

Integration of land evaluation and the analytical hierarchical process method for energy crops in Kanchanaburi, Thailand

Kanlaya Tienwong^{a,*}, Songkot Dasananda^a, Chalie Navanugraha^b

^a School of Remote Sensing, Institute of Science, Suranaree University of Technology, Nakornratchasima 30000, Thailand

^b Faculty of Environment and Resource Studies, Mahidol University, Nakornpathom 73000, Thailand

*Corresponding author, e-mail: kanlayatien@yahoo.com

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ABSTRACT: The main objective of this study is to evaluate the land suitability for cultivation of some economically important energy crops, which are sugarcane and cassava, in Kanchanaburi province, Thailand. To achieve this goal, multi-criteria decision making (MCDM) integrated with the 1976 FAO framework for crop plantation was used to assess suitable areas for growing these crops. Several biological and economical factors involved in the analysis were selected based on the FAO framework and experts' opinions. Their data were kept, displayed, and used as individual and combined GIS layers. Each factor received a weight and a score which represented its relative importance in the suitability evaluation by using the analytical-hierarchical process method which is one of the widely used MCDM techniques. A land suitability map for each crop selected was produced based on the linear combination of weight and rating score of each factor involved and classified into 4 suitability classes according to the FAO standard. The proportion of the area highly suitable or moderately suitable for cultivation of sugarcane was 52%, and for cultivation of cassava, 45%. Only a small percentage of the area was not suitable. Typically, the most suitable areas for both crops were located in the eastern and lower part of the province having highly fertile soil and abundant water resources available therein. It was also found that most parts of the suitable area of both crops were located in the existing agricultural land (but being used for other crops/plants).

KEYWORDS: multi-criteria decision making, GIS, sugarcane, cassava

INTRODUCTION

It is clear that the energy crisis has spread all over the world as the price of petroleum has dramatically increased in recent years. One possible solution to ease this problem is to find renewable energy source such as ethanol as an alternative to petroleum. Ethanol is a liquid obtained from biomass of agricultural raw materials. Typically, two of the most popular crops for producing ethanol are sugarcane and cassava because they are cheaper than other candidate crops. As a result, the Thai government has recently issued a new policy in order to increase production of these two crops to meet growing demand in the energy market. The main objective of this study is therefore to find suitable areas for cultivating these crops efficiently.

The land evaluation method is the systematic assessment of land potential to find out the most suitable area for cultivating some specific crop. Theoretically, the potential of land suitability for agricultural use is determined by an evaluation process of the climate,

soil, water resources, topographical, and environmental components under the criteria given and the understanding of local biophysical restraints¹. At present, this process could be done efficiently and conveniently by using multi-criteria decision making (MCDM) integrated with a geographic-information system (GIS), which is an essential tool in storage, management, and analysis of spatial and non-spatial data. In the process, data of all selected factors (for each crop) are kept, displayed, and managed as individual or combined GIS layers which make them convenient to be analysed together spatially. Each factor (or criterion) is given a specific weight, which represents its relative importance in the suitability evaluation, by using some MCDM techniques like multi-criteria evaluation (MCE) or analytical hierarchical process (AHP). Each criteria weight could be multiplied with its associated criteria suitability rating (or score) for each land mapping unit and the results (from all factors) could be summed to produce a suitability score for each land unit of the final suitability map