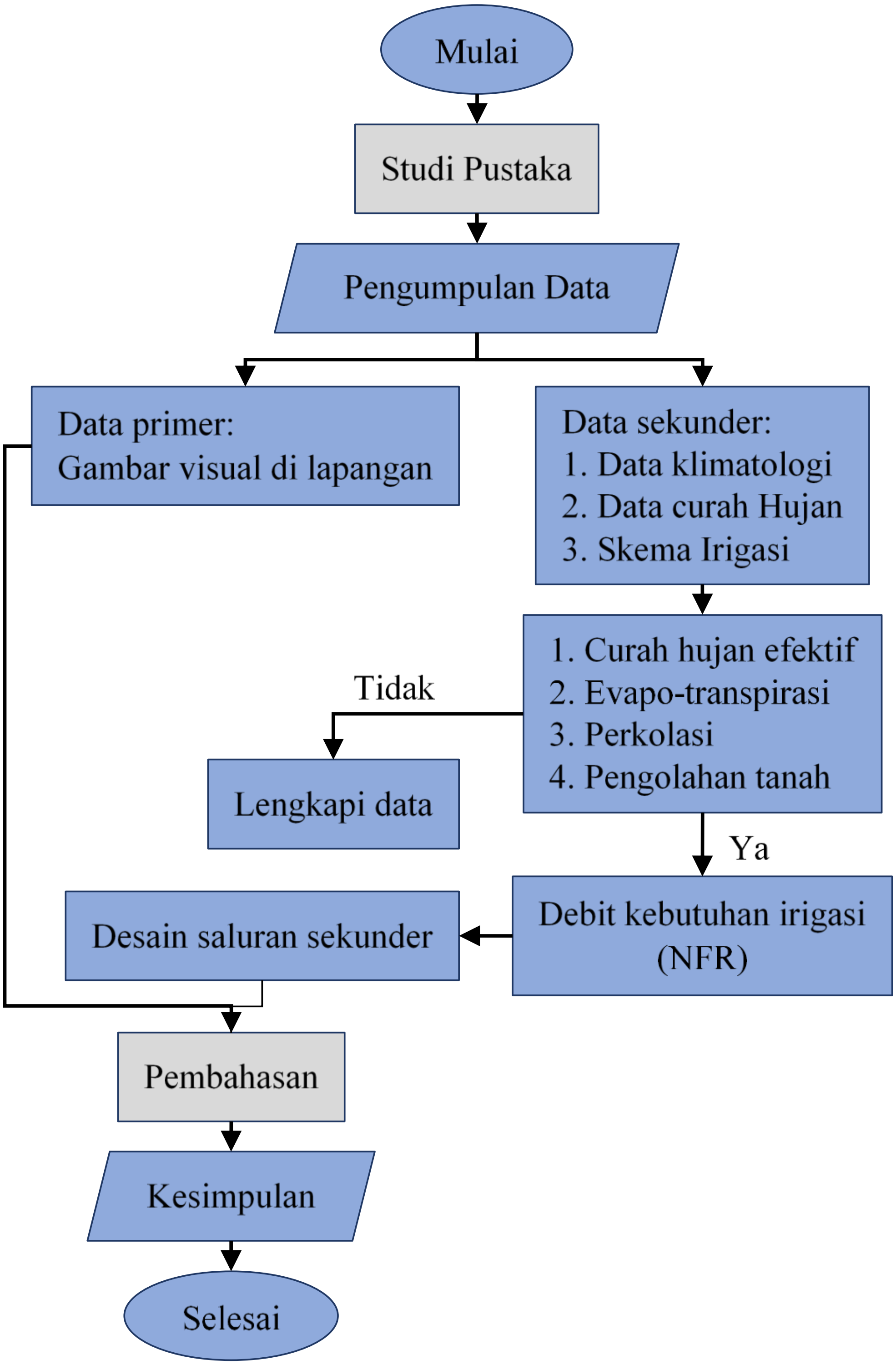


Figure 3.1 Flowchart of Final Project Writing

The preparatory stages carried out include a literature study and a preliminary survey in visual field data collection at the job site. Data collection, in the form of secondary data and existing literature, can support the preparation of the final project. The secondary data is in the way of irrigation network schemes, topographic maps of D.I. Trunk Alai, hydrological data (rainfall), and climatology (evapotranspiration). Processing and verification of data is a process of processing and validating secondary data during the calculation process.

4. RESULTS AND DISCUSSION

4.1 Study Sites

The research was conduct in the Batang Alai Irrigation Area, located in Central Hulu Sungai Regency, South Kalimantan Province. The study locations include the Batang Alai Irrigation Area in the Tanah Habang Secondary Canal.

4.2. Climatological Data

The Hydro - Meteorological Station around the project site that can be using is the Kahakan Hydro-Meteorological Station, whose management is under the Hydrology Unit's supervision of the South Borneo Regional Office for Regional Infrastructure. Climate Data required for calculation analysis includes air temperature, wind speed, relative humidity, and sun brightness during the recording period 1984 - 1996.

1) Air Temperature

The mean monthly temperature was 27.3 ºC. The temperature fluctuation is relatively small, with the smallest value in January 26.8 ºC and the highest in October 28.3 ºC.

2) Relative Humidity

The monthly average relative humidity was 80.2%. The sluggishness fluctuation is relatively not too big and is relatively the same throughout the year, where the lowest value was 71.6% in August and the highest was in January 86.1%.

3) Long exposure to the sun

Average monthly sunshine is 47.9%, with the maximum duration in August is 66.9% and the minimum peroid in November is 33.2%.

4) Wind Velocity

The monthly average wind speed is 21.82 m/det, with the smallest value in May 18.25 m/det and the most considerable amount in October 26.63 m/det.

