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Article Info

Keywords

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Abstract

Almost all of the Gunung Kidul area is dry mountainous land with rainfed land. The use of technology is needed to get a solution for the use of barren dry land. Cultivation of plants with high economic value is expected to alleviate poverty in remote communities. How to cultivate using monoculture and polyculture systems. Automatic control based on digital technology will increase the efficiency of the farming system. The RDS (Rain Driphonic System) technology used for irrigation is able to meet the water needs of agricultural land. RDS can be applied in various isolated dry areas. Solar energy is used to raise water from the main holding pool to the water tower. The flow of water from the water tower utilizes the force of gravity. The use of natural energy is to preserve the environment and reduce the impact of global warming.

Keywords: dry land, automatic control, digital technology, RDS, natural energy

Introduction

The agricultural sector is the largest contributor to the economy in Gunungkidul Regency with a contribution of 25.5%. In addition, the agricultural sector absorbs the largest workforce, namely 52.8% in Gunungkidul Regency. Most of the rice in Gunungkidul Regency is produced from the type of field rice. The harvested area of this type of rice accounts for 42,078 ha or 73.8 percent of the total rice harvested area. The yield of fruit groups in Gunungkidul Regency was 135,816 quintals of bananas, 96224 quintals of mangoes, and 5219 quintals of papaya. In the plantation sub-sector only coconut, rubber and cocoa are cultivated in Gunungkidul Regency (BPS, 2016).

Rice farming gives the smallest contribution to the income of farmer households in dry land. This is because the soil in the karst mountains is not suitable for rice cultivation. Rice is a plant that requires a lot of water, while in karst areas there are frequent droughts and water shortages. In addition, the soil conditions in the karst mountains contain rocks so that rice production becomes less than optimal. The crops cultivated include corn, cassava and peanuts. Of the three commodities, the biggest profit is peanuts (Khotimah, et al, 2019).

The potential of dry land agriculture in Gunungkidul is used for upland area of 3,258 hectares with commodities of corn, peanuts, cassava, some soybeans and sweet potatoes. Dry land in addition to potentially increasing food security also has several problems such as low soil water content, large surface runoff, high sedimentation values. These problems can lead to reduced production of food crops, reduced water quality, and drought. One of the longest droughts occurred in 2015 with a time span of 7 months, namely from June to December and caused Tepus District to become the most severely drought-affected sub-district in the Gunungkidul Regency. According to Sari, et al., (2016) the availability of water is strongly influenced by physical hydrometerological factors (rainfall, temperature, duration of sunlight, humidity, slope, and soil/rock type). Evapotranspiration that occurs in plants is influenced by climatic and physiological factors of the plant.

According to Khalimi and Kusuma (2018), the results of the analysis of the potential for available water in the Tepus Gunung Kidul area are based on soil characteristics in several land uses as shown in Figure 1.

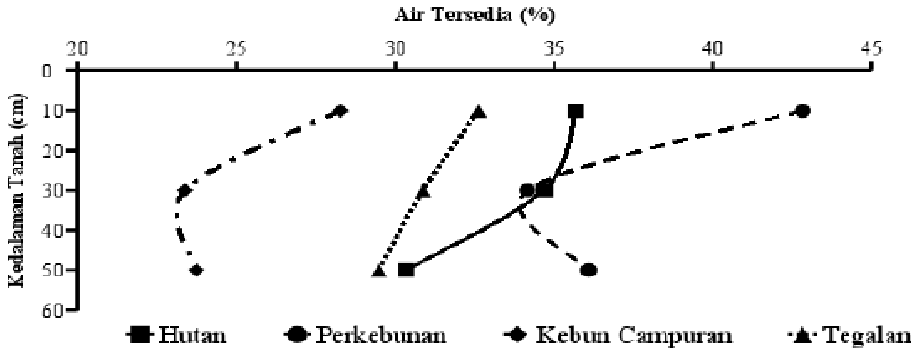

Figure 1. Water Potential in Various Land Uses (Khalimi and Kusuma, 2014).

Based on research by Aji (2014), drought occurs because rain is lower than evapotranspiration. The highest evapotranspiration value is on dry land, so that the potential value of water entering the soil is the lowest. Soil characteristics do not have a close relationship with the potential for available water in the soil.

Irrigation problems for dry land are a major concern. The use of rainwater for irrigation in Gunungkidul at a low cost should also be a major concern. The economic condition of the villagers who have been rain-fed farmers is very worrying. So we need plants with high economic value to alleviate poverty in areas with dry land.

