WATER MANAGEMENT OF RIVER ESTUARY FOR THE PREPARATION OF ECOTOURISM IN COASTAL AREA OF BALI PROVINCE

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ABSTRACT

Surface water flowing in the river is a resource of useful raw water to meet the needs of society and as irrigation water is managed by Subak in Bali, Indonesia. Bali has experienced water deficit, along with the increasing number of inhabitants and tourism activities. Results of research of the Ministry of Environment (MOE, 2009) stated that Bali has experienced water deficit of 7.5 billion m^3/year in 2000 and 2015 deficit is estimated at as much as 27.6 billion m^3 of water/year. The purpose of this research was to evaluate the potential of water in the estuary Saba in order to support ecotourism in coastal areas of the province of Bali and formulating water resource management scheme for coastal areas in Buleleng regency. This research uses quantitative methods with the research location is in the Saba river estuary in Buleleng Regency. Data collected consist of primary data and secondary data. Simulation models for water resources management and statistical analysis using software RIBASIM (River Basin Simulation). As a result of this research is the potential of water in the estuary Saba. The result of measurements in the dry season (September 2013) is amounted to 0.156 m^3/sec and in the rainy season (January 2014) of 1,023 m^3/sec. Potential water in Saba river estuary based on the simulation of RIBASIM is 9.34 million m^3/year, can be used as society water domestic for 81 851 inhabitants, for the water industry (hotel) is 1364 rooms, amounted to 2 ha of fish pond water and for irrigation water (agricultural) is 148 ha. Results of water quality research to the smell, color, temperature, turbidity meet quality standards, while taste, and salinity do not meet quality standards. For the chemical aspect, that is pH and detergent meet quality standards while for BOD and COD does not meet the water quality standard Class I. In terms of biology, total coliform does not meet the quality standards of class I. Saba River water potential for ground water of 7.46 million m^3 (6%), residual water irrigation (Return Flow) amounted to 54.74 million m^3 (41%) and the balance/allocation of water in an area (water District) amounted to 71.54 million m3 (53%). Water resources management in the Saba River estuary for the water potential in the river estuary can be managed by making reservoirs (reservoir), and dam movement and arrangement of the beach.

Keywords*:* river estuary, water management, ecotourism, coastal area.

INTRODUCTION

River estuary is the area of the body of water where the entry of one or more of the river to the sea, lake, dam, ocean or river to another larger. In coastal areas, estuaries are highly affected by water conditions such as flow inland freshwater and sediment, as well as sea water such as tidal, wave, and the influx of salt water inland.

Depending on the location and environmental conditions, estuaries may contain many ecological niches within a small area, and so is associated with high biodiversity.

Estuary of major rivers can form estuaries and a delta. According to Ross (1995), river estuary is downstream of the river associated with the sea. The area of land that drains water into a body of water called watersheds or drainage basin. The water that flows from the mainland toward a body of water is called run-off (surface run-off), and the water flowing in the river to the sea is called the flow of river water (river run-off). Approximately 69% of the water that enters the river from rain, melting ice/snow, and the rest comes from groundwater, the overall running water is a water resources (Effendi, 2003).

Water resources is water, water sources and water force contained in it, while the basin is the territorial integrity of the management of water resources in one or more watersheds. The rivers that flow in Bali, Indonesia, is Bali Penida River Regional Unit consisting of 391 Watershed (PU Bali, 2012). River in Bali there are purified by Hindus because the river is used in religious ceremonies activity. The rivers in Bali water flows to the north and to the south due to the division of the island of Bali by mountains which stretches from the west-east of the island. River water flowing from upstream to downstream will be discharged into the sea through the river estuary or Loloan.

The water flowing in the river is the water surface due to rain, springs, groundwater and waste or household waste disposal. The total population of the world every day increases, resulting in the need for quality and quantity of water is also increasing, while the availability of water sources of the river in the world that can be used directly as clean water which has a threshold of human consumption is not much, every day people need clean water to drinking, cooking, bathing, washing, etc., and approximately 80% will be disposed of in a form that is filthy and polluted, known as waste water.

The water quality in the estuary of the river in the province of Bali is still within the limits of tolerance. Water quality criteria, is it still feasible to be used or not always associated with water quality standards, the difference with the quantity of water where the level of community needs for water can be met or not based on the amount of discharge or water supply within a certain period.

General water quality shows water quality or condition associated with an activity or a particular purpose. While the quantity of water needed regarding the

number of humans in certain activities. Clean water is needed in the fulfillment of human needs to do all the activities. So keep in mind how the water is said to be clean in terms of quality and can be used in adequate amounts in the daily activities of man.

