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Optimization Analysis of Irrigation Water Using Linear Program

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Abstract: **Irrigation water is a resource that is very strategic agriculture, the role of irrigation water has a very large dimensions. These resources not only affect productivity but also affects the spectrum utilization of agricultural commodities. Along with population growth, the demand for irrigation water to produce food (rice) will continue to increase. This is related to the fact that the setting and management of irrigation water are critical to improving agricultural productivity ..**

Therefore we need a system of regulation and management of water resources so that irrigation water can be used optimally, including the provision of irrigation water that is tailored to their needs. Provision of irrigation water is the optimal amount of irrigation water supplied from the source through carrier channels (primary and secondary), tertiary canals, until the rice fields as needed.

In this study, the optimization is done by using a Linear Program. Value obtained from this optimization needs irrigation water as needed.

In addition to the optimization is done, to achieve high efficiency and the need for channel maintenance of existing irrigation facilities so not much irrigation water is wasted.

Keywords: **Optimization, Water Irrigation, linear program.**

I. INTRODUCTION

Provision of irrigation water properly and efficiently can be done by measuring the discharge on each channel. In so doing the necessary means to measure the debit building that serves to determine the flow of water through the channel. So that the provision of water to the mapped-mapped fields can be monitored, and is therefore expected that the water supply is not an exaggeration or a shortage and corresponding water needs of plants that exist in the mapped fields (Directorate General of Agriculture, 1986).

Crop water requirement is the amount of water supplied to compensate for the water lost through evaporation and transpiration. The water needs in the field is the amount of water that must be provided for the purposes of land preparation plus crop water needs. The water requirement of plants is absolutely necessary for their growth and production (Doorenbos and Pruit, 1984).

Irrigation efficiency is the number ratio of the actual amount of irrigation water used for crop growth requirements with the amount of water coming out of the door making (intake). Irrigation efficiency is a major determinant of employment form a system of irrigation networks. Efficiency of irrigation consists of drainage efficiency, which generally occurs in the main network and the secondary network efficiency of buildings divider till fields. Irrigation efficiency based on the assumption that most darijumlah water taken would be lost either canals or cropped fields. Water loss is calculated to include the operation of irrigation water loss rate of tertiary, secondary, and primary.

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The amount of water lost each is influenced by the length of the channel, the surface area of the channel, around the wet line and the position of the groundwater (Directorate general of Irrigation, 1986).

The irrigation network is an integral channel and buildings required for the regulation of irrigation water, ranging from the provision, retrieval, sharing, giving and its use. In the hierarchy of the irrigation network is divided into the main network includes the building, the primary channel and secondary channel. While the tertiary network consists of buildings and channels that are in tertiary. A union territory which get water from irrigation networks called the Irrigation Area (Directorate General of Water Resources, 1986).

II. REVIEW OF THE LITERATURE

A. *Optimization using Linear Program*:

The use of mathematical models as an analytical tool can utilize water resources optimally is the way that has been commonly used. Now even the various approaches available tools and quantitative methods for analyzing projects economically inundated. Quantitative methods were used to analyze the operation of a project or helping management are methods that are based on optimization approaches. The principle of the method of optimization is to optimize an objective function (objective function) of the constraints (constraint) (Jayadi, 2000).

Linear programming is one of optimization techniques incorporated in mathematical programming. According jayadi (2000) that the general procedure begins with the completion of mathematical programming component defines the following issues:

a. Decision variable: as the amount that would be sought value.

b. Parameters: measures of worth remains and can be applied in calculations such as price, costs, benefits and others.

c. Constrain: a limiting factor / constraints that need to be formulated mathematically.

d. Objectif function: is a quantitative statement of the case optimization.

Linear Program is a mathematical model that has two main functions, namely the function of the purpose and function kendala.pembatas. Linear program aims to achieve maximum or minimum value of a goal. The equation can be solved using linear programming for the purpose of optimizing the resource constraints expressed in the equation ($=$) or inequality ($\geq$ / $\leq$).

If Xi is the value of the capacity of the water needs of cropped fields while Zi is the value of profits every fields, then the objective function (objective function) for this problem are:

$$\text{Maximum } Z = \Sigma^{n}{}_{i}=1(ci*xi)*zi \quad \ldots\ldots\ldots\ldots\ldots\ldots(2\text{-}1)$$

with:

Z = the objective function maximum advantage (benefit).

Xi = tertiary water needs.

n = number of tertiary

Zi = value gains each paddy planting season i.

Ci = weighting factor for the optimization variables

Optimizing profits earned in the growing season and water needs of each tertiary there are several obstacles that must be considered. One of the obstacles that must be considered is that the amount of irrigation water requirements for the growing season in a certain specific time should be less than or equal to the debit available at that time and evaporation that occurs in each channel (mass balance). These constraints can be written:

Qout = Q in ..... (2-2)

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with:

Q out = water irrigation

Q in = Debit provided in the dam.

In this study the crop water needs are divided into two, namely: water requirements for rice and water requirements for crops. For rice plants necessary calculations for the water needs while land preparation, development and enlargement as well as when to harvest. As for the calculation of crop water needs only necessary for plant growth and at harvest.

To make optimization studies on crop water requirements in the tertiary requires supporting data. The data used in this research is data that is ready to use. The data source is the Department of Water Resources, Department of Agriculture Indramayu, West Java and Research Central Rice Seed Indramayu District.

B. Research Methods:

The logic in doing this research was preceded by collecting the data needed for the analysis, the necessary data as berikur:

• Data climatology (Rice Seed Research Institute).

• Data rainfall at 5 post recording rainfall.

• Data river discharge weir Well Watu

• Data on the rice area network Watu irrigation wells and water needs.

• Data retrieval needs of intake weir water wells Watu.

C. Conclusion Acknowledgement and Appendix:

The approach taken to obtain optimal irrigation flow on Irrigation Area Cipanas I especially in the area of Network Irigas performed with a linear approach.

Fungi tujuan :

Max Z = $(0.02*X_1 + 0.02*X_2 + 0.06*X_4 + 0.03*X_5 + 0.3*X_3 + 0.02*X_7 + 1*X_8 + 0.01*X_{10} + 0.02*X_{12} + 0.006*X_{11})$*Rp 6 058 200.

Fungsi Kendala :

$(X_9-0.9) - (0.7*X_{12}) - X_{14} \geq 49$

$(X_6-0.6) - (0.7*X_7) \geq 2634$

$3050 - X_1 - (0.7*X_2) - X_4 - X_5 \geq 890$

From the equation above the value of 0:02; 0:03; 0:06; 0.3; 0006 and 1.0 is the coefficient comparison of tertiary area, while the X_1, X_2, X_3, X_4, X_5, X_7, X_8, X_{10}, X_{11} and X_{12} is a flow towards the tertiary plots.

III. CONCLUSION

From the results obtained with optimizations performed by the linear program can be summed up in meeting water needs for the plant can be provided for throughout the growing season.

The advantage of using Linear Program are:

- The program is fairly simple, so easy to understand.

- The result is a definitive and precise results.

- Linear program is very effective in planning an objective optimization problem.

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