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Evaluation Of Primary Canal Discharge In Pulo Ie Thoe Irrigation Area, Nisam District, North Aceh Regency

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Abstract
This study aims to determine the amount of discharge taken and discharged available in the Pulo Ie Thoe Irrigation AreaNisam District, North Aceh Regency. This Irrigation Area has an area of 40 ha. The Pulo Ie Thoe irrigation area requires the largest average withdrawal discharge of 0.0947 m^3/s in July so that 0.0947 m^3/s is available to meet agricultural needs.The irrigation area of Pulo Ie Thoe has an available discharge of 92.56 m^3/s for a 2-year renewal period. The Pulo Ie Thoe Irrigation Area has enough water to meet irrigation activities in the area. So that there is *a water balance*, which is a condition where the amount of water available is more than the amount of water needed. The existing channel design resulted in a channel discharge of 0.051816 m^3/s. The discharge of the channel has a smaller value compared to the discharge needed in the Irrigation Area so that the irrigation channel is not able to drain the discharge for the irrigation area so it needs to be redesigned. The design of the planned channel is 0.85 m wide, 0.45 m in flow, with a wet cross-sectional area of 0.383 m^2, and a wet circumference of 1.76 m. The design of this planned channel produces a discharge of 0.10323 m^3/s so that it is able to drain the required discharge in the Pulo Ie Thoe Irrigation Area.

Keywords: irrigation; discharge; channel dimension, water balance

INTRODUCTION
Irrigation is an effort to provide and regulate water to support agriculture. In its management, properly functioning facilities and infrastructure are needed to meet human needs. Aceh's agricultural product production in 2023 decreased compared to 2022. This is because a number of irrigations do not function properly, so that rice fields lack water discharge. North Aceh with an area of 3,296.86 km2 is one of the regencies in Aceh Province that has the largest harvest area, which is 60,154 ha (Hafli, 2022). One of the irrigation areas in North Aceh is the Pulo Ie Thoe Irrigation Area which is located in Nisam District, North Aceh Regency which is ± 30 km from Lhokseumawe City which can be reached by road for ± 45 minutes.

An analysis of water needs and availability needs to be carried out because it is an important step in planning water resource management. There are several factors that cause this to happen, such as the increase in the age of water buildings, higher needs due to population growth, and irresponsible human activities such as damaging irrigation buildings, and so on. Evaluation of irrigation canals is carried out to determine the condition and condition of irrigation (Asrul, 2021). Therefore, a study is needed that examines channel evaluation in order to increase agricultural productivity and meet the needs of the community.

LITERATURE REVIEW
Debit withdrawal is also called planned debit. The planned discharge is the amount of discharge in a certain re-period that is expected to pass through the planned water building. The planned discharge is the amount of water volume that is tapped from the river and then flowed into the irrigation canal to meet the irrigation water needs. The planned discharge of a channel is calculated by the irrigation intake discharge formula, Irrigation Planning Standard (KP-03, 2013). The water requirement in the rice field for rice or *net field water requirement* (NFR) is the need for clean

irrigation water in the rice fields. According to the Irrigation Planning Standard (KP-01, 2013), the water requirement in the rice field for rice crops is determined by several things, namely, the need for water for land preparation (IR), the need for water for consumptive use of crops (ET_c), the need for water for percolation and seepage (P), the need for water for the change of water layer (WLR), effective rainfall (Re). For planning purposes, it is considered that one-fifth to one-quarter of the amount of water taken to flow in the canal is lost before reaching the rice fields. This water loss needs to be minimized, especially in areas with limited water availability so that it can be used as efficiently as possible (KP-02, 2013).

Available debits are existing debits. The available discharge can be calculated by a rational method. According to Handajani, N. (2005), rainfall frequency analysis or hydrological analysis is the repetition of rainfall, both the number of time unity frequencies and the recurrence period. Irrigation Canal is one of the irrigation infrastructure with the function of taking water from water sources, bringing or draining water from water sources to agricultural land, distributing water to plants and regulating and measuring water flow. Carrier channels are the second most weighted physical infrastructure after the main building in the context of assessing the performance of the irrigation system. Flow Discharge is the amount of liquid flowing through the transverse view of the flow per unit of time measured in the volume of the liquid per unit of time. According to Bambang Triatmodjo, (2018) An economical open channel is a channel that is able to drain large discharges and minimum wet circumference. The semicircular channel cross-section has a large drinking and discharge wet circumference, but the manufacturing process is quite difficult compared to other forms of cross-section, so it is rarely used in the field. The channel dimension must be able to drain the planned discharge or in other words the discharged discharge must be equal to or greater than the planned discharge. To prevent the water level from overflowing, it is necessary to have a guard height on the channel, namely the vertical distance from the top of the channel to the water surface in the planned discharge condition.

