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SUMMARY OF DOCTORAL THESIS

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Title of Doctoral Thesis: Land Cover Classification and Land Evaluation for Land Use Planning of Agricultural Crops Using Remote Sensing and GIS in North-west Bangladesh.

リモートセンシングと GIS を用いた北西バングラデシュにおける農業土地利用計画のための土地被覆区分と土地評価に関する研究

The agriculture sector plays a very important role in the economy of Bangladesh accounting for 36 percent of total GDP. Still more than 65% of the country's population depends on agricultural activities for their livelihood. Rice is the most important crop and staple food for the people. Due to ineffective land use, change of cropping pattern and natural hazards, the rice production of Bangladesh does not meet the food demands of rapidly growing population. So, to meet up the food demand of ever increasing population, we should have to emphasize to the more effective land use planning and management for producing more food from the limited land resources. Regarding the issues, we oriented our focuses in this work to land cover classification and land suitability evaluation for land use planning of agricultural crops.

The study in chapter 2 focuses on the comparison between the pixel-based and object-based image classification methods of remote sensing imageries in a typical Bangladesh agricultural environment with its small-spaced fields. Land use in Bangladesh typically consists of small agricultural fields, complex vegetation covers, and scatteredly distributed residential areas, which have been problematic in terms of land use mapping using remote sensing data due to the complexity of the spatial structure. Thus, some conventional methods of remote sensing image classification may not be suitable. In order to investigate an appropriate method for agricultural land classification, pixel-based and an object-based image classifier were tested and compared using Terra/ASTER image in Sylhet district, north-east Bangladesh. The result shows that the object-based method gave more accurate results and has achieved an overall accuracy of 80.45% with a kappa coefficient of 0.77, compared with 71.47% (kappa 0.67) that was derived from the conventional pixel-based method. Therefore, it can be stated that by using an object-based approach, the mapping of the agricultural land with its small-spaced fields in Bangladesh can be carried out more reliably when compared with the conventional pixel-based classification techniques.

The second analysis in chapter 3 is to determine physical land suitability for rice crop using remote sensing and Geographical Information System (GIS) and to compare present land use vs. potential land use. Integration of remote sensing and GIS is a new approach in Bangladesh because it has not been utilized to solve problems related to agricultural topics, such as in the case of identifying suitable areas for specific crops. The study was carried out in Haripur Upazila (sub district) of Thakurgaon district in Bangladesh. Relevant biophysical variables of soil and topography were considered for suitability analysis. All data were stored in GIS and the criterion/factor maps were generated. For Multi-Criteria Evaluation (MCE), Pairwise Comparison Matrix known as Analytical Hierarchy Process (AHP) was applied and the suitable areas for rice crop were identified. To generate present land use/cover map, Terra/ASTER 2003/03/22 satellite image was classified by maximum likelihood classification method. Finally, we overlaid the land use/cover map with the suitability map for rice production to identify differences and similarities between the present and potential land use. The results of this research identified in the study area, 37% of current paddy fields were under highly suitable areas and 25% of that was under moderately suitable areas. 35% of current paddy fields were under marginally suitable areas. This research provided information at local level that could be used by farmers to select cropping pattern and suitability.

In third analysis of chapter 4, we attempted to develop a methodology for land evaluation and land use planning of wheat cultivation. Land use planning and management is considered a very complex issue since it is usually solved by the multisectoral-interdisciplinary hierarchy decomposition approaches. In general, land use planning indicates the consideration of integrating biophysical and socio-economic variables. This study aims at integrating biophysical and socio-economic data with Geographical Information System (GIS) for land suitability evaluation of irrigated wheat cultivation. The selected area is located in Haripur Upazila, Thakurgaon district, north-west part of Bangladesh. Relevant biophysical variables such as soil texture, soil moisture, soil drainage, soil depth, soil pH, soil organic matter, slope, land type and supplementary water resource were considered. The socio-economic factors used in this study were availability of manpower, market linkage and road linkage. The suitability is based on the FAO framework for land evaluation. For MCE, the Analytical Hierarchy Process (AHP) was applied for judging the parameters and computing the priority index to each parameter. The various thematic layers were overlaid using ArcGIS version 9.2 software to create land suitability evaluation map of unique characteristics. To generate current land use/cover map, Terra/ASTER 28 February 2001 satellite image was classified through supervised classification using ERDAS Imagine version 9.1 software. The results present that the overall environmental condition in the study site, which was mostly classified as moderately (40.42%) to marginally (31.65%) suitable classes for wheat cultivation, while the not suitable class is determined as the smallest area. The results also show that moderately suitable areas for wheat were mainly located close to the location of tube well and surface water sources.

The effectiveness of combining the analytical hierarchy process (AHP) with remote sensing and GIS for land evaluation for agricultural crops in North-west Bangladesh has been proved. Therefore, this method would have great economical and technical advantages for sustainable agricultural development.

Key Words: Agricultural land cover, Object-based classification, Segmentation, Terra/ASTER, GIS, Remote sensing, Biophysical database, Land suitability, Land evaluation, Crop.