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Foundation:
Understanding the Watershed: Case Study at Cidanau Watershed

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Abstract: Proper watershed monitoring is the most essential parts of watershed management. However this step should be continued with other important process, such as developing environmental information data bases. The data bases were required to understand the watershed response, and to identify the influential factors of environmental problems. The approach for establishing this data bases are process identification, statistical analysis, and simulation using appropriate watershed model. This paper conveys important message to every stockholder to continue watershed monitoring with reasonable cost to maintain our environment in healthy condition.

Keywords: *Information databases, Model simulation, Watershed monitoring*

1. Introduction

Watersheds are characterized by the location of the pour-point, or mouth, of the waterbody main flow to which all the other flow points join and eventually drain from the watershed. Since it follows the processes of hydrologic cycle, the condition is depending on rainfall conditions. Some time it is wet or dry with many differences in quality and flow depending upon the individual storm, the season, and the year. Nutrients and chemicals are circulated throughout the watershed's system as result of interaction between activities within a watershed and hydrologic cycle. Aquatic species (fish, or aquatic insects), terrestrial species (birds, or small mammals), and also anthropogenic activities are the important players. However, these human activities are considered as major impacts on the movement of water, water quality, and the quality of the natural habitat. People use these environments to grow food, build their homes and businesses, and travel from one place to another.

Watersheds act as a reservoir and oxidation pond. It stores water from precipitation and the release the water during dry periods. It also filters and purifies the runoff, providing clean water for drinking, irrigation, and industry. A variety of plant and wildlife communities are the indicator for watershed function. Watershed also provides recreation and leisure for many people, taking advantage of boating, fishing, and swimming in a lake. Therefore, scientists recognize the best way to protect our water resources is to understand and manage them on a watershed basis. Human activities as well as natural events that occur in a watershed can impact throughout the entire system.

2. Understanding a watershed

2.1. Environmental monitoring

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Many different attributes are needed to maintain a high quality, biotically rich, functioning watershed. Healthy watersheds provide stable habitats for both biological diversity and human recreational uses. These stable systems are capable of adaptation towards environmental changes over time and are good indicators of the quality in the surrounding habitat. Good watersheds usually function best with low turbidity, minimal suspended sediment in the water, and infrequent shifts in water levels. Frequency and intensity of fluctuating water levels are also very important considerations. Adequate shade, river meanders, and biological diversity also consider as good indicators since they involve on control the environmental temperature, pollutant load, and system stability.

Watershed monitoring is considered as cost centre for most of developing country's governments. Therefore scientists try to reduce budget by considering the purpose of monitoring, and the sub system within the watershed such as nature and anthropogenic sub system. This consideration would reduce the number of observation points and the interest indicators, but at the same time still maintain the requirement for learning processes.

2.2. Environmental Information Database

Knowledge database of environmental behavior at watershed level is crucially important for good, scientifically and economically accepted strategic planning design. It can be used to evaluate the status of the watershed: to learn the watershed response towards several changes: and to estimate the countermeasures for specific problems. This will involve a long period of data observation.

There are at least three approaches for developing the information databases, such as process identification, statistical analysis, and modeling. Process identification involves expertise that may not be existed in all locations to deal with local wisdom. Statistical analysis requires special skill that able to explain the available data and estimate the

trend or future condition with constant assumptions. While modeling approach involves limited data but also may predict future condition with different set of scenario. Most of scientists believe this approach is the most suitable method.

2.3. Environmental Simulation

Hydrological model have been developed from a need to analyze and solve specific hydrological problems. Though the problems are maybe different, variation of state-variables over space and time need to considered and internal flow processes have to be computed, in order to obtain useful outcome of the modeling exercise. According to suitable solution for those problems, hydrological model was differentiated into distributed and lumped model.

Distributed hydrological model are necessary if variation of state-variables over space and time are more important rather than direct relationship between rainfall and discharge. Usually, distributed hydrological model employed many physical based parameters. Therefore, it well known as 'white box approach' or physically based hydrological models. Physically based distributed models of the hydrological cycle can in principle be applied to almost any kind of hydrological problem. These models are based on our understanding of the physics of the hydrological processes that control catchments response and use physically based equations to describe these processes.

However, this approach highly depends on modeling performance and sensitivity. It means all the simulation result should be interpreted based on the model consideration. For instance, some models only considering certain aspect of watershed system while, another only consider a lump hydrological aspect. Simulation also depends on future and extreme condition selections. The study to identify the future condition considering wide aspect are required, while extreme condition may be obtain from statistical analysis.

2.4. Cidanau Watershed Case

A watershed water quality model for T-N Phenomena was developed for the Cidanau watershed, Indonesia. The performance was evaluated in view of the model's applicability to water pollution issues. The watershed water quality model consists of a sub-catchments-based application of the tank model and water quality components. This type of modeling is considered as the most appropriate by taking consideration on data availability and spatial variability. The LQ and the dissolution-type for the water quality components were employed, and parameter setting method was based on sub-catchments grouping in order to verify and obtain the best model structure. The established watershed water quality model was expected to perform as a simulation tool for identification of the influential factors in water pollution.

The Cidanau watershed is changing rapidly in term of agricultural aspects, and the river is the water source for industrial estate. However the suitable data to describe to understand and to solve the related water problems is not sufficiency available. Therefore seasonal field surveys were conducted to obtain the best sufficiency data in order to explain the phenomena of the water problems.

As the result paddy field and swamp areas were considered as an important factor for the Nitrogen pollutant discharge. It was suggested that land use types are maintained, especially at upper catchment area.

3. Conclusion

The necessity for watershed monitoring was explained, and the suitable approach for understands the watershed was presented. The important message is to continue watershed monitoring with all cost: involvingvarious stake holder to understand our environment: and to keep it in healthy condition.

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