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## **Clean Water Crisis and Climate Change: Study of Clean Water Resource Management in Gunung Kidul**

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### **Abstract**

Gunung Kidul is one of the areas in the Special Region of Yogyakarta Province which is always hit by a clean water crisis. In fact, clean water is one of the most important human needs that must be protected by its resources. The higher amount of consumption has made many regions experience an air crisis, one of which is Gunung Kidul. In fact, there are effects of climate change that lead to the quantity and quality of water in Gunung Kidul. Therefore, this study aims to explain the policy phenomenon carried out by the Gunung Kidul Government in air management by using a type of literature study research where the authors collect various sources from journals and other literature on climate change, management policies, and the water crisis. By using the theory of implementing public policy and the concept of integrated water resource management, the results show that Gunung Kidul Regency is experiencing climate change, as seen from an increase in average air temperature, inconsistent rainfall, and rising seawater. Climate change that occurs indirectly affects the quantity and quality of existing resources, causing a clean water crisis in various areas in Gunung Kidul Regency. In response to this, the government has not implemented the air resources management policy optimally, this is based on the incomplete air distribution, high PDAM water rates, minimal utilization of water resources, and water resources conservation activities that have not been optimal. Therefore, some appropriate steps that can be taken are, first, making efforts to utilize air resources other than air resources. Second, expanding the distribution of air pipelines from PDAM along with affordable payment rates. Third, maintaining the quality of resources in drought-prone areas through mining activities.

Keywords: *Climate Change, Water Crisis, Water Management Policy*

### **Abstrak**

Gunung Kidul merupakan salah satu kawasan di Provinsi Daerah Istimewa Yogyakarta yang selalu dilanda krisis air bersih. Padahal, air bersih merupakan salah satu kebutuhan penting manusia yang harus dilindungi ketersediaan sumber dayanya. Jumlah konsumsi yang semakin tinggi membuat banyak daerah mengalami krisis air, salah satunya Gunung Kidul. Namun sesungguhnya ada pengaruh perubahan iklim yang menyebabkan penurunan kuantitas dan kualitas air di Gunung Kidul. Oleh karena itu penelitian ini bertujuan untuk menjelaskan fenomena kebijakan yang dilakukan oleh Pemerintah Gunung Kidul dalam pengelolaan air dengan menggunakan jenis penelitian studi pustaka dimana penulis mengumpulkan berbagai sumber dari jurnal dan literatur

lainnya tentang perubahan iklim, kebijakan pengelolaan, dan krisis air. Dengan menggunakan teori implementasi kebijakan publik dan konsep pengelolaan sumber daya air terpadu maka hasil penelitian menunjukkan bahwa Kabupaten Gunung Kidul sedang mengalami perubahan iklim, terlihat dari peningkatan suhu udara rata-rata, curah hujan yang tidak konsisten, dan kenaikan air laut. Perubahan iklim yang terjadi secara tidak langsung mempengaruhi kuantitas dan kualitas sumber daya air yang ada, sehingga menimbulkan krisis air bersih di berbagai wilayah di Kabupaten Gunung Kidul. Menyikapi hal tersebut kebijakan pengelolaan sumber daya air yang dilakukan oleh pemerintah belum dilaksanakan secara maksimal, hal ini didasari oleh distribusi air yang belum tuntas, tarif air PDAM yang tinggi, pemanfaatan sumber daya air yang masih minim hingga kegiatan konservasi sumber daya air yang belum maksimal. Oleh karena itu, beberapa langkah tepat yang dapat diambil adalah, pertama, mengupayakan pemanfaatan sumber daya air lain selain sumber daya air tanah, Kedua, memperluas distribusi pipa air dari PDAM dibarengi dengan tarif pembayaran terjangkau. Ketiga, menjaga kualitas sumber daya air di daerah rawan kekeringan dengan menghentikan kegiatan penambangan.

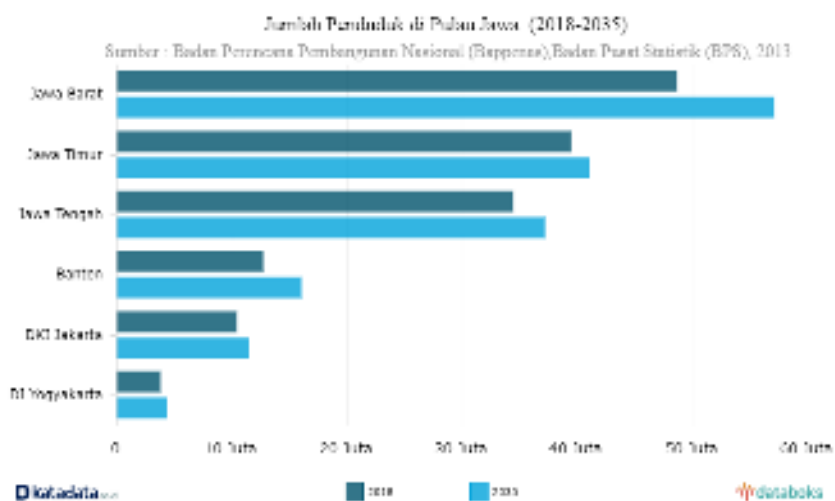
Kata Kunci: Perubahan Iklim, Krisis Air, Kebijakan Pengelolaan Air

