The effect on land-use changes on water availability in the Cidongkol Irrigation Area

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Abstract. The city of Tasikmalaya has now changed, especially in the field of infrastructure. The impact of infrastructure development affects uncontrolled land-use change. One of the transportation infrastructure built by the City of Tasikmalaya Government is Mangin Road. Paddy fields that meet the area gradually began to become settlements. Transfer of land functions in the area, resulting in reduced paddy fields. The Cidongkol Irrigation Area currently has a 116 ha rice field area from an initial 192 ha area. The purpose of this study was to determine the fulfilment of the rice field area and to be associated with previous research. The data processing method is analyzing the availability that comes from Cikalang Channel and water needs. In the initial condition, the required discharge of about 92% was not fulfilled. Whereas with an area of 116 ha of rice fields, around 92% was not met. Cikalang Channel serves 246 ha of paddy fields. With conditions like this, Cikalang Channel is not able to serve the entire area. To meet water needs, farmers use modified cropping patterns. The City Government of Tasikmalaya has managed the excavation area, and part of the land has been replanted to restore its function.

1. Introduction
The population of Indonesia has always been the majority of livelihoods in agriculture. At that time, Indonesia's natural wealth was very much. But now the name of an agrarian country has begun to fade because, in terms of food independence, Indonesia is difficult to be called an agrarian country because it has not been able to meet the food needs of its people and some still rely on imports to meet their needs.

At present, the population of Indonesia is around 265,015 million people, and the province of West Java, with the largest population, is 48,683 million people [1]. To compensate for the increase in population from year to year continues to increase, it is necessary to increase infrastructure, especially settlements. Infrastructure development, in addition to settlements, is also intended to support other human activities, such as the construction of workplaces and transportation infrastructure. The development of an area will cause a movement of people towards that area and followed by an increase in water and food needs [2]. Climate change is not the only factor affecting water supply and demand; population and economic growth in a country also urbanization is very likely to further increase water demand [3]. All countries take action to protect the quality and quantity of water and to reduce water crises caused by climate change and human activities [4].
West Java Province also experienced a decrease in rice production from 2013 to 2015. (Central Statistics Agency of West Java Province, 2018) [1]. Tasikmalaya City, one of the regions in West Java Province, is now 18 years old. The area of Tasikmalaya City is 183.85 km², with a population of 662,723 people (Kota Tasikmalaya in Figures, 2019). Development in various sectors continues to be done so that the face of Tasikmalaya City has now changed, especially in the fields of infrastructure, transportation, and urban planning. The impact of infrastructure development has an impact on uncontrolled land-use change. Land-use change in watersheds, climate change causes uncertainty of water balance in watersheds [5]. Extreme rainfall is estimated to occur annually in tropical climates [6].

One of the transportation infrastructure built by the Tasikmalaya City Government is the road that connects Mangkubumi District and Indihiang District, better known as Mangin Road. The construction of the Mangin Road aims to facilitate access between Mangkubumi District and Indihiang District through the Bungursari District, but also to unravel the traffic jams that are going to urban areas.

With the existence of Mangin Road, the population movement to build settlements and businesses. In general, people choose a place to live in a good place even though the price of land is high [7]. Paddy fields that fill the area gradually begin to become settlements, while many hills are dug up to take sand and then sell. With the change of land use in the area, resulting in reduced paddy fields. Irrigation infrastructure development will run well if supported by adequate costs [8]. Land changes by the community result in changes in the biogeochemical and biogeophysical properties of the earth's surface and affect the climate system [9]. Water scarcity is becoming more increasing in many parts of the world. The effective use of water resources for agriculture is a top priority for improving food security [10].

Cidongkol Irrigation Area, which is located around Mangin Road based on the Minister of Public Works and Public Housing Regulation Number 14 PRT/M/2015 concerning Criteria and Status Determination Irrigation Area has an area of 192 hectares, and this irrigation area is one area that has an area of over 100 hectares. The availability of water is the main thing from the use of agricultural water, especially rice fields [11]. As a result of land conversion, the Cidongkol Irrigation Area currently has an area of 116 hectares (Tasikmalaya City Public Works and Spatial Planning Office, 2019). Whereas overall, the irrigation areas under the authority of the Tasikmalaya City Government were 51 Irrigation Regions with an area of 4239 hectares. Meanwhile, based on the Public Works and Spatial Planning Office of Tasikmalaya City, currently, the irrigation area under the authority of the Tasikmalaya City Government covers an area of 1749 hectares.

2. Methods
The deciding factor in calculating irrigation water availability is the width of the river basin. The width of the watershed starts from the Cidongkol weir to the upstream and climatology. Equipment is installed to monitor and record climatological parameters [12]. While the water needs in the paddy fields are calculated based on the paddy fields served.

