



University of
Bayreuth

Complex Terrain and Ecological Heterogeneity (TERRECO): Evaluating Ecosystem Services in Mountainous Landscapes



N cycle and retention of croplands in complex terrain in South Korea

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Introduction & Aims:

One part of this study focuses on [fertilizer budgets](#) for the dryland farmland zone and on quantifying the [dynamics of N](#) in soil-plant systems. The balances of elements and their fluxes are the main background information in soil-plant studies. Secondly, charred biomass and synthetic polymers are experimentally applied in the run-off plots to determine whether these additives can contribute significantly to sustainable farming methods in the Haeen Basin.

Each treatment will be tested for erosion prevention, infiltration enhancement, nutrient balances, plant growth, yield and agricultural C balances. Lab work will focus on their effects on living microbial biomass, soil organic matter as well as plant residues decomposition and C sequestration.

Finally, [best agricultural management practices](#) for sustainable land use of sloping uplands will be suggested.

Methods:

The methods of our research are primarily based on application of isotopes (¹³C, ¹⁴C, ¹⁵N). The approaches aim both on monitoring (natural abundance: passive) and on experiments (labelling, tracer application: active).

[Isotope studies with ¹⁵N](#) in the field site allow examination of uptake by plants, movement by percolation to deep soil layers, lateral transport, and overall retention within the farmland ecosystems (see Fig.2). The determination of the total input of reactive nitrogen from the atmosphere into the soil-plant-system will be conducted by the ¹⁵N dilution method (ITNI). This method measures directly the active uptake of nitrogen by aboveground plants.

[Isotope studies using ¹⁴C](#) under lab conditions provide insights about C fluxes in soil-plant systems, such as total ¹⁴CO₂ efflux dynamics of soils as well as soil C sequestration. Understanding these dynamics as well as their rates is therefore essential. ¹⁴C-labelled maize and rice residues will be used to differentiate and quantify the contribution of plant residues-derived C and native soil organic C.