## INTRODUCTION

The island of Java is currently experiencing an expansion of clean water crisis areas where the area of the water crisis has increased from 6.0% in 2000 to 9.6% in 2045, while water quality is also expected to decrease (Bappenas, 2019). Based on the statement of the Chairperson of the Indonesian Hydrological Society which states that the availability of water on the island of Java is only around 1,200 cubic meters per capita per year, far below the minimum water availability requirement of around 1,600 g cubic meters per capita per year (Kumparan, 2019).

According to the National Development Planning Agency (Bappenas) estimates that in the year 2035, population growth in Java will continue, If in 2018 the estimated population is 149.6 million, then in 2035 it will grow to 167.3 million, or increase by 11.82% (Badan Pusat Statistik, 2013).

**Figure 1.** Number of inhabitants in Java 2018-2035

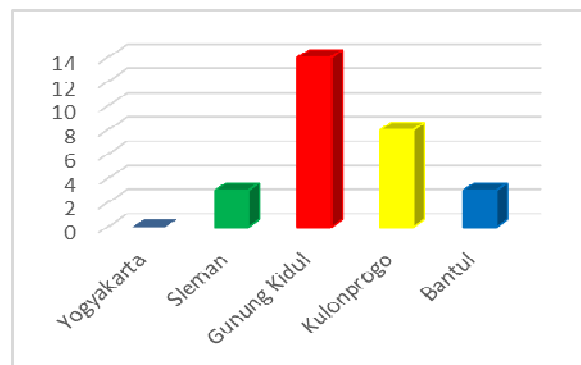


Source: Badan Pusat Statistik, 2013

Although it is the province with the fewest population, Special Region of Yogyakarta as an educational and tourist destination is one of the provinces with the

highest number of visits, in 2018 alone, an increase in tourist visits to Special Region of Yogyakarta increases by 15% (Wardhani, 2018). Indirectly the increase in existing population affects water consumption, so surely in the future, the increase in water consumption will be even higher. On the other hand, with high water consumption, the problem of the water crisis continues to occur where one of the regions in the Special Region of Yogyakarta that often experiences a water crisis is Gunung Kidul Regency. Universitas Muhammadiyah Yogyakarta disaster expert Rahmawati Husain said, currently Special Region of Yogyakarta is one of the regions affected by extreme climate change, especially in the Gunung Kidul area which is experiencing a long drought (Setiawan, 2020).

**Figure 2.** Number of villages experiencing drought



*Source: Environmental Statistics of DI Yogyakarta, 2019*

The data is indeed very visible that drought is one of the big problems in Gunung Kidul, it is seen from the Environmental Statistics data in Yogyakarta in 2018/2019 that Gunung Kidul is an area with the highest number of drought disasters with 14 villages or villages experiencing drought (BPS DI Yogyakarta, 2019). According to a study from Sivakumar et al. (2011) that in general the incidence of drought can be viewed from the aspect of hydrometeorology, where drought arises and is caused by reduced rainfall during a certain period.

In addition, other factors that cause drought when viewed from the hydrological aspect of drought are characterized by reduced water in rivers, reservoirs and lakes (Nalbantis & Tsakiris, 2009). Drought is a natural phenomenon that usually occurs due to the influence of climate circulation and global climate distortion such as El Nino. Indonesia's location is close to the equator Indonesia has a hot climate so the region is vulnerable to drought. In addition, the location of Indonesia which is between two oceans causes the climate of Indonesia is also influenced by climate symptoms caused by the movement of sea surface temperatures of the Indian Ocean and Pacific Ocean. Both of these sea surface temperature movement activities cause two climate symptoms, namely positive Indian Ocean Dipole (IOD) and El Nino. Both of these symptoms are a strong cause of drought in Indonesia (Liong, 2003).

Climate change is a global phenomenon that has had a significant impact lately. Characteristics of global climate change phenomena, including average water vapor, and rainfall are projected to increase (Mizyed, 2009). In addition to these factors, a characteristic feature of the recent climate change is global warming which causes the ice at the north and south poles to melt, causing sea level rise which can have implications for tides in coastal areas (Numberi, 2009).

The impact of climate change is indicated to affect the availability of clean water in Gunung Kidul Regency, especially in its coastal areas. This makes it difficult for

residents to meet their clean water needs. Even though clean water is a very important component in carrying out activities of daily life. To overcome the existing clean water crisis, the Gunung Kidul government is always trying to provide clean water to its citizens, but indeed due to long drought and limited clean water sources. Therefore, in 2019 the clean water crisis that hit Gunung Kidul affected 143,398 people in 16 sub-districts (Kompas.com, 2019).

