# 2.5 DIVISION OF ENVIRONMENTAL SCIENCE AND TECHNOLOGY

In this century, society faces a challenge and responsibility to transition toward sustainable living and to ensure healthy environment for future generations. The Division aims to create knowledge of the sustainable management of ecosystems, through the integration of technology and natural sciences. Division of Environmental Science and Technology consists of 7 chairs and 16 laboratories on forest, agriculture, soil and hydrology as like Chair of Comparative Agricultural Science (Lab. of Comparative Agricultural Science), Chair of Bioenvironmental Science (Lab. of Forest Ecology, Lab. of Forest Hydrology and Lab. of Forest Biochemistry), Chair of Agro-ecosystem Science (Lab. of Tropical Agriculture, Lab. of Soil Science. Lab. of Environmental Mycoscience and Lab. of Ecological Information), Chair of Environmental development Engineering (Lab. of Agricultural Facilities Engineering and Lab. of Water Resources Engineering), Chair of Land and Water Resources Engineering (Lab. of Irrigation, Drainage and Hydrological Environmental Engineering, and Lab. of Rural Planning), Chair of Bioproduction Engineering (Lab. of Agricultural Systems Engineering, Lab. of Field Robotics and Lab. of Agricultural Process Technology), and Chair of Radiation Safety Control (Lab. of Radiation Safety Control). Such various and extensive laboratories are in partnership each other and are studying for existing human beings on the earth, producing food and preserving environment in 21st century.

The division had a total enrollment of 173 (114 in the Master's Program including 3 foreign students and 59 in the Doctor's Program including 11 foreign students)

# Chair of Comparative Agricultural Science

# 2.5.1 Laboratory of Comparative Agricultural Science

Staff Associate Professor: Torii, Kiyoshi, Dr. Agric. Sci. Associate Professor: Akamatsu, Miki, Dr. Agric.Sci. Associate Professor: Tanaka, Ueru, Dr. Agric. Sci. (Graduate School of Global Environmental Studies) Associate Professor: Mori, Yoshiaki, Dr. Agric. Sci. (Academic Center for Computing and Media Studies) Assistant Professor : Morita, Katsuko Students and research fellows

Doctor's program: (1) Master's program: (1)

# A. Research Activities (2004.4-2005.3) A-1. Main subjects

a) Constructing GIS (Geographic Information System) in the field of comparative agricultural Science

We are intending to integrate information on agricultural water management, hydrological data, geographical data, topographical data, irrigation system, land use and vegetation, watershed, and regional development plans on the basis of satellite image data and to review regional agricultural water management utilizing data processing center and personal computer networks in order to construct efficient system to comprehend water environment in the whole basin. At present, accuracy of satellite image is improving rapidly, and the number of observation satellites is increasing. With powerful satellite image analysis software which has become applicable, we are carrying out analysis of the satellite image data on Kojima Bay, Okayama, inside the country, and in overseas, on Yangsangan Tideland Reclamation Project Area in Korea, the large-scale irrigation projects in the suburbs of Bangkok in Thailand, flood plain in Bangladesh, semi-arid area in Iran, Inner Mongolia and Hetao district in China and the southern part of Taiwan together with field investigations. (Torii)

b) Application of image measurements to regional environmental studies and development of a numerical simulator

We are observing regional environments based on high-resolution satellite image data and analyzing water balance and flow patterns in the basin by linking to the results of numerical calculations to develop a simulator of high prediction accuracy. We are getting interesting results by applying numerical calculation to coastal flows and flows in fresh water lakes. (Torii)

c) Interaction mechanism of the neurotoxic insecticides with the receptors

Chloronicotinyl insecticides including imidacloprid act at the nicotinic acetylcholine receptor of insects as agonists. To clarify the interaction mechanism of chloronicotinyl compounds, the several receptors having amino-acid mutations have been constructed based on the crystallographic structure of acetylcholine binding protein by computer graphics and binding of the model receptor and agonists such as imidacloprid has been simulated by a molecular mechanics calculation. In this year, the modeling procedures were evaluated using the new protein modeling software PDFAMS. (Akamatsu)

d) Permeation of drugs having diverse structures across artificial model membranes and prediction of permeability across monolayers of human intestinal epithelial (Caco-2) cells

It is important to examine transport of various chemicals across the intestinal epithelium from the point of view of the development of orally bioavailable therapeutic agents. The permeability of various pharmaceuticals and related compounds across artificial lipid membranes was measured to evaluate absorption of the compounds by the transcellular route. The relationship between the Caco-2 cell permeability coefficient in references and the measured artificial membrane permeability coefficient of compounds was then determined. In this year, whether a variety of pesticides act as substrates of human P-glycoproteins (efflux pumps for xenobiotics) was also investigated. (Akamatsu)

e) Evaluation of estrogen- and androgen-receptor binding affinities of DDT derivatives and their metabolites