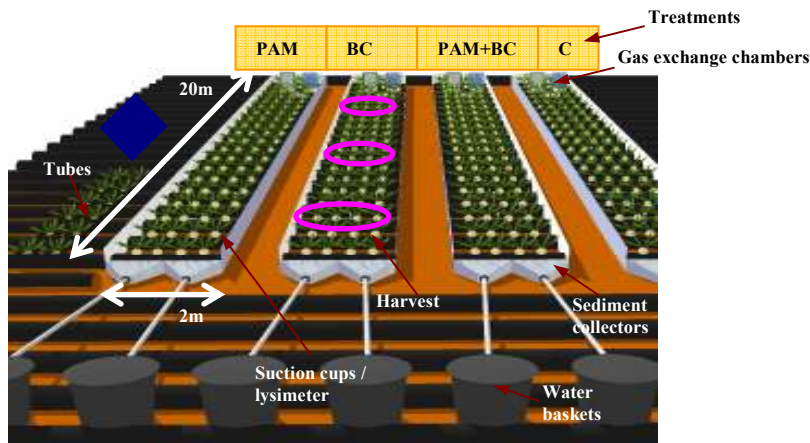


Fig.1: Integrated experimental strategy within run-off plot

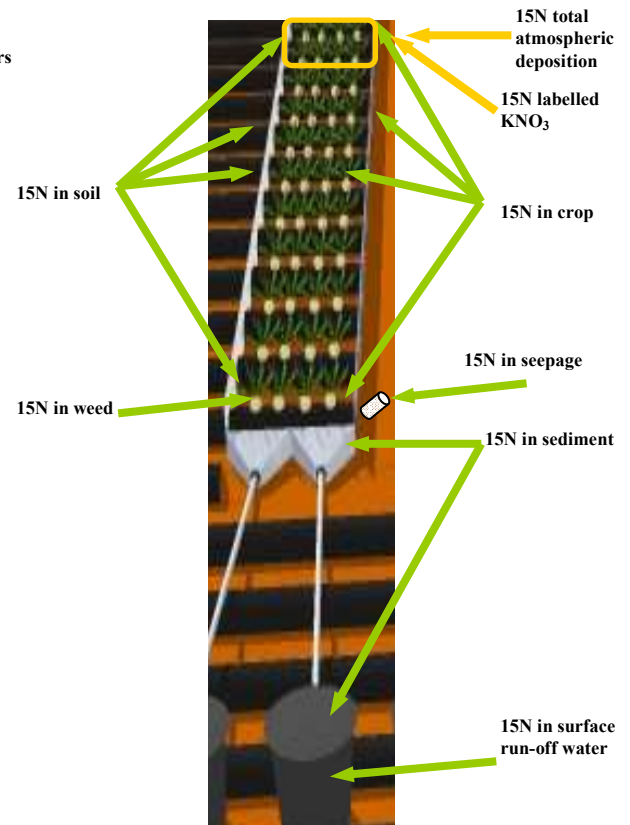


Fig.2: Nitrogen retention within run-off plot

Approach 1:

The approach of an overall nitrogen retention uses an [integrated experimental strategy within run-off plots](#) (see Fig.1). Since research goals focus on dryland farming zone, the selected experimental field sites can all be found on upland slopes of the Haeen Catchment. Firstly, we installed run-off plots on different field sites but with similar conditions in this field campaign. On the other side, run off plots on the same field site but with different topographic conditions will be set up next year. Different treatments have been implemented: PAM, bio char, a mix of PAM and biochar as well as a control without no applications.

In order to analyze nitrogen inputs and cycling, on each treatment ¹⁵N labelled KNO₃ was applied (Fig.2). Fig. 2 also shows the nitrogen pools which are analyzed from sowing until harvest.

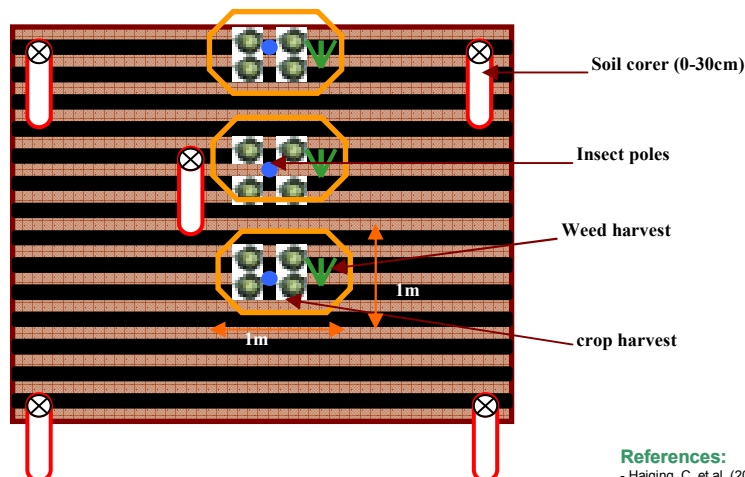


Fig.3: Nitrogen budget within spatial approach

Approach 2:

The second integrative approach is based on a larger spatial allocation of field sites, different management types, and on typical crops of the Haeen basin. This allows more representative conclusions for the entire catchment as well as for the modelling. Differences between [organic and conventional farming](#) play a key role in this integrative project and are examined from various perspectives (Insect diversity, weed concurrence/invasion, above-/belowground N pools, biomass development, and crop yields) as shown in Fig.3. Within that approach, this project aims for an estimation of a general [fertilizer budget](#) at catchment scale as well as the determination of N use efficiency of local crops. Finally, we will identify crops with the least efficient balances. Calculations are based on NPK input, NPK uptake by aboveground plants, and NPK withdrawal from the fields by harvesting.

References:

- Haiqing, C. et al. (2009): Effect of land use types on decomposition of ¹⁴C-labelled maize residue (*Zea mays* L.). In: European Journal of Soil Biology, Vol. 45, Issue 2, p.123-130.
- Russow, R. & Boehme, F. (2005): Determination of the total nitrogen deposition by the ¹⁵N isotope dilution method and problems in extrapolating results to field scale. In: Gerdoerma, Vol. 127, Issue 1-2, p.52-60.