

## Development of the Water Potential in River Estuary (Loloan) Based on Society for the Water Conservation in Saba Coastal Village, Gianyar Regency

<sup>1</sup>Dr. Ir. I Gusti Agung Putu Eryani, MT, <sup>2</sup>Ir. Putu Gede Suranata, MT  
<sup>1,2</sup>Department of Civil Engineering, Warmadewa University, Denpasar Bali, Indonesia

### -----ABSTRACT-----

*Saba village is located in Gianyar regency near by the coastal area, which is currently ±9,176 inhabitants. Water is a major necessity for life processes on earth, which means water is very important to human life. Potential water of the river flows from upstream to downstream wasted into the sea through the river estuary. Water as the most important natural resources often had a problem in its existence of its circulation and its spreading, therefore it is necessary to conserve water. This research examines the development of water potential in the river estuary based on the society for water conservation in Saba village based on SWOT analysis. Data collected: water potential, watershed topography, Saba village management structures, environmental conditions at river estuary and beaches. Analysis of potential water data using Ribasim software. The result is the water potency in dry season 0.88 m<sup>3</sup>/s, and rain season 1.141 m<sup>3</sup>/s. The potential water in the river estuary can be developed by the society by prioritizing the society initiatives that is the ability of management and maturity of a uniform society. The society thinks, formulates, plans, implements, and evaluates the needs in the development of water potentials submitted to Saba society organizations.*

**Keywords:** coastal, estuary, river, water conservation, water potential.

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### I. INTRODUCTION

Bali island consists of 8 Regency town. The total area of Bali is 3254 Km<sup>2</sup>. Petanu river estuary in the Saba village including the District Blahbatuh, Gianyar, Bali Province. Saba village is one of the villages located in Gianyar regency, which is currently 9,176 inhabitants. Saba village is a coastal village that has an area of 600.60 ha stretching from north to south with a height of 0-500 villages above sea level.

Saba village is bordered by Blahbatuh Village in the North, Pering Village East, South Indonesia Ocean, and Sukawati Subdistrict in the West. Geographically, Saba Village is located south of Blahbatuh Subdistrict and Blahbatuh Village. To reach the village of Saba can be reached through the Banjar Perangsada, Pering Village with a 2.10 km highway or can be reached by road by pass (Prof. DR Ida Bagus Mantra street). Relatively high rainfall occurred in January, February, March, November and December. During the rainy season, the water source in Watershed (DAS) in Bali is abundant, while in the dry season it has begun to experience water deficit. Rivers naturally offer various possibilities for human life. Humans also naturally have a tendency to exploit the potential of water that exist in the river for its purposes such as bathing, washing and latrines.

Water is one of the most important natural resources for living things but is often a problem in its existence (occurrence), circulation and distribution. In addition, because of its properties, water is very easily contaminated with other chemicals through environmental pollution. Therefore, conservation efforts are needed through effective and efficient management system so that their benefits can be sustainable to the next generation.

Development, is an effort to optimally utilize water resources and efficient use of observations conducted in Saba Village Blahbatuh District. In Gianyar Regency it is known that most residents utilize the Petanu River water resources to meet the daily water needs by direct way to the river and via pipelines. The majority of the population of Saba Village utilize the Petanu River water source as the main water source or raw water source.

This research will examine the method of developing the water potential at the river estuary or loloan based on the society for water conservation in Saba village of Gianyar Regency, based on SWOT analysis. To be able to preserve the water in Bali Province.

## II. LITERATURE REVIEW

### 1. Potential Water

Potential water is the potential of water resources that already exist now and that meet the water needs for the foreseeable future. According to the Directorate General of Irrigation [1], Indonesia's surface water potential is approximately 1.789 billion m<sup>3</sup> / year.

### 2. River Estuary (Loloan)

Estuary of the river (loloan) is the territorial water body where one or more rivers enter the sea, to oceans, lakes, dams, or to other larger rivers. In coastal areas, river estuary are severely affected by terrestrial water conditions such as freshwater and sediment flow, as well as seawater such as tides, waves, and the inclusion of salt water on land. [2]

### 3. Water Conservation

According to Arsyad [3] water conservation is a deliberate behavior with the aim of reducing the use of fresh water, through methods of technology or social behavior.

