Current situation on research core of Integrated Field Control

Masahiko SAIGUSA

Integrated Terrestrial Station, Field Science Center, Graduate School of Agricultural Science, Tohoku University, 232-3, Yomogida, Ooguchi, Naruko, Tamatsukuri, Miyagi, 989-6711, Japan.

Food production systems have been studied in order to improve production capacity and quality in individual bio-production fields, and these advances have contributed to establishing a sufficient food supply to meet the needs of the increasing world population since the industrial revolution. However, it has also been clarified in the last two decades that agricultural activity has also contributed to increases in environmental loading such as global warming gas increase, stream and subterranean water pollution, soil degradation, etc. The development of environmentally friendly bio-production systems that integrate high production efficiency with the ecosystems, including human society, is expected to be of great interest.

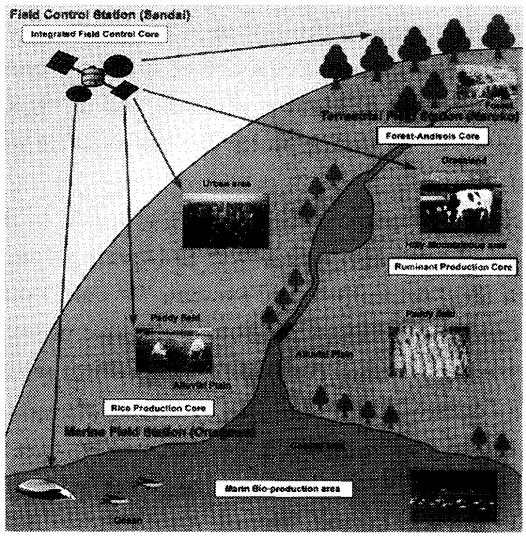
To facilitate the development of environmentally friendly bio-production systems that consider the ecosystem, the new Field Science Center was established in 2003 through the merger and reorganization of two former educational and research facilities for field science : the University Farm, and the Education and Research Center of Marine Bio-resources. The new center has three educational and research stations: the Field Control Station (Sendai), the Terrestrial Field Station (Naruko), and the Marine Field Station (Onagawa). It also has five following research cores : the Forest-Andisols Research Core, the Ruminant Production Research Core, the Rice Production Research Core, the Marine Bio-production Research Core, and the Integrated Field Control Research Core.

The **Integrated Field Control Core** was formed to promote an environmentally, friendly, high quality and high yielding bio- production and to hasten the integrated field science in terrestrial-marine ecosystems.

[Recent topics in field control core]

1). Occurrence and significance of silicon in integrated eco-systems : Silicon is one of the main components in the soil and occupied about 33% of it in average. Silicon exists generally as opal such as plant opal (phytoliths) in the leaf of tree (Morikawa and Saigusa 2004) and leaf of Gramineae plant (Saigusa et al 2000), opaline silica in Andisols (shoji and Saigusa 1978) and diatom in stream and ocean (Ichinomiya 2004). It is not one of essential elements for higher plants but is agronomically essential for rice cultivation because of its multi-functions, such as accelerating photosynthesis, increasing rice blast resistance, water use efficiency, and lodging resistant, etc (Saigusa 2002). Diatom is also important as a feed of "Ayu" fish (*Plecoglossus*), or animal-plankton (feed for fishes in the food chain) and as an environmental index.

2). Transported soils distributed in integrated eco-systems : Both Alluvial soils(paddy soils) and volcanic ash soils (Andisols) are transported soils, and their soil-type and distribution pattern depend on topography, geology, climate, and distance from the source volcano or stream. Allophanic Andisols are distributed in the area close to the source volcano, whereas nonallophanic ones are located far from it and are very much influenced by the wind deposition of loess materials from China (Saigusa and Matsuyama 1998). On the other hand, the soil type and clay mineralogical composition of paddy



soils depend on their topography and geology of upper stream. Fine heavy clay soils with smectite and/or halloysite are located in the back swamp, whereas coarse sandy soils with kaolinite, zeolite and chlorite are located in natural levee (Saigusa 1979). The paddy soils located in Tohoku Districts are generally abundant in 2:1minerals reflecting upstream tertiary green-tuff geology and show fertile soil characteristics.