Rain Driphonic System (RDS)

Rain is used for irrigation of agricultural land. High rainfall intensity must be able to meet the water needs for agricultural crops during the dry season. The irrigation water flow must be designed so that the water demand during the dry season on dry land remains optimal.

When the intensity of rain is high enough, there will be a lot of puddles and water is wasted. This is because conventional irrigation methods which have been the main means of agricultural land have not been efficient so that there is a lot of excessive waste (Bhattacharya, 2007). Irrigation performance is a priority in solving irrigation management and development problems. Irrigation systems that function not optimally cause water distribution to be non-uniform and unpredictable. Pressurized irrigation systems can produce cost effectiveness and efficiency (Khatririya, et al., 2021). According to Cobo, et al., (2014) in recent years, more efficient pressurized irrigation systems such as drip, drip and sprinkler irrigation have become more useful than open channel irrigation systems to improve water use efficiency. It is necessary to increase irrigation efficiency by optimizing irrigation water in conditions of limited water availability.

RDS is applied to areas where the soil formation cannot store water. For irrigation purposes, rainwater is captured and stored. Drip Irrigation is a method of irrigation that uses water very efficiently. Nutrients needed by plants are put into the mixer tank and the supply of these nutrients can be controlled in a controlled manner according to plant needs. This is the most important principle in hydrophonic systems.

Figure 2. Typical Lay-Out RDS on Dry Land.

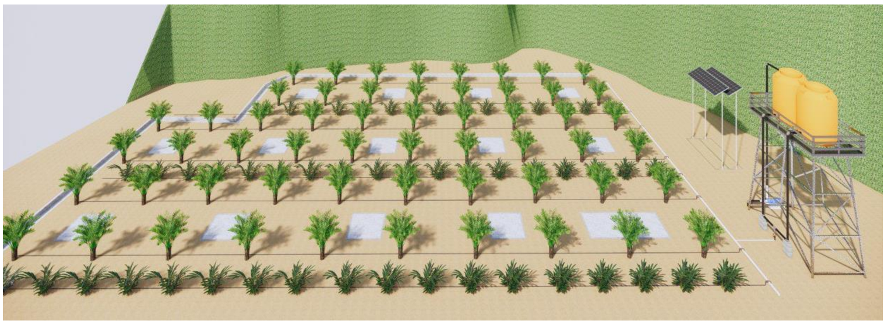

Figure 3. Lay-Out Schematic of Drip Irrigation System with Solar Energy.

Digital Technology

According to Pasha, et al., (2020) with more advancements in the IoT field expected in the coming years, these systems are often more efficient, much faster, and cheaper. In the future, this technique is often created as an intelligent system, where in the system predicting user actions, rainfall patterns, harvest time, animal intruders in the field and communicating knowledge through advanced technologies such as IoT are often applied so that farming systems are often made independent of operations. humans and successively large quality and quantity results are often obtained. By making use of the soil moisture sensor, the level of soil moisture/moisture can be checked. Whenever there is an adjustment of tackiness on the ground, this sensor detects the change and the disturbance signal is passed to the microcontroller and relies on this the water system works.

The agricultural sector is the main contributor to the economy of a nation. Most water system frameworks work physically. These outdated methods are being replaced by semi-computerized systems and robotization. By utilizing a computerized framework for water systems, the above problems can be changed. The system requires logical and iterative human intervention. So current progress is needed to resolve the issue and should support a better Water framework. For that, we can have a framework, namely "Automatic Irrigation System based on Internet of Things (IoT) using Wireless Sensor Network (WSN)". WSN has correspondence, estimation and recognition limits. An augmentation between the real physical world and the virtual universe can be provided by WSN. It has many jobs in home robotization, normal establishment, science, security and cultivation.

