Title	農民の商品選択と土地評価に関する意思決定を支援する地理情報システム(GIS)に関する研究
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論 文 題 目	Research on a Geographic Information System (GIS) to Assist Farmers in Making a Decision Regarding Commodity Selection and Land Evaluation		
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論文の内容の要旨

This study proposes a framework of the Geographic Information System (GIS) to assist farmers in decision-making. Bandung Regency is one of the centers of agriculture in the province of West Java. The main agricultural product of this district is vegetable commodities, but the production of food crops is also one of the pillars of the fulfillment of food needs in Indonesia. Bandung Regency area was chosen as the study area because it has good potential for agriculture. The challenge that motivates the Research on GIS is that farmers can use GIS directly and practically to assist in decision making. This study divides into three major stages. The first stage aims to develop a decision-making system for selecting potential commodities in Indonesia. This stage generates commodity rankings to support efficiency-based agriculture. This study complements the AHP method with alternative selection and classification. It is because there are so many commodities that farmers can cultivate. We select agriculture commodities based on plant characteristics and the topology of Indonesian agricultural areas to make alternative comparisons equal. The final ranking shows that the AHP method with selection and classification extension on the criteria makes the commodity ranking more valid. The second stage integrates the Multi-Criteria Decision Making (MCDM) with Geographic Information System (GIS) Method to evaluate the land suitability for potential commodities. This study proposed framework for land suitability evaluation. The first part the framework focuses on providing Georeferenced to the collected data. Part two focuses on building the thematic maps layer. In the third part, this study complements the AHP method with alternative selection and classification. We provide limitations and classifications of alternative selection based on plant characteristics and the topology of Bandung District agricultural areas. Based on the distribution of land suitability areas, then comparing with the statistical data of the current situation, this second stage concludes that the integration between MCDM and GIS methods can produce valid and relevant land suitability maps. The last research stage aims to integrate GIS with AR visualization capabilities to present interactive 3D maps. This study proposes a mobile-based system to visualize land suitability maps to make it easier for farmers to understand

the map. Then to enrich the usability aspect, this study equips the system with augmented reality features. This study evaluates the system with two testing methods. The first testing method is the performance test, and the second is a qualitative test using a questionnaire that aims to find out the user's response to the system. Based on the evaluation results, this study can conclude that overall, AR-GIS can provide good information visualization. However, some farmers still have difficulties in understanding the land suitability map. In future research, adding collaboration features to AR-GIS will be a challenging topic. Collaborative AR can facilitate the knowledge exchange between farmers, GIS experts, and other stakeholders. The system with Collaborative AR-GIS is expected to enhance the farmer's understanding of the land suitability map. Furthermore, with good insight into the land suitability map, it is hoped that it will reduce the risk of crop failure and increase the productivity of the agricultural sector in the future.

Keyword: Augmented Reality GIS, Commodity Selections, Decision-Making, Land Suitability Evaluation, MCDM.

論文審査の結果の要旨

This study proposes a framework of the Geographic Information System (GIS) to assist farmers in decision-making. Bandung Regency is one of the centers of agriculture in the province of West Java. The government of Bandung Regency allows the residents to manage part of the forest area for agriculture. Some of them work on forests located in other sub-districts. Therefore, it is necessary to know the suitability of the land for a large area. The main agricultural product of this district is vegetable commodities, but the production of food crops is also one of the pillars of the fulfillment of food needs in Indonesia. Bandung Regency area was chosen as the study area because it has good potential for agriculture. The challenge that motivates the Research on GIS is that farmers can use GIS directly and practically to assist in decision making.

The study divides into three major stages. The first stage aims to develop a decision-making system for selecting potential commodities in Indonesia. This stage generates commodity rankings to support efficiency-based agriculture. This study complements the AHP method with alternative selection and classification. The second stage integrates the Multi-Criteria Decision Making (MCDM) with Geographic Information System (GIS) Method to evaluate the land suitability for potential commodities. This study proposed framework for land suitability evaluation. The first part of the framework focuses on providing Georeferenced to the collected data. Part two focuses on building the thematic maps layer. The study converts all thematic maps into a raster format. Then, reclassify the raster maps using the land suitability guidelines issued by the Indonesian government. The reclassification process aims to ensure that the land suitability map has an accurate class in accordance with the plant growth requirements. In the third part, this study complements the AHP method with alternative selection and classification. The study provides limitations and classifications of alternative selection based on plant characteristics and the topology of Bandung District agricultural areas. Based on the distribution of land suitability areas, then comparing with the statistical data of the current situation, this study concludes that the proposed framework can produce more valid and relevant land suitability maps. The last research stage aims to integrate GIS with AR visualization capabilities to present interactive 3D maps. We analyze the weaknesses in current GIS

agriculture, then we propose a system to visualize land suitability using a mobile-based system to increase familiarity. To enrich the usability aspect, this study equips the system with augmented reality features. The study takes advantage of unity3D's capabilities in customizing virtual environments. The study tested the system using two mobile devices with different specifications. Based on performance test results, the study showed that hardware and network specifications influence the system's performance. Based on the evaluation results, this study can conclude that overall, AR-GIS can provide good information visualization. However, some farmers still have difficulties in understanding the land suitability map.

This is an excellent dissertation and we approve awarding a doctoral degree to MAULANA, Hanhan.