5) Rainfall Calculation

Table 4.1. Recapitulation of Half Monthly Rainfall 1978 - 2006 Kahakan Hydro-Meteorological Station

No	Tahun	Januari		Februari		Maret		April		Mei		Juni		Juli		Agustus		September		Oktober		November		Desember	
		I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
1	1978	176,7	108,0	184,0	116,3	15,4	15,8	14,6	7,2	5,6	30,3	5,0	10,0	6,0	16,1	11,1	13,0	6,3	3,2	7,5	10,4	61,9	19,8	9,7	15,6
2	1979	107,0	103,0	190,0	315,0	99,0	74,0	145,0	118,0	125,0	84,0	156,0	147,0	84,0	23,0	83,0	38,0	93,0	65,0	9,0	95,0	254,0	131,0	199,5	376,0
3	1980	163,0	201,0	64,0	267,0	73,0	105,0	195,0	136,0	137,0	85,0	52,0	107,0	31,0	126,0	14,0	61,0	14,0	21,0	58,0	190,0	56,0	217,0	170,0	114,0
4	1981	83,0	65,0	125,0	122,0	104,0	146,0	137,0	176,0	156,0	68,0	90,0	81,0	140,0	101,0	42,0	39,0	66,0	126,0	140,0	102,0	115,0	136,0	177,0	147,0
5	1982	279,0	199,0	153,0	84,0	205,0	181,0	283,0	85,0	160,0	51,0	69,0	36,0	8,0	3,0	55,0	8,0	0,0	70,0	62,0	28,0	108,0	130,0	156,0	191,0
6	1983	241,0	160,0	44,0	43,0	99,0	17,0	28,0	121,0	114,0	79,0	70,0	122,0	77,0	73,0	45,0	49,0	115,0	27,0	34,0	113,0	186,0	132,0	130,0	79,0
7	1984	81,0	247,0	288,0	72,0	110,0	81,0	147,0	163,0	147,0	135,0	94,0	35,0	135,0	106,0	26,0	62,0	123,0	84,0	280,0	14,0	59,0	254,0	177,0	127,0
8	1985	267,0	46,0	195,0	8,0	171,0	159,0	84,0	108,0	81,0	143,0	157,0	26,0	47,0	65,0	97,0	56,0	21,0	93,0	32,0	21,0	108,0	116,0	97,0	92,0
9	1986	106,0	303,0	128,0	168,0	206,0	152,0	172,0	114,0	155,0	80,0	24,0	23,0	52,0	114,0	0,0	0,0	81,0	93,0	108,0	65,0	209,0	141,0	73,0	164,0
10	1987	188,0	365,0	0,0	0,0	0,0	0,0	0,0	0,0	233,0	250,0	130,0	13,0	15,0	6,0	12,0	49,0	0,0	32,0	20,0	42,0	132,0	59,0	88,0	157,0
11	1988	347,0	324,0	156,0	112,0	226,0	147,0	63,0	173,0	302,0	140,0	174,0	126,0	133,0	165,0	89,0	36,0	204,0	161,0	180,0	171,0	290,0	280,0	125,0	179,0
12	1989	147,0	119,0	145,0	127,0	214,0	187,0	216,0	185,0	109,0	71,0	87,0	31,0	187,0	123,0	27,0	123,0	60,0	121,0	103,0	282,0	185,0	198,0	154,0	173,0
13	1990	160,0	95,0	156,0	179,0	140,0	121,0	121,0	77,0	157,0	79,0	18,0	13,0	39,0	105,0	121,0	20,0	59,0	41,0	16,0	71,0	60,0	247,0	121,0	99,0
14	1991	68,0	245,0	143,0	90,0	120,0	315,0	358,0	94,0	118,0	103,0	108,0	19,0	15,0	19,0	9,0	0,0	27,0	29,0	31,0	58,0	103,0	163,0	236,0	213,0
15	1992	130,0	86,0	20,0	115,0	137,0	84,0	121,0	77,0	166,0	194,0	63,0	89,0	47,0	96,0	42,0	31,0	110,0	18,0	116,0	194,0	48,0	282,0	160,0	233,0
16	1993	153,0	256,0	60,0	43,0	154,0	264,0	82,0	118,0	122,0	50,0	121,0	67,0	50,0	87,0	36,0	79,0	10,0	40,0	65,0	97,0	90,0	92,0	272,0	193,0
17	1994	246,0	195,0	270,0	84,0	154,0	264,0	82,0	118,0	122,0	50,0	170,0	84,0	226,0	2,0	143,0	27,0	18,0	0,0	95,0	26,0	35,0	52,0	223,0	175,0
18	1995	197,0	140,0	114,0	94,0	81,0	132,0	144,0	226,0	165,0	56,0	198,0	116,0	125,0	53,0	142,0	52,0	38,0	69,0	157,0	79,0	131,0	199,0	156,0	264,0
19	1996	218,0	194,0	228,0	175,0	98,0	127,0	72,0	138,0	57,0	109,0	146,0	50,0	0,0	0,0	69,0	100,0	123,0	74,0	0,0	0,0	0,0	0,0	0,0	0,0
20	1997	157,0	127,0	0,0	0,0	221,0	32,0	0,0	0,0	73,0	20,0	0,0	0,0	0,0	0,0	0,0	28,0	0,0	0,0	12,0	36,0	124,0	40,0	33,0	193,0
21	1998	26,0	91,0	20,0	23,0	21,0	32,0	51,0	39,0	97,0	194,0	114,0	254,0	203,0	173,0	53,0	157,0	48,0	168,0	189,0	181,0	256,0	166,0	240,0	196,0
22	1999	297,0	270,0	123,0	200,0	267,0	86,0	112,0	86,0	136,0	107,0	23,0	22,0	40,0	21,0	23,0	85,0	43,0	37,0	46,0	188,0	265,0	134,0	302,0	317,5
23	2000	251,0	59,0	179,0	207,0	37,0	109,0	182,0	49,0	58,0	169,0	82,0	178,0	48,0	65,0	135,0	17,0	7,0	55,0	96,0	209,0	108,0	116,0	97,0	92,0
24	2001	172,0	126,0	204,0	73,0	163,0	30,0	193,0	72,0	150,0	143,0	118,0	118,0	7,0	21,0	11,0	1,0	36,0	130,0	79,0	153,0	54,0	224,0	212,0	262,0
25	2002	67,0	173,0	69,0	145,0	215,0	182,0	106,0	134,0	186,0	15,0	93,0	146,0	0,0	38,0	3,0	0,0	39,0	39,0	69,0	66,0	18,0	113,0	245,0	260,0
26	2003	100,0	147,0	160,0	203,0	155,0	162,0	149,0	107,0	83,0	23,0	70,0	92,0	44,0	22,0	26,0	125,0	17,0	130,0	118,0	207,0	176,0	382,0	216,0	129,0
27	2004	241,0	172,0	133,0	92,0	250,0	93,0	106,0	161,0	0,0	0,0	0,0	0,0	97,0	68,0	0,0	3,0	36,0	12,0	16,0	90,0	197,0	230,0	0,0	0,0
28	2005	166,0	367,0	224,0	213,0	152,0	190,0	177,0	211,0	213,0	156,0	133,0	136,0	151,0	103,0	53,0	50,0	0,0	0,0	0,0	0,0	0,0	0,0	209,0	224,0
29	2006	85,0	156,0	266,0	184,0	155,0	429,0	118,0	146,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rata-rata		169,6	177,2	139,3	122,6	139,4	135,1	126,2	111,7	125,1	92,6	88,4	73,8	69,2	61,9	47,1	45,1	48,1	59,9	73,7	96,2	118,2	146,7	147,5	160,9

