University of Bayreuth

Complex **Ter**rain and **Eco**logical 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 Haean Basin. Each treatment will be tested for erosion prevention, infiltration enhancement, nutrient balances, plant growth, yield and agricultural C balances (see Fig.1). 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 (^{13}C, ^{14}C, ^{15}N). The approaches aim both on monitoring (natural abundance: passive) and on experiments (labelling, tracer application: active).

Isotope studies with ^{15}N 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 ^{15}N dilution method (ITNI). This method measures directly the active uptake of nitrogen by aboveground plants.

Isotope studies using ^{14}C under lab conditions provide insights about C fluxes in soil-plant systems, such as total $^{14}CO_2$ efflux dynamics of soils as well as soil C sequestration. Understanding these dynamics as well as their rates is therefore essential. ^{14}C-Labelled maize and rice residues will be used to differentiate and quantify the contribution of plant residues-derived C and native soil organic C.

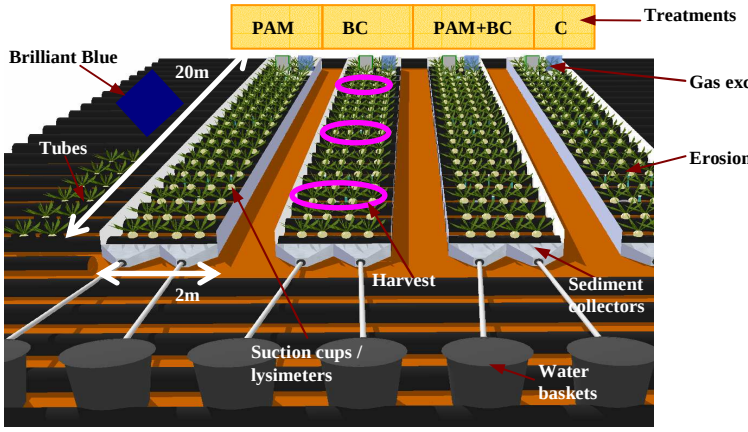

Fig.1: Integrated experimental strategy within run-off plot

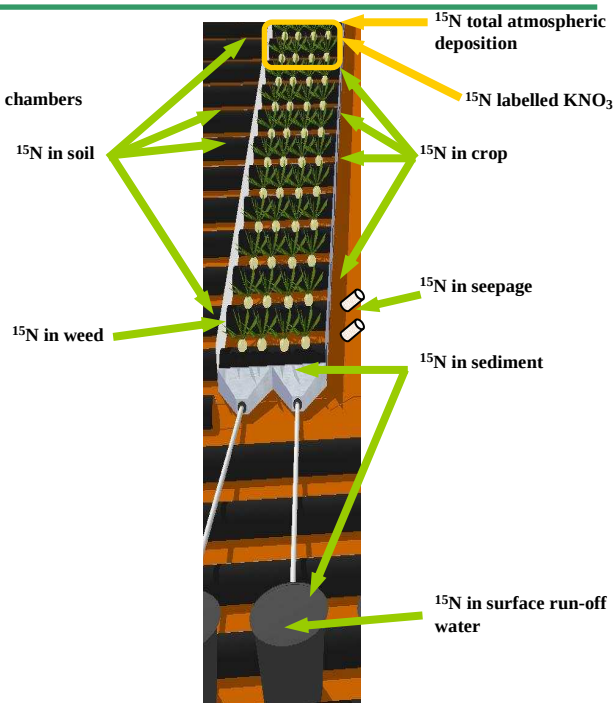

Fig.2: Pathways of N within run-off plot, using stable N isotopes

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 the dryland farming zone, the three selected experimental field sites can all be found on upland slopes of the Haean Catchment. Firstly, we installed run-off plots on different field sites but with similar conditions in this field campaign. Secondly, run off plots on the same field site but with different topographic conditions will be set up next year. Different treatments have been implemented on each plot:: synthetic PAM, bio char, a mix of PAM and biochar as well as a control without no applications. Simultaneous use of ^{15}N labelled KNO_3 allows the study of nitrogen cycling and turnover, Fig. 2 shows the nitrogen pools which are analyzed from sowing until harvest.

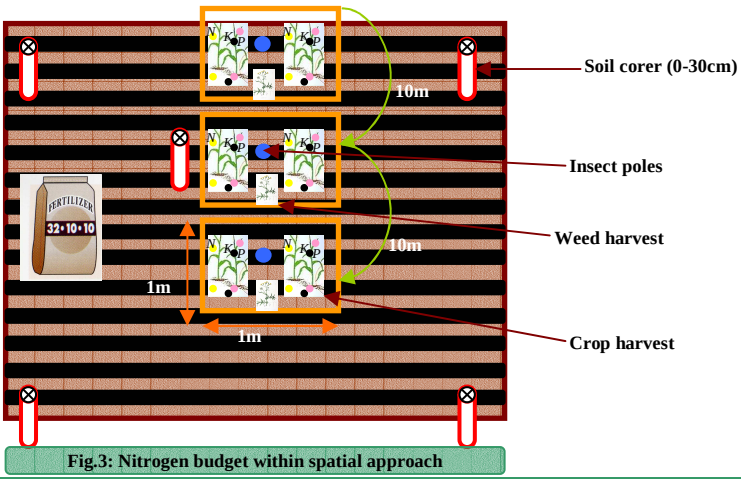

Fig.3: Nitrogen budget within spatial approach

Approach 2:

The second integrative approach is based on a larger spatial allocation of in total 32 field sites, different management types (organic/conventional), and on five typical crops of the Haean basin. This allows 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). The different perspectives and their sampling methods are 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:
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