ABSTRACT

This study aims to find water resource management methods both monitoring conditions and making appropriate action decisions, to prevent flooding in the rainy season and avoid the crisis of the availability of clean water in the dry season. This can be achieved by the use of fuzzy logic to model and compile microcontroller software programs, which are connected with water level sensors as input and opening actuators and door closers for the sake of maintaining survival in the city of Makassar on the availability of adequate and adequate clean water consumption without pollutants. This system can think and act like humans in taking the right action.

The trial of the application of the system to the upper waters of the Jeneberang River on Mount Bawakaraeng flows through the city of Makassar and empties into the Makassar Strait, making it a major clean water resource and at the same time a threat to life in the city of Makassar. The trial succeeded very well in providing real-time information on the surface of the water to the holders of mobile phones that were included in the program. The success rate reaches 95% to 100%. System failure can only occur in the form of a delay in sending signals due to interference with the internet net.

Key words: Management, Real-Time, Resource, Water, Fuzzy.
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1. INTRODUCTION

Although the availability of water on the earth is abundant, but clean water that is consumed is decreasing, it is even very difficult to find in some places, and only around five percent (± 5%) of the total amount of water that is on the earth, which is suitable for water drink, the rest is sea water. According to the National Ocean Service in the United States, about 70% of the earth's surface consists of oceans with an average depth of 3,700 meters to the most 11,000 meters in the Bermuda triangle. The ocean holds around ± 1,338,000,000,000 m³ of water, but it cannot be consumed directly without going through the processing process first. So there is a deep concern about the danger of lack of clean water, so that various human efforts arise to maintain the sustainability and continuity of the availability of clean water that is suitable for consumption.

Environmental damage is one of the causes of the reduction in sources of clean water. The widespread extent of coastal abrasion also causes seepage of sea water to the land, which in turn will contaminate sources of clean water that are below the surface of the soil. Disposal of careless garbage in the river also causes river water to become dirty and unhealthy to use.

In Indonesia it is estimated that 60 percent of the river, especially in Sumatra, Java, Bali and Sulawesi, has been polluted by various wastes, ranging from organic matter to coliform bacteria and fecal coliform to diarrhea. According to Ministry of Health data in 2002 there were 5,789 cases of diarrhea which left 94 people dead. Deforestation and logging of trees that reduce the absorption of soil from water, also participate in increasing the reduction in clean water intake.

In connection with this water crisis, it is predicted that in 2025 almost two-thirds of the world's population, namely ± 1.8 billion people, will live in areas that experience absolute water scarcity. The forecast was reported by the World Water Assessment Program (WWAP), the formation of the United Nation Educational, Scientific and Cultural Organization (Unesco). The agency stressed that the water crisis in the world would have a devastating effect. Not only does it cause an epidemic of disease that takes lives, but it will also lead to famine.

Jacques Diouf, Director General of the World Food and Agriculture Organization (FAO), said that currently the world's water use has more than doubled compared to a century ago, but its availability has actually declined. Without access to hygienic drinking water, 3,800 children die every day from disease. The problem is so complicated that experts argue that someday, there will be a “fight” to make this clean water. The same is true for battles over oil and gas energy sources.

In addition, in Indonesia there has been a decline in the ability of water supply to be quite large, because of changes in land use for industrial and residential purposes, due to the development of economic activities and population growth has resulted in a reduction in the area of catchment areas and the ability to absorb water. This condition is exacerbated by the decreasing capacity of water storage structures such as rivers and reservoirs as a result of increased sedimentation. The low level of operation and maintenance also results in the decreasing level of water resources infrastructure services.
Another problem related to the threat to the sustainability of the carrying capacity of water resources is the increased damage to watersheds. In 1998 the number of critical watersheds had reached sixty-two and tended to increase. This condition has resulted in a reduction in water supply, which has led to increasingly uncontrolled use of ground water. Some areas in urban areas, especially industrial areas, have experienced excessive exploitation of ground water resulting in environmental damage in the form of a decrease in groundwater level, seawater intrusion and land subsidence. If it is not controlled, this condition will threaten the sustainability of the carrying capacity of water resources and become a disaster for human life.

Climate in Indonesia causes uneven distribution of water availability. At five wet months eighty percent is available, while the remaining twenty percent is in seven dry months. This condition resulted in some areas at one time being oversupplied, even experiencing a large flood. On the other hand, in the dry season some regions experience drought which results in a decline in the harvested area of agricultural products and inadequate supply of raw water for household needs.