### 4. SWOT Analysis

The SWOT analysis can be arranged by consider both of the external and internal factors, and also determining the key success factors. The external environment surrounding a strategic plan in the form of opportunities and threats can vary from region to region. External factors that influence political, economic, social, cultural, technological, competitor, stakeholder and other external factors. While the internal environment in the form of strength and weakness including human resources, natural resources, facilities and infrastructure, finance (funds), information, strategies, and so forth. Strengths are resources, skills or other advantages relative to competitors and needs that a system wants to serve. One important result of SWOT analysis is the formulation of strategic issues in order to achieve the objectives and mission of a system effectively and efficiently. Key issues can be potential, opportunities, strengths, challenges, constraints, and weaknesses encountered, including resources, funds, facilities and infrastructure, and legislation and policies used by government agencies in their activities.

Several steps that can be done in order to obtain the key issues include:

- Identify Potential Strategic Issues.

Strategic issues are the ongoing or expected incidents or trends that have a major impact on the implementation of the vision, mission, goals, objectives and strategies.

- Make Priority Issues

Is done by determining five to ten strategic sequential issues from the most important or considered the most significant impact. Prioritizing the most important issues will enable those issues to get a proportional attention.

- Analyze issues.

This step is an important step. At this step, tested whether the issue is really valid or not.

### 5. Development and Management by the Society

Based on Rahardjo [4] Society-based development implies direct involvement of the society in managing water resources regardless of the gender of the society in an area. Society-based management means the society that think, formulate, plan, implement, evaluate and monitor something that becomes their needs. The magnitude of the percentage of each form of participation can vary from one society with the other society. Sudarmadji [5] states that the society involvement in monitoring, control and evaluation activities is a manifestation of actual accompaniment that has been done to form a high sense of ownership from the society.

## III. METHODOLOGY

The research method is conducted by collecting potential data of Petanu watershed downstream in Saba Village of Gianyar Regency. These secondary data include topographic data, rainfall data, and supporting data. Then proceed to calculate the availability of existing water infrastructure in the downstream area of the Petanu River which is carried out to determine the flow of water in the river. This river water discharge is needed to know the ability of water and other water in flowing a certain amount of water discharge within a certain time.

Sampling method is done by simple random sampling. Data collection technique is done by observation, interview, questionnaire and documentation. Data analysis techniques used descriptive analysis and through four stages of editing, coding, table-making and analyzing, and SWOT analysis. The results showed that the habit of utilization of Petanu River water potential by the people of Saba Village of Gianyar Regency is influenced by daily activities and the biggest water utilization for household water needs such as bathing, washing clothes, drinking, toilet gel, cooking, watering plants, washing Family furniture and religious ceremonies.

The average water requirement of the population per day is 95 liters / person / day. Based on the results of research types of activities that this type of research using quantitative descriptive analysis method supported by qualitative with Ribasim software, and cross tabulation method. This research consists of: preliminary survey, primary and secondary data collection based on the type of participation followed by processing and data analysis.

The focus of this research is the society (in this case affected society) that located around the provision of raw water to obtain the data and description of community participation in water resources management. Technique of collecting technical data is done by studying various documents with supportive power, that is: image of location map, general condition of research area, demography condition of population and socio economy which generally taken from office of Central Bureau of Statistics and Environment Agency of Bali Province.

Data analysis in this research using the type of quantitative data, that is statistics that used to analyze data by way of describing or data that has been collected. The data considered valid is tabulated and the records for analysis are then presented in the cross-table, the frequency with which the percentage is present and the data described in the report form.

#### **IV. RESULT AND DISCUSSION**

##### **1. Water Development and Management**

The results of the study using Arc. GIS 10 with a shapefile from the watershed area on the island of Bali, using the UTM 500 S coordinate system and the polygon calculation geometry, then calculated the area of each watershed polygon, the Petanu River Basin is 96,970 km<sup>2</sup>, with the main river length of 46.770 km. The morphological characteristic of the Watershed (DAS) is the character of the Petanu River form, which can be seen based on the width and shape of the watershed, the length of the river and the width of the watershed and the density of river flow and slope. Petanu watershed has an elongated morphological shape with a magnitude of RC (basin circularity) value of 0.27 to 0.46, meaning lower flooding fluctuations. Level of slope 0 - 8% (low flow velocity) and very steep > 40% (very high flow rate). Characteristics of soil type yellowish brown regosol. Petanu River is a river that cross the 2 districts of Bangli and Gianyar.



