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学 位 論 文 内 容 の 要 旨

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学 位 論 文 題 名

Satoyama System Establishment as Sustainable Land Management in Sabah, Malaysia
(マレーシアサバ州における持続的な土地管理としての里山システムの構築)

In 20th century, large amounts of natural resources including food and energy were used to maintain a lifestyle of mass production, mass consumption and mass disposal. Considering limitation of such resources on the earth, this type of lifestyle in 21st century has to be changed and there has been strong desires and pressing needs to build a sustainable society where limited resources can be used in a sustainable manner. Our challenge is to reduce dependence on petroleum as a source of energy and change such petroleum-dependent society to a sustainable society. In other words, our society requires food and energy independence so that the area either at national, regional and local level can become independent. Thus, a sustainable society, especially in rural or local societies, should construct a sustainable system on food self-sufficient and renewable energy usage, and also on economic enhanced mechanisms. In this context, establishment of the *Satoyama* system is promising way to move forward to realize a sustainable society. The '*Satoyama* System', which expresses a stratification to effectively use the universally available low intensity solar energy is based on the idea of a society with nature-human coexistence.

Recognizing above, this thesis aimed at studying possibility of establishing integrated *Satoyama* System in Sabah, Malaysia with a focus on food security, biomass energy potential and social and natural capital. To propose and establish an "Integrated Sustainable Land Management System", this thesis analyzed the food-energy based sufficiency and potential of biomass energy in Sabah for the first time. Then, as a case research, Tudan village was selected to analyze biomass energy potential and natural and social capital.

It was found by analyzing sets of data of 2010 that food self-sufficient ratio in Sabah was 46.40%. It was also pointed out that population growth and land for food production could be a factor giving a big impact on the ratio.

In the meantime, biomass energy potential in Sabah was analyzed as around 65,590,323 GJ/year, which derived from oil palm (EFB: Empty Fruit Bunch and shell),

coconut shell, rice, livestock and forest. Most biomass energy came from oil palm, which was around 62,045,584 GJ/year. If this total energy potential is applied at a power plant with efficiency ratio of 25% and 8,000 hour per year of operation, this has potential of 572 MW, which is equivalent to electric power of one small nuclear plant in Japan. Looking at the local situation at Tudan village, it was revealed that around 50 % of total energy consumption in the village came from gasoline. Tudan village has no public transportation like bus, so people need to go to town for buying daily goods, go to hospital and go to local government office by their own car which was located far away from the village. Therefore, portion of gasoline amount used out of total consumption was high among others such as electricity, gas, diesel and firewood. On the contrary, it was also found that Tudan had huge potential of biomass energy derived from forest, livestock waste and rice, which covered around 74 % of total energy consumption. This indicated that Tudan village had potential for building a self-standing structure in terms of energy.

Happiness survey was conducted to evaluate human interaction with nature to identify issues for realizing human-nature coexistence society. Happiness survey indicated that local farmers were proud of clean environment, traditional agriculture while they put more priority on solidarity and cohesion among communities, and peaceful life. These can be regarded as social capital which needs to be taken into consideration in developing *Satoyama* System. As well as social capital, natural capital value at Tudan village was analyzed. Public interest functions of forests and agricultural land were analyzed. Though all natural capitals cannot be evaluated into economic value, natural capitals with potential to be carefully studied and enhanced in future were identified. Biodiversity-related capitals such as traditional herbal plants, carbon storage function by bio char, and traditional agriculture with less chemical fertilizer, to name a few, were among them.

Food security, utilization of biomass energy, and enhancement of social and natural capital are key concept to achieve the *Satoyama* System which is based on a 'low-carbon society', a 'recycling society', and a 'society in harmony with nature'. Such concept needs to be realized in an integrated manner through establishment of industry- and ecosystem- based regional partnership (urban-rural partnership).

This thesis visualized overall picture of necessary components of *Satoyama* System in Sabah, Malaysia for the first time, and results could serve as a guiding framework for designing *Satoyama* System in future in Sabah and could be replicated and modified to other sites in Malaysia and beyond.