Recently, environmental implications of endocrine active substances are important issues. One mode of action of endocrine active substances is to bind to estrogen- and androgen-receptors. Several kinds of pesticides and their metabolites are considered to show estrogen- and androgen-receptor binding affinities. In this study, estrogen-receptor binding affinities of DDT derivatives and their metabolites were measured. The 2nd phase metabolites of methoxychlor were synthesized and their binding affinity was evaluated to clarify the structure-affinity relationships of the metabolites. (Akamatsu)

 f) Analysis of pesticide residues in environment around the suburban agricultural fields of Bangkok

Used pesticides were surveyed at the suburban agricultural fields of Bangkok, Thailand, to know whether pesticides are used safely and appropriately. River bottom and field soils around the area were sampled and pesticide residues in the samples were analyzed. A few pesticides were detected in several samples although the amount was small. The pesticide residue analysis in this area will be continued. (Akamatsu, Torii, Mori, Tanaka)

 g) Studies on soil management systems and environment conservation in Semi-arid West Africa (Burkina Faso, Niger):

Field studies were conducted in the Sahel region of West Africa to elucidate the characteristics of ecosystems, soils, local husbandry systems which lead approaches to ecologically sound land use systems, prevention of desertification and restoration of degraded lands. (Tanaka) h) Studies on rural development, environmental conservation and disaster management at

human scale (Viet Nam)

Preliminary field studies were conducted in some villages of Central Viet Nam, where natural disaster frequently hits. Agro-ecological characteristics and local husbandry systems were described in order to design research/development project for participatory rural development, environmental conservation and disaster management. (Tanaka)

### A-2. Publications and presentations

### a) Publications

#### Books

- Torii,K.: [ZuyderZee Project in Netherland] (translation) A5 225 pages shoukadou-publisher ISBN4-87974-044-6
- Mizokami, S., H. Tamamura, K. Hiramatsu, M. Mizumoto, M. Akamatsu, H. Nakashima, Z. Wang, S.C. Peiper, N. Yamamoto, A. Otaka and N. Fujii: New leads of low molecular weight CXCR4 antagonists based on enhancement of the T140-based pharmacophores. Peptide Science 2003(Ed. M. Ueki), pp. 285-288, The Japanese Peptide Society, Tsukuba, 2004

#### Original papers

- Torii, K.: 「Worm eye's view, bird eye's view, historical eye's view from human's view point to view point of God -」 Sderd Vol.61 pp26-29, Mar2005
- Takahashi, Y., K. Torii and, T. Sakai: Survey of vegetation cover density using IKONOS data and airborne lidar data. pp. 733-738 The 25th ACRS, 2004
- Nakagawa, T., K.Torii, S. Takeshita, T. Mitsuno: Evaluation of Sediment Trap Function of Agricultural Ponds in Urban Areas Using RS and GIS. pp.656-661 The 25th ACRS, 2004
- Torii, K., K. Yaota, T. Hata and Abdlhadi: Possibility of R/S & GIS Applications to promotion of participatory water management in Gezira Scheme in Sudan. pp.231-237 The 1<sup>st</sup> Asian Space Conference, 2004
- Miyashita, M., T. Shimada, S. Nakagami, N. Kurihara, H. Miyagawa and M. Akamatsu: Enantioselective Recognition of Mono-demethylated methoxychlor metabolites by the estrogen receptor. Chemosphere 54, 1273-1276, 2004
- Ano, R., Y. Kimura, M. Urakami, M. Shima, R. Matsuno, T. Ueno and M. Akamatsu: Relationship between structure and permeability of dipeptide derivatives containing Tryptophan and related compounds across human intestinal epithelial (Caco-2) cells. Bioorg. Med. Chem. 12, 249-255, 2004
- Ano, R., Y. Kimura, M. Shima, R. Matsuno, T. Ueno and M. Akamatsu: Relationships between structure and high-throughput screening permeability of peptide derivatives and related compounds with artificial membranes: application to prediction of Caco-2 cell permeability. Bioorg. Med. Chem. 12, 257-264, 2004
- Wanchana, S, F. Yamashita, H. Hara, S. Fujiwara, M. Akamatsu and M. Hashida: Two- and three-dimensional QSAR of carrier-mediated transport of β-lactam antibiotics in Caco-2 cells. J. Pharm. Sci. 93, 3057-3065, 2004

### Reports

- Tanaka, U.: Soil fertility management in Africa with special interest to the gaps abetween field realities and our general understanding. International Cooperation of Agriculture and Forestry, 27-3, 6-10, JAICAF, 2004 (in Japanese)
- Tanaka, U.: Soil drying. Encyclopedia of conservation agriculture (R. Ishii, ed.), p. 902, Maruzen, Tokyo, 2005
- b) Conference and seminar papers presented
- The 26<sup>th</sup> Asia Remote sensing Conference: 2 report

The 2<sup>nd</sup> Asia Space Conference: 1 report

The meeting of Japan Society for Bioscience, Biotechnology, and Agrochemistry in 2004: 1 report The 30th Annual Meeting of Pesticide Science Society of Japan: 1 report The 41st Peptide Symposium: 1 report