**Fig 1.** Map of the river basin and estuary of Petanu River

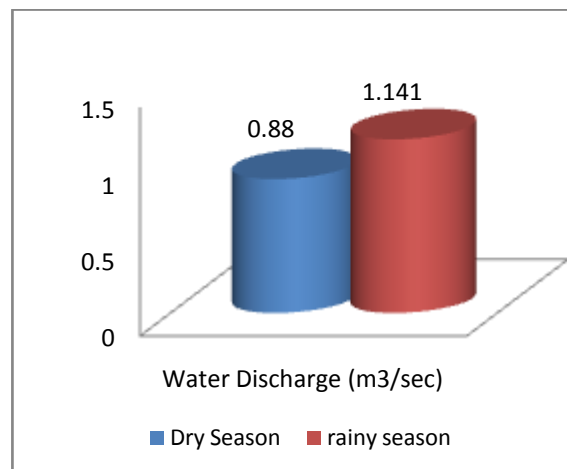
##### **2. Water Potential**

Downstream Petanu watershed is located at the bottom and is the estuary or place of unity of all sources of flow originating in the upper part / upstream. Therefore, the fluctuation of the discharge is greatly influenced by the Sub-Basin-Sub DAS on it. In addition, considering the downstream area is very close to the sea, the debit condition is very fluctuating.

The analysis of the discharge in the Petanu River Basin of Gianyar Regency and the river water level is also affected by the tides. The observation of water level and discharge at the river estuary post at Saba beach shows that the monthly average downstream discharge pattern is similar to the average monthly discharge pattern in the Sub-Basin at the top.

The potential of water in the watershed Petanu amounted based process using RIBASIM software input the data in the to 6.86 m<sup>3</sup>/s, whereas during the dry season (in September form of Hydrology (rainfall, evaporation)the potential of water in Petanu river estuary amountedto 0.88 m<sup>3</sup>/s. and during the rainy season (in January) of 1.141 m<sup>3</sup>/s.

The average monthly rainfall graph shows that the pattern and the amount of discharge that occurs are still normal and reasonable, its means that the fluctuation is still in accordance with the average monthly discharge pattern in the sub-basin of the upper basin. However, at the time of the lowest discharge and accompanied by the retroactivity of the old sea water, it will be found a decrease in the water level is high enough.



**Fig 2.** Water Potential in the Petanu River Estuary

The SWOT analysis process is based on external and internal environmental assessment and then there will be some main issues, such as:

1. Identification the downstream watershed of petanu river and forest areas in the upstream of the watershed that is still beautiful.
2. Household improvement in some areas of Gianyar Regency.
3. The rise of illegal logging and illegal mining in the upper watershed.
4. Lack of spatial application in accordance with its function.
5. planting pattern of the society in the processing of agricultural land that is not in accordance with the rules of soil conservation.
6. Good cooperation between government agencies and the society in flood prevention in Gianyar Regency.
7. Weak supervision of the destruction of forest area in the upstream of Petanu Basin.

Based on the matrix of potency and pattern of utilization of Petanu River water resources hence can be developed development strategy by methodSWOT analysis matrix, which can be generated four sets of possible alternative strategies that will be faced in the utilization of Petanu River water resources in Saba Village, that is by mapping the components of "Strength", and "Weakness" to the "Opportunities" and "Threats" So the results of the mapping are as follows:

a. S-O Strategy

- Development of river estuary areas in Saba village as rainforest forest catchments that are guided bygovernment policy of Gianyar Regency related to forest management and water resources of estuary of Petanu River. (O 1,2,3,4-S 1,2,3,4).
- Improving infrastructure and facilities to support development in terms of utilization of Petanu River water resources to be more wise (O2-S1,2,3).

b.O 2-W 2 Strategy

- Improving the quality of human resources and the mastery of the science and technology of the people living in the estuary of the river or whose farmers convert the forest into gardens to realize regional development plans and strategies, especially Saba Village with various education and training (O 2-W 2).
- Seeking the best solution to solve the problem of Petanu River water resource utilization in Saba Village in more direction good again (O 2-W 1.3).

c. S-T Strategy

- To formulate policies regulating the management of river estuary and utilization of water resources of estuary of Petanu River (S 1,2,3-T 1,3)
- Formulate policies that regulate development around the Saba Beach area while maintaining the sustainability of the potential power of natural resources and environmental sustainability (S 1-T 2.3).

d. T-W Strategy

- Re-planting existing ecosystems along the damaged Petanu basin (T1,2,3-W 1,2,3).

