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EFFICIENCY OF IRRIGATION WATER ALLOCATION AT LODOYO BLITAR OF INDONESIA

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ABSTRACT

The aim of this study was to know the pattern of water irrigation allocation and to analyze water irrigation which was suitable with plantation water need. Location of study was at Lodoyo irrigation area, Blitar Regency of Indonesia. The methodologies consisted of empirical and theoritical approaches. The empirical approach was intended to analyze water irrigation need using Relative Second-crop Factor (FPR) method and the theoritical one was used to analyze plantation water demand which was developed to area water demand and irrigation water demand. Results were used to optimize the efficiency of irrigation water allocation. The results were consisted of Conversion Plantation Coefficient (KTK), Conversion of Cropping Area Factor (FLTK), Standard of Available Number (APK), Conversion of Plantation Factor (FTK)
KEYWORDS: irrigation water allocation, irrigation water demand, plantation water need.

INTRODUCTION

The issue of water resources uses and prediction had long been of scientific importance. Nowadays, it had to extremely consider social and political character [1]. This is due to the increasing some factors related to water consumption by the agriculture, population, industry, and other changes in global and climate change. Analysis of changes of water uses with the condiseration of possible economy in the country was used to forecast water need and availability. Therefore, estimation of water resources recently was associated with identifying socio-economic conditions and global climate changes.

Water resources management had changed from a focus applied to supply-kind solutions to integrated management [2]. Resources should be developed which could assist water utilities and government agencies to analyze accurately how much water was available and how much water was used in their region. Otherwise, it was to prepare the solution of how they could support water services in the future. However, water demand analysis were an economic comerstone of demand side water management, water supply planning, and the design of efficient water values [3]. The economy water demand reference was based on microlevel data that included the amount of water consumed by a water supplier over some period.

The challenge of how to plan water resources was one of the greatest issues. The challenge was due to recognition of flow requirements, increasing demand for multiple users, and others values. Water managers frequently faced the challenge general resource management as well as a low hudrological knowledge base, variability in hydrological system, complex cultural and social dynamics, and limited experience and capability among water agancies and stakeholders [4].

MATERIALS AND METHODS

Location of study was at Lodoyo Irrigation Area, Blitar Regency of Indonesia. Area irrigation number was 917 ha and it was supllied by Wlinga Raya Dam. Map of locatioan was as in Figure 1 below. Location of Irrigation Scheme was presented as in Table 1 below.

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Figure 1 Map of Location

This study was used descriptive apoproach. Data needed in this research was included ; (1) map of location, (2) map of topography, (3) exploitation scheme of Lodoyo Irrigation Area of Blitar, (4) soil texture for determinating percolation rate, (5) rainfall in the year of 2000 to 2010 (it was recorded from Lodoyo, Klampok, and Birowo rainfall stations), (6) discharge at tertiary channel (in the year of 2000 to 2010), (7) data of plantation and soil preparation in one year from 2000 to 2010, (8) data of climate in the year of 2000 to 2010 from Meteorology and Geophysical of Karangkates, and (9) ten daily cropping pattern in one year.