The 32nd Symposium on Structure-Activity Relationships: 1 report

The 6th Australia/Japan Symposium on Drug Design and Development: 1 report

The 15th European Symposium on Quantitative structure-Activity Relationships & Molecular Modeling; 1 report

### A-3. Off-campus activities

#### Membership in academic societies

- Torii, K.: Japanese Agricultural Systems Society(Board member), Japanese Society of Irrigation, Drainage and Reclamation Engineers (Member of Research and Advisory Committee)
- Akamatsu, M.: Pesticide Science Society of Japan (Board member), Division of Structure-Activity Studies, the Pharmaceutical Society of Japan (Board member)

Tanaka U. Japanese Society of Pedology (Editorial board member)

#### Research grants

- Akamatsu, M.: Monbukagakusyo Research Grant, Research (C): Prediction of behavior of endocrine disrupting chemicals and their metabolites in human bodies (Akamatsu, Head)
- Akamatsu, M.: Monbukagakusyo Research Grant, Research (C): Evaluation and prediction system of physicochemical properties for drug design and the fundamental research (Kobe Pharmaceutical College Yamagami, Head; Akamatsu, Member)
- Akamatsu, M.: CREST: Development of the highly sensitive mass spectrum and the analysis of endocrine disruptors (Osaka University Katakuse, Head; Akamatsu, Member)

#### A-4. International cooperations and overseas activities

#### International meetings (roles)

- Akamatsu, M.: The 6th Australia/Japan Symposium on Drug Design and Development, Sydney, Australia (presentation, chair), The 15th European Symposium on Quantitative structure-Activity Relationships & Molecular Modeling, Istanbul, Turkey (presentation)
- Tanaka, U.: International conference on "Perspectives and approaches for sustainable rural development in Africa", SCSRD, Tanzania (member of the organizing committee)
- Tanaka, U. Sokoine University Center for Sustainable Rural Development Project (JICA, Tanzania)

### Memberships in international academic societies abroad

Torii,K: Membership of American Society of Civil Eng., International Association of Hydraulic Research

Akamatsu, M.: American Chemical Society

Tanaka, U: International Society of Soil Science

## International joint researches, overseas research surveys

- Akamatsu, M.: Pesticide residue analysis in environment around the suburban agricultural fields of Bangkok (Bangkok, Thailand)
- Tanaka, U.: Studies of fragility of local farming and soil degradation in the Sahel (Burkina Faso), Development of soil fertility management in Semi-arid tropical Africa (Niger), Studies on rural development, environmental conservation and disaster management at human scale in central Viet Nam (Viet Nam)

# B. Educational Activities (2004.4-2005.3)

# B-1. On-campus teaching

a) Courses Given

Undergraduate level: Scientific English (Agriculture) (Akamatsu, Tanaka), Information processing basics (Torii)

Graduate level: Comparative Agricultural Science (Torii), Comparative Study of Resources and Environment (Akamatsu, Tanaka), Agriculture and environment in Japan (Akamatsu, Tanaka)

# B-2. Off-campus teaching, etc

## Part-time lecture

- Torii K.: Processing of topographical Information, Dept. of Agriculture, Shiga Prefectural University, Kobe University, Faculty of Agriculture (Photogrammetry & remote sensing)
- Mori, Y.: Statistics for Social Sciences, Exercise of Statistics for Social Sciences, Nara Women's University, Exercise for computer basic practice,Osaka International College
- Tanaka U.: Japan International Cooperation Agency, Lecture on rural development course (Africa and rural development)

# C. Other Remarks

- Torii, K.: Member of committee of the Faculty level: Committee of Information system in Faculty of Agriculture.
- Akamatsu, M., Tanaka, U.: Member of committee of the Faculty level: Committee of International academic exchange
- Akamatsu, M.: The Ministry of Agriculture, Forestry, and Fisheries of Japan, tentative member of Councils of agricultural materials, pesticide division Chemicals Evaluation and Research Institute, Japan, tentative member of committee of research development and assessment. National Institute of Technology and Evaluation, Japan, member of committee of quantitative structure-activity relationships
- Mori, Y.: Member of Field Science Educational Research Center committee.
- Tanaka U.: Member of committee of the Faculty level: Committee of International academic exchange; Global Environmental Forum, member of advisory committee for the project of anti-desertification and technology transfer

# Chair of Bio-environmental Science

# 2.5.2 Laboratory of Forest Ecology

Staff	Professor	: Takeda, Hiroshi, Dr. Agri.
	Lecturer	: Osawa, Naoya, Dr. Agri.
	Assistant Professo	or : Osono, Takashi, Dr. Agri.