Surface water can be obtained through flowing water (rivers) and shelter (lakes, reservoirs, embungs, etc.). Due to poor physical quality then before surface water use was clarified first with a cleansing process as well as other

processes to improve the chemical quality of water. In the upstream areas, the fulfillment of water needs in quantity and quality can be supplied by the river water, whereas in the downstream areas the water needs can no longer be supplied, due to environmental factors such as sedimentation and human behavior so that water sources become polluted and even scarce.

The raw water source from the river prior to use must meet the physical and chemical requirements. Transmission system from the surface water of a system that serves to deliver clean water from water sources (rivers / lakes) to the ground reservoir is then distributed to areas that require clean water. The way of water distribution depends on the location of the water source located downstream of Petanu River.



**Fig 3.** River Downstream Conditions In Saba Village

The high level of society participation is influenced by the type of society work. Type of work is a very influential factor in the process of increasing the society participation. It further argued that this type of work in this case is more emphasized on the provision of time and energy to participate in society. There are several factors that can affect community participation in a program. The nature of these factors exist that can support a successful program but there are also the nature can disrupt the success of the program.

For example, the factors of age, sex, education, occupation and income and length of stay, usually referred to as internal factors or from within the society. The high level of society participation is strongly influenced by the length of stay. The length of time a person lives in a particular environment and his or her experience of interacting with that environment will have an effect on one's participation. The longer he lives in a certain environment, the sense of belonging to the environment tends to be seen in his large partitions in every activity of that environment.

Society-based development initiatives that prioritizes people demanded, among others, managerial ability and maturity equitable society, because the water potential management handed over to community organizations. To accommodate the problems in water resources management based central government, then drafted a collaborative model that blends elements of the government and in the management of user groups known as co-management. Raakjaer Nielsen and Thomas Vedsmand [6] define co-management as an arrangement in which responsibility for resource management is shared between government and user groups (co-management approaches aim to implement marine resource management by bringing together relevant institutions especially the society, the government and other stakeholders in each process management, from planning, implementation, utilization, and supervision.

Implementation of co-management in the long term is believed will provide changes to a better direction, that is:

- Raising public awareness of the importance of natural resources in supporting life
- Improving the capacity of the society, so as to be able to participate in every stages of integrated management
- Increasing the income (income) of society, with forms of sustainable and sustainable utilization and environmentally sound.

Co-management is an alternative choice that combines top-down and bottom-up management systems, in other words co-management combines centralized government-based management with society-based management. In open access, there is no regulation of what, when, where, who, and how natural resources are utilized, and how free-for-all occurs. In the utilization of natural resources, can trigger the tragedy of the common, resource damage, conflict between actors and economic disparities.

The development of water potential by the community is an alternative solution as it proves to provide a number of benefits due to livelihood security, equitable access to natural resources and conflict resolution mechanisms,

and sustainability oriented [7]. Referring to the Berkes and Scott concept, Satria [8] identifies the three dimensions of society water resource management. First, the normative dimension. This dimension contains a value system that forms the basis for the natural resource management process. Second, is the regulative dimension, which contains governance and natural resources.

Ostrom [9] has tried to deliver some performance indicators of water resources management institutions. The indicators are as follows:

- Boundary clarity: boundaries are clearly defined so that everyone is easy to identify and recognize.
- Conformity to local conditions: have appropriate rules for the sake of resource sustainability, local economic protection, and strengthening of social systems and those rules are easy to enforce and easy to monitor.
- Rules are organized and managed by resource users: society are able to create rules based on scientific considerations, local knowledge, and local wisdom through local agency mechanisms.
- The existence of local institutions that function to manage the management mechanism, make rules, revise the rules, and decision-making mechanism.
- Oversight performers who are respected by the community: the community has its own instruments and oversight mechanisms with the supervisors who have the legitimacy of the society.
- Applicability of sanctions: a measure of success of a rule is the enforcement of sanctions for offenders, whether social sanctions, administrative sanctions or economic sanctions.
- Conflict resolution mechanisms: society have alternative mechanisms for conflict resolution outside formal mechanisms.
- Strong government recognition and may be in the form of shrimp laws, government regulations, or local regulations.
- The existence of bonds or networks with outside agencies. Networks with the outside world in question are both bridging social networks and outside society such as universities, NGOs, and private (linking social capital).