Based on the background of the above problems, this research will try to explain and analyze clean water management policies in Gunung Kidul Regency. By looking at the policies carried out and the impacts that occur in the community. This study aims to explain the phenomenon of the policy carried out by the Gunung Kidul government in managing water and see whether it is in accordance with the problems that are present in the form of climate change which is causing a long drought in Gunung Kidul. This research has benefits as input for the Gunung Kidul Regency government in water management.

## **RESEARCH METHOD**

This research is a type of library research. Where according to Sugiyono (2009) library research is a theoretical study, references and other scientific literature related to culture, values and norms that develop in the situation social research. In addition, library research also means techniques for data by reviewing literary works such as books, notes and various reports related to the problem being studied (Nazir, 1988).

In addition, according to Sarwono (2006), library research is also research that studies various books and references to previous research results that aim to get a theoretical basis for the problem being studied. Therefore, here the authors collect various sources from journals on climate change, management policies, and the water crisis. In addition, other supporting sources are printed books, official websites, journals and articles that have been identified, analyzed, clarified and interpreted, so that they become works that can be justified.

## **RESULT AND DISCUSSION**

### **General Description of Gunung Kidul Regency**

Gunungkidul Regency is one of the regencies in the Special Region of Yogyakarta, with its capital city Wonosari. The area of Gunungkidul Regency is 1,485.36 km<sup>2</sup> or around 46.63% of the total area of Special Region of Yogyakarta. Wonosari City is located in the southeast of the city of Yogyakarta (the capital of Special Region of Yogyakarta), with a distance of ± 39 km. The area of Gunungkidul Regency is divided into 18 Districts and 144 villages. The geographical location of Gunung Kidul Regency is 1100 21 'to 1100 50' East Longitude 70 46 'to 80 09' South Latitude.

Based on the topography of Gunungkidul Regency, it is divided into 3 (three) development zones, namely, the North Zone is called the Batur Agung region with an altitude of 200 m - 700 m above sea level. The situation is hilly, there are sources of groundwater 6m-12m from the ground surface. Soil type is dominated by latosol with volcanic mother bed and typhoon sediments. This area includes Patuk, Gedangsari, Nglipar, Ngawen, Semin, and northern Ponjong Districts.

The Central Zone is called the Ledok Wonosari development area, with an altitude of 150 m - 200 masl. Soil type is dominated by red mediterranean association and black grumosol with limestone mother material. So that despite the long dry season, water particles are still able to survive. There is a river above the ground, but dry season is dry. The depth of the ground water ranges from 60 m - 120 m below the surface of the land. This region includes the Districts of Playen, Wonosari, Karangmojo, Central Ponjong and the northern Semanu District.

The South Zone is called the Seribu Mountain development area (Duizon gebergton or Zuider gebergton), with an altitude of 0 m - 300 masl. The basic rock forming is limestone with the characteristics of conical hills (Conical limestone) and is a karst region. In this region, many underground rivers are found. This Southern Zone includes Saptosari, Paliyan, Girisubo, Tanjungsari, Tepus, Rongkop, Purwosari, Panggang, southern Ponjong Districts, and southern Semanu Districts.

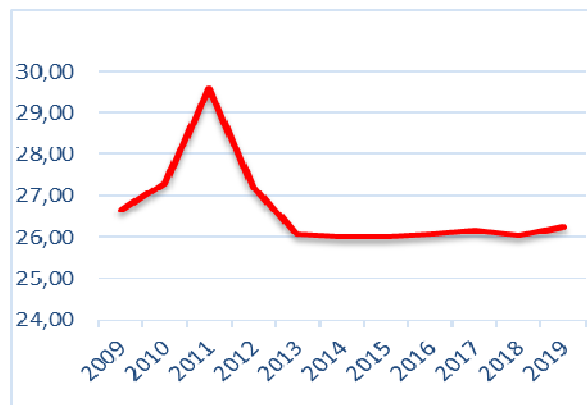
### Climate Change in Gunung Kidul Regency

Based on studies conducted by Amalia & Sugiri (2014) that have been done previously, that to know the occurrence of climate change can be done by looking at the increase in air temperature, decrease in rainfall and tides.

#### 1. Increased Air Temperature

Below is a diagram of the air temperature in Special Region of Yogyakarta, because there is no detailed temperature data in Gunung Kidul Regency, the authors take data from the Special Regency of Yogyakarta Province, which Gunung Kidul Regency is still included in the Special Regency of Yogyakarta region.

