

## 【Grant-in-Aid for Scientific Research (S)】

### Biological Sciences (Agricultural Sciences)



Title of Project : Establishment of “Minimum-loss” agriculture

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Research Area : Environmental agronomy

Keyword : Environmentally friendly agriculture, ecosystems, traditional agriculture, soil microorganisms

#### 【Purpose and Background of the Research】

The main objective of the present study is to establish a “minimum-loss” agricultural system to mitigate the risks of long-term sustainability of agricultural production as well as to cope with environmental problems derived from human agricultural activities, both of which have risen during the development of modern agriculture. The “minimum-loss” agriculture system involves techniques to minimize: 1) the leaching loss of nutritional elements from the bottom of soils, 2) the emission loss of gaseous components from soil surface and 3) erosion of soil particles and organic materials from the soil surface. We aim to study ecosystem processes and agro-technical management of natural and traditional agricultural ecosystems, respectively, that have sustained for at least certain period in the past, by adopting the approach and methodology of ecology and/or regional studies (farming technology theory), and identifying several techniques available in the context of modern agriculture.

#### 【Research Methods】

In order to establish “minimum-loss” agriculture, we set up research phases in three stages. In order to analyze the ecological processes in individual ecosystems (stage 1), the following sub-themes were developed both in the natural and traditional agricultural ecosystems in Asia and Africa, 1) to examine the process of establishing a symbiotic relationship between plants and soil microbes in the rhizosphere and determining factors of nitrogen flux in the context of resource (N and P) acquisition strategy of these ecosystems, 2) to understand the energy transformation and biochemical reactions in plant-microbial symbiosis, 3) to analyze nutritional-requirements of traditional crops, 4) to evaluate land and water management practices in traditional agriculture by monitoring soil properties, rainfall and water movement in agricultural land, and 5) to re-evaluate multiple cropping systems for traditional agriculture. These ecological processes

analyzed above are interpreted by application of the farming technology theory (stage 2), followed by reconstruction of probable technical components in the context of “minimum-loss” agriculture (stage 3).

#### 【Expected Research Achievements and Scientific Significance】

The following four points are expected to be direct and indirect achievements:

- 1) Local agriculture is understood in the context of biogeochemical and ecological adaptation.
- 2) Establishment of “minimum-loss” agriculture based on ecological insights.
- 3) These research achievements would enable a “paradigm shift” from agricultural technologies that emphasize high yield and increased benefits to that based on sustainability and environmental rationale.
- 4) It creates an opportunity to recognize local agriculture again amidst globalization.

#### 【Publications Relevant to the Project】

- Funakawa S (Ed) 2017: Soils, Ecosystem Processes, and Agricultural Development: Tropical Asia and Sub-Saharan Africa. Springer, pp.392.
- Funakawa S, Watanabe T, et al. 2011: 4 Soil resources and human adaptation in forest and agricultural ecosystems in humid Asia and 5 Pedogenetic acidification in upland soils under different bioclimatic conditions in humid Asia. In World Soil Resources and Food Security. Eds. R. Lal and B.A. Stewart. p.53–269, CRC Press, Taylor & Francis Group, Boca Raton, London, New York.

【Term of Project】 FY2017-2021

【Budget Allocation】 148,500 Thousand Yen

#### 【Homepage Address and Other Contact Information】

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