## Academic Prizes and Awards

### 1. Prize of the Japanese Society of Soil Science and Plant Nutrition

***Studies on the ecology and function of Actinomycetes in soil***

Dr. Kiyotaka Miyashita, a Principal Research Director at NIAES, won the 2007 prize of the Japanese Society of Soil Science and Plant Nutrition. Soil is a habitat for diverse microorganisms, which are present there in huge numbers. These soil microorganisms play a crucial role in the cycling of carbon and other elements on Earth. Actinomycetes are typical bacteria that are abundant in soil, and they are considered to have evolved adaptations to the soil environment. Although Actinomycetes are major decomposers of organic matter in the soil, their ecology and function had not yet been studied intensively because of taxonomic confusion and a lack of suitable analytical methods. By developing new methods, Dr. Miyashita was able to conduct physiological, biochemical, and molecular biological studies on Actinomycetes from the viewpoint of ecology. The outline of his study is as follows.

Because the Actinomycetes are morphologically diverse, their taxonomic classification has been based on their morphology. Controversy, however, has abounded as to whether or not this morphology reflects their phylogeny. Dr. Miyashita has shown that chemo-taxonomy based on differences in the specific constituents of cells is useful in classifying Actinomycetes at the genus level, and that total-DNA relatedness is effective for classification at the species level. By using these techniques, Dr. Miyashita showed that the composition of species of *Streptomyces*, a major genus of Actinomycetes, in soil samples was phylogenetically highly diverse.

Potato scab, a major disease of potato, is caused by *Streptomyces scabies*. However, it has been claimed that morphologically different strains cause the same disease. Dr. Miyashita demonstrated that *Streptomyces* strains phylogenetically distant from *S. scabies* can also cause potato scab. The novel strains, identified as *S. acidiscabies*, were shown to be acidophilic and acid tolerant; these features enabled the species to dwell in potato field soils artificially acidified to prevent disease. Dr. Miyashita suggested that horizontal transfer of pathogen-related genes between the species has occurred.

Among the various hydrolyzing enzymes produced by *Streptomyces*, chitinase is unique in that it inhibits the growth of fungi, including plant pathogens. He studied the chitinase system of *Streptomyces* by using molecular and biochemical techniques. *Streptomyces* spp. showed an extraordinarily high multiplicity of chitinase genes, which differed in amino acid sequences and domain structure. This indicated that the high efficiency of decomposition by the chitinases in *Streptomyces* is at least partly due to the high multiplicity and diversity of these enzymes. *Streptomyces* produce chitinases only in the presence of a substrate, chitin. Production is regulated accurately at the level of transcription. A transporter of chitobiose (a product of the hydrolysis of chitin by chitinase) and regulatory proteins are involved in the regulation of gene expression.

Soil biology is often treated as a black box in soil science. Although bacteria—prokaryotic single-cell organisms with small genomes—are usually considered to be simple organisms, each bacterium has evolved to survive in a specific niche in the complicated soil ecosystem. Dr. Miyashita has developed a new field of soil microbiology by showing that elucidation of strategies for adaptation to the environment is inevitable if we are to understand the ecology of bacteria.

### 2. The 6th Progress Prize of the Foundation of Agricultural Sciences of Japan

***Nutrient balance and heavy metal load on farmland and their environmental impact assessment***

The Foundation of Agricultural Sciences of Japan presented the 6th Progress Prize to Dr. Shin-Ichiro Mishima. The foundation awarded a prize to young researchers (under 40 years of age) who contribute to the progress of agricultural sciences. The study undertaken by Dr. Mishima is outlined as follows:

1. Residual N and P defined as the unutilized N and P in agricultural production, were estimated from 1980 to 2002 on a Japanese national scale. Residual N and P per farmland area peaked in 1985—the same year in which chemical fertilizer application peaked—and then declined, and declined to 2002. Residual N among prefectures varied widely and was determined by the amounts of chemical fertilizer and livestock excreta. Utilization of controlled-release fertilizer in vegetable crops and promotion of the use of livestock excreta on forage crops would be helpful in reducing residual N levels in each prefecture. However, prefectures where excessive amounts of livestock excreta are being used on farmland and there is a lack of local land use have no mitigation protocols in place.
2. N and P outflows in the river waters of two medium-scale river basins were estimated, and agriculture-derived N and P loadings of the rivers were compared between the two basins. Although residual N and P levels were the same in the two river basins, agricul-

ture-derived N and P loads to farmland differed by 1.8 times. This difference would come from differences in the sources of residual N and P: namely, residual N and P derived from chemical fertilizer flowed more easily into the river water than those derived from livestock excreta. However, because intensive livestock production has been conducted in the area only during the last one or two decades, we were unable to quantify the effect of residual N and P derived from livestock excreta and, therefore, the true effect of this component on river water quality over the long term in each basin.

3. Cadmium, copper, and zinc in chemical fertilizers and sewage sludge manures were measured and their loadings to farmland evaluated. Cadmium loading was associated mainly with chemical P fertilizer application, although the Cd concentration in chemical fertilizer is now one-third of that in the 1970s. Copper and zinc loads were derived mainly from livestock excreta, and half of the copper and zinc in livestock excreta was disposed of with the disposal of livestock excreta, especially pig excreta. Therefore, promotion of the use of livestock manure would cause an increase in copper and zinc loadings. The levels of heavy metals in sewage sludge manure were the same as in pig manure; the contents of these metals have been decreasing or constant over the last three decades.

