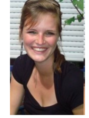
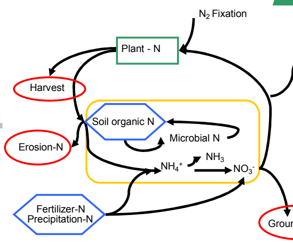
2009 AGU Fall Meeting
14–18 December :: San Francisco, CA, USA
ID# B13C-0525

Bayreuth Center of Ecology and Environmental Research



N cycling depending on different soil additives in agroecosystems in complex terrain in South Korea



Janine Kettering[1], Sebastian Arnhold[2], Yasser Awad[4], Yakov Kuzyakov[1], Bora Lee[3], Steve Lindner[3], Yong-sik Ok[4], Marianne Ruidisch[2], John Tenhunen[3]

1 University of Bayreuth, Dept. of Agroecosystem Research, GER-95440 Bayreuth
2 University of Bayreuth, Dept. of Soil Physics, GER-95440 Bayreuth
3 University of Bayreuth, Dept. of Plant Ecology, GER-95440 Bayreuth
4 Kangwon National University, Dept. of Biological Environment, KOR-Chuncheon

Introduction

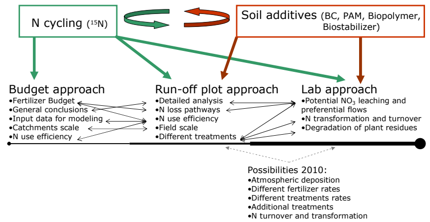


Fig.1: Research design

Research Area - where

- *Field sites located in Haean basin, central Korea, just south the demilitarized zone*
- *Intensive land use with high levels of fertilization*
- *Distinctive erosion during summer monsoon*

Background – why

- *Precise measurements of actual fertilizer N-use efficiency, N losses, and their pathways at farm level strongly needed*
- *Understanding N cycle is a starting point for any improvement*
- *Most common problems in upland farming are erosion, low soil fertility as well as productivity, and low fertilizer efficiency due to rapid leaching of nitrogen*

Hypothesis – what

- *Tested additives can improve farmland productivity by*
  - *-decreasing surface runoff and soil erosion*
  - *-increasing soil hydraulic conditions*
  - *-increasing nutrient availability and turnover*

Approaches

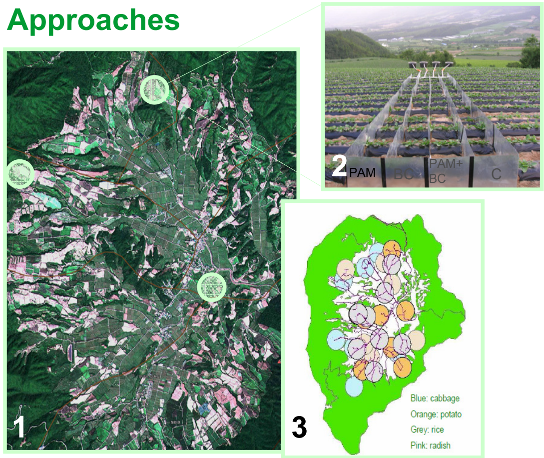


Fig.2:Two approaches for N management

Map1+2

- *Distribution of the three installed run off plots in catchment*
- *Field sites can all be found on upland slopes with similar conditions*
- *Different treatments have been implemented and will be tested on soil erosion, soil hydrology and nutrient cycling*

Map3

- *2^{nd} approach based on larger spatial distribution*
- *In total 40 field sites all over the catchment*
- *Typical amounts of NPK accumulation and removal by 5 major Korean crops, their use efficiency, and yields will be presented*
- *These are important values for developing a nutrient budget on catchment scale*

Approach I

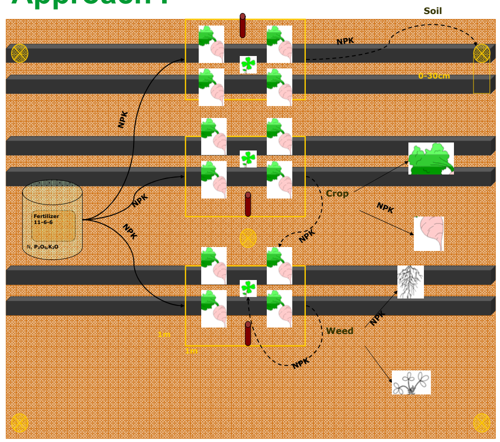


Fig.4:Budget approach design 2009

Objective

- *Fertilizer Budget on catchment scale*
- *Differences between organic and conventional farming*

Methods

- *Calculations for fertilizer balance based on*
  - NPK input, uptake by plants, output with harvest, and retention in the soil
- *Efficiency with which crops convert nutrients taken up into grain yield determined by:*
  - [(total crop N removed) - (N coming from soil + N deposited in the rainfall)] / fertilizer N applied to crop

Results

- *Efficiency values used to determine recovery of applied fertilizer as well as uptake of residual nutrients*
- *Identification of crops with most and least efficient balances*

Approach II

Fig.3:Runoff plot design for process studies

Objective

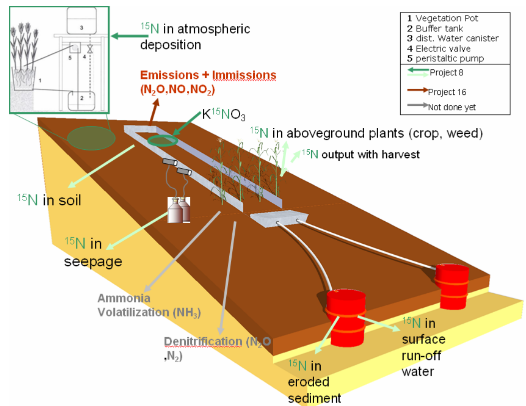
- *Detailed understanding of N cycling on upland slopes*
- *Finding and controlling major N loss pathways*
- *Determining atmospheric deposition*
- *Comparison of different soil additives*

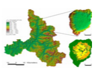
Methods

- *Use of labeled $K^{15}NO_3$ as tracer*
- *Follow its fate in below shown pools*

Results

- *Recovery rate (percentage of applied ^{15}N fertilizer taken up by aboveground plants)*
- *Retention rate (percentage of applied ^{15}N fertilizer recovered in the top 100 cm of the soil profile)*
- *Loss rate (subtracting the recovery rate and retention rate from 100)*
- *Comparison of relative NUE within the different treatments*










References:
-**Ju, X.T. et al.** (2009): *Reducing environmental risk by improving N management in intensive Chinese agricultural systems.* In: PNAS, vol.106, no.9, p.3041-3046.
-**Mosier, A., Syers, J.K. & Freney, J.** (2004):*Agriculture and the Nitrogen Cycle Assessing the Impacts of Fertilizer Use on Food Production and the Environment.* Washington, D.C.
-**Oh, S.J., Jung, P.G. & Shin, J.S.** (1998): *Soil conservation practices on upland field.* In: Annual Report of National Institute for Agricultural Sciences and Technology (Korea), pp. 334-336.
-**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.

www.bayceer.de

Janine.Kettering@uni-bayreuth.de