An approach to bio-based product-related land use change analysis

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1. Introduction – Developing a climate-smart bio-based economy is essential to the continuation of economic development, reduction of greenhouse gas emissions, and adaptation to climatic change. Important role in progressing of those processes is attributed to land use change due to a potential increase of demand for biomass which can rebound and cancel out environmental performances and the primary assumption of sustainability [1]. The objective of this paper is to present a procedure for application of the Markov chains to description of the bio-based product-related land use changes (probability matrix) through prediction of future changes up to the land use – land cover (LU-LC) equilibrium.

2. Data and Method – The CORINE Land Cover (LCC) inventory was the basis of collected data. The time series (1990, 2000, 2006 and 2012) for the north-eastern region of Poland "Warmia and Mazury" were completed on the basis of linear raster 100 m resolution maps. The land cover was divided into four categories: arable land, grassland, forest, and other. The land changes between 1990 and 2000 were taken as the initial (S_t) and final status (S_{t+1}) of LU-LC and the Markov chain analysis was applied to provide the probability transfer matrix for prediction of the next states of land use changes [2]. Besides, the indicators of land use change dynamics were presented to highlight the rate of land use changes in time.

3. Results and Discussion – The research problem related to land use change is on how to utilize the historical data on LU-LC for and prediction of the future LU-LC changes in the context of description environmental and socio-economic consequences. In this paper we consider geospatial models that involve simulation of spatial patterns for land use change, given a prediction matrix. The potential models are based on (i) cellular automata (CA) theory and the GIS framework and (ii) the discrete-time Markov chains (CA-Markov chain). The latter one is for prediction of land use change while CA is for simulating for the spatial patterns in the future [3].

4. Conclusions – The process of increasing biomass availability is related to growing demand for land and interrelated with socio-economic changes and environmental impacts to land changes. The use of Markov chain analysis supported with change dynamics indicators can be useful in interpretation of the past and future LU-LC changes. The results confirm that short and medium-term prediction are more robust than prediction of the long-term trends and the state of equilibrium because the prediction depends only on the initial state. The simulated impacts resulted from changes in land cover can serve as a sustainability indicator.

5. References

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