3). Bio-diversity in integrated ecosystem : Both "Wakasagi" fish (*Hypomesus*) and "Ayu" fish (*Plecoglossus*) living as landlock fishes are relatively smaller in size compared to those of fresh water-sea water type ones (Ikeda et al 2002). However, both the landlock type and freshwater-sea water types of each fish are genetically identical. On the other hand, "Sujiebi" shrimp (*Palaemon paucidens*) has genetic polymorphism and shows different tolerance in salt stress (Fidhiany et al 1990).

4). Bioorganic waste and cycling Agriculture : Bioorganic waste is produced in great extent in terrestrial-marine ecosystems, and the amount of its nitrogen is worth three times of nitrogen fertilizer consumed in Japan(Ito et al 2003). Therefore, both recycling agriculture and increase of self-sufficiency rate of agricultural products are urgent subjects in Japanese agriculture for environmental preservation.

5). Others : 1) Development of techniques to maintain secondary natural environment in hilly-mountainous area and strategy to maintain farmer's livelihood (Saigusa et al 2002) 2) comparative study on remediation system of agricultural environment in reference to Japan and Korea field survey (Kudo et al 2001)) and 3) establishment of ideal model adapted to cycling society by integrating multi-cycling systems were also studied.

[Future Prospects] The feasible projects in this research core are as follows: 1) Development of both ideal techniques and systems for composting and generating electricity from bioorganic waste. 2) Promoting precision agriculture using remote sensing techniques with GPS and GIS 3) Effects of riverside forest on environment prevention in integrated eco-systems. 4) Evaluation of material and energy flows and land use in terrestrial-marine ecosystems.

References

Fidhiany, L., A. Kijima and Y.Fujio : Premating and postmating isolation among local populations of freshwater shrimp Palaemon paucidens in Japan. ***Nippon Suisan Gakkaishi*, 56** : 1407-1411 (1990).

Ichinomiya M. : Seasonal variability of phytoplankton assemblage in Matsushima Bay, including their viable resting stage cells on the bottom. ***Abstract of Doctor thesis for Tohoku University***, 1-10 (2004).

Ikeda, M. and Taniguchi, N. Genetic variability and divergence in populations of ayu (Plecoglossus altivelis), including endangered subspecies, inferred from PCR-RFLP analysis of the mtDNA D-loop region. ***Fisheries Science*, 68** : 18-26. (2002)

Ito T. T. Yokota and M. Saigusa : Measurement of total phosphorus and organic phosphorus contents of animal manure composts by the dry combustion method, ***Soil Sci. Plant Nutr.* 49**, 267-272, (2003)

Kudo A. ed. : Comparative study on remediation system of agricultural environment in reference to Japan and Korea field survey, supported by Grant-in-Aid for Scientific Research (No. 10041059) from the Japan Society for the Promotion of Science, p1-177(2001) (in Japanese)

Morikawa K. and M. Saigusa :Mineral composition and accumulation of silicon in tissues of blueberry (*Vaccinum corymbosus* cv. Bluecrop) cuttings ***Plant and Soil* 258** : 18, (2004).

Saigusa M : Role of Silicon on the Production of Rice, Second Silicon in Agriculture Conference Abstract pp. 221-226 (2002) :

Saigusa M. : Clay mineral composition of lowland soils in relation to the river system. ***Pedologist*, 23**, 11-22 (1979) (in Japanese)

Saigusa M. ed : Development of techniques to maintain secondary natural environment in hilly-mountainous area and strategy to maintain farmer's livelihood, supported by Grant-in-Aid for Scientific Research (No. 11358010) from the Japan Society for the Promotion of Science p1-324 (2002) (in Japanese)

Saigusa M. and N. Matsuyama : "Distribution of allophanic Andosols and Non-allophanic Andosols in Japan" ***Tohoku J. Agr. Res.* 48**, 75-83 (1998)

Saigusa, M. A. Yamamoto and K. Shibuya : Agricultural use of porous hydrated calcium silicate, effects of porous hydrated calcium silicate on resistance of rice plant (*Oryza sativa* L.) to rice blast (*Pyricularia olyzae*)., ***Plant Production Science***, **3** , 51−54 (2000)

Shoji S. and M. Saigusa : Occurrence of laminer opaline silica in some oregon Andosols. ***Soil Sci. Plant Nutr.***, **24,** 157−160 (1978)