Sourcer: BWS Kalimantan II

Tabel 4.2 Calculation of Effective Rainfall for Rice and Palawija

Periode (hari)		Januari		Februari		Maret		April		Mei		Juni		Juli		Agustus		September		Oktober		November		Desember	
		31		28		31		30		31		30		31		31		30		31		30		31	
		15	16	15	13	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16
No	P (%)	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
22	95,65%	106,0	108,0	69,0	73,0	99,0	81,0	82,0	77,0	83,0	50,0	52,0	22,0	15,0	19,0	11,1	13,0	10,0	21,0	16,0	28,0	56,0	92,0	97,0	99,0
21	91,30%	107,0	119,0	114,0	84,0	99,0	84,0	82,0	85,0	97,0	51,0	63,0	23,0	15,0	21,0	12,0	17,0	14,0	27,0	20,0	36,0	59,0	113,0	97,0	114,0
20	86,96%	130,0	126,0	123,0	84,0	104,0	86,0	84,0	86,0	109,0	56,0	69,0	26,0	31,0	21,0	14,0	20,0	17,0	29,0	31,0	42,0	60,0	116,0	121,0	127,0
19	82,61%	147,0	127,0	125,0	90,0	110,0	93,0	106,0	94,0	114,0	68,0	70,0	31,0	39,0	22,0	23,0	27,0	18,0	32,0	32,0	58,0	61,9	116,0	125,0	129,0
18	78,26%	153,0	140,0	128,0	92,0	120,0	105,0	106,0	107,0	118,0	71,0	70,0	35,0	40,0	23,0	26,0	28,0	21,0	37,0	34,0	65,0	90,0	130,0	130,0	147,0
17	73,91%	157,0	147,0	133,0	94,0	137,0	109,0	112,0	108,0	122,0	79,0	82,0	36,0	44,0	38,0	26,0	31,0	27,0	39,0	46,0	66,0	103,0	131,0	154,0	157,0
16	69,57%	160,0	156,0	143,0	112,0	140,0	121,0	118,0	114,0	122,0	79,0	87,0	50,0	47,0	53,0	27,0	36,0	36,0	40,0	58,0	71,0	108,0	132,0	156,0	164,0
15	65,22%	163,0	160,0	145,0	115,0	152,0	127,0	121,0	118,0	125,0	80,0	90,0	67,0	47,0	65,0	36,0	38,0	36,0	41,0	62,0	79,0	108,0	134,0	156,0	173,0
14	60,87%	166,0	172,0	153,0	116,3	154,0	132,0	121,0	118,0	136,0	84,0	93,0	81,0	48,0	65,0	42,0	39,0	38,0	55,0	65,0	90,0	108,0	136,0	160,0	175,0
13	56,52%	172,0	173,0	156,0	122,0	154,0	146,0	137,0	118,0	137,0	85,0	94,0	84,0	50,0	68,0	42,0	49,0	39,0	65,0	69,0	95,0	115,0	141,0	170,0	179,0
12	52,17%	176,7	194,0	156,0	127,0	155,0	147,0	144,0	121,0	147,0	103,0	108,0	89,0	52,0	73,0	45,0	49,0	43,0	69,0	79,0	97,0	124,0	163,0	177,0	191,0
11	47,83%	188,0	195,0	160,0	145,0	155,0	152,0	145,0	134,0	150,0	107,0	114,0	92,0	77,0	87,0	53,0	50,0	48,0	70,0	95,0	102,0	131,0	166,0	177,0	193,0
10	43,48%	197,0	199,0	179,0	168,0	163,0	159,0	147,0	136,0	155,0	109,0	118,0	107,0	84,0	96,0	53,0	52,0	59,0	74,0	96,0	113,0	132,0	198,0	199,5	193,0
9	39,13%	218,0	201,0	184,0	175,0	171,0	162,0	149,0	138,0	156,0	135,0	121,0	116,0	97,0	101,0	55,0	56,0	60,0	84,0	103,0	153,0	176,0	199,0	209,0	196,0
8	34,78%	241,0	245,0	190,0	179,0	205,0	181,0	172,0	146,0	157,0	140,0	130,0	118,0	125,0	103,0	69,0	61,0	66,0	93,0	108,0	171,0	185,0	217,0	212,0	213,0
7	30,43%	241,0	247,0	195,0	184,0	206,0	182,0	177,0	161,0	160,0	143,0	133,0	122,0	133,0	105,0	83,0	62,0	81,0	93,0	116,0	181,0	186,0	224,0	216,0	224,0
6	26,09%	246,0	256,0	204,0	200,0	214,0	187,0	182,0	163,0	165,0	143,0	146,0	126,0	135,0	106,0	89,0	79,0	93,0	121,0	118,0	188,0	197,0	230,0	223,0	233,0
5	21,74%	251,0	270,0	224,0	203,0	215,0	190,0	193,0	173,0	166,0	156,0	156,0	136,0	140,0	114,0	97,0	85,0	110,0	126,0	140,0	190,0	209,0	247,0	236,0	260,0
4	17,39%	267,0	303,0	228,0	207,0	221,0	264,0	195,0	176,0	186,0	169,0	157,0	146,0	151,0	123,0	121,0	100,0	115,0	130,0	157,0	194,0	254,0	254,0	240,0	262,0
3	13,04%	279,0	324,0	266,0	213,0	226,0	264,0	216,0	185,0	213,0	194,0	170,0	147,0	187,0	126,0	135,0	123,0	123,0	130,0	180,0	207,0	256,0	280,0	245,0	264,0
2	8,70%	297,0	365,0	270,0	267,0	250,0	315,0	283,0	211,0	233,0	194,0	174,0	178,0	203,0	165,0	142,0	125,0	123,0	161,0	189,0	209,0	265,0	282,0	272,0	317,5
1	4,35%	347,0	367,0	288,0	315,0	267,0	429,0	358,0	226,0	302,0	250,0	198,0	254,0	226,0	173,0	143,0	157,0	204,0	168,0	280,0	282,0	290,0	382,0	302,0	376,0
Rerata		**200,4**	**208,8**	**174,2**	**153,0**	**169,0**	**168,9**	**155,9**	**136,1**	**152,4**	**115,7**	**113,4**	**94,8**	**90,3**	**80,3**	**61,1**	**59,0**	**62,8**	**77,5**	**95,2**	**123,5**	**148,8**	**185,6**	**185,2**	**199,4**
R_{80} (mm/periode)		**150,6**	**134,8**	**126,8**	**91,2**	**116,0**	**100,2**	**106,0**	**101,8**	**116,4**	**69,8**	**70,0**	**33,4**	**39,6**	**22,6**	**24,8**	**27,6**	**19,8**	**35,0**	**33,2**	**62,2**	**78,8**	**124,4**	**128,0**	**139,8**
Re Padi (70%) (mm/hari)		**7,03**	**5,90**	**5,92**	**4,91**	**5,41**	**4,38**	**4,95**	**4,75**	**5,43**	**3,05**	**3,27**	**1,56**	**1,85**	**0,99**	**1,16**	**1,21**	**0,92**	**1,63**	**1,55**	**2,72**	**3,68**	**5,81**	**5,97**	**6,12**
Re Palawija (50%) (mm/hari)		**5,02**	**4,21**	**4,23**	**3,51**	**3,87**	**3,13**	**3,53**	**3,39**	**3,88**	**2,18**	**2,33**	**1,11**	**1,32**	**0,71**	**0,83**	**0,86**	**0,66**	**1,17**	**1,11**	**1,94**	**2,63**	**4,15**	**4,27**	**4,37**