Table 1 Location of Irrigation Scheme

No	Name of structure	Nomen clature	Tertiary block	Irrigation area number	Administrative area		
				(ha)	Village	District	Regency
	Secondary channel						
	of Lodoyo Satu						
1	Taping structure	BLS. 1	LS. 1 ka	32	Jingglong	Sutojayan	Blitar
2	Taping structure	BLS. 2	LS. 2 ka	28	Jingglong	Sutojayan	Blitar
				20	Kalipang	Sutojayan	Blitar
				22	Sukorejo	Sutojayan	Blitar
			LS. 2 ki	5	Jingglong	Sutojayan	Blitar
3	Taping structure	BLS. 3	LS. 3 ka	5	Sukorejo	Sutojayan	Blitar
4	Taping structure	BLS. 4	LS. 4 ka	10	Sukorejo	Sutojayan	Blitar
5	Taping structure	BLS. 5	LS. 5 ka	66	Sukorejo	Sutojayan	Blitar
				4	Kalipang	Sutojayan	Blitar
				12	Sumberjo	Sutojayan	Blitar
6	Taping structure	BLS. 6	LS. 6 ka1	151	Sutojayan	Sutojayan	Blitar
			LS. 6 ka2	59	Sumberjo	Sutojayan	Blitar
7	Taping structure	BLS. 7	LS. 7 ka	36	Sumberjo	Sutojayan	Blitar
				55	Bacem	Sutojayan	Blitar
8	Taping structure	BLS. 8	LS. 8 ka	5	Bacem	Sutojayan	Blitar
9	Taping structure	BLS. 9	LS. 9 ka	54	Bacem	Sutojayan	Blitar
			LS. 9 ki	2	Bacem	Sutojayan	Blitar
10	Taping structure	BLS. 10	LS. 10 ka	40	Bacem	Sutojayan	Blitar
				17	Sutojayan	Sutojayan	Blitar
11	Taping structure	BLS. 11	LS. 11 ka	15	Sutojayan	Sutojayan	Blitar
12	Taping structure	BLS. 12	LS. 12 ka	62	Sutojayan	Sutojayan	Blitar
				35	Kedungbunder	Sutojayan	Blitar
				15	Pandanarum	Sutojayan	Blitar
13	Taping structure	BLS. 13	LS. 13 ka	22	Pandanarum	Sutojayan	Blitar
14	Taping structure	BLS. 14	LS. 14 ka	15	Pandanarum	Sutojayan	Blitar
15	Taping structure	BLS. 15	LS. 15 ka	5	Pandanarum	Sutojayan	Blitar
16	Taping structure	BLS. 16	LS. 16 ka	14	Kedungbunder	Sutojayan	Blitar
				14	Pandanarum	Sutojayan	Blitar
17	Taping structure	BLS. 17	LS. 17 ka1	10	Kedungbunder	Sutojayan	Blitar
			LS. 17 ka2	14	Pandanarum	Sutojayan	Blitar
18	Taping structure	BLS. 18	LS. 18 ka	30	Kedungbunder	Sutojayan	Blitar
			LS. 18 ki	43	Kedungbunder	Sutojayan	Blitar

The steps of plantation water requirement analysis was to collect the data needed for this analysis, it was included data of plantation, conversion plantation coefficient, and actual discharge; and then to analyze factor of relative second crop (FPR) and area number of relative second crop (LPR) by uisng the fomulation (1) presented below.

Water need for irrigation was included of water need for plantation and area preparation, consumptive use, percolation and seepage, efficiency of irrigation, and effective rainfall. Water need for plantation was formulated by the factor of relative second crop. The method was developed from Pasten Method which was used in Netherland. The formulation was [5]

$$FPR = \frac{Q}{LPR} \tag{1}$$

Note:

FPR = factor of relative second crop
Q = discharge flow in river (l/s/ha)
LPR = area number of relative second crop

The steps of irrigation water requirement analysis was included to collect the data of plantation, climate, soil, and rainfall, and then to analyze plantation coefficient, potential evapotranspiration, and percolation. The end step was to analyze irrigation water requirement. Feasibikity study for determining area number of relative second crop, actual and standard of relative second crop factor was to collect plantation data, coefficient of conversion plantation, and actual discharge at the first, and then to analyze actual factor of relative second crop which had the constraint between 0.06 and 0.12. The end step to analyze standard discharge.

Feasibility study of standard of relative second crop factor was to collect the data of plantation, standard of relative second crop factor, area number of conversion plantation, and irrigation water requirement. The end step was to find the standard of relative second crop factor which had to be suitable to the factor of conversion plantation, and then factor of conversion plantation could be determined. The standard of available number (APK) was determined by collecting coefficient of conversion plantation and area number factor of conversion plantation. Then the standard of available number (APK) could be determined.

RESULTS AND DISCUSSION

Lodoyo irrigation scheme was supplied water from Brantas River of Wlingi Raya Dam. This irrigation scheme had irrigation structures which conducted with secondary channel, tapping structure, and other supported structure of irrigation. Table 2 was described area water requirement. Table 3 presented area number factor of conversion plantation and area factor of relative second crop (FLTK), and Table 4 was described the conversion.

Table 2 Recapitulation of area water requirement								
Month	Periode	Area water requirement (lt/s/ha)						Second crop
		Rice			Sugar cane			
		Work	seed	crop	seed	young	Old	
Nov.	I	1.609	1.072					0.567
	II	1.609	1.152					0.647
	III	1.609	1.225					0.807
Dec	I			1.287				0.942
	II			1.31				1.005
	III			1.271				0.974
Jan.	I			1.097				0.831
	II			1.018				0.695
	III			0.939				0.572
Feb.	I			0.949				0.468
	II			0.949				
	III			0.949				
Mar.	I	1.492	0.901		0.495			0.495
	II	1.492	0.965		0.495			0.56
	III	1.492	1.023		0.495			0.688
Apr.	I			1.09	0.501			0.808
	II			1.109	0.513			0.859
	III			1.077	0.526			0.834
May	I			0.915	0.503			0.704
	II			0.852	0.521			0.595
	III			0.789	0.538			0.498
Jun.	I			0.825		0.589		0.425
	II			0.825		0.619		
	III			0.825		0.643		
Jul.	I	1.525	0.95			0.73		0.516
	II	1.525	1.019			0.757		0.585
	III	1.525	1.081			0.771		0.723
Aug	I			1.303		0.882		0.953
	II			1.327		0.906		1.017
	III			1.287		0.922		0.985
Sept.	I			1.295		1.023		0.97
	II			1.198		1.04		0.803
	III			1.102		1.058		0.654
Oct.	I			1.066		1.032		0.51
	II			1.066		1.041		
	III			1.066		1.049		