Students and research fellows:

JSPS Research Fellow: (1) (PD: 1) Research Fellow : (1) Doctor's program : (4) Master's program : (8) Undergraduate : (1)

### A. Research Activities (2004.4-2005.3)

## A-1. Main subjects

a) Decomposition process of leaf litter in forest ecosystems

Decomposition process of leaf litter has been studied at a cool temperate forest in Ashu, a pine plantation in Kamigamo and Tanakami, mainly focused on the interaction among leaf litter, decomposer-microorganisms, and soil.

b) Fine root dynamics and the role of soil animals in a forest soil

Fine root dynamics at a forest ecosystem is studied at Kamigamo Experiment Station Japan, and evergreen forest, Thailand. The manipulated experiments for the analysis of community structure and the function of soil animal are mainly performed at Kamigamo Experiment Station, and that for the fine root dynamics are mainly done at evergreen forest, Thailand.

c) Module Dynamics of Forest trees

Forest trees are characterized by their foraging behaviors for capturing the nutrients and light. Foraging behavior of trees has been studied through the population dynamics of modules, such as buds, current shoots, and leaves. The knowledge of module dynamics is important for the understandings of plant community.

d) Community structure of insect community and the role of herbivore in forest ecosystem

We are performing our research to clarify the impact of herbivorous insects on the community structure and its dynamic of the forests in Ashu and Tanakami experimental station, from a view point of the seasonal and spatial variation of plant quality and plant growth.

e) Impacts on ground arthropod community by artificial logging

Arthropod community at the Kamigamo Experiment station has been studied to clarify to clarify the impact of logging on forest ecosystem since July 1999.

### A-2. Publications and presentations

a) Publication

#### **Original** papers

Fujimaki, R., Tateno R., Hirobe M., Tokuchi N., and Takeda H.: Fine root mass in relation to soil

N supply in a cool temperate forest. Ecological Research 19, 559-562.2004

- Fujimaki R., McGonigle T.P., and Takeda H.: Soil micro-habitat effects on fine roots of Chamaecyparis obtusa Endl.: a field experiment using root ingrowth cores. Plant and Soil 266: 325-332, 2004
- Hasegawa S. F. and Takeda H.: Current year shoot based approach for annual variation in the reproductive output in Siberian alder (*Alnus hirsuta var. sibrica*). Trees 18, 436-441. 2004
- Hirobe M., Sabang J., Bhatta B.K., and Takeda H.: Leaf –litter decomposition of 15 tree species in a lowland tropical rain forest in Sarawak: dynamics of carbon, nutrients, and organic constituents. Journal of Forest Research 9, 347-359. 2004
- Hirobe M., Sabang J., Bhatta B.K., and Takeda H.: Leaf-litter decomposition of 15 tree species in a lowland tropical rain forest in Sarawak; decomposition rates and initial litter chemistry. Journal of Forest Research 9, 341-346. 2004
- Hishi T., Hirobe M., Tateno R., and Takeda H.: Spatial and temporal patterns of water-extractable organic carbon (WEOC) of surface mineral soil in a cool temperate forest ecosystem. Soil Biology and Biochemistry 36, 1731-1737, 2004
- Ishimaru K., Tokuchi N., Osawa N., Kawamura K., and Takeda H.: Estimating the suitability of four broad-leaved tree species in different successional stage for revegetating an eroded granite hill slope. Journal of Forest Research 10: 27-34, 2005
- Kawamura K. and Takeda H.: Rules of crown development in the clonal shrub *Vaccinium hirtum* in a low-light understory: a quantitative analysis of architecture. Canadian Journal of Botany 329-339, 2004
- Mizumachi E., Osawa N., Akiyama R., and Tokuchi N..: The effects of herbivory and soil fertility onthe growth patterns of Quercus serrata and Q. crispula saplings at the shoot and individual levels. Population Ecology 46:203-211, 2004
- Mori A. and Takeda H.: Architecture and neighborhood competition of understorey saplings in a subalpine forest in central Japan. Ecoscience 10; 217-224, 2004
- Mori A. and Takeda H.: Light-related competitive effects of overstory trees on the understory conifer saplings in a subalpine forest. Journal of Forest Research 8; 163-169, 2004
- Mori A. and Takeda H: Effects of mixedwood canopies on conifer advance regeneration in a subalpine old-growth forest in central Japan. Ecoscience 11; 36-44, 2004
- Mori A. and Takeda H.: Functional relationships between crown morphology and within-crown characteristics of understorey saplings of three codominant conifers in a subalpine forest in central Japan. Tree Physiology 24; 661-670, 2004
- Mori A., Mizumachi E., Osono T., and Doi Y.: Substrate-associated seedling recruitment and establishment of major conifer species in an old-growth subalpine forest in central Japan. Forest Ecology and Management 196: 287-297, 2004
- Osada N., Tateno R., Hyodo F., and Takeda H.: Changes in crown architecture with tree height in two deciduous tree species: development constraints or plastic response to the competition for light? Forest Ecology and management 188, 337-347. 2004.
- Osono T. and Takeda H.: Potassium, calcium, and magnesium dynamics during litter decomposition in a cool temperate forest. Journal of Forest Research 9: 23-31, 2004
- Osono T., Bhatta, B. K., and Takeda H.: Phyllosphere fungi on living and decomposing leaves of giant dogwood. Mycoscience 45; 35-41, 2004

