Complex Terrain and Ecological Heterogeneity (TERRECO):
Evaluating Ecosystem Services in Mountainous Landscapes
The Impact of Socio-Economic Land-Use Decisions on Ecosystem Services in a South Korean Watershed
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Background

Human land-use activities induce substantial changes to the biophysical attributes of the Earth's land cover, thereby modifying structures and functions of terrestrial ecosystems. Thus, given ecosystem services' global importance for biogeochemical and energy fluxes, human decisions on land use are a key driver of global change issues. They contribute considerably to climate change, loss of biodiversity, as well as soil degradation.

Such impacts are highly relevant for Korean agricultural landscapes, which in spite of the country's mountainous characteristics cover as much as 48% of the land area. Therefore, the project's main goal is to model the spatially-explicit impact of agricultural land-use decisions on ecosystem services, which will provide a tool for optimizing landscape management under economic and social considerations.
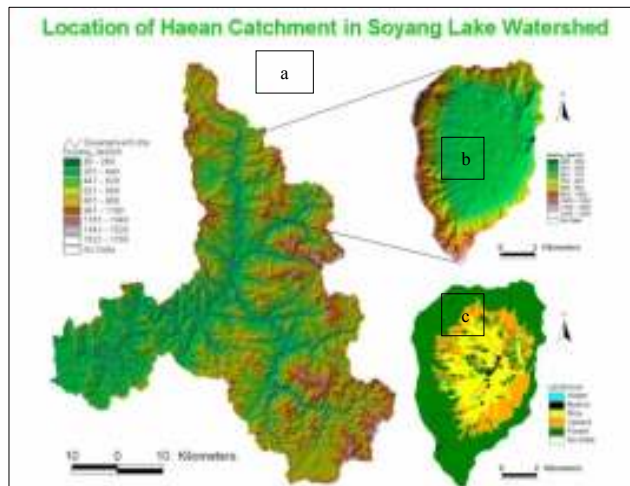

Figure 1. a: Soyang Lake watershed. b: Topography of Haean catchment. c: Land cover of Haean catchment.

Study area

The study takes place in Haean basin; a catchment contributing to rivers feeding Soyang Lake in the northeastern part of South Korea. The basin is dominated by agricultural production, where annual crops follow the terrain's gradient from paddy rice in the flat core region to dryland crops in the outskirts, until finally land cover changes to forest where slopes become too steep.

Agricultural land-use practices in Haean come along with heavy erosion, which can amount up to 60 cm soil loss. Furthermore, farmers' problems with unseasonably low temperatures have increased in recent years, which perils the cultivation of their traditional crops. Government's attempts at fostering perennial crops are poorly adopted due to missing incentives, and private as well as public actors living downstream suffer from the turbidity of the water coming from Haean.

Methods

As land-use decision-making is part of a multilayered human-environment system, the model will incorporate social, economic and ecological considerations of local actors. Its scientific framework is adapted from the 'Theory of planned behavior' by Ajzen, which assumes human decision-making to be based on i) cost-benefit expectations, ii) subjective norms, and iii) perceived behavioral control.

In order to cope with these different dimensions, the model will use influence diagrams based on Bayesian statistics, also referred to as Bayesian Belief Networks. They allow easy incorporation of data from various sources and handling situations afflicted with uncertainty, which makes them specifically well suited for decision-modeling.
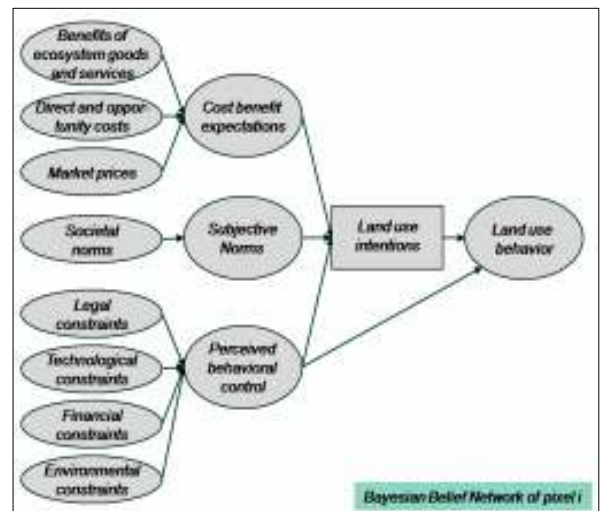

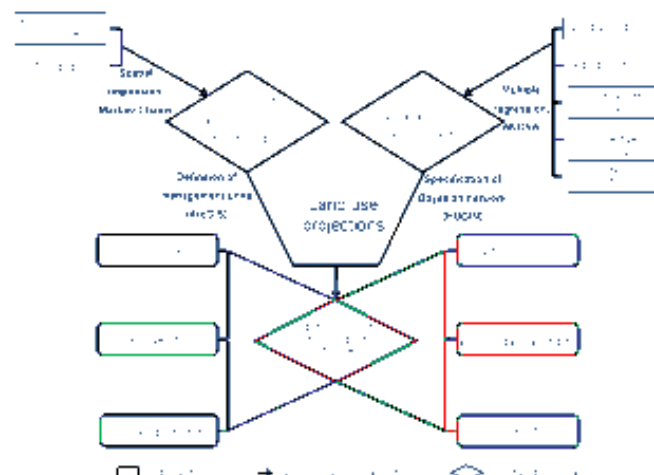*Figure 2. Bayesian Belief Network based on decision theory by Ajzen.*

Outlook

Being embedded in the International Research Training Group TERRECO, the model will be implemented at the interface between the involved disciplines of socio-economic and ecological sciences. This will ensure its basement on sound data derived from research area-specific sources.

The model's results about land-use decision-making will be displayed in a spatially-explicit manner with the help of Arc GIS maps. In this way, it will be possible to show the spatial changes in land use under different management options, and how these changes impact the provision of ecosystem services.

This model can be a powerful tool for providing decision support in landscape management, which incorporates more than economic considerations in human decision-making and pays heed to the resulting effects of land-use changes on Ecosystem Services.

Figure 3. Land use model structure as integrative part of TERRECO.

References

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