Source: Calculation results

4.3. Calculation of Evapotranspiration using the Modified Penman Method

Table 4.3 Temperature Relationship with ea, W and f (t) values

Suhu (ºC)	ea (m.bar)	W	1 - W	f (t)
		Elevasi 0 - 250 mdpl		
24,0	29,85	0,735	0,265	15,40
24,2	30,21	0,737	0,263	15,45
24,4	30,57	0,739	0,261	15,50
24,6	30,94	0,741	0,259	15,55
24,8	31,31	0,743	0,257	15,60
25,0	31,69	0,745	0,255	15,65
25,2	32,06	0,747	0,253	15,70
25,4	32,45	0,749	0,251	15,75
25,6	32,83	0,751	0,249	15,80
25,8	33,22	0,753	0,247	15,85
26,0	33,62	0,755	0,245	15,90
26,2	34,02	0,757	0,243	15,94
26,4	34,42	0,759	0,241	15,98
26,6	34,83	0,761	0,239	16,02
26,8	35,25	0,763	0,237	16,06
27,0	35,66	0,765	0,235	16,10
27,2	36,09	0,767	0,233	16,14
27,4	36,50	0,769	0,231	16,18
27,6	36,94	0,771	0,229	16,22
27,8	37,37	0,773	0,227	16,26
28,0	37,81	0,775	0,225	16,30
28,2	38,25	0,777	0,223	16,34
28,4	38,70	0,779	0,221	16,38
28,6	39,14	0,781	0,219	16,42
28,8	39,61	0,783	0,217	16,46
29,0	40,06	0,785	0,215	16,50

Sumber: Guide on Hydrologi, Ditjen PSDA, Dept PU, 1992

Table 4.4 The value of angot (Ra) in the evaporation equivalent and its relation to the latitude position

Bulan	Lintang Utara				Lintang Selatan				
	6	4	2	0	2	4	6	8	10
Januari	13,0	14,3	14,7	15,0	15,3	15,5	15,8	16,1	16,1
Februari	14,0	15,0	15,3	15,5	15,7	15,8	16,0	16,1	16,0
Maret	15,0	15,5	15,6	15,7	15,7	15,6	15,6	15,5	15,3
April	15,1	15,5	15,3	15,3	15,1	14,9	14,7	14,4	14,0
Mei	15,3	14,9	14,6	14,4	14,1	13,8	13,4	13,1	12,6
Juni	15,0	14,4	14,2	13,9	13,5	13,2	12,8	12,4	12,6
Juli	15,1	14,6	14,3	14,1	13,7	13,4	13,1	12,7	11,8
Agustus	15,3	15,1	14,9	14,8	14,5	14,3	14,0	13,7	12,2
September	15,1	15,3	15,3	15,3	15,2	15,1	15,0	14,9	13,3
Oktober	15,7	15,1	15,3	15,4	15,5	15,6	15,7	15,8	14,6
November	14,8	14,5	14,8	15,1	15,3	15,5	15,8	16,0	15,6
Desember	14,6	14,1	14,4	14,8	15,1	15,4	15,7	16,0	16,0
Rerata	**14,8**	**14,9**	**14,9**	**14,9**	**14,9**	**14,8**	**14,8**	**14,7**	**14,2**
Minimum	**13,0**	**14,1**	**14,2**	**13,9**	**13,5**	**13,2**	**12,8**	**12,4**	**11,8**
Maksimum	**15,7**	**15,5**	**15,6**	**15,7**	**15,7**	**15,8**	**16,0**	**16,1**	**16,1**