Cikalang canals are widely used to irrigate paddy fields consisting of 5 irrigation areas, including, Cidongkol Irrigation Area (116 hectares), Cibadodon Irrigation Area (15 hectares), Gunung Mindi Irrigation Area (17 hectares), Leuwimunding Irrigation Area (26 hectares), and the Cikalang Irrigation Area (72 hectares).

The Cidongkol Irrigation Area with a weir is located in Bantarsari Village, Bungursari District, Tasikmalaya City. The water source of the Cidongkol Irrigation Area comes from the Cikalang Channel, which flows and empties into the Citanduy River. The water source of the Cikalang Channel comes from the Cibanjaran Main/Primary Channel, flowing through the center of Tasikmalaya City, and some of it is already invisible because many are covered by buildings. Figure 1 shows the Cidongkol weir.
Figure 1. Cidongkol weir (source: google maps).

Lakes, reservoirs, rivers are bodies of water to contribute water to the soil [13]. The amount of discharge calculated is based on previous research data in the Cibanjaran River from 2006 to 2017. Retrieval of data is adjusted to the Cibanjaran River data because the Cikalang Channel originate from the Cibanjaran Main Channels side by side so that they have the same characteristics, and both are at the foot of the mountain Galunggung.

The parameters calculated are effective rainfall and evapotranspiration. Climate parameters are factors that influence ETo [14]. The availability of water in the Cikalang Channel comes from the Cibanjaran Main Channel by dividing a portion of the discharge to be channeled into the Cikalang Channel.

3. Results and discussion
The condition of the Cikalang Channel flow area has changed a lot, especially after the operation of the Mangkubumi-Indihiang Road, which crosses the Cikalang Channel. The land use condition from the weir to the upstream area has changed many functions, especially the Cikalang Channel flow alongside the road leading to the tourist attractions Galunggung Mountain. At present, the condition in the upstream of the weir has a lot of hills that are dug up to take sand, so that the area becomes flat due to many trees being cut down and many paddy fields are piled up to become settlements. For the next few years, it will get worse because the area is promising to be a place of business.

With a large number of land-use changes around the upstream dam and based on the results of repeated measurements carried out by the Tasikmalaya City Public Works and Spatial Planning Office, the area of Cidongkol Irrigation Area is shrinking, only about 60% is left to be served by Cikalang Channel.

The water balance based on the calculation results is shown in Figures 2 and 3. For initial and final conditions with an area of 192 ha and 116 hectares, the required discharge of about 92% cannot be fulfilled.

Accurate determination of evapotranspiration (ETo) is very important for agriculture, hydrological, and environmental studies. The Penman-Monteith FAO-56 Model (FAO-PM) is known as the most
accurate model [15]. The Cibanjaran River is the source of water for the Cibanjaran Irrigation Area, while the Cidongkol Irrigation Area is the source of water from the Cikalang Channel. The existence of sand mining activities around the upstream of the Cibanjaran River resulted in some of the sand from mining easily entering the river when it rains. Resulting in the siltation of the Cibanjaran River, and the impact on the main channel becomes turbid. Cikalang Channel, in addition to irrigating the Cidongkol Irrigation Area, is also used to irrigate the 246 ha irrigation area. Mining activities are also carried out in the upstream area of the Cikalang Channel to around Mangin Road. The impact of the existence of mining activities results in the Cikalang Channel having to accept the consequences, one of which is silting up.

![Water Balance for 192 ha](chart1.png)

**Figure 2.** Water balance curve for 192 ha.

![Water Balance for 116 ha](chart2.png)

**Figure 3.** Water balance curve for 116 ha.

Cikalang channel currently has to serve paddy fields in the area of Tasikmalaya City, covering an area of 246 ha. With conditions like this, Cikalang Channel is not able to serve the entire area. So, in addition
to using the class system in water distribution, it is also assisted by rainfall that falls into the rice fields directly.

4. Conclusion
Upstream of the Cidongkol Irrigation Area, namely in Bantarsari Village, Bungursari District. With this road, there has been a significant change in land conditions, especially the existence of sand mining activities in the Bungursari District. Changes in the land-use change also occurred in the upstream area of the Cibanjaran River and impacted the main channel, which turned turbid when heavy rain occurred and was carried over to the Cikalang Channel where water was used to irrigate 246 ha of rice fields.

Cikalang channel that is used to meet water needs in the Cidongkol Irrigation Area cannot serve all of them. So to meet the water needs in the fields, farmers use modified cropping patterns. The City Government of Tasikmalaya has managed the excavation area, and part of the land has been replanted to restore its function.

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