The main problem in the management of water resources in the city of Makassar is how to avoid flooding in the rainy season and how to overcome the drinking water crisis in dry season. During the rainy season, the capacity of the Jeneberang river to channel water directly to the Makassar Strait sea was inadequate, resulting in overflowing residential areas, while drainage in the city of Makassar was not good. During the dry season, the coverage or coverage of drinking water piping installation services in the city of Makassar is low. The challenge of the development of drinking water is to improve the quality of drinking water management, increase drinking water production capacity and service coverage, and apply reasonable tariffs. clean water with piping in urban areas has only reached ± 33.3 percent, while in rural areas only ± 6.2 percent.

Waste water services, the main problem is the low coverage of wastewater services, among others, caused by the still low awareness of the community in handling wastewater. The challenge of developing wastewater is to increase public awareness of the importance of clean and healthy living behavior (PHBS), developing services for centralized sewerage systems, communal systems, and on-site systems.

Solid waste services, the main problem is the declining quality of waste management which results in air and water pollution which, among other things, is caused by a decrease in the quality of landfill management, increasing volumes of waste dumped into rivers, and the limited land area in urban areas for landfill. The challenge of solid waste development is to increase public awareness about the inappropriate behavior of littering.

Drainage services, the main problem is the widespread expansion of inundation areas caused by the reduction of green open land, the optimal non-functioning of drainage channels, the use of drainage channels for waste disposal, and the low operation and maintenance of drainage channels. The challenge of the construction of drainage is to increase public awareness not to dispose of garbage into the drainage canal, maintain the area of green open land, improve drainage operations and maintenance, and the construction of integrated drainage channels with flood control.

**Problem Formulation**

Based on the background above, the problem can be formulated as follows:

- How to provide real-time information about the state of accurate water resources, so that it can take appropriate actions to avoid flooding and overcome the crisis of the availability of clean water for survival in Makassar city.
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- How to monitor the processing process to maintain the quality of clean water that is suitable for drinking water in the city of Makassar.

Research Objectives
The research objectives to be achieved are as follows:

- New modeling that is more precise and easy to implement in providing real-time information about the state of accurate water resources, so that it can take appropriate actions to avoid flooding and overcome the crisis of the availability of clean water for survival in the city of Makassar.

- Finding new ways to monitor the processing process in order to maintain the quality of clean water that is suitable for drinking water in the city of Makassar.

Benefits of Research
The benefits obtained from this study are as follows:

- Can improve the quality of clean water because it is processed and supervised by a faint logic-based control system, so it no longer has fatigue and carelessness as long as the system equipment is in good condition.

- Model the system with a new approach using vague variables in the form of linguistic or language variables so that it can produce a new formula as a new finding.

2. LITERATURE REVIEW
Management is an effort to plan, implement, monitor, and evaluate the implementation of conservation, utilization of water resources, and control of water damage. Water is all water found on, above and below the surface of the land, including in this sense surface water, ground water, rainwater and seawater utilized on land. Source of water is a place / container of water both found on, above, or below the surface of the soil. Water power is the potential contained in water and / or water sources that can benefit human life and livelihood.

Water resources are water, water sources, and water power contained therein. Conservation of water resources is an effort to maintain the existence, sustainability of the condition, nature and function of water resources so that they are always available in sufficient quantity and quality to meet the needs of living creatures both at present and in the generations to come. Utilization of water resources is an effort to optimize, provide, use, develop, and exploit water resources in an effective and efficient manner. Control and control of destructive power of water is an effort to prevent and overcome environmental damage caused by the destructive force of water which can be in the form of floods, cold lava, waves, tidal waves, and others.

The strategy for managing water resources, taking into account the various problems faced, so that in order to maintain the continuity of the availability of clean water that is suitable for consumption in the city of Makassar, continuous management needs to be done holistically. As shown in Figure 1. Sustainable water resource management below:
Figure 1. Management of water resources with PDCA

Plan, do (carry out), check and act (follow up) is a total quality management method strategy to maintain water resources so that they can be sustainable. Management is holistic starting from upstream to downstream, from water resources, distribution facilities including the culture of the people to the distribution to the user community and sources of pollution, and the dangers that can be caused as follows:

- Anticipating floods by increasing coordination between related agencies and working with communities in flood-prone areas of Makassar, South Sulawesi. Another activity carried out was to improve the management of an early warning system in Jeneberang. Thus, information about the potential for flooding can be known earlier by the community so that they can immediately take anticipatory steps. In an effort to encourage an increase in the role of the community in flood prevention, training was also carried out to deal with flooding and continuous socialization of flood emergency responses in the city of Makassar, South Sulawesi Province.