Source: Guide on Hydrologi, Ditjen PSDA, Dept PU, 1992

Table 4.5 Relationship between eas for various RH states

ea (m.bar)	RH							
	55	60	65	70	75	80	85	90
29,50	16,23	17,70	19,18	20,65	22,13	23,60	25,08	26,55
30,25	16,64	18,15	19,66	21,18	22,69	24,20	25,71	27,21
30,50	16,78	18,30	19,83	21,35	22,88	24,40	25,93	27,44
30,75	16,91	18,45	19,99	21,53	23,06	24,60	26,14	27,67
31,00	17,05	18,60	20,15	21,70	23,25	24,80	26,35	27,88
31,25	17,19	18,75	20,31	21,88	23,44	25,00	26,56	28,10
31,50	17,33	18,90	20,48	22,05	23,63	25,20	26,78	28,33
31,75	17,46	19,05	20,64	22,23	23,81	25,40	26,99	28,55
32,00	17,60	19,20	20,80	22,40	24,00	25,60	27,20	28,77
32,25	17,74	19,35	20,96	22,58	24,19	25,80	27,41	28,99
32,50	17,88	19,50	21,13	22,75	24,38	26,00	27,63	29,22
32,75	18,01	19,65	21,29	22,93	24,56	26,20	27,84	29,44
33,00	18,15	19,80	21,45	23,10	24,75	26,40	28,05	29,66
33,25	18,29	19,95	21,61	23,28	24,94	26,60	28,26	29,88
33,50	18,43	20,10	21,78	23,45	25,13	26,80	28,48	30,11
33,75	18,56	20,25	21,94	23,63	25,31	27,00	28,69	30,33
34,00	18,70	20,40	22,10	,23,8	25,50	27,20	28,90	30,55
34,25	18,84	20,55	22,26	23,98	25,69	27,40	29,11	30,77
34,50	18,98	20,70	22,43	24,15	25,88	27,60	29,33	31,00
34,75	19,11	20,85	22,59	24,33	26,06	27,80	29,54	31,22
35,00	19,25	21,00	22,75	24,50	26,25	28,00	29,75	31,44
35,25	19,39	21,15	22,91	24,68	26,44	28,20	29,96	31,66
35,50	19,53	21,30	23,08	24,85	26,63	28,40	30,18	31,89
35,75	19,66	21,45	23,24	25,03	26,81	28,60	30,39	32,11
36,00	19,80	21,60	23,40	25,20	27,00	28,80	30,60	32,33
36,25	19,94	21,75	23,56	25,38	27,19	29,00	30,81	32,55
36,50	20,08	21,90	23,73	25,55	27,38	29,20	31,03	32,78
36,75	20,21	22,05	23,89	25,73	27,56	29,40	31,24	33,00
37,00	20,35	22,20	24,05	25,90	27,75	29,60	31,46	33,23
37,25	20,49	22,35	24,21	26,08	27,94	29,80	31,68	33,45
37,50	20,63	22,50	24,38	26,25	28,13	30,00	31,89	33,67
37,75	20,76	22,65	24,54	26,43	28,31	30,20	32,10	33,89
38,00	20,90	22,80	24,70	26,60	28,50	30,40	32,31	34,12
38,25	21,04	22,95	24,86	26,78	28,69	30,60	32,53	34,34
38,50	21,18	23,10	25,03	26,95	28,88	30,80	32,74	34,56
38,75	21,31	23,25	25,19	27,13	29,06	31,00	32,95	34,78
39,00	21,45	23,40	25,35	27,30	29,25	31,20	33,16	35,01

Source: Guide on Hydrologi, Ditjen PSDA, Dept PU, 1992.

Table 4.6. The Evaporation Value of the Penman-Modification Method

No	Parameter	Satuan	Bulan (mm)											
			Januari	Februari	Maret	April	Mei	Juni	Juli	Agustus	September	Oktober	November	Desember
1	Suhu Udara (T)	°C	26,81	26,88	27,25	27,12	27,08	27,08	27,08	27,63	27,98	28,30	27,73	26,66
2	Kelembaban Relatif (RH)	%	86,08	84,92	82,45	82,75	81,67	80,83	76,58	71,58	72,92	75,25	81,75	85,08
3	Penyinaran Matahari (n/N)	%	38,15	40,39	40,42	38,65	44,72	55,62	62,92	66,90	60,30	49,78	33,18	44,02
4	Kecepatan Angin (U)	m/det	20,83	20,30	18,99	18,69	18,25	22,96	21,63	24,82	24,28	26,63	22,84	21,65
5	Koordinat Lintang	° LS	2,36	2,36	2,36	2,36	2,36	2,36	2,36	2,36	2,36	2,36	2,36	2,36
6	Weighting faktor, tergantung suhu (w)	-	0,76	0,76	0,77	0,77	0,77	0,77	0,77	0,77	0,77	0,78	0,77	0,76
7	(1-w)	-	0,24	0,24	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,22	0,23	0,24
8	Angka Angot (R_A)	m.bar	15,34	15,34	15,34	15,34	15,34	15,34	15,34	15,34	15,34	15,34	15,34	15,34
9	Radiasi Gelombang Pendek (Rs)	mm/hari	6,99	7,18	7,18	7,03	7,54	8,44	9,04	9,37	8,83	7,96	6,58	7,48
10	Fungsi suhu, f (t)	-	16,06	16,08	16,15	16,12	16,12	16,12	16,12	16,23	16,30	16,36	16,25	16,03
11	Tekanan Uap Jenuh (ea)	m.bar	35,27	35,41	36,19	35,92	35,83	35,83	35,83	37,00	37,77	38,48	37,22	34,96
12	Tekanan Uap Sebenarnya (ed)	m.bar	30,35	30,08	29,84	29,72	29,26	28,96	27,44	26,48	27,54	28,96	30,43	29,74
13	(ea-ed)	m.bar	4,93	5,34	6,35	6,20	6,57	6,87	8,39	10,52	10,23	9,52	6,79	5,22
14	Fungsi tekanan uap, f (ed)	m.bar	0,10	0,10	0,10	0,10	0,10	0,10	0,11	0,11	0,11	0,10	0,10	0,10
15	Fungsi lama penyinaran, f (n/N)	-	0,44	0,46	0,46	0,45	0,50	0,60	0,67	0,70	0,64	0,55	0,40	0,50
16	Fungsi kecepatan angin, f (U)	-	0,33	0,32	0,32	0,32	0,32	0,33	0,33	0,34	0,34	0,34	0,33	0,33
17	Radiasi Gelombang Panjang (Rn1)	mm/hari	0,70	0,74	0,75	0,72	0,83	1,00	1,18	1,29	1,14	0,93	0,63	0,80
18	Evapotranspirasi potensial, Eto	mm/hari	3,99	4,10	4,18	4,09	4,35	4,81	5,16	5,49	5,24	4,83	3,96	4,23
19	Koef. Klimatologi	-	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10
20	Kebutuhan air tanaman, Etc	mm/hari	**4,38**	**4,51**	**4,60**	**4,50**	**4,78**	**5,29**	**5,68**	**6,03**	**5,76**	**5,31**	**4,36**	**4,65**
21	Kebutuhan air tanaman, Etc	mm/bulan	**135,90**	**126,30**	**142,49**	**135,01**	**148,20**	**158,66**	**176,12**	**187,05**	**172,87**	**164,53**	**130,68**	**144,11**