Dr. Mishima and his colleagues are working on the quantitative assessment of nutrient outflows from farmland, greenhouse gas emissions at the national and prefectural scale, and of residual N and P in each crop in each prefecture. The theme of his future work is the development of an integrated agro-environmental indicator for the realization of low environmental impacts and sustainable agricultural production from the viewpoint of manure and chemical fertilizer use.

## 3. Statistical GIS Promotion Prize: Statistical Information Institute for Consulting and Analysis 2007 prize recognizing outstanding GIS applications

***Analysis of land use change over 120 years using a historical GIS database derived from the Rapid Survey Maps.***

The Statistical Information Institute for Consulting and Analysis (Sinfonica) is a foundation established to disseminate national statistical data, such as the national population census, collected by the Ministry of Internal Affairs and Communication. As part of its activities, Sinfonica awards an annual prize to outstanding applications of statistical analysis using geographical information systems (GIS), called the Statistical GIS Promotion Prize. The 2007 prize was awarded to two NIAES researchers, David Sprague and Nobusuke Iwasaki of the Division of Ecosystem Informatics at the annual Statistical Information Seminar held by Sinfonica in Tokyo.

The prize recognized the expertise of Drs. Sprague and Iwasaki in building historical GIS databases integrating map data of various scales and map projections from multiple time periods, then using the database to analyze land use changes extending back 120 years. The base data of their historical GIS database are the Rapid Survey Maps (*Jinsoku Sokuzu*), the oldest topographic map series surveyed by modern cartographic methods in Japan. The Rapid Survey Maps were surveyed between 1881 and 1886, and cover most of the Kanto Plain surrounding Tokyo. These colorful maps show land use in great detail at 1/20,000 scale. Drs. Sprague and Iwasaki established methods to georeference the Rapid Survey Maps, and other early topographic maps, to modern map coordinates. They digitized the land use data into the GIS, and by combining this information with modern vegetation maps, they analyzed rural land use changes at multiple time intervals.

Through their research, Drs. Sprague and Iwasaki have found that the Japanese rural landscape of 120 years ago was utilized to support traditional agriculture, which required large areas as sources of natural resources. Even in the Kanto Plain, where the topography is relatively flat, large proportions of the landscape in the 1880s consisted of woodlands and grasslands. Through GIS analysis, they showed that many of the woodlands and grasslands were transformed into fields with the modernization of agriculture. More recent maps reveal that the rural landscape is undergoing rapid urbanization near cities and towns along major railways.

Historical GIS is a rapidly growing field of geographical analysis that is necessary for evaluating the ecological changes overtaking rural regions around the world. By developing GIS analyses using early maps, Drs. Sprague and Iwasaki are pioneering tools to quantify transformations in rural landscapes, measured against the historical baselines as depicted by early maps.

**Further reading:**

Sprague DS, N. Iwasaki, S. Takahashi (2007): Measuring rice paddy persistence spanning a century with Japan's oldest topographic maps: georeferencing the Rapid Survey Maps for GIS analysis. *International Journal of Geographical Information Science*, **21**, 83-95.

Statistical Information Institute for Consulting and Analysis, http://www.sinfonica.or.jp.

## 4. Certificates of Appreciation from IPCC for contributing to the award of the Nobel Peace Prize

The 2007 Nobel Peace Prize was awarded to the Intergovernmental Panel on Climate Change (IPCC) and former US vice-president Al Gore "for their efforts to build up and disseminate greater knowledge about man-made climate change."

IPCC, which was established jointly by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in 1988, has a membership of about 3,000 scientists from 130 countries. From the publication of its First Assessment Report in 1990, the IPCC has issued forecasts on global warming and its impacts based on scientific evidence, and has proposed measures for adapting to and mitigating global warming. In its Fourth Assessment Report issued in 2007, the IPCC concluded that warming of the climate system is unequivocal and that it is having definite impacts on the natural environment and human societies worldwide. It predicted that if greenhouse gas emissions continue to rise, the climate system will undergo further large-scale warming. The IPCC has also issued a number of special reports on topics such as carbon dioxide capture and storage, and methodology reports such as its Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories.

In April 2008, the IPCC sent Certificates of Appreciation to Japanese researchers who participated in preparing its reports to date for contributing to the work that won it the Nobel Peace Prize. Among NIAES researchers, former NAIES Director General Katsuyuki Minami, former Greenhouse Gas Emission Team Leader Haruo Tsuruta, and Carbon and Nutrition Cycles Division Senior Researcher Kazuyuki Yagi received certificates. Dr. Minami has been a member of the IPCC since its inauguration, and helped to author the First and Second Assessment Reports. Dr. Tsuruta was one of the authors of the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, and Dr. Yagi helped to author both the Good Practice Guidance and the Guidelines for National Greenhouse Gas Inventories.

NIAES will continue to contribute to the IPCC and other organizations and farmers, both in Japan and overseas, through monitoring of global warming and through research to assess the impacts of global warming on the agricultural environment and research into global warming mitigation measures.

**Cover photograph explanation**

Certificate of Appreciation sent by the Intergovernmental Panel on Climate Change (IPCC) to NIAES researchers in recognition of their contribution to the award of the Nobel Peace Prize to the IPCC.