- Sugiura S., Yamazaki K., and Fukasawa Y.: Weevil parasitism of ambrosia galls. Annals of the Entomological Society of America 97; 184-193, 2004
- Tateno R., Hishi T., and Takeda H.: Above- and belowground biomass and net primary production in a cool-temperate deciduous forest in relation to topographical changes in soil nitrogen. Forest Ecology and Management 193; 297-306, 2004
- Tateno R. and Takeda H.: Forest structure and tree species distribution in relation to topography-mediated heterogeneity of soil nitrogen and light at the forest floor. Ecological Research 18, 559-571.2004
- Yamashita T., Kasuya N., Shimamura S., and Takeda H.: Effects of root zone trenching on soil nitrogen dynamics in Japanese cedar and cypress plantations. Journal of Forest Research 9, 333-340. 2004
- b) Conference and seminar papers presented
- Aphidophaga 9. (Ceske Bujevoice, Czech Republic, September 2004). Number of presentations 1 (Osawa)
- The 51th annual meeting of Japanese Ecological Society. (Kushiro, 2004, August). Number of presentations 2 (Takeda et al.)
- The 52th annual meeting of Japanese Ecological Society. (Osaka, 2004, March). Number of presentations 9 (Takeda et al.)
- The 115th annual meeting of Japanese Forestry Society. (The University of Tokyo, 2004, March). Number of presentations 11 (Takeda et al.)
- The 48th annual meeting of The Mycological Society of Japan. (Nagasaki Sievold university, 2004, May). Number of presentations 1 (Osono et al.)
- The 55th annual meeting of Kansai Branch of Japanese Forestry Society (Tamaguchi, 2004, October). Number of presentations 5 (Takeda et al.)
- 1st East Asian Federation of Ecological Societies (EAFES) International Congress. (Mokpo National University, Mokpo, Korea, 2004, October). Number of presentations 4 (Takeda et al.)
- IV Asia Mycological Congress. (Lotus Hotel Pang Suan Kaew, Chiang Mai, Thailand, 2004, November 2004,). Number of presentations 1 (Osono et al.)
- XXVII Symposium on Polar Biology. (National Institute of Polar Research, Tokyo, Japan, 2004,December). Number of presentations 1 (Osono et al.)

### A-3. Off-campus activities

#### Membership in academic societies (roles)

- H. Takeda: The Society of Population Ecology (Editor), The Japanese society of Tropical Ecology (Commendatory member), The Japanese Society of Soil Animals (Councilor)
- N. Osawa: The Society of Population Ecology (Secretary General)

#### Research grants

- Ministry of environment. Environmental studies on tropical carbon metabolism (Rep. co-researcher, H. Takeda).
- Grant-in-Aid for Scientific Research from the Ministry of Education, Science and Culture, Japan. Community studies on nutrient cycling and interactions among animals and plants. (N. Osawa).
- Grant-in-Aid for Scientific Research from the Ministry of Education, Science and Culture, Japan.

Studies on dispersal and colonization of pioneer fungus species in forest succession. (Rep. co-researcher, N. Osawa).

- Grant-in-Aid for Scientific Research from the Ministry of Education, Science and Culture, Japan. Community studies on the interaction among insects and mushrooms. (Rep. co-researcher, N. Osawa).
- Ministry of environment: Evaluation of biodiversity for rapid assessment (Rep. co-researcher, N. Osawa).
- Grant-in-Aid for Scientific Research from the Ministry of Education, Science and Culture, Japan. Role of phyllosophere fungi in litter decomposition (T. Osono).

# A-4. International cooperation and overseas activities

## International joint researches, overseas research surveys

Takeda, H.: Decomposing process in tropical forests, JSPS ronpaku program, in Thailand.

# B. Educational activities (2004.4-2005.3)

# B-1. On-campus teaching

a) Courses given

- Undergraduate level: Practice of Forest Ecology (H.Takeda and N.Osawa), Seminar of Forest Ecology (H.Takeda and N.Osawa). Community Ecology (N.Osawa), Practice of Forest Sciences II &III (N. Osawa and T. Osono). The Practice of Ecology (N. Osawa and T. Osono).
- Graduate level: Practice of Forest Ecology (H.Takeda and N. Osawa), Seminar of Forest Ecology (H.Takeda and N. Osawa). Special Lecture of Community Ecology (N.Osawa).

# B-2. Off-campus teaching

# Part-time Lecturer

H. Takeda: Undergraduate and Graduate Course, Kyoto Prefectural University (Lecture of Forest Ecology). Meijyo University (Forest Ecology).