**Figure 3.** Average air temperatures in Yogyakarta in 2009-2019 (°C)



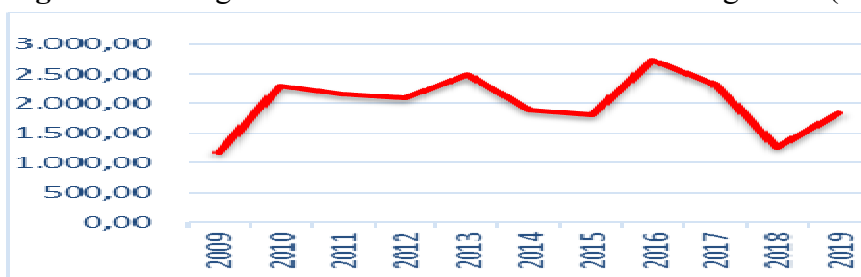
Source: Badan Pusat Statistik Yogyakarta, 2020

From this curve it can be seen that there was an increase and decrease in the existing air temperature, but there was a drastic increase in 2011, although there was a drastic decline also in 2012, but the increase continued to occur again until 2019. The interesting thing was, the ups and downs the temperature in Gunung Kidul Regency is inconsistent, even the most noticeable difference in the increase in air temperature, which initially only stood at around 27 degrees in 2010, increased to nearly 30°C in 2011, but experienced a significant decline again in the years after. Inconsistent temperature ups and downs still continue in the years after that until 2019 which has increased again. This is in accordance with one of the characteristics of climate change that is inconsistent rising and falling air temperatures which cause global warming.

#### 2. Increasing and Decreasing Rainfall

Rainfall is one indicator to see the climate change that occurs in an area. Climate change that occurs makes the occurrence of uneven precipitation resulting in differences in rainfall between one area with another.

**Figure 4.** Average rainfall in 2009-2019 in Kab. Gunung Kidul (mm)



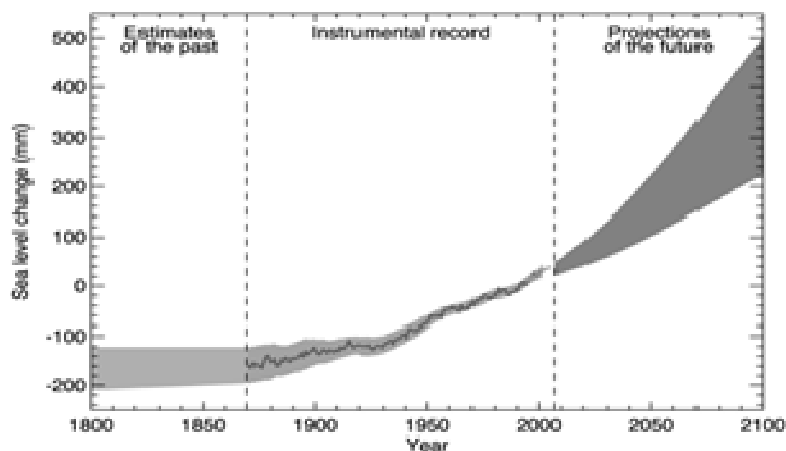
*Source: BPS DI Yogyakarta, 2020*

From the curve it can be seen that during the 10 years (from 2009-2019) the rainfall that occurred in Gunung Kidul Regency experienced rainfall inconsistent, which if observed has increased drastically and has improved dramatically each year. In 2009, if observed rainfall is at a low level of only around 1,000.00 mm, but in the following years it has increased dramatically to almost touch the number 2,500.00 mm, if it is seen there is a correlation between inconsistent average rainfall in 2009 to 2010 with an inconsistent increase in air temperature. Increasing and decreasing rainfall drastically continue to occur until 2019, where there was a drastic decline in 2018 but experienced another increase in 2019.

### 3. Tidal Seawater

Sea level rise in an area becomes one of the forms or characteristics of climate change. It occurs due to global warming occurring on Earth, based on data from the International Panel for Climate Change or IPCC issues related to climate change including is global warming where the temperature of the earth's surface has increased by around 0.80C since the end of the 19th century. The IPCC further explains that atmospheric temperatures are expected to increase around 1.50C to 5.80C during the 21st century and one of the effects of global warming is the rise in advance sea water (IPCC, 2007).

**Figure 5.** Rising Global Seawater in the Past, Present and Future



*Source: IPCC, 2007*

According to McCarthy et al. (2007) sea level rise can threaten coastal ecosystems, settlements, and resources in coastal areas. Gunung Kidul Regency itself is one of the regions in Special Region of Yogyakarta whose territory is in the coastal

area. Based on a study conducted by Mutaqin et al. (2012) that the Gunung Kidul Regency area which is in the coastal area there has been an increase in sea levels that have high and low levels of vulnerability, namely high susceptibility to marine deposition coast typology and very low susceptibility to structurally shaped coast typologies.

In addition to the tidal pattern that often results in natural disasters abrasion around the karst area of Gunung Kidul and is one of the characteristics of climate change where the rising sea waves, abrasions that occur in the karst area of Gunungkidul Regency form a residual landform from the marin process (Mutaqin et al., 2012). These piles are the stack (rock collapsed at the base of the cliff), marin terraces, beach fronts, beach nests, and sea arches.