Source: Calculation results

4.4. Calculation of Water Requirements

1) Calculation of Water Needs for Common Varieties of Corn - 120 Days (1,000 Ha))

Table 4.7. Water Needs for Common Varieties of Corn - 120 Days (1,000 Ha)

NO	KETERANGAN		April		Mei		Juni		Juli		Agustus	
			1	2	1	2	1	2	1	2	1	2
			15	15	15	16	15	15	15	16	15	16
1	% tingkat tumbuh		4,20	4,20	20,80	20,80	46,70	46,70	71,70	71,70	92,50	92,50
2	Evapotranspirasi tetapan, Eto		55,24	55,24	58,67	62,58	64,90	64,90	69,73	74,38	82,27	87,76
3	Koefisien tanaman rerata, Kc		0,46	0,46	0,59	0,59	1,02	1,02	1,05	1,05	0,91	0,91
4	Etc = Kc. Eto	(mm)	25,41	25,41	34,62	36,92	66,20	66,20	73,22	78,10	74,87	79,86
5	U	(mm/hari)	1,69	1,69	2,31	2,31	4,41	4,41	4,88	4,88	4,99	4,99
6	Pengolahan tanah, L	(mm)	0	0	0	0	0	0	0	0	0	0
7	Perkolasi, P	(mm)	60	60	62	62	60	60	15	15	0	0
8	W = P + L + U	(mm)	61,69	61,69	64,31	64,31	64,41	64,41	19,88	19,88	4,99	4,99
9	Curah hujan, Ra	(mm)	155,91	136,14	152,41	115,73	113,41	94,82	90,27	80,32	61,10	58,95
10	1/Re = 1/Ra + 1/(1,3 W	(mm)	0,019	0,020	0,019	0,021	0,021	0,022	0,050	0,051	0,170	0,171
11	Curah hujan efektif, Re	(mm)	3,53	3,39	3,88	2,18	2,33	1,11	1,32	0,71	0,83	0,86
12	NFR = I = (W - Re)	(mm/setengah bulan)	58,16	58,30	60,43	62,13	62,08	63,30	18,56	19,17	4,16	4,13
13	I1 = @	(mm/hari)	4,847	4,858	5,036	4,854	5,173	5,275	1,547	1,498	0,347	0,323
14	I2 = @	(l/det Ha)	0,561	0,562	0,583	0,562	0,599	0,610	0,179	0,173	0,040	0,037
15	Qdr	(lt/det)	560,766	562,116	582,624	561,564	598,553	610,316	178,960	173,323	40,152	37,321
16	Qdr	(m3/det)	0,561	0,562	0,583	0,562	0,599	0,610	0,179	0,173	0,040	0,037

Source: Calculation results

2) Calculation of Water Needs for Rice Plants for Variety I - 140 Days (1,000 Ha)

Table 4.8 Water Requirements for Variety I - 140 Days (1,000 Ha)

NO	KETERANGAN		September		Oktober		November		Desember		Januari		Februari	
			1	2	1	2	1	2	1	2	1	2	1	2
			15	15	15	16	15	15	15	16	15	16	15	13
1	% tingkat tumbuh		-	-	10,70	10,70	32,90	32,90	54,30	54,30	76,40	76,40	93,60	93,60
2	Evapotranspirasi tetapan, Eto		86,44	86,44	79,61	84,92	65,42	65,42	66,38	70,81	65,75	70,13	67,66	58,64
3	Koefisien tanaman rerata, Kc		-	-	0,86	0,86	1,13	1,13	1,34	1,34	1,22	1,22	0,88	0,88
4	Etc = Kc. Eto	(mm)	-	-	68,46	73,03	73,92	73,92	88,95	94,89	80,22	85,56	59,54	51,60
5	U	(mm/hari)	-	-	4,56	4,56	4,93	4,93	5,93	5,93	5,35	5,35	3,97	3,97
6	Pengolahan tanah, L	(mm)	66,70	66,70	133,30	133,30	-	-	-	-	-	-	-	-
7	Perkolasi, P	(mm)	180,00	180,00	62,00	62,00	60,00	60,00	15,00	15,00	-	-	-	-
8	W = P + L + U	(mm)	246,70	246,70	199,86	199,86	64,93	64,93	20,93	20,93	5,35	5,35	3,97	3,97
9	Curah hujan, Ra	(mm)	62,77	77,50	95,18	123,50	148,81	185,59	185,20	199,39	200,44	208,82	174,23	152,97
10	1/Re = 1/Ra + 1/(1,3 W)	(mm)	0,019	0,016	0,014	0,012	0,019	0,017	0,042	0,042	0,149	0,149	0,200	0,200
11	Curah hujan efektif, Re	(mm)	0,92	1,63	1,55	2,72	3,68	5,81	5,97	6,12	7,03	5,90	5,92	4,91
12	NFR = I = (W - Re)	(mm/setengah bulan)	245,78	245,07	198,31	197,14	61,25	59,12	14,96	14,81	-	-	-	-
13	I1 = @	(mm/hari)	20,481	20,422	16,526	15,402	5,104	4,927	1,246	1,157	-	-	-	-
14	I2 = @	(l/det/Ha)	2,370	2,363	1,912	1,782	0,591	0,570	0,144	0,134	-	-	-	-
15	Qdr	(lt/det)	2.369,690	2.362,851	1.912,087	1.781,990	590,579	570,044	144,207	133,905	-	-	-	-
16	Qdr	(m3/det)	2,370	2,363	1,912	1,782	0,591	0,570	0,144	0,134	-	-	-	-