- Control of the destructive power of water, especially in terms of flood prevention, prioritizing a non-construction approach through conservation of water resources and watershed management by taking into account the integration of regional spatial planning. Increased community participation and partnerships among stakeholders continue to be sought not only during the flood event, but also at the stage of post-disaster prevention and recovery.

- Take preventive actions against flood hazards which can occur at any time due to leakage or breakdown of the Jeneberang and Bili-bile dikes that can threaten various joints of life in the city of Makassar, as well as flood control with a flood management approach if there is a flood in Makassar city.

- Emergency response to floods is sought through the provision of rescue equipment, evacuation, and provision of refugee equipment, as well as preparation of flood material in the form of sacks and gabions to reduce the impact of disasters. In addition to responding to emergency response, contingency plans were also carried out to find alternative flood mitigation solutions. River maintenance must also be carried out to maintain flow capacity and prevent damage to buildings along the river.

- Reducing the threat of the sustainability of the destructive power of water resources and increasing the guarantee of the availability of water, by making efforts to conserve water resources through water source conservation programs, including the construction and maintenance of reservoirs. In addition, efforts were made to prevent the entry of sediments in the river body and the entry of debris from the Caldera Mountain Bawakaraeng sediment into the Bili-Bili Reservoir. Emergency response measures were taken by moving the intake of raw water supply to the reservoir so that it could still be processed as water drinking Makassar City.
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- Water resource management is carried out by taking into account the harmony between conservation and utilization, between upstream and downstream, between the use of surface water and groundwater, between managing demand and managing supply, and between fulfilling short-term interests and long-term interests.
- Utilization of water resources for fulfilling irrigation water needs both short and long term is focused on efforts to improve the function of irrigation networks that have been built, but have not yet functioned, rehabilitation of damaged irrigation areas, and improvement in operation and maintenance performance.
- Conducting revitalization of agriculture, through the Development and Management of Irrigation, Swamp, and Other Irrigation Networks Network, the construction and completion of irrigation networks was carried out with wider coverage of the Bili-Bili dam.
- Provision of raw water must be in line with the increasing need because the development of residential and industrial areas in the city of Makassar, developed the use of small ground water and retention basins or reservoir basins, especially in coastal areas.

3. SYSTEM MODELING

The high and low water levels in the water resources will fluctuate based on rainfall, so it can be described as a wave around the water surface height in normal conditions which is determined to be a reference or set point, like Figure 2 below:

![Figure 2. Wave water surface change of reservoirs or rivers](image)

Based on data at four BMKG stations (BMKG = Climatology and Geophysical Meterology) namely Panakkukang station, Hasanuddin station, Paotere Maritime station and Panaikang station in Makassar City from year 2006 to 2015 as follows:

- Average rainfall occurs in April-May 696.25 mm³/month
- The peak of the rainy season occurs in December-January with the highest rainfall averaging 986.25 mm³/month.
- The peak of the dry season occurs in August-September with the lowest average rainfall is 83.25 mm³/month.
The average water level as the basis for setting the height of the sensor placement above the water surface is 350 cm, and the lowest water level in the dry season with sensors as high as 600 cm, and the distance between the water level is highest in the rainy season with sensors as high as 200 cm.

**FLC Reasoning and the Results of the Decision**

IF  E is V_SMALL and  DE is NEGATIF then is V_DANGER, Led is ON, alarm is ON.
IF  E is V_SMALL and  DE is ZERO  then is DANGER, Led is ON, alarm is OFF.
IF  E is V_SMALL and  DE is POSITIF  then is SECURE, Led is OFF, alarm is OFF.
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Full reasoning is stated in Table 1, below:

<table>
<thead>
<tr>
<th>E</th>
<th>DE</th>
<th>V_SMALL</th>
<th>SMALL</th>
<th>ZERO</th>
<th>BIG</th>
<th>V_BIG</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEGATIF</td>
<td>V_DANGER</td>
<td>DANGER</td>
<td>SECURE</td>
<td>SECURE</td>
<td>SECURE</td>
<td></td>
</tr>
<tr>
<td>ZERO</td>
<td>DANGER</td>
<td>SECURE</td>
<td>SECURE</td>
<td>SECURE</td>
<td>CRISIS</td>
<td></td>
</tr>
<tr>
<td>POSITIF</td>
<td>SECURE</td>
<td>SECURE</td>
<td>SECURE</td>
<td>CRISIS</td>
<td>V_CRISIS</td>
<td></td>
</tr>
</tbody>
</table>

System Testing Results Design system testing is done by observing the actual condition of the water surface in the existing water resources directly and then arranged the simulator tool in the laboratory and placed the sensor according to the distance of the actual distance at the observation location. With a simulator of the water level placed in a container that can be raised down, the results obtained in Table 2 below are obtained:

<table>
<thead>
<tr>
<th>No</th>
<th>Input</th>
<th>Condition of water resources</th>
<th>Led-Sensor conditions</th>
<th>Buzzer-sensor conditions</th>
<th>Contents of the SMS sent</th>
<th>SMS Sending time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>536 cm</td>
<td>V_CRISIS</td>
<td>Flashing</td>
<td>Ringing</td>
<td>Turn off a lot of flow</td>
<td>7 sec</td>
</tr>
<tr>
<td>2</td>
<td>488 cm</td>
<td>V_CRISIS</td>
<td>Flashing</td>
<td>Ringing</td>
<td>Turn off a lot of flow</td>
<td>7.5 sec</td>
</tr>
<tr>
<td>3</td>
<td>360 cm</td>
<td>SECURE</td>
<td>OFF</td>
<td>OFF</td>
<td>Operation continues.</td>
<td>9.5 sec</td>
</tr>
<tr>
<td>4</td>
<td>280 cm</td>
<td>DANGER</td>
<td>Flashing</td>
<td>OFF</td>
<td>Little open the spill way</td>
<td>8 sec</td>
</tr>
<tr>
<td>5</td>
<td>211.2 cm</td>
<td>V_DANGER</td>
<td>Flashing</td>
<td>Ringing</td>
<td>Large open the spill way</td>
<td>9 sec</td>
</tr>
<tr>
<td>6</td>
<td>235.2 cm</td>
<td>V_DANGER</td>
<td>Flashing</td>
<td>Ringing</td>
<td>Large open the spill way</td>
<td>10 sec</td>
</tr>
<tr>
<td>7</td>
<td>428.8 cm</td>
<td>SECURE</td>
<td>OFF</td>
<td>OFF</td>
<td>Operation continues</td>
<td>10.5 sec</td>
</tr>
<tr>
<td>8</td>
<td>384 cm</td>
<td>SECURE</td>
<td>OFF</td>
<td>OFF</td>
<td>Operation continues</td>
<td>11 sec</td>
</tr>
<tr>
<td>9</td>
<td>452.8 cm</td>
<td>CRISIS</td>
<td>Flashing</td>
<td>OFF</td>
<td>Turn off a few flow</td>
<td>8.7 sec</td>
</tr>
<tr>
<td>10</td>
<td>246.4 cm</td>
<td>V_DANGER</td>
<td>Flashing</td>
<td>Ringing</td>
<td>Large open the spill way</td>
<td>7.3 sec</td>
</tr>
</tbody>
</table>

The results of the system testing shown in table 2 above state that the success rate of monitoring water level conditions in the Jeneberang River reaches 95% to 100% without failure.

**6. CONCLUSIONS**

Based on the results of research conducted starting from water resources in Makassar and surrounding areas to the distribution of water to consumers in Makassar as described in the previous chapter and the results of system trials, it can be concluded that the application of a sustainable water resource management system based on vague logic is as follows:
Water level monitoring modeling with faint logic successfully applied very well, and practically as well as more precise and easy to apply to providing real-time information on the state of accurate water resources, so that it can take appropriate actions to avoid flooding and overcome the crisis of availability clean water for survival in the city of Makassar.

The application of cryptic logic in modeling real-time conditions of water resources is a very appropriate and accurate choice for monitoring the process of managing water resources in order to maintain the quality of clean water that is suitable for drinking water in the city of Makassar.

REFERENCES