Population growth and the demands of a more viable livelihood has been encouraging people to continue to try to meet all their needs. But behind it there will be negative impacts on the environment, especially river water. Industrial waste and household waste are transported river waters continues to increase from year to year.

Potential water available in the downstream area in the river or river estuaries can also be utilized as a supporter of the raw water, so it is not allowed to be wasted into the sea during the rainy season, but can be accommodated to support the potential of water in the dry season. Surface water flowing in the river mouth until now there has been maximally utilized for the needs of the community raw water, so the water is wasted into the sea.

The purpose of this research is: (1) to evaluate the potential of water in the estuary Saba Buleleng regency in order to support a sustainable agriculture and ecotourism development plan in coastal areas of the province of Bali; (2) to establish a model of sustainable water resources management for the area of the river estuary Saba Buleleng regency which is in line with the ecotourism development plan.

LITERATURE REVIEW

Water Potential

Water is essential for human life, every day people are expected to require minimal clean water as much as 100 liters per person, such as for drinking, cooking, bathing, washing and others (Taty and Satmoko, 2007). Water potential is the potential of water resources that already exist today and that meet the water needs for the foreseeable future. Potential is the average water discharge at the point of the review.

Water Resources

Water resources is water, water sources and water force contained therein. Water is all the water contained in, above, or below the ground surface, including surface water in this sense. Surface water is all water found on the surface of the soil.

Estuary

According to Ross (1995), estuary of the river is an area of water bodies where the entry of one or more of the river to the sea, ocean, lake, dam, or to another larger river. In coastal areas, river estuaries are highly affected by water conditions such as flow inland freshwater and sediment, as well as sea water such as tidal, wave, and the influx of salt water inland. Depending on the location and environmental conditions, estuaries may contain many ecological niches within a small area, and so is associated with high biodiversity. Estuary of major rivers estuaries can form a estuaries and a delta.

The river is a natural waterway that flows toward another river, lake, sea or ocean. River containing water was flowing in accordance with the properties of water, ie from a high place to a lower place. Before reaching other body of water, the first water to seep into the ground. Water rains fell to the ground, then flows through the river and then carried to the mouth of the river. River starts from a spring that flows into several tributaries. Then tributaries joining to form a major river. End of the river trip is the river estuaries, and so on, so that the river becomes part of the hydrological cycle.

Estuarine coastal plain is the type most common estuary, where the formation occurs as a result of raising sea levels that inundate the river on the sloping beach (Kamal and Suardi, 2004).

Estuarine is water semi-enclosed relating freely to the sea, so the sea water with high salinity can be mixed with fresh water Combination effects of sea water and fresh water will produce a community that is distinctive, with environmental conditions vary, among other things: a meeting place of the river with tidal currents, the opposite cause a strong influence on the sedimentation, mixing water, and other physical characteristics, as well as the huge impact on biota. The mixing of the two kinds of water to produce a special physical properties of the environment is not the same as the nature of the river water and sea water properties.

Morphology of River Estuary

Triatmodjo (1999) suggested that the morphology of the estuary of the river consists of three types: river estuary dominated by streamflow. This occurs at river estuary of the river to flow throughout the year is large enough that empties into the sea with a relatively small waves. At the time of low tide will be pushed into the estuary sediment and spread at sea. River estuary is dominated by wave motion. The river

estuary is affected by the large waves that occur on sandy beaches can pose transport of sediment either perpendicular or parallel/along the coast. The sediment transport can move into the river estuary and the area has been calm wave conditions, the sediment will settle, the greater the larger the waves and sediment transport more sediment that settles in the estuary of the river. River estuary is dominated by the movement of the tide. Estuary of the river affected by tides, high tides if large enough, the volume of the incoming tide huge river. The water will accumulate in water from upstream rivers. At low tide, a very large volume of water was flowing out in a given period of time depending on the type of tides. Thus the current speed during low tide is large, the potential to form the river estuary. This type of river estuary funnel-shaped or bell.

River Estuary Management

There are two management strategy of the river estuary, there are river estuary is always open: the river estuary is always open so that required two long jetties to avoid sedimentation in the flow of river estuary and tongue formation sand. River estuary may be closed where there are two options: the river estuary should not be allowed to turn or move. Diversion of river river estuary can cause longer and can reduce the ability to skip discharge. To resist bending river estuary need to be made jeti medium, short jeti, building on the cliffs of sediment dredging the river estuary or regular basis (Triatmodjo, 1999).