MATERIALS & METHODS

This study is a type of simple quantitative research that uses hydrological analysis to obtain discharge that describes the conditions in the field in the planning of primary channels to meet the water needs of the Pulo Ie Thoe Irrigation Area, North Aceh Regency. This research was carried out by conducting a literature study first. Then data collection was carried out which included primary data and secondary data. Primary data consists of the results of measuring channel dimensions, flow velocity, and physical condition of the channel obtained from calculations and direct observation in the field. Secondary data are rainfall data, climatological data, and irrigation network schemes obtained from the North Aceh Irrigation PUPR and the Meteorology, Climatology and Geophysics Agency (BMKG). Then a hydrological analysis was carried out to obtain the intake discharge and available discharge and evaluate the primary channel for the needs of the Pulo Ie Thoe Irrigation Area, North Aceh Regency. Then if the results are obtained that the channel is not able to drain the discharge needed by the irrigation area, the primary channel is redesigned so that the water needs in the irrigation area are met.

RESULTS AND DISCUSSION

This Irrigation Area has an area of 40 ha. The irrigation area of Pulo Ie Thoe requires an average withdrawal discharge of 0.05846 m^3/s with the largest discharge in July of 0.0947 m^3/s. The irrigation area of Pulo Ie Thoe has an average available discharge of 284677.07 m^3/s. The Pulo Ie Thoe Irrigation Area has enough water to meet irrigation activities in the area. So that there is a water balance, which is a condition where the amount of water available is more than the amount of water needed. The existing channel design resulted in a channel discharge of 0.051816 m^3/s. Irrigation canals are not able to drain discharge for the irrigation areas needed, so a new and economical channel design is needed. The planned channel design is 0.85 m wide, and 0.45 m into the flow.

3.1. Water Balance

The comparison between water availability and demand is seen by comparing the value of discharge taken and discharged available. The following table shows the value of the withdrawal discharge against the available discharge in the irrigation area of Pulo Ie Thoe.

Table 1. Value of discharge taken and discharged available

Month	Nov		Des		Jan		Feb	
	I	II	I	II	I	II	I	II
Debit Intake	0,05902	0,05902	0,03459	0,04635	0,05746	0,05746	0,05879	0,04437
Debit Available	92,556	92,556	92,556	92,556	92,556	92,556	92,556	92,556
Month	Mar		Apr		May		Jun	
	I	II	I	II	I	II	I	II
Debit Intake	0,02626	0			0,06409	0,06409	0,08184	0,09359
Debit Available	92,556	92,556	92,556	92,556	92,556	92,556	92,556	92,556
Month	Jul		Aug		Sep		Oct	
	I	II	I	II	I	II	I	II
Debit Intake	0,09470	0,09470	0,09253	0,07806	0,06219	0		
Debit	92,556	92,556	92,556	92,556	92,556	92,556	92,556	92,556

Available								

From the data in **Table 1.** it can be concluded that there is enough water available to fill and drain the required Pulo Ie Thoe Irrigation Area.

3.2. Comparison of the discharge taken to the channel discharges

From **Table 2.**, it can be concluded that the discharge of the existing channel is smaller than the discharge in January, June, and July. Thus, it can be concluded that the discharge of the channel is not able to drain the discharge needed in the irrigation area. This is caused by several things, namely the physical condition of the damaged tissue, lack of channel maintenance so that the channel is overgrown with plants that hinder the flow rate, and the accumulation of sedimentation. This is in line with Irwansyah's research (2020) which stated that the damage to one of the irrigation buildings could result in a decrease in irrigation performance, then Haris (2016) stated that the condition of the damaged channel would affect the flow discharge, and Dania's research (2022) stated that the performance of the existing system could be affected if there was damage to one of the irrigation buildings.