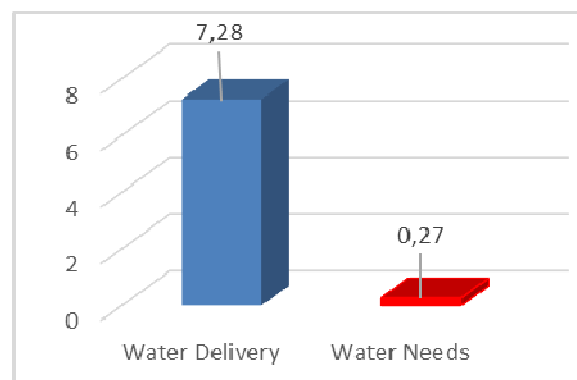
The presence of faults and burrows in limestone forming cliffs cause differences in rock resistance, causing the formation of headlands and bays. The wave energy coming into the headland and bay is not as great. This is because in the cape wave convergence occurs which causes the concentration of the incident wave, whereas in the bay the wave divergence occurs so that the concentration of the incident wave does not occur. Therefore, the bumps that occur in both of them become different, where in the bay formed pocket pisses (pocket beach) due to marine deposition and the cape occurs the process of marin erosion (abrasion).

Beaches with bay morphology have the danger of wave blows due to wave reflection. This wave of reflection can not only occur in incident waves but can also occur in tsunami waves that reach the bay. In addition, in the morphology of the bay there is often a reverse current (rip current). Backflow is a backflow concentrated through a narrow path that flows strongly toward the sea from the zone of emptiness across the breaking waves until it is in the offshore sea (Sunarto, 2003).

### Clean Water Crisis in Gunung Kidul Regency

Clean water crisis has occurred in Gunung Kidul Regency for a long time. According to Salim (2016) that for the Gunung Kidul area even though it is located in the karst rock area, the available water availability exceeds the water demand in the region (see figure 6), but it does not guarantee that the existing water can be utilized in such a way, because the area Kars in Gunung Kidul is in a critical status area, so that the available water is limited in number, it is probably due to geomorphological conditions where karst area consists of rocks that are easily dissolved by water so as to produce many gaps that are able to pass water below the surface, consequently water on the surface only a few are restrained. This is also reinforced by Langi & Sudibiyakto (2007), that only 25% of the water that falls in this area is retained on the surface and can be directly utilized. Most of the others (75%) enter below the surface and flow along the subsurface river flow into the open sea without being used by the community. The same thing was said by Adji (2010) that the area consisting of karst rocks is a barren region.

**Figure 6.** Comparison between water availability and water needs of the Gunung Kidul karst area in 2014 ( $m^3/year$ )



*Source: Salim, 2016*

In addition, the prolonged dry season is also one of the reasons why Gunung Kidul is experiencing a clean water crisis, as the opinion of the head of the Gunung Kidul Regional Disaster Management Agency (BPBD), that the long drought that has resulted in water supply problems (Pertana, 2019). The long dry season that occurs is none other than the anomaly of the weather, where the seasonal changes that occur are uncertain.

### **Implementation of Water Resources Management Policies in Gunung Kidul Regency**

Water is one important aspect in the continuity of human life. The need for water is not only in the household aspect, but has also reached other aspects such as industry. But when it comes to water, the relationship with the community is very close. Therefore, if the need for water increases, it is certain that an increase in population therein.

Water is the most unique natural resource compared to other resources because of its renewable and dynamic nature. This means that the main source of water in the form of rain will always come in the season according to time. However, under certain conditions water can become non-renewable, for example in certain geological conditions where groundwater travel takes thousands of years, so that if groundwater is overloaded, water will run out (Kodoatie & Sjarief, 2010).

If you look at basic needs, then water is used in almost every aspect of human life such as cooking, bathing, washing to drinking. Therefore, the need for water is one of the most important aspects, especially clean water. The availability of water, especially clean water, is closely related to the condition of the population in an area. Like the research of Hunter (2001) that population dynamics have a very important influence on ecosystems, including those related to water availability. In addition, according to Rachmawati & Hidayati (2006) high growth rates and population density can certainly have implications for access to clean water. However, there are many intervening variables that bridge the relationship between the availability of clean water and the population, including technology, policy and culture.

Regarding the policy itself, there are several important things that must be considered, according to Ridwan (2016) in implementing the policies, namely:

1. The behavior of the institution or agency tasked with running the program in accordance with the flow of implementation and its objectives.
2. Various networks of power in political, economic and social terms that have a direct influence on the parties involved.
3. The desired or undesired effects or impacts on the programs that have been implemented.

Furthermore, it is adjusted to the theory of public policy implementation. According to Meter and Horn, there are five variables that affect implementation performance, namely; (1) standards and policy objectives (2) resources (3) communication between organizations and strengthening activities (4) the characteristics of the executing agent and (5) social, economic and political conditions (Subarsono, 2012). Adding according to Grigg (1996), water resources management is defined as the application of structural and non-structural means to control air and man-made resource systems for human and environmental purposes. Structural measures for