Third, the cognitive dimension, which contains the techniques of management and local. Local knowledge is often coupled with terms such as traditional ecological knowledge or indigenous knowledge. But Ruddle [10] prefers to use the term local knowledge and identify the characteristics of local knowledge as follows:

- A long-term, empirical, local-based observation adapted to local conditions and capable of covering a number of local variations, as well as detailed.
- Be oriented on practical and behavioral issues, and focus on the types of resources and species.
- Structured so that it is in fact compatible with western biological and ecological concepts, particularly related to awareness of ecological linkages and the importance of conservation of natural resources
- Has dynamic properties

These three dimensions are related to each other. That is, the normative dimension will affect the regulative dimension that contains the rules in the management of natural resources. The rules are based on local knowledge systems owned by the community (cognitive dimension). Thus, management by society is a system in which there are interrelated elements.

**Table 1.** Direction Of Society-Based Water Potential Development

Dimension	Normative	Regulative	Cognitive
<b>Model 1</b>	Increased resilience of cultural values	<ul style="list-style-type: none"> <li>• Codification rules</li> <li>• Capacity building</li> <li>• Network strengthening</li> <li>• Facilities and infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>• Identification, inventory, and formulation in writing of existing local knowledge</li> <li>• Cooperation with science</li> </ul>
<b>Model 2</b>	Socialization and internalization of the old values are positive for the sustainability of water resources, economic, and social	<ul style="list-style-type: none"> <li>• Identification, inventory, and revitalization of old rules that have faded</li> <li>• Organizational capacity building</li> <li>• Network strengthening</li> <li>• Facilities and infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>• Identification, inventory, and formulation in writing of local knowledge that once existed</li> <li>• Cooperation with science</li> </ul>
<b>Model 3</b>	Socialization and internalization of local values and religious values for the management of water resources	<ul style="list-style-type: none"> <li>• Organizational capacity building</li> <li>• Network strengthening</li> <li>• Learning from other community success stories</li> </ul>	<ul style="list-style-type: none"> <li>• Education management of water resources</li> <li>• Learning from success stories from other society</li> </ul>

The development of water potentials with the empowerment of local wisdom-based society implies the laying of local values as an input to poverty alleviation. Every society has its own characteristics that are not necessarily owned by other communities. The cultural values they embrace consist of a view of life and belief, both

enclosed by ethos (ethical guidelines concerning good and bad). Culture is a system of knowledge used by humans to shape their actions, and interpret the behavior of others. One of the goals of society empowerment is the creation of development. The development paradigm used is people center development which puts the community as the focus and the main source of development.

Community development can be understood through three orientations:

- Efforts to provision of basic services to complement the basic needs strategy, identified with the improvement of social services and the provision of social services, such as health facilities, nutrition, education, and sanitation for the welfare of the society.
- The planned effort to achieve goals is more complex and varied, in order to achieve more difficult social objectives such as fairness, equity, cultural enhancement, peace, and equal opportunity.
- Efforts to improve the human capacity to act and improve its postentiality, mobilize its enthusiasm to participate actively in the decision-making process or policies related to the development of water potential in the river estuary.

Management of water quality in estuaries can be carried out via water treatment to obtain water quality that meets the requirements, provision of clean water in the building can be done with a special treatment. Water treatment is designed according to standard water conditions, in a well-equipped and well-equipped device that can have components to neutralize water conditions physically, chemically and biologically. The level of society participation in water resources management and development in Gianyar Regency is included in the level of partnership. According to the classification, the level of participation with a score of 264 while the accumulated score of 620 scores are in the interval score of 600 to 1125 including the level of participation manipulation. This means that the form of community property participation in water resources management in Gianyar regency can generate a sense of awareness and a sense of ownership of the infrastructure built, such as contribution contributions starting from the implementation stage until the maintenance phase.

The level of community participation in the form of personnel has a score of 240 at the level of participation of delegated power, while for the accumulated variable value is 630 which is located at the interval value of 600-1125 as well as at the level of participation manipulation. This means the form of society participation that can foster a sense of togetherness in realizing a concern for the condition of the settlement environment, which can give a big influence for the smooth development activities in the management of drinking water facilities and the distribution of piped water, such as the contribution of labor and materials at the implementation stage.

