Forest Diversity and Land Surface Functions in the Soyang Lake Watershed

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Problem Statement:

Forests provide numerous goods and services for the benefit of the society (Fig. 1). Forests are a resource for timber products, and they play an important role in water resources management, prevent erosion, retain sediments, increase air quality, and provide a habitat for a variety of species. Their capacity for carbon sequestration is crucial for the mitigation of climate change. In addition, forests form an important part of landscape amenities, recreational activities, and cultural heritage.

Changes in land use and forest management and the impact of climate change can cause dramatic shifts in services provided by forests as well as in downstream aquatic systems.

Overall Goals:

The forest research group identifies driving factors and describes key processes governing ecosystem functions in the Soyang Lake Watershed social-ecological system (SES).

Understanding those processes is the fundamental basis for assessing response to future change with respect to ecosystem goods and services.

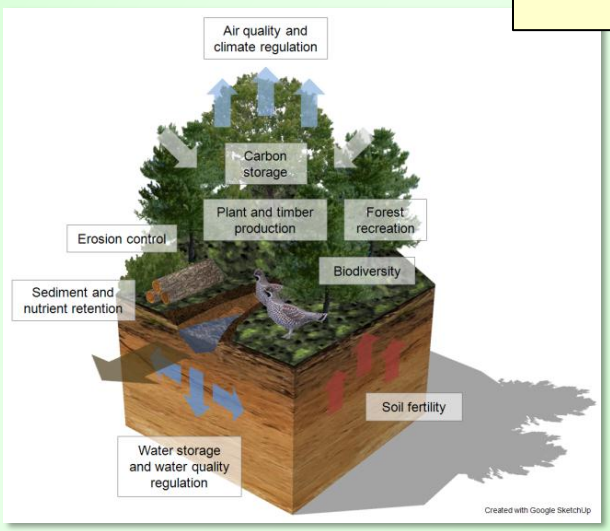

Figure 1. *Key ecosystem services provided by forests in the Soyang Lake watershed SES*

Methodology, Project Linkages and Research Organization:

The investigation of forest ecological processes and their relation to economic benefits requires an interdisciplinary research framework over multiple scales (Fig. 2).

Fluxes of water and carbon between soils, plants, and the atmosphere are key processes for plant growth and carbon storage. Detailed plot studies are conducted using soil incubation experiments, sap flow, and eddy covariance measurements, and simulation models are applied to upscale those processes to catchment areas.

Vegetation structure plays a critical role for the quantity of water and carbon fluxes, but also for the suitability of forests to provide habitats for various animals. In order to describe its variability and functions, species inventories and remote sensing approaches are performed.

Diversity in soil properties controls water and carbon fluxes, and significantly affects vegetation development within sub-catchments and the entire landscape of the watershed. Digital soil mapping is conducted based on field measurements and the application of statistical models.

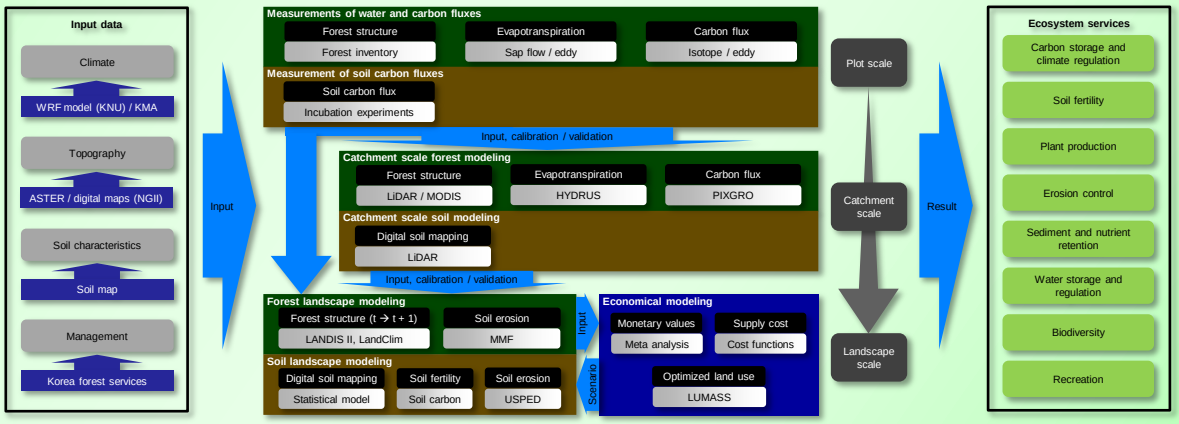

Figure 2. *Framework of research projects to investigate forest ecosystem functions at different scales in the Soyang Lake Watershed SES*

By using simulation models, production potentials and the development of forest structure over time are predicted for the entire SES based on created soil data sets and previous findings of detailed plot and catchment scale studies. In addition, risk analyses (soil erosion and woody debris transport) are performed in order to quantify the environmental impacts of the forest ecosystem on downstream water quality.

Economic evaluation transforms forest ecosystem functions into monetary values representing the benefits for society. Cost function analyses and economic modeling are applied to assess the tradeoffs between the economic gains through forest plantation production and economic losses through externalities such as water quality degradation in Soyang Lake.

Cross-cutting Issues and Links to Other Project Groups:

Together with the **agricultural group**, the forest research group describes the key processes occurring in the terrestrial component of the Soyang Lake Watershed SES and provides major inputs for the **hydrology group** investigating the processes in the aquatic system. Knowledge of both terrestrial and aquatic processes form the framework of tools to assess ecosystem services for the entire watershed.

This assessment framework allows us to evaluate land use processes described by the research **group of socio-economic drivers**. Evaluating the responses to these processes provides the basis for developing sustainable management strategies for the Soyang Lake Watershed SES.