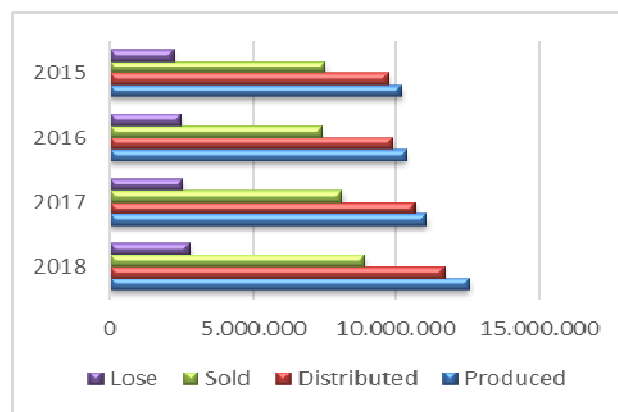


water management are the facilities used to control water flow and quality. Non-structural measures for water management are programs or activities that do not require built facilities (Kodoatie & Sjarief, 2010). Global Water Partnership, offers an attractive integrated concept for Integrated Water Resources Management. According to GWP, the important elements in integrated water resources management can be grouped into 3 main elements, namely:

1. The Environmental is the general framework of national policies, legislation, regulations, finance for the management of natural resources by actors. Its function is to compile and formulate policies, regulations and finances. So that it can be called the rules of the games.
2. Institutional roles of various administrative levels and actors. Its role defines the actors.
3. Management tools are operational instruments for effective regulation, monitoring and law enforcement that enable decision making to make informed choices among alternative actions. These choices must be based on agreed policies, available resources, environmental impacts and social and cultural impacts. So a policy can be in the form of regulations or programs that can later have an impact on society based on joint decision making. Therefore implementation becomes important because from there it can be assessed whether the success or failure of a policy.

Based on the theory and concept above, if it is seen from the aspect of the institutional role, the institution in charge of providing the distribution and supply of clean water in Gunung Kidul is the PDAM.

**Figure 7.** Water Production and Distribution by Regional Water Supply Company (m3)



Source: BPS Gunung Kidul, 2019

Looking at the drinking water production and distribution data by the drinking water company in the Gunung Kidul Regency area, it is seen that drinking water production always increases every year, followed by water distribution. However, water sales have not really experienced a drastic increase, even water losses continue to occur and follow an upward trend, even though Gunung Kidul continues to be forged by drought which has resulted in a water crisis. On the other hand, if you look at the trend of clean water crisis that is happening in Gunung Kidul Regency in terms of distribution, the Government has not really utilized the existing water resources.

Based on **(table 1)** it can be seen that in the capacity of water sources, Gunung Kidul does not not have it, even enough to meet the existing water distribution, such as in Baron water sources whose source capacity is 800 Lt / Sec but the pump capacity for distribution is only 78 Lt / Sec, Different things are shown in water sources in Seropan

which have a water source capacity of 950 Lt / Sec with a higher pump capacity of 144.42 Lt / Sec.

On the other hand there are still five locations of water source installations which have not been used optimally such as Sawahan and Trayu. Based on this fact, in terms of water resources management, the government of Gunung Kidul Regency has not really maximized the existing potential, starting from the minimum capacity of pompa until the utilization of water resources has not been fully utilized.

So it is natural to look at the current conditions where there are still many areas affected by climate change in the form of drought which has caused the people of Gunung Kidul to continue to experience a clean water crisis.

**Table 1.** Drinking Water Installation Managed by Regional Drinking Water Companies (PDAM) by Location

<b>Installations Placement</b>	<b>Resource Capacity (Lt/Sec.)</b>	<b>Pump Capacity (Lt/Sec.)</b>	<b>Distribution System</b>
Banyumeneng	15	2	Pompanization
Tahunan	10	2	Pompanization
Ngobaran	180	49	Pompanization
Baron	800	78	Pompanization
Sawahan	-	-	Pompanization
Pucung	10	2,5	Pompanization
Trayu	-	-	Pompanization
Seropan	950	144,42	Pompanization
R1	750	67,46	Pompanization
Payak	8	5,2	Pompanization
Grogol	4	2,4	Pompanization
Hargobinangu 1	30	14	Pompanization
Hargobinangu 2	40	28	Pompanization
Ngembel	20	18	Pompanization
Gelung	10	5	Pompanization
Tawarsari	25	13,65	Pompanization
Gempur	20	13	Pompanization
Siyono	20	14,60	Pompanization
Baleharjo	17	11	Pompanization
Plosodoyong	40	10	Pompanization
Ledoksari	20	9	Pompanization
Mendongan	7	3,50	Pompanization
Gading	-	-	Pompanization
Bunder	40	17	Pompanization
Ngleri	-	-	Pompanization
Belik Ri	-	-	Pompanization

*Source: BPS Gunung Kidul, 2019*

In addition to the problem of water resource distribution and its utilization that has not been carried out to the maximum, when referring to the clean water tariff data in the form of drinking water, there has been a drastic increase in the category of non-commerce customer groups such as household customers in either category 1 or 2. But strangely enough for Commerce customer groups such as little commerce and big trade decrease drinking water tariffs. It was found by the authors when comparing data in 2017 and 2018.