Source: Calculation results

3) Calculation of Rice II Common Varieties - 120 Days (500 Ha)

Table 4.9 Water Needs for Rice II Regular Varieties - 120 Days (500 Ha)

NO	KETERANGAN		April		Mei		Juni		Juli		Agustus	
			1	2	1	2	1	2	1	2	1	2
			15	15	15	16	15	15	15	16	15	16
1	% tingkat tumbuh		-	-	12,50	12,50	38,30	38,30	63,30	63,30	88,30	88,30
2	Evapotranspirasi tetapan, Eto		55,24	55,24	58,67	62,58	64,90	64,90	69,73	74,38	82,27	87,76
3	Koefisien tanaman rerata, Kc		-	-	0,89	0,89	1,20	1,20	1,37	1,37	1,00	1,00
4	Etc = Kc. Eto	(mm)	-	-	52,22	55,70	77,88	77,88	95,53	101,90	82,27	87,76
5	U	(mm/hari)	-	-	3,48	3,48	5,19	5,19	6,37	6,37	5,48	5,49
6	Pengolahan tanah, L	(mm)	66,70	66,70	133,30	133,30	-	-	-	-	-	-
7	Perkolasi, P	(mm)	180,00	180,00	62,00	62,00	60,00	60,00	15,00	15,00	-	-
8	W = P + L + U	(mm)	246,70	246,70	198,78	198,78	65,19	65,19	21,37	21,37	5,48	5,49
9	Curah hujan, Ra	(mm)	155,91	136,14	152,41	115,73	113,41	94,82	90,27	80,32	61,10	58,95
10	1/Re = 1/Ra + 1/(1,3 W)	(mm)	0,010	0,010	0,010	0,013	0,021	0,022	0,047	0,048	0,157	0,157
11	Curah hujan efektif, Re	(mm)	4,95	4,75	5,43	3,05	3,27	1,56	1,85	0,99	1,16	1,21
12	NFR = I = (W - Re)	(mm/setengah bulan)	241,75	241,95	193,35	195,73	61,93	63,63	19,52	20,38	4,33	4,28
13	I1 = @	(mm/hari)	20,146	20,162	16,112	15,291	5,160	5,303	1,627	1,592	0,36	0,33
14	I2 = @	(l/det/Ha)	2,331	2,333	1,864	1,769	0,597	0,614	0,188	0,184	0,04	0,04
15	Qdr	(lt/det)	1.165,453	1.166,397	932,104	884,595	298,532	306,766	94,106	92,108	20,86	19,33
16	Qdr	(m3/det)	1,165	1,166	0,932	0,885	0,299	0,307	0,094	0,092	0,02	0,02

Source: Calculation results

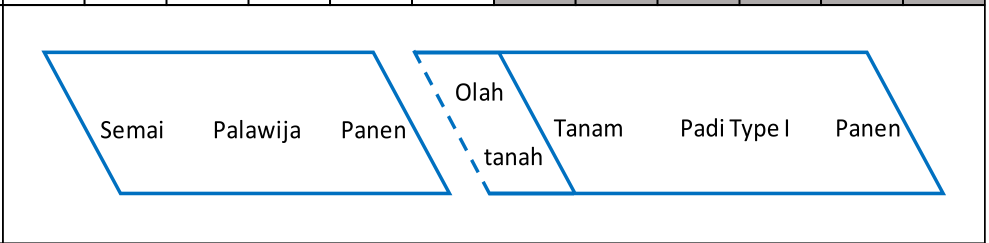
4) Calculation of Rice Variety I - 140 days (500 Ha)

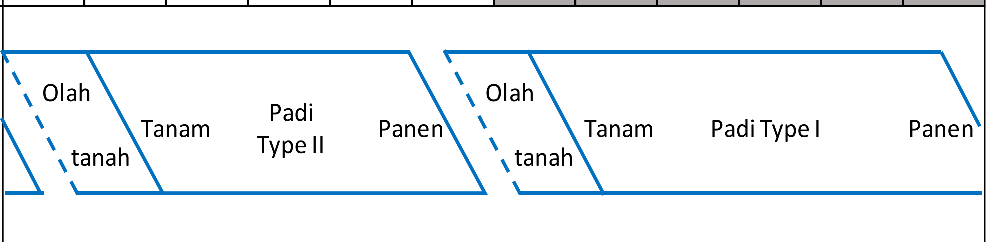
Table 4.10 Water Requirements for Rice Plants Variety I - 140 days (500 Ha)

NO	KETERANGAN		September		Oktober		November		Desember		Januari		Februari		Maret	
			1	2	1	2	1	2	1	2	1	2	1	2	1	2
			15	15	15	16	15	15	15	16	15	16	15	13	15	16
1	% tingkat tumbuh		-	-	5,00	5,00	21,40	21,40	42,90	42,90	65,00	65,00	86,40	86,40	97,90	97,90
2	Evapotranspirasi tetapan, Eto		86,44	86,44	79,61	84,92	65,42	65,42	66,38	70,81	65,75	70,13	67,66	58,64	68,94	73,54
3	Koefisien tanaman rerata, Kc		-	-	0,86	0,86	1,13	1,13	1,34	1,34	1,22	1,22	0,88	0,88	0,88	0,88
4	Etc = Kc. Eto	(mm)	-	-	68,46	73,03	73,92	73,92	88,95	94,89	80,22	85,56	59,54	51,60	60,67	64,72
5	U	(mm/hari)	-	-	4,56	4,56	4,93	4,93	5,93	5,93	5,35	5,35	3,97	3,97	4,04	4,04
6	Pengolahan tanah, L	(mm)	66,70	66,70	47,80	47,80	18,75	18,75	-	-	-	-	-	-	-	-
7	Perkolasi, P	(mm)	180,00	180,00	30,00	30,00	60,00	60,00	46,00	46,00	-	-	-	-	-	-
8	W = P + L + U	(mm)	246,70	246,70	82,36	82,36	83,68	83,68	51,93	51,93	5,35	5,35	3,97	3,97	4,04	4,04
9	Curah hujan, Ra	(mm)	62,77	77,50	95,18	123,50	148,81	185,59	185,20	199,39	200,44	208,82	174,23	152,97	168,95	168,91
10	1/Re = 1/Ra + 1/(1,3 W)	(mm)	0,019	0,016	0,020	0,017	0,016	0,015	0,020	0,020	0,149	0,149	0,200	0,200	0,196	0,196
11	Curah hujan efektif, Re	(mm)	0,92	1,63	1,55	2,72	3,68	5,81	5,97	6,12	7,03	5,90	5,92	4,91	5,41	4,38
12	NFR = I = (W - Re)	(mm/setengah bulan)	245,78	245,07	80,81	79,64	80,00	77,87	45,96	45,81	-	-	-	-	-	-
13	I1 = @	(mm/hari)	20,481	20,422	6,735	6,222	6,667	6,489	3,830	3,579	-	-	-	-	-	-
14	I2 = @	(l/det/Ha)	2,370	2,363	0,779	0,720	0,771	0,751	0,443	0,414	-	-	-	-	-	-
15	Qdr	(lt/det)	1.184,845	1.181,426	389,596	359,950	385,680	375,413	221,549	207,058	-	-	-	-	-	-
16	Qdr	(m3/det)	1,185	1,181	0,390	0,360	0,386	0,375	0,222	0,207	-	-	-	-	-	-