Tabel 2. Value of The Discharge Taken To The Channel Discharges

Month	Nov		Des		Jan		Feb	
	I	II	I	II	I	II	I	II
Debit Intake	0,05902	0,05902	0,03459	0,04635	0,0575	0,05746	0,05879	0,04437
Discharge Channel	0,05182	0,05182	0,05182	0,05182	0,0518	0,0518	0,05182	0,05182
Month	Mar		Apr		May		Jun	
	I	II	I	II	I	II	I	II
Debit Intake	0,02626	0			0,06409	0,06409	0,08184	0,09359
Discharge Channel	0,05182	0,05182	0,05182	0,05182	0,0518	0,0518	0,05182	0,05182
Month	Jul		Aug		Sep		Oct	
	I	II	I	II	I	II	I	II
Debit Intake	0,09470	0,09470	0,09253	0,07806	0,06219	0		
Discharge Channel	0,05182	0,05182	0,05182	0,05182	0,0518	0,0518	0,05182	0,05182

3.3. Planned Channel Dimension

The design of the planned channel is 0.85 m wide, 0.45 m in flow, with a wet cross-sectional area of 0.383 m^2, and a wet circumference of 1.76 m. The design of this planned channel produces a discharge of 0.10323 m^3/s.

Equations

This study uses various main formulas to obtain calculations from intake discharge, shallow discharge, discharge, water balance and discharge from irrigation canals in the area.

$$Q = \frac{DR \,.\, A}{1000} \quad (1)$$

$$DR = \frac{NFR}{ef \; x \; 8{,}64} \quad (2)$$

$$Q = 0{,}2778 \; C.I.A \quad (3)$$

$$Q = A \,.\, V \quad (4)$$

The planned discharge of a channel is calculated by the irrigation intake discharge formula, Irrigation Planning Standard (KP-03, 2013). According to Handajani, N. (2005), rainfall frequency analysis or hydrological analysis is the repetition of rainfall, both the number of time unity frequencies and the recurrence period. Flow Discharge is the amount of liquid flowing through the transverse appearance of the flow per unit of time measured in the volume of liquid substances per unit of time with the following formula (Bambang Triatmodjo, 2018).

CONCLUSIONS

The irrigation area of Pulo Ie Thoe requires the largest withdrawal discharge in July, which is 0.0947 m^3/s. Thus, the Pulo Ie Thoe Irrigation Area needs at least 0.0947 m^3/s every month to meet the water needs in the irrigation area. The irrigation area of Pulo Ie Thoe has a larger available discharge compared to the discharge that is taken. Therefore, it can be concluded that there is enough water available to meet the water needs of the Pulo Ie Thoe Irrigation Area. The existing channel design resulted in a channel discharge of 0.051816 m^3/s. The discharge of the channel has a smaller value compared to the discharge needed in the Irrigation Area, so it can be concluded that the irrigation channel is not able to

drain the discharge for the irrigation area, so it needs to be redesigned. The planned channel design is 0.85 m wide, 0.45 m into the flow, with a wet cross-sectional area of 0.383 m^2, and a wet circumference of 1.76 m. The design of this planned channel produces a discharge of 0.10323 m^3/s so that it is able to drain the required discharge in the Pulo Ie Thoe Irrigation Area.

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REFERENCES

[1] Asrul, A., 2021. *Evaluasi Saluran Sekunder Irigasi Sigata Kota Padang Panjang* (Doctoral dissertation, Universitas Muhammadiyah Sumatera Barat).

[2] Departemen Pekerjaan Umum, Direktorat jenndral Pengairan, Standar Perencanaan Irigasi KP-01, KP-02, KP-03, 2013.

[3] Agoes, H.F., Muhlis, A., 2012. Identifikasi Saluran Primer Dan Sekunder Daerah Irigasi Kunyit Kabupaten Tanah Laut.

[4] Haris, V.T., Saleh, A., Anggraini, M., 2016. Perencanaan Dimensi Ekonomis Saluran Primer Daerah Irigasi (Di) Bunga Raya. Siklus : Jurnal Teknik Sipil 2, 47–57.

[5] Edwar, F.D., Fauzi, M., 2013. Evaluasi Kinerja Saluran Primer Dan Bangunan Sadap Untuk Menentukan Metode Pemeliharaan Daerah Irigasi Air Ngalam Kabupaten Seluma.

[6] Jansen M, E., 1990. Evapotranspiration Water Requirments, American Society of Civil Engineers, New York.

[7] Lubis, F., 2016. Analisa frekuensi curah hujan terhadap kemampuan drainase pemukiman di kecamatan kandis. *Program Studi Teknik Sipil*, *2*(1), pp.34-46