**Table 2.** Drinking Water Rates according to Customer Group and Classification of Consumption Volume in Gunungkidul 2017

Customer Groups	A (0-10m3)	B (11-20m3)	C (>20m3)
<i>Non-commerce</i>			
Household 1	3.750	4.000	4.250
Household 2	4.000	4.250	4.500
<i>Commerce</i>			
Little Commerce	6.000	6.500	7.000
Big Trade	7.000	7.500	8.000

*Source: BPS Gunung Kidul, 2018*

It can be seen from the table above that there are indeed differences in tariffs for non-commerce and commerce groups where the rates given for non-commerce groups are lower than commerce, which is rational because, the use of water in non-commerce groups for daily needs such as bathing and wash. Unlike the commerce group that uses water to support businesses. But in 2018 (see table 3) there was a very significant reduction in tariffs for commerce groups that initially ranged from Rp. 6,000 to only around Rp. 4,250. On the other hand the non-commerce group experienced an increase in tariffs, especially the non-commerce category Household (2) C (> 20m3) which initially was only around Rp. 4,500 to Rp. 5,750. Even though if you look at the needs and facts in the field, there are still many people in Gunung Kidul who have difficulty buying PDAM water that will be used for daily needs, due to economic factors coupled with frequent drought due to climate change.

**Table 3.** Drinking Water Rates by Customer Group and Classification of Consumption Volume in Gunungkidul Regency 2018

Customer Groups	A (0-10m3)	B (11-20m3)	C (>20m3)
<i>Non-commerce</i>			
Household 1	3.750	4.000	4.500
Household 2	4.000	4.500	5.750
<i>Commerce</i>			
Little Commerce	4.250	4.750	5.500
Big Trade	4.250	4.750	5.500

*Source: BPS Gunung Kidul, 2019*

This it can be seen that there are problems regarding the management of clean water which is not really done optimally. Starting from the community who have not used PDAM water as a whole even though the production produced by the Gunung Kidul government is quite high, on the other hand there is a correlation between buying interest or community consumption of PDAM water with tariffs given by the Gunung Kidul Government. With the increase in tariffs, people are less interested in using PDAM water, added based on public complaints that the services provided by PDAM Gunung Kidul have not been maximized. This has caused many people in Gunung Kidul who are in the middle to lower economy to rely more on using ground water or wells, due to expensive water rates. This is in line with studies conducted by Kjellén & McGranahan (2006) that people who have a sufficient economy prefer to use ground water rather than PDAM water because they have to pay. That is because the poor population must pay for clean water is far more expensive compared to the rich population (Maryono, 2011). Even according to the results of a World Bank study, the poor population even had to pay up to 30 times more expensive than the rich to get clean water services (Rizani, 2010). In addition, studies conducted in the Philippines or

more precisely in Manila also said the same thing that only 28% of people using water connected to the pipeline 72% preferred to use alternative sources such as groundwater (Chiplunkar et al., 2012).

In addition, the distribution of water using pipes that are not comprehensive so that the use of water installations that have not been maximized is one of the factors why there are still many areas in Gunung Kidul that do not have PDAM water access. This is in line with a study conducted by Alihar (2018) that due to the limited distribution network of PDAM, not all households in an area can enjoy clean water.

Another policy pattern in managing clean water resources is that it can be seen based on Government Regulation No. 42 of 2008 concerning Water Resources Management, article 1 paragraph (8), states that water resources management patterns are the basic framework in planning, implementing, monitoring, and evaluating water resources conservation activities, therefore managing water resources by conserving in order to maintain the quality of water resources in accordance with the rules must be considered.

### **Water Resources Conservation**

Conservation is the use of water as efficiently as possible and the timing of the flow that allows water flow is not destructive. This understanding is detailed by two main activities. The two main activities include efforts to maintain the amount of water that can be used for a long time (including maintaining water quality) and to use water optimally and efficiently (Arsyad, 2009). Adding, according to Bayu & Prabawa (2013) (Mutaqin et al., 2012) that conservation practices include three main activities, namely preservation, protection and utilization. Preservation here is a water cycle arrangement that allows the distribution of space so that the time can still meet water needs in a long time, it can be done by maintaining the catchment area, building infiltration wells or making reservoirs. Protection of water resources is maximized as an effort to prevent water resources from being damaged by making regulations on the quality standards of wastewater and ground water. Regarding the utilization of water resources earmarked for their use, they can guarantee the continuity of use in the future.

Water preservation activities carried out by the Gunung Kidul Regency government are by carrying out the construction of dams and reservoirs. In Gunung Kidul itself, the government has built several dams such as the Simo dam as a source of water for the community, especially in terms of water distribution to community agricultural land. On the other hand the construction of the reservoir has also been carried out, by the government but if the rainfall is really low, even the water source in the reservoir will be completely dry as well.

In addition to the construction of dams and reservoirs, one form of water preservation in conservation activities is by making absorption wells, but on this matter, the Gunung Kidul government still does not really do this, even though the use of absorption wells is very useful for absorbing water to the ground. Actually the uptake well construction has been carried out but it was not the intention of the Gunung Kidul government, but from the private sector, as was the case for the construction of dozens of wells in Nglanggeran Village by Ades. Therefore the Gunung Kidul government must be able to pay more attention to alternative water absorption developments.