Source: Calculation results

From the calculation of the water requirements for rice and corn plants above, the Schematic of the Planting Pattern Group I (Penman Method) is obtained.

GOLONGAN POLA TANAM	APR	MEI	JUNI	JULI	AGT	SEP	OKT	NOV	DES	JAN	FEB	MAR
P-1 (1000 Ha)												
I = @ (l/det/ha)	1,58	1,77	2,40	1,67	1,43	4,73	3,69	1,16	0,28	0,00	0,00	0,00
Qdr (m³/det)	1,58	1,77	2,40	1,67	1,43	4,73	3,69	1,16	0,28	0,00	0,00	0,00

GOLONGAN POLA TANAM	APR	MEI	JUNI	JULI	AGT	SEP	OKT	NOV	DES	JAN	FEB	MAR
P-2 (500 Ha)												
I = @ (l/det/ha)	4,66	3,63	1,21	0,37	0,08	4,73	1,50	1,52	0,86	0,00	0,00	0,00
Qdr (m³/det)	4,66	3,63	1,21	0,37	0,08	4,73	1,50	1,52	0,86	0,00	0,00	0,00

Source: Calculation Results

Figure 4.1. Planting Scheme Group I (Penman Method)

4.5. Calculation of Carrier Channel Discharge for the Left Batang Alai Irrigation Network

No.	Nama Saluran	A (Ha)	Q (m^3/det)	B (m)	h (m)	Ao (m^2)	P (m)	R = Ao/p	Fb (m)	H (m)	m	K	V (m/s)	i	Keterangan
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	**Saluran Sekunder: Tanah Habang**														Q = Debit Rencana B = Lebar Dasar h = Kedalaman Air H = Tinggi Saluran m = Kemiringan Talud (1 : m) V = Kecepatan Aliran I = Kemiringan K = Koefisien Kekasaran
	B.BT.2 - BTh.1	729	1,393	1,70	1,09	3,04	4,78	0,64	0,60	1,69	1,00	40,00	0,46	0,000240	
	BTh.1 - BTh2	493	1,336	1,70	1,06	2,93	4,70	0,62	0,60	1,66	1,00	40,00	0,46	0.000245	
	BTh.2 - BTh.3	226	0,345	0,80	0,74	1,14	2,89	0,39	0,40	1,14	1,00	35,00	0,30	0.000260	
	BTh.3 - BTh.4	205	0,313	0,80	0,70	1,05	2,78	0,38	0,40	1,10	1,00	35,00	0,30	0.000270	
	BTh.4 - Kehakan	142	0,217	0,60	0,62	0,76	2,35	0,32	0,40	1,02	1,00	35,00	0,28	0.000300	

Source: Calculation Results

5. CONCLUSIONS AND SUGGESTIONS

5.1 Conclusion

Based on the results of the analysis of the calculation of water requirements for the Group I Planting Pattern (Penman Method) in the Batang Alai Irrigation Channel, Central Hulu Sungai Regency, South Borneo Province, the following conclusions are obtained:

1. Need for irrigation water in rice fields
   a. The largest water requirement for corn plants in June = 0.722 l / sec / ha, while the smallest in April = 0.254 l / sec / ha.
   b. The largest water requirement for rice variety I was in October = 1.302 l / sec / ha while the smallest was in February = 0.165 l / sec / ha.
   c. The largest water requirement for rice variety II was in May = 1,120 l / sec / ha while the smallest was in August = 0.671 l / s / ha.
2. Secondary channel dimensions to meet water needs:
   a. B.BT.2 – BTh.1. The bottom canal width (b) = 1.70 m, the bottom water level (h) = 1.09 m, the talud slope (m) = 1, the guard height (fb) = 0.6 m.
   b. BTh.1 – BTh.2, the width of the canal bottom (b) = 1.70 m, the bottom water level of the canal (h) = 1.06 m, the slope of the talud (m) = 1, height of guard (fb) = 0, 6 m.
   c. BTh.2 – BTh.3, Channel bottom width (b) = 0.8 m, Channel bottom water level (h) = 0.74 m, Talud slope (m) = 1, Guard height (fb) = 0, 4 m.

d. BTh.3 – BTh.4, Channel bottom width (b) = 0.8 m, Channel bottom water level (h) = 0.70 m, Talud slope (m) = 1, Guard height (fb) = 0.4 m.
e. BTh.4 - Keenness, the width of the canal bottom (b) = 0.6 m, the height of the bottom of the canal (h) = 0.62 m, the slope of the talud (m) = 1, the height of the guard (fb) = 0.4 m.

5.2. Suggestion

This calculation analysis only discusses the Batang Alai Irrigation Water Needs in Central Hulu Sungai Regency. Therefore it is necessary to carry out further development research, including :

1. It is necessary to disseminate information to the surrounding community about operating procedures and maintenance to minimize problems in the future.
2. There is a need for coordination between related institutions to cooperate with officials from associated agencies because steady coordination is a need in the O&M irrigation networks.

   This water requirement is useful as reference material in determining the length and width, and depth of the channel dimensions needed to plan and build irrigation network systems.

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