MANAGEMENT OF MELANA WATERSHED USING MULTICRITERIA DECISION MAKING APPROACHES

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Laporan projek ini dikemukakan
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ABSTRACT

Nowadays, watershed management is very important and need to be given attention especially by government agencies because all resources between it are related. This project proposed using Multicriteria Decision Making Approach (MCDM) to identify and rank which subwatershed in Melana need to given priority by government authorities in planning their strategies or alternatives for improvement Melana catchment. Each subwatershed was ranked using Multicriteria Decision Making Approaches specifically applying Fuzzy Composite Programming (FCP) and Analytic Hierarchy Process (AHP). There were 3 selected subwatershed which were residential, light industry and heavy industry. The objective of this project i) to identify basic indicator for management of Melana watershed, ii) to rank subwatershed in Melana watershed using MCDM approaches, iii) to compare FCP and AHP technique and analyses based on selected basic indicators. The FCP and AHP structures contained 13 first-level indicators, 5 second level indicators, 3 third level indicators and the final indicators. The highest ranking subwatershed was residential with the highest ordered sequence value. The highest ranking subwatershed was also associated with the shortest distance between the fuzzy box and ideal point. The highest ordered sequences value means that subwatershed was the best in economy, water quantity and quality. The critical subwatershed was the lowest ordered sequence value which was heavy industry. In AHP, the highest priority index value was heavy industry. This subwatershed is the critical watershed which need be given attention and conservation. This study showed that FCP has a similar result with AHP.

ABSTRAK

Sejak kebelakangan ini, pengurusan tadahan menjadi sesuatu yang amat penting dan perlu diberi perhatian terutama oleh badan kerajaan kerana semua sumber di dalam tadahan adalah saling bergantungan. Project ini mencadangkan penggunaan *Multicriteria Decision Making Approach (MCDM)* untuk mengenal pasti dan menentukan subtadahan mana yang perlu diberi keutamaan oleh badan kerajaan untuk diambil tindakan dalam mengatur strategi atau menyediakan alternatif untuk memulihkan keadaan tadahan Melana. Setiap subtadahan akan dipangkatkan dengan menggunakan *Multicriteria Decision Making Approaches specifically* iaitu *Fuzzy Composite Programming (FCP)* dan *Analytic Hierarchy Process (AHP).*Terdapat tiga subtadahan yang dipilih iaitu industri berat, perumahan dan industri ringan. FCP dan AHP struktur mengandungi tiga belas petunjuk peringkat pertama, lima petunjuk peringkat kedua, tiga petunjuk peringkat ketiga dan akhirnya sistem. Pangkat teratas bagi ketiga-tiga subtadahan ialah perumahan.dengan nilai susunan jujukan tertinggi. Pemangkatan subtadahan tertinggi adalah berkaitan dengan jarak terdekat diantara kotak fuzzi dan titik unggul. Nilai susunan jujukan tertinggi menunjukkan bahawa subtadahan tersebut adalah yang terbaik dari aspek ekonomi, kuantiti dan kualiti air. Subtadahan yang kritikal adalah yang mempunyai nilai susunan jujukan yang terendah iaitu industri berat. Dalam AHP, pula, nilai indeks keutamaan tertinggi adalah subtadahan industri berat. Subtadahan ini adalah subtadahan kritikal yang mana perlu diberi perhatian. Kajian ini menunjukkan bahawa FCP mempunyai keputusan yang sama dengan AHP.

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BOD	-	Biochemical Oxygen Demand
COD	-	Chemical Oxygen Demand
DO	-	Dissolved Oxygen
TSS	-	Total Suspended Solid
MCDM	-	Multicriteria Decision Making
FCP	-	Fuzzy Composite Programming
AHP	-	Analytic Hierarchy Process
km^3	-	Kilometre cubic
km^2	-	Kilometre squire
ET	-	Evapotranspiration
%	-	Percentage
F	-	Fahrenheit
EPA	-	Environmental Protection Agency
CaCO3	-	Calcium Carbonate
N	-	Nitrogen
DA	-	Decision Analysis
S_{ij}	-	The actual value of basic index in second-level group j of basic indicators
L_{ij}	-	The composite index for second-level group j of basic indicators
Nj	-	The number of basic indicators in group j
α_{ij} t	-	The weight expressing the relative importance of basic indicators in group j
Pj	-	The balancing factor among indicators for group j