# 2.5.3 Laboratory of Forest Hydrology

Staff Professor : Tani, Makoto, Dr. Agric. Sci. Associate Professor: Ohte, Nobuhito, Dr. Agric. Sci. Assistant Professor : Kosugi, Yoshiko, Dr. Agric. Sci. Postdoctorial Fellow: Matsuo, Naoko, Dr. Agric. Sci. Student and research fellows

JSPS Research Fellow: (1)		Doctor's program:	Doctor's program: (5)	
Master's program	: (9)	Undergraduate :	(2)	

### A. Research activities (2004.4-2005.3)

a) Runoff process and biogeochemistry

Detailed runoff processes and effects of their heterogeneities on biogeochemistry in forested catchments are studied to evaluate roles of forest in water and nutrient cycles.

The control mechanism of dissolved organic carbon (DOC) was investigated through measuring the distribution of its concentration in small forested catchments. In the surface soil layer, DOC concentration was controlled both through acidic properties yielded by decomposition processes and through inorganic ion chemistry involved in soil-development processes, whereas a change of DOC concentrations in the perennial groundwater was controlled by the hydrological mean residence time.

Observation results on the temporal and spatial distributions of stream-water chemistry at various scales from 0.1 to 500-ha catchment areas demonstrated that the concentration of  $SiO_2$  was produced by the mixing of soil-water and bedrock groundwater and that the contribution of soil water increased with an increasing of runoff rate. These tendencies were detected in each scale of the catchments.

Roles of slope, stream channel and riparian zone in hydrochemical processes were investigated in small catchments. The recent results showed that stream water chemistry was controlled by the vertical distribution of soil deposition in a riparian zone and that DOC concentration increased with distance downstream, suggesting an importance of decomposition processes within stream channel.

Our study also focuses on influences of topographies such as hollow, side slope and wetland on hydrological and hydrochemical processes. Comparisons of storm hydrographs between hollow and side slope showed that storm runoff was only generated from the side slope when the storm size was small and that storm runoff from the hollow gradually increased as the storm size was getting large, suggesting that the variable source area concept did not explain the storm-runoff generation in our steep terrains.

b) Gas exchange between forest and the atmosphere

Our laboratory is conducting long-term observations on gas exchange processes between forest and the atmosphere using the eddy covariance method to evaluate the physical and physiological control by forest ecosystem. Our main fields are a Hinoki Cypress forest in Japan and a tropical rainforest in Malaysia.

Seasonal characteristics of evapotranspiration and energy exchange were accurately estimated from the cypress forest through the cross-checking of catchment water budget and eddy covariance methods.

For the estimation of carbon dioxide exchange above forest by eddy covariance method is continuously conducted in our study forests. In our recent study, the flux estimation was examined by the data of  $CO_2$  dynamics in forest consisting of soil, trunk and leaf respirations as well as the vertical distribution of  $CO_2$  concentration. The measurements of soil respiration in our cypress forest and our tropical rainforest demonstrated their spatial distribution characteristics controlled by the soil temperature and moisture conditions in both forests.

In our scaling-up study of the gas exchange from an individual leaf scale to a forest scale, the heterogeneity in stomatal behaviour was measured and its effects on gas exchange at a forest scale were analyzed using a multi-layer model, showing that an afternoon depression in photosynthesis in our tropical rainforest was well explained by considering patchy stomatal closure.

### A-2. Publications and Presentations

a) Publications

### Books and reviews

Roberts, J.M., J.H.C. Gash, M. Tani and L.A. Bruijnzeel: Controls on evapotration in lowland rainforest.
In Bonell M. and L.A. Bruijnzeel (eds.): Forests, Water and People in theHumid Tropics.
p. 287-313, Cambridge University Press, Cambridge, 2004

#### Original papers

- Asano, Y., Ohte, N. and Uchida, T.: Sources of weathering-derived solutes in two granitic catchments with contrasting forest growth. Hydrological Processes 18: 651-666, 2004
- Tokuchi, N., Ohte, N., Hobara, S., Kim, S. and Katsuyama, M.: Changes in biogeochemical cycling following forest defoliation by pine wilt disease in Kiryu experimental catchment in Japan. Hydrological Processes 18: 2727-2736, 2004
- Ohte, N., S. D. Sebestyen, J. B. Shanley, D. H. Doctor, C. Kendall, S. D. Wankel, and E. W. Boyer: Tracing sources of nitrate in snowmelt runoffusing a high-resolution isotopic technique. Geophysical Research Letters 31: L21506, doi:10.1029/2004GL020908, 2004
- Yoshimura, K., T. Oki, N. Ohte, and S. Kanae: Colored moisture analysis estimates of variations in 1998 Asian monsoon water sources, Journal of Meteorological Society of Japan 82(5): 1315-1329, 2004
- Katsuyama, M., N. Ohte, and N. Kabeya: Effects of bedrock permeability on hillslope and riparian groundwater dynamics in a weathered granite catchment. Water Resources Research 41: W01010, doi: 10.1029/2004WR003275, 2005
- Takanashi, S., Y. Kosugi, Y. Tanaka, M. Yano, T. Katayama, H. Tanaka and M. Tani: CO<sub>2</sub> exchange in a temperate Japanese cypress forest compared with that in a cool-temperate deciduous broad-leaved forest. Ecological Research 20: 313-324, 2005.
- Kawasaki, M., N. Ohte, M. Katsuyama: Biogeochemical and hydrological controls on carbon export from a forested catchment in central Japan. *Ecological Research 20: 347-358, 2005*
- Itoh, M., N. Ohte, M. Katsuyama, K. Koba, M. Kawasaki and M. Tani: Temporal and spatial variability of Methane flux in a temperate forest watershed. J. Japan Soc. Hydrol. & Water Resour. 18: 244-256, 2005
- Obote, T., N. Ohte and M. Tani: Vertical profiles of gaseous and particulate matter in a Japanese Cypress Forest. J. Aerosol Res. 20 (2): 144-152, 2005