Management of Water Resources and Coastal Watersheds

Sunaryo and Walujo (2004) said there are seven scope of water resources management that is:

1. Management of catchment (watershed management) are attempts to do so as a function of water catchment areas can be maintained with reforestation, terracing and land use controls.
2. Management of water quantity (water quantity management) is the water supply in a fair and transparent, where the achieve is done through the establishment of the licensing water use and allocation of water and control water distribution.
3. Water quality management (water quality management) is an effort to maintain water quality in order to remain in accordance with the conditions established quality standard.

4. Flood control (flood control management) is a flood control measures such as minimizing runoff that occurs when it rains, restrict groundwater pumping is causing subsidence of ground water.
5. Environmental management of the river (river environment management) is an effort to control the use of land in the area of riparian and aquatic biota in order to increase the function of water resources is maintained.
6. Management of water infrastructure (infrastructure management) is an attempt to do in the management of irrigation facilities and infrastructure function that is maintained in accordance with the age and the intended purpose.
7. Research and development is to support and improve the management of water resources in a region with innovations both in the field of technology and management.

Water Discharge

In hydrology stated that water discharge of the river estuary is the river water level that measured by a measuring tool surface river water. The measurements were carried out every day, or else with the understanding that the discharge or flow is the flow rate of water (in the form of water volume) passing through a river cross section per unit time. In the SI unit system the amount of discharge is expressed in units of cubic meters per second (m^3/s).

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from upstream rivers. At low tide, a very large volume of water was flowing out in a given period of time depending on the type of tides. Thus the flow velocity during the low tide is large.

Water Quality

Bali Provincial Government are in the process of formulating its own water quality standards based SKAN (National Water Quality Standards) are new. SKAN newly formulated and describes 4 classes for the use of water benefits the population is as follows:

- Class I. Raw water to clean water supply (drinking) with the processing and all other uses of Class II to Class IV
- Class II. Water for recreation and all other uses of class III and class IV
- Class III. Water for freshwater fisheries for breeding and utilization of class IV
- Class IV. Water for Irrigation water.

METHODOLOGY

The research location is in the River Estuary Saba ended on the beach Pengastulan, Buleleng Bali Province. Data velocity and depth of the estuary of the river water to obtain a water discharge at river estuary is obtained from measurements with current meter and morphology of river estuary is obtained from a field survey to see the profile of the mouth of the river and water quality.

Water sampling estuaries held for one year is the dry season and the rainy season in 2013/2014. This research intended to collect potential of the water at the estuary of the river in terms of water discharge (quantity of water) and some of the water quality in a body of water that will be researched in the field and in the laboratory, with a number of specific sample but has the same characteristics as body water. Samples were taken at three points, with the distance of each point of 100 m. Sampling was carried out around the point 1 at 14:50, point to 2 at around 15:00, and point to 3 approximately at 15:10.

Water sampling using a Van Dorn water sample. First water sample to be used should be clean, rinsed with distilled water first, then with the water sample to be taken. After the closing tool to open before the water sample that sunk into the water sample by means of a water depth of 1 m and a weight was dropped right on top of the device

through the rope so that the lid tightly closed. Then the water is put into bottles until it is full and closed well to avoid contact with air.

Preservation of samples intended to prevent disturbances that could alter the nature of the original state of the sample. This research used a special glass bottles with different treatments depending on the parameters in the review. For testing samples of COD and BOD use glass bottles to be filled and sealed with a glass bottle cap. There should be no bubbles, if there is a bubble of water then water sampling repeated.

Water testing of the parameters of physics, chemistry and biology is done with the following steps: before entering the water samples, the mouth of the bottle first heated, then fill the sample until the bottle is full, then discarded samples 3/4, the mouth of the bottle in reheat, then closed with aluminum foil to avoid contact with air. After sampling, the bottle is stored in a special box so that the quality of water taken unchanged from its original nature.

The analysis should be carried out on a sample depending on the type of water body being examined, the usefulness of these water bodies to local communities for drinking water supply and agriculture and the kind of pollution that could be expected to occur. Several other elements are not lost from the aqueous solution during the course of the river, such as Cl, SO4 and various types of metals. Standard solution was made carefully and should not be polluted, for example, because it is not stored properly or part of the solution has been taken.

Map of the water system in the region of Saba River upstream and downstream as well as at the river estuary has been processed using software RIBASIM by entering the hydrological data. Map of the water system will illustrate the potential of water and water management as well as the layout of the building suitable to manage the water.

RESULT AND DISCUSSION

Results of the analysis with the help of software RIBASIM obtained Potential water resources in the watershed Saba consists of ground water for 7.46 million m^3 (6%) of the overall potential of the water, the waste water irrigation (Return Flow) amounted to 54.74 million m^3 (41%) of the total water potential and balance/allocation of water in an area (water District) amounted to 71.54 million m^3 (53%).