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Malaysia is gifted with an enormous source of good land and fresh water supply. It supported by more than 2500 mm annual rainfall and a dense network of rivers and streams which about 150 major river basins. So that's mean, Malaysia supposedly must enjoy with these natural resources. No doubt Malaysia is called as a country of "water resource-rich" (Ayob Katimon and Supiah Shamsudin, 2005).

In terms of hydrologic water balance, Malaysia has received 990 km^3 annual rainfalls and lost 360 km^3 due to evaporation (36 percent), which has 540 km^3 (54 percent) fresh water surpluses. The total surface runoff (the surface water generated by a combination of rainfall and watershed system) is 566 km^3 and about 64 km^3 contribute to groundwater recharge. Without considering water supply from groundwater system, it is clear that Malaysia has a surplus in fresh water supply. Water is very important for people, food and rural development, economic development and environment.

But unfortunately, many states in Malaysia still have a problem with water supply especially in water supply shortages, low water quality, flash flood in urban

area and economy. So to prevent these problems, we need to manage our watershed from overall aspects. Management of watershed is suggested by using multi criteria decision making approaches.

There are many techniques, adopting complex mathematical models and theories, are developed for decision making. Although all decision makers endeavor to improve final outcomes of decision making, the researcher is more concerned about the decision making process. From scientific point of view, a good final outcome depends upon a good decision making process. Principally, the purpose of MCDM is to provide help and guidance to the decision maker for further discovering his/her true preference in order to catch the most desirable solution of the problem.

A large number of multicriteria decision making (MCDM) methods have been proposed in the past and applied to manage watershed or water resource planning (Keeney and Wood, 1977). In real-world decision-making processes in watershed management, decision making theory has become one of most important fields. It uses the optimisation methodology connected with a single criterion, but also satisfying concepts of multiple criteria. Fuzzy Composite Programming and Analytic Hierarchy Process are one of Multicriteria Decision Making methods. These methods were applied to manage Melana watershed and used to rank sub watershed based on their relative degree of potential to determine a potential that an individual site possesses. These methods also helped to identify sub watershed that need to pay more attention. These approaches are useful for handling watershed system complexity, use more through data and allowing for flexible analysis.

1.2 Problem Statement

Nowadays, we always heard problem about water supply shortage and water quality. That happened because of we have not manage our watershed with proper methods. Management of watershed is very important to guide and coordinate the use of land and other resources in sustainable manner in order to obtain proper product such as water supply without affecting future values and productivity. This can be done through conservation of physical and environmental quality.

A watershed has a strong basis for management because all resources within it are interrelated with each others. All resources include water, soil, forest, minerals, nutrient, habitats and clean air. So if we want all that resources preserve or sustainable for future generation, so we must identify, protect and improve the watershed first by using multi criteria decision making approaches.

1.3 Objectives Of The Study

The objective of this study is to identify and rank manage Melana subwatershed by using multi criteria decision making approaches. Fuzzy Composite Programming and Analytic Hierarchy Process is used in this study as multi criteria decision making methods.

The determination of the best strategy from a number of potential alternatives in watershed management is a complex decision making process. It may include conflicting quantitative and quality criteria and multiple decision-makers. The decision making process will be carried out using the multi-criteria decision making techniques.

The evaluation and ranking of alternatives by MCDM techniques is based on criteria values associated with each of the alternative, and the objectives and preferences by decision makers. Watershed ranking provides watershed scoring technique which would help prioritization of concerns and applicable for the purpose of preservation and mitigation potentials.

Watershed preservation priorities should be defined to give special attention to watersheds in need of restoration and protection the most. There are three objectives for this study:

1) to identify basic indicator for management of Melana watershed

2) to rank Melana subwatershed using MCDM (FCP and AHP) approaches

3) to compare FCP and AHP technique in ranking Melana subwatershed.