Participation of labor intended here is how the society is involved directly or physically in the implementation of maintenance and prevention activities and the preservation of water potential. The activities carried out are such as reforestation, and other water resources conservation measures, such as environmental conservation, conservative and eco-friendly farming practices and activities that require direct society participation.

The participation rate in the form of skills to water resources management conducted by the Gianyar Regency society of 100 respondents scores 260 scores including the participation rate of delegated power, and for the accumulated score of 605 lies in the interval value of 600-1125 including the level of participation manipulation. This means that the form of participation that can foster a sense of togetherness in realizing a concern for the environmental conditions that can give a big enough effect for the smoothness of water conservation development activities in a sustainable manner.

The level of society participation in the form of thinking towards sustainable water resources management has a score of 265 including partnership participation rate and for the accumulated score of 640 which also lies at intervals of 600 - 1125 including the level of participation manipulation. Participation of ideas is the participation of society in the form of non-physical, that is how the society is involved in giving his thoughts in the process of maintenance and conservation of water resources. Participation can be realized on various occasions, such as through meetings, through letters / suggestions and responses. The distribution of ideas, ideas and thoughts can be channeled through existing formal and non-formal institutions.

The level of society participation in the social form of sustainable water resources management scores 282 including the level of participation, for the accumulated score of 604 which also lies in the interval value of 600-1125 including the level of participation manipulation. The economic, social and cultural characteristics of society are aimed at analyzing the reality that shows the dominant patterns of relationships and actions that influence the lives of the people. The level of society participation in the management and development of water resources in a sustainable total score of 3,201 is included in the partnership participation rate ranging from the interval value of 3226 - 3750.

This means that the form of participation that can generate a sense of awareness and sense of ownership of the infrastructure built in relation to the management of water resources, such as contribution contributions, personnel, skill, thought and social starting from the implementation stage until the maintenance phase. Based on these facts in the category of Arstain the participation rate that occurs that belongs to the category of Partnership. This stage is influenced by:

- a synergic relationship between members of the society so that each has responsibilities in accordance with the roles and positions in the management of society organizations.
- the capacity of government organizations and institutions that support the implementation of government programs so that appropriate steps should be taken to empower society.
- socio-cultural background considerations of low income groups, the society needs to be given strength and ability in a series of actions / steps taken by the government in the mastery of knowledge, attitude of conscious behavior and skill.
- The society is not given the opportunity or the right to express opinions / ideas because it is considered not to have the ability and the initiative is the party who needs assistance so that the activities carried out without any feedback to the society.

#### **Factors Affecting Community Participation**

Factors that affect the participation of the results of this study when viewed from the probability of its probability value of  $0.305 > 0.05$  then it can be concluded that the gender variables do not affect the community participation. Saba village community participation at the consultation level is the community taking part in water potential development activities such as policy formulation, implementation of the program in advance to consult with the Saba Village management.

#### **Interactive Participation**

The society participation of Saba Village at this interactive level is the society directly involved in the implementation of the program. The village society of Saba has a duty in the activity. Participation for Incentives participation for Saba Villagers, at this incentive level is the community contributing labor and earning wages, in the process of facilitating facilities, cleaning and other activities such as, discussion activities involving all components of society.



**Fig 4.** Estuary (Loloan)Petanu River

#### **Functional Participation**

The participation of the Saba Village community at this functional level is local decision making by the community. The team of river estuary and Saba Beach as a director in carrying out water conservation activities.

### **V. CONCLUSION**

All Stakeholders in the Petanu river estuary and Saba beaches include its society that should be given a role in accordance with existing rules in determining the allocation of water potential so that there is joint control of the Government and all stakeholders. The need for water in the coastal area of Saba is very limited hence required the pattern of water saving through engineering water resources such as conventional water treatment techniques Participation of the community in the management and development of water potential starting from planning, policy formulation, implementation and utilization Based on research results of the highest activity type utilizing water is a bath 40 lt/person/day while the lowest is drinking activity 2 lt/person/day. The distance factor between residential houses with relatively close water sources and ease of obtaining river water at no cost is the reason why people are more likely to use river water than other sources such as wells and hand pumps. This is supported by the installation of piped water that drains water from water sources / rivers / water reservoirs directly to people's homes, which are derived from the development of water potential by the community.

Various water conservation techniques on civilian methods of civil engineering work to slow surface water flow, collect and distribute surface water streams in order not to damage, repair and increase water infiltration and provide water for plants.



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