plantation factor (FTK)

Table 3 Area number factor of conversion plantation (FLTK)

Rice			**Sugar cane**			**Second crop**
Work	**Seed**	**Plant**	**Seed**	**Young**	**Old**	
Pattern I						
2.439	1.729	1.490				1.000
Pattern II						
2.614	1.676	1.457	1.386			1.000
Pattern III						
2.557	1.639	1.618		1.252		1.000

Table 4 Recapitulation of conversion plantation factor (FTK)

Tertiary block		**Cropping pattern**	
	I	**II**	**III**
BLS.1 Ki	0,034-0,429	0,039-0,558	0,516-0,962
BLS.1 Ka	0,054-0,456	0,110-0,583	0,503-0,959
BLS.2 Ki	0,052-0,466	0,104-0,575	0,487-0,960
BLS.2 Ka	0,043-0,434	0,078-0,569	0,470-0,961
BLS.3 Ki	0,036-0,454	0,083-0,575	0,427-0,962
BLS.3 Ka	0,019-0,420	0,083-0,580	0,462-0,961

Analysis of actual discharge (Q actual) and theoretical discharge (Qtheoritical)

Actual discharge between Novembers to March was trended decreased. It was caused by there was water supply from rainfall. In the beginning of April, actual discharge was increasing because it was the period of second cropping pattern and water supply from rainfall had been decreased. Actual discharge was contant between May to June beacause at this period plantation water requirement was trended permanent. Actual discharge was decreased on June because there was generative period in June. Soil preparation and seeding was done in July, so that in this period actual discharge was increased. There was no water supply from rainfall and irrigated warer in August. Therefore, actual discharge was increased.In November, theoretical discharge was constant because there was growing period.

Theoritical discharge in November was constant and in this period there was soil preparation and seeding during 30 days. Between December and February, theoretical discharge was trended constatnt because conversion plantation area (LTK) on this period was trended permanent. Theoritical discharge was increased in March because there was soil preparation and seeding in this period. Between April and June discharge was increased because there was soil preparation and seeding in this period. Discharge was decreased between August and October because plantation water requirement was trended decreased. It was occurred too before harvest in October.

Analysis of actual relative second crop (Actual FPR) and conversion plantation factor (FTK)

Actual FPR and FTK was trended constant between November and February because relative second crop area (LPR) was constant and actual FPR was increased in March. In this period there was soil preparation and seeding and LPR and actual discharge was trended constant. Between March and June was trended constant because LPR was constant. Actual FPR was increased in July because there was soil preparation and seeding that caused LPR increased but actual discharge was trended constant. Between August and October actual FPR was constant because LPR was trended constant.

FTK was trended fluctuated between November and December so that was influenced limited value of FTK. In the end of December to February, discharge and LTK was decreased. In March to April FTK was trended increased because discharge and LTK was decreased. In June and October there was no second crop. In July and August FTK was fluctuated, it was depended on LTK and discharge.

Analysis of relative second crop area (LPR) and conversion plantation area (LTK)

LTR and LTK were constant in November because LPR was constant and there was soil preparation and seeding. Between December and January LPR was constant during cropping and growing period. LPR was decreased in February because part of irrigated area had been harvest so that LPR was decreased. In March LPR was decreased because area irrigated preparation was decreased. Between April and May was constatnt because LPR was constant and there was no area addition. In June LPR was decreased because part of area had been harvest so that LPR was decreased. In July LPR was increased because there was soil preparation and seeding in this period. Between August and September LPR was constant because there was no area addition in this period. In October LPR was decreased because part of irrigated area had been harvest so that LPR was decreased.

CONCLUSION

The maximum of irrigation water requirement at Lodoyo irrigation scheme was 3.87 liter/s and the minimum was 0 liter/s. The minimum requirement was occurred in January and October because there was not enough rainfall in this period.

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