In addition to preserving water resources, another important thing to do to manage water resources is to protect water resources. In Gunung Kidul itself, the policy to protect water resources is contained in the Regional Regulation of Gunungkidul District Number 17 of 2012 concerning Permits for the Use of Groundwater and Permit for Groundwater Exploitation. As explained in article 21 that in the use of ground water, it is required to have prior permission from the Regent. However, the existence of written law does not mean that the implementation is truly appropriate. On the other hand the

Gunung Kidul Regency government has issued Gunungkidul District Regulation Number 2 of 2014 concerning Mineral Mining Business, in article 7 it is explained that in mining, one of which is stone mining, is required to have permission from the Gunung Kidul Regent, but in fact there are still many stone mining limestone in the illegal karst mountainous area occurs in Gunung Kidul as in the 2014 Tribunjogja news report that illegal limestone mining in the karst area continues to occur, so that government assertiveness is needed to overcome this (Tribunjogja.com, 2014).

Moreover in article 2 that explains the principles of mining business activities that, must continue to hold the principle of sustainable and environmentally friendly, in the sense that the mining business activities carried out must continue to maintain the surrounding environmental ecosystems, especially in the case of water ecosystems. However, in the research of Suryatmojo and Hatma (2004) that exploiting the potential of natural resources by mining allows to disturb the environmental balance, this is related to the function of karst areas as water buffer zones. In addition, Walhi's research on the Apriando (2014) clearly states that mining will damage karst rocks that are identical to underground rivers. At present, in some locations, water discharge is significantly decreasing. If the karst landscape continues to be damaged, it is certain that underground river discharge will decrease and even disappear. It is even said that community participation in protecting the environment of karst rocks in Gunung Kidul Regency does not include the community at all so that it can be said that the Environmental Impact Analysis (AMDAL) is procedural flawed.

## **CONCLUSION**

Climate change has occurred in Gunung Kidul Regency. This can be seen from several factors that the authors have outlined, namely where there has been an increase in temperature in the last 10 years, the intensity of the average inconsistent rainfall to rising sea levels that cause damage in coastal areas in the form of abrasion. Disasters caused by climate change can also be seen, namely the clean water crisis that occurs during the dry season. Although in terms of water resources, Gunung Kidul has sufficient resources, but due to being in the karst rock area that is critical of water, with the clean water crisis the Gunung Kidul Regency government must be able to respond with maximum policy.

However, in reality the implementation of the policy has not been truly maximized. This can be seen from several factors namely in terms of drinking water production from PDAM Gunung Kidul always increasing every year, followed by water distribution. Even though, water sales have not really experienced a drastic increase, even water losses continue to occur and follow an upward trend, this indicates that the people of Gunung Kidul have not fully trusted to use water from PDAM Gunung Kidul. This has a correlation between people's buying interest or consumption of PDAM water and the tariffs given by the Gunung Kidul Government. With the increase in tariffs, people are less interested in using PDAM water, plus based on public complaints that the services provided by the Gunung Kidul PDAM are not optimal. In addition, in terms of water distribution, the government of Gunung Kidul Regency has not really maximized the existing potential, starting from the low capacity of pomba until the utilization of water resources has not been fully utilized. So it is natural to see the current conditions where there are still many areas affected by climate change in the form of drought.

Besides, in managing water resources, water resources management is needed by carrying out conservation in order to maintain the quality of water resources in accordance with the rules must be considered. In water conservation policies based on three important points, namely preservation, protection and utilization of water

resources. In terms of preservation of water resources, the Gunung Kidul government has undertaken the construction of reservoirs, dams to infiltration wells but again the capacity of development carried out to date has not been comprehensive. On the other hand in terms of protection and utilization of water resources. The Gunung Kidul government has issued regulations to safeguard its water resources, but there are still many illegal limestone mining activities that damage water resources, then the use of surface water resources such as the Serayu Opak River Region which has the potential for water availability in total actually exceeds the needs. But many have not been utilized. So that at certain times the water supply has not been sufficient because of the lack of water uptake infrastructure at certain locations.

Under such conditions the Gunung Kidul government must be able to provide concrete strategies to overcome the water crisis caused by climate change. Therefore, some appropriate steps that can be taken are, first, try to utilize other water resources besides groundwater resources because climate change will continue to affect the quantity and quality of ground water, such as surface water resources and rainwater that can be accommodated, it requires massive development such as the construction of a uniform reservoir to absorption wells. Second, expanding the distribution of water pipes from the PDAM so that it can be felt by the entire community of Gunung Kidul, but that must be accompanied by payment rates that reach the economic community down. Third, maintaining the quality of water resources in drought prone areas by taking action on mining activities that can damage the environment of water resources.

To complete research on climate change and clean water resource management policies, further research is needed on more detailed areas in Gunung Kidul Regency, to map areas that are truly affected by drought, which is caused by climate change. in order to support the right policy data to be carried out in the future by the Gunung Kidul Government.

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