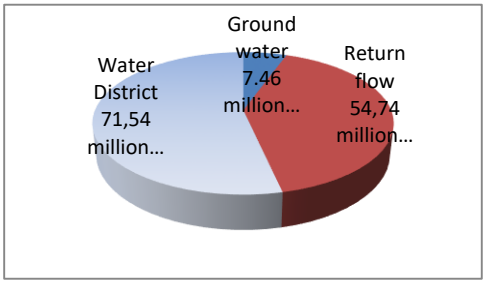

Figure 1.
Water Pontential in Saba Watershed

Based on the flow rate semimonthly for Saba River from AWLR post Seririt recording the data obtained during the dry season (September 1998-2012) amounted to 1,023 m^3/sec, and the rainy season (January 1998-2012) amounted to 1.369 m^3/sec or. The total discharge of water flow analysis semimonthly during the year amounted to 9.3 million m^3/year.

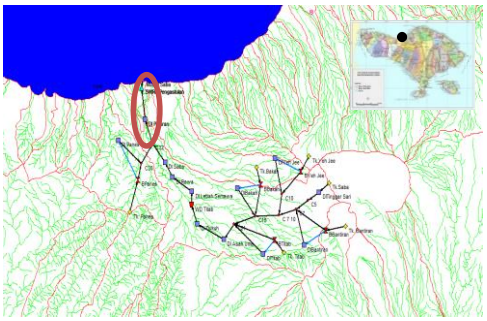

Figure 2
Map of the Water System in Saba Watershed

Results of the analysis of water discharge in Saba River estuary during the dry season (September 2013) amounted to 0.156 m^3/sec and in the rainy season (January 2014) of 1, 023 $m^{3/}$sec. Based on the flow rate in the DAS Saba semimonthly then simulated by software RIBASIM, the obtained water potential of 9,336,514 m^3/year (9.34 million m3/year) water potential is assumed to be used: 50% for irrigation water, domestic water (household) 40%, for industrial water (water for the hotel) 8% and 2% fish pond water, water potential Saba River estuary in Buleleng, amounting to 9.34 million m^3/year can be used for the water industry (hotel) 1364 room, for domestic water 81 851 inhabitants, 2 ha of fish pond water and irrigation water for 148 hectares.

Management of water resources in coastal areas Saba River estuary, the potential of the water can be managed with the reservoir, through the management of water quantity (water quantity management), management of water quality (water

quality management), water management and flood/control of water damage (flood control management) as well as the environmental management of river estuary. The draft model of management of water resources at the mouth of the river estuary Saba can be done by observing the morphological characteristics of the watershed, the morphological characteristics of the river estuary, water potential, infrastructure and utilization of water resources of the river estuary area.

The water management stated above is a preparation for carrying out an ecotourism project in a coastal area in Bali. It is in accordance with a tourism paradigm called alternative tourism because it covers a river area in a village.

CONCLUSIONS AND SUGGESTIONS

Based on the analysis can be summarized as follows:

1. Potential Saba River estuary water in the dry season (September 2013) amounted to 0.156 m^3/sec and in the rainy season (January 2014) of 1,023 m3/sec.
2. Results of water quality testing in Saba River estuary, to the smell, color, temperature, turbidity, taste, pH and detergent meet quality standards, while the sense of salinity, BOD, COD and total coliform do not meet water quality standard Class I.
3. The potential of the water is assumed to be used: 50% for irrigation water, domestic water (household) 40%, for industrial water (water for the hotel) 8% and 2% fish pond water, water potential Saba River estuary in the District Buleleng, amounting to 9.34 million m^3/year can be used for the water industry (hotel) room 1364, for domestic water 81 851 inhabitants, 2 ha of fish pond water and irrigation water for 148 hectares.
4. Regarding all the facts above, ecotourism plan needs to be well developed.

Based on the results of research and data analysis in this research, then it needs to be recommended are:

1. Management of water potential Saba River estuary, and coastal areas in the village Pengastulan Seririt Buleleng, in the design of the model need to add economic aspects and socio-cultural aspects. Keep the socialization of public awareness to care and take responsibility for the environment, for example by: (a) Do not waste water/feces in river because the feces is the best medium for the growth of germs from mild to severe. (b) Do not throw garbage in the river. Waste dumped

carelessly in the river water flow in the river will cause stunted and collected at the mouth of the river. Moreover, it can trigger a flood of rainy season

2. Domestic wastewater should be treated before it is discharged into the sewer that leads towards the river/water body with the intention of lowering the inorganic nitrogen and suspended substances.

ACKNOWLEDGMENT

The writers thank to all those who have helped the retrieval of data and carried out measurement and water testing, especially the staffs of Public Works, Bali Province.

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