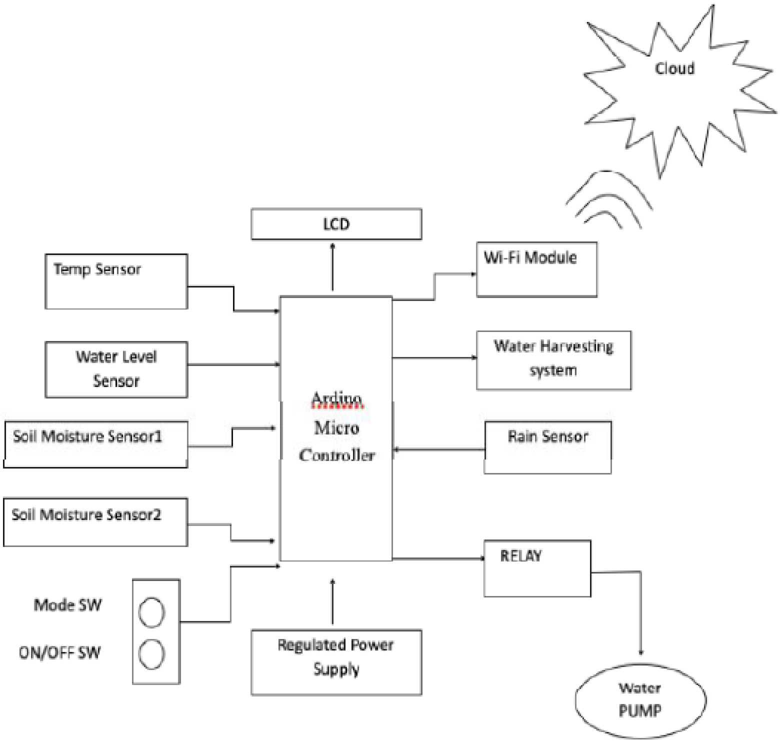

Figure 4. Block Diagram of Irrigation System Using Wireless Sensor Network (Pasha, et al., 2020)

Decision making based on the data collected from IoT based sensors used in the agriculture land.

$y \rightarrow f(x)$
$X(ij) \in i = 0,1,2,3, \ldots$ i = i th sensor

j = attribute in the data send by the 'i' th sensor
$j \rightarrow 0$ to $|m|$ where m is no of data columns

In this Auto Mode Irrigation is controlled and depends on the threshold level of humidity and temperature sensors. Sensor Threshold Levels for each crop is set in the algorithm written in the controller. Farmers need to select the crop button according to cultivation. The sensor status will be sent to the Thing-speak cloud. Water Level Sensor Used to monitor the water level in the well/tank. If the water is pre-set, then only the controller will allow the pump ON. The LCD will display the sensor and pump status.

Natural Energy

The availability of conventional electrical energy is still very expensive for rural communities. Conventional electricity becomes impossible to apply to agricultural land in remote areas. Conventional electricity grids are also unable to cover large agricultural areas. The ever-increasing demand for energy requires new technologies based on renewable energy resources. Solar energy is the most promising because the sun provides a large amount of heat and light. According to Chandel, et al., (2015) and Selvan and Ali, (2016), Photovoltaic powered water pumps are one such application, which has received great attention in recent decades. The use of PV-based pumps is also location dependent, as the performance of photovoltaic devices is governed by several factors such as total radiation and temperature (Foster and Cota 2014). It is clear that many irrigation systems are underperforming. This situation can lead to non-uniform and unreliable water distribution. A well-designed pressurized irrigation system is essential in realizing the goals of an irrigation scheme such as maximizing efficiency and cost-effectiveness.

The irrigation system must also meet various demands while meeting minimum pressure requirements. A cost-effective solution that meets the system's hydraulic constraints is always desirable, but such a solution is very difficult to achieve when a pressurized irrigation system is run under a solar photovoltaic pump. Under such conditions newly introduced irrigation techniques such as, rain pipe irrigation technique which can operate under low pressure as well and are most suitable for growing vegetable crops and close range crops like peanuts, shallots, garlic etc and can adapt to almost all type of soil.

Figure 5. 28 Year Old PV Water Pumping System Showing Degradation at Hamirpur India (Chandel, Et Al., 2015).

Hight Value Commodities

Intensive agriculture or plantations with RDS are appropriate if the cultivated plants have high economic value, so that cost recovery can be met immediately. Date palms have a great opportunity to become plants of high economic value because the demand for dates is very large. Tepus Gunung Kidul, with most of the population farming rainfed land, will become farmers with large economic income if the date palm cultivation is successful in this area.

Figure 6. Dates Plants in Tepus Dry Land, Gunung Kidul.

Poverty Alleviation

Empowerment of dry land farming communities with RDS is expected to increase the level of welfare significantly. RDS as an alternative solution to dry land problems is expected to be able to answer the problem of dry land irrigation. Utilization of natural energy, namely solar energy, in the application of RDS is environmentally friendly so that the preservation of nature is maintained properly. Cultivation of date palms which have high economic value is expected to be communal for residents in dry land villages to become high-income so that they are able to meet their daily needs better.

Conclusion

RDS with natural energy and drip technology is significantly able to answer the problems of irrigation systems in mountainous dry land areas. Solar power technology is a solution to electricity grid problems in rural areas. Utilization of solar energy is also environmentally friendly so as to minimize the effects of global warming.

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