#### Reports

- Kosugi, Y., S. Takanashi, M.Tani, N. Matsuo, T. Mitani and Abdul Rahim N.: Estimates of carbon and water exchanges of a tropical rain frest at Pasoh in Peninsular Malaysia. Sidle, R.C., M.Tani, Abdul Rahim Nik and Tewodros Ayele Taddese (eds.): Forests and Water in Warm, Humid Asia, Proceedings of a IUFRO Foresr Hydrology Workshop, p. 27-30, Kyoto University, Kyoto, 2005
- Matsuo, N., Y. Kosugi, N. Ohte, M. Tani: Temporal and spatial variation in water-use efficiency of Broad-Leaved Trees Based on Stable Carbon Isotope Analysis. ibid. p.35-36, Kyoto University, Kyoto, 2005
- Katsuyama, M., N. Ohte: Intercomparison of the streamwater hydrochemistry in weathered granite catchments -mixing model approach. ibid. p.145-147, Kyoto University, Kyoto, 2005
- Ohte, N., D. Sebestyen, C. Kendall, J.B. Shanley, S.D.Wankel and D.H. Doctor: Nitrogen Isotopes as indicators of streamflow generation processes in a headwater forested catchment: focusing on atmospheric NO<sub>3</sub><sup>-</sup> contribution using δ<sup>18</sup>O signature. ibid. p.148-153, Kyoto University, Kyoto, 2005
- Tani, M: Properties on storm runoff responses in mountainous catchments. ibid. p.267-270, Kyoto University, Kyoto, 2005

b) Conference and seminar papers presented

The 115th Annual Meeting of Japanese Forestry Society: 12 topics. The Annual Meeting of Japan Society of Hydrology and Water Resources: 2 topic. The 51th Annual Meeting of Japanese Ecological Society: 3 topics. The 68th Annual Meeting of Japan Society of Limnology: 3 topics. 2002. Western Pacific Geophysics Meeting Honolulu 2004:3件、The fall meeting of AGU: 4 topics, Forest Hydrology Workshop, "Forests and Water in Warm Humid Asia": 5 topics

### A-3. Off-campus activities

### Membership in academic societies (roles)

Ohte.: Japan Society of Hydrology and Water Resources (Member of Editorial Review Board), and Journal of Forest Research (Member of Editorial Review Board), Kosugi: Japan Society of Revegetation Technology (Secretary of Editorial Review Board), and Asia Flux Network (Member of News Letter Editorial Board).

### Membership in Science Council of Japan, etc.

Tani Member of Hydrological Sciences in Science Council of Japan. Chairman of Eco-hydrology Sub-Committee in Science Council Japan. Ohte.: Member of GWSP (Global water System Project) Sub-committee in Science Council of Japan. Member of Eco-hydrology Sub-Committee in Science Council Japan.

### Research grants

- Grant-in Aid for Scientific Research (A)1 Micrometeorological and ecological analyses on interactions between carbon, water and energy fluxes in various kinds of terrestrial ecosystems. (Tani and Kosugi, members). CREST R&D Hydrological Modeling and Water Resources System (Tani).
- Global Environment Research Fund (Ministry of the Environment) Integrated Study for Terrestrial Carbon Management of Asia in the 21st Century Based on Scientific

Advancements: Carbon balance in temparate forest ecosystems (Tani, Ohte and Kosugi, members) and Carbon balance in tropical forest ecosystems (Tani and Kosugi, members). CREST R&D Hydrological Modeling and Water Resources System (Tani)

# A-4. International cooperation and overseas activities

### International Meetings (roles)

Tani: Co-chair of IUFRO Forest Hydrology Working Group. IUFRO Forest Hydrology Workshop, "Forests and Water in Warm Humid Asia" (Co-convener and presentation). Ohte, Kosugi and Matsuo: IUFRO Forest Hydrology Workshop, "Forests and Water in Warm Humid Asia" (presentation). Ohte : Speaker Western Pacific of Geophysics Meeting Honolulu 2004 (Presentation), and the fall meeting of AGU (presentation).

### International joint researches, overseas research surveys

Tani and Kosugi: Investigation on carbon balance in tropical rainforest (Malaysia).

# B. Educational Activities (2004.4-2005.3)

# B-1. On-campus teaching

a) Courses given

## Undergraduate level

Basic Science for Forest and Biomaterials 3 (Tani), Forest and Biomaterials Sceince 3 (Ohte),
Forest Hydrology (Tani), Interaction of Forest and Environment (Ohte), Laboratory
Course in Forest and Biomaterials Sceince 3 (Tani, Ohte), Laboratory Course in Physics
of Forest and Biomaterials (Ohte, Kosugi), Laboratory Course in Forest Hydrology and
Erosion Control (Ohte, Kosugi), Practice in University Forest 2 (Ohte, Kosugi).

# Graduate level

Forest Environmental Physics (Ohte), Seminar of Forest Hydrology (Tani, Ohte), Special Laboratory Work in Forest Hydrology (Tani, Ohte).

# B-2. Off-campus teaching, etc.

### Part-time lecturer

Tani: Faculty of Agriculture of Kyoto Prefectural University. Ohte: Graduate School of Life and Environmental Sciences, University of Tsukuba.

# 2.5.4 Laboratory of Forest Biochemistry

Staff Professor : Azuma, Jun-ichi, D. Agric. Sci. Assistant Professor : Sakamoto, Masahiro, D. Agric. Sci.

Students and research fellows

Doctor's program : (2) Master's program : (4) Undergraduate : (4) JSPS Researcher : (1)

### A. Research Activities (2004.4-2005.3)

#### A-1. Main subjects

a) Biosynthsis and improvement of plant biomass constituents (Sakamoto)

Characterization of biosynthetic mechanism of biomass constituents is a key step for their better use. In this theme, biochemical and molecular biological approach is carried out for characterization of photosynthetic products and secondary metabolites in woody and monocotyledonous plants. In addition, enzymic approach is carried out to give information about biosynthesis of cell-wall polysaccharides/glycoconjugates and elongation growth of monocot. For improvement of biomass production, a system of chloroplast DNA from bamboo and cotton, the very important non-woody biomass-plants, is also investigated.

b) Structure and function relationships of biomass constituents and their biodegradation mechanism (Azuma)

Carbohydrates, which comprise more than 70% weight of cell-walls of higher plants, not only play various physiological functions but also are important for recycling of C on the earth. In this theme, characterization of interactions between cellulose and hemicellulose in the helical fibrous network of plant cell-wall was carried out to find out ways to produce biodegradable artificial woody materials and improve the physical properties of lignocelluloses. In addition, because of importance of cellulolytic enzymes in the ecosystem, biodegradation mechanisms of cellulose by termite-protozoa and termite-fungi symbiotic systems are also investigated.

c) Recycling of biomass and zero-emission (Azuma, Sakamoto)

Biomass plays a key role in recycling of organic matters on earth. Therefore, the behaviors of environmental aspects of biomass in ecosystem are very important problems. The object of this study is to develop new technologies which make recycling of biomass possible and lead to attaining zero-emission.

In addition, microwave energy is used to develop comprehensive method for utilization of diverse woody, agricultural and food-waste biomass materials. Hydrothermal effects of microwave on diverse biomass materials are mainly studied under high temperature and high pressure as well as low temperature and low pressure.

### A-2. Publications and presentations

### a) Publications

### Books and reviews

- Azuma, J., Shiro Saka : New degradation methods for cellulose, Cellulose Commun., 11, 140-147(2004)
- Azuma, J.: Gellous Puyo-Puyo Celluloses, Reports of Seminar for Staffs of Technical Supports in Schoolof Agricultural Science, Kyoto University, 7、6-19 (2004)
- Azuma, J. : High performance recycling use of waste biomass by Microwave Energy, 223-255, Financial Support System of Technology of Wakayama, The Industrial Technology Center of Wakayama Prefecture (WINTEC), and Congress of Development of Industrial Technology, 2004.

#### Original papers

- Fujimura, C., J. Azuma, and M. Sakamoto: The study on the diversity of the gene for beta subunit of mitochondrial ATPase from bamboos. Bamboo Journal, 21, 1-7 (2004)
- Takahata, K., M. Takeuchi, M. Fujita, J. Azuma, H. Kamada and F. Sato, Isolation of putative glycoprotein gene from early somatic embryo of carrot and its possible involvement in somatic embryo development, Plant Cell Physiol., 45(11), 1658-1668 (2004)
- L. Indrarti, J. Amuma, M. Sakamoto and R. Yudianti, Characterization and Properties of Cellulose Hydrogel from Various Kinds of Basil Plants in Indonesia, Proc. The Fifth Intern. Wood Sci. Symp, 193-198 (2004).
- R. Yudianti, L. Indrarti, M. Sakamoto and J. Amuma, Morphological Properties of Seed Coat of Salvia spp., Proc. The Fifth Intern. Wood Sci. Symp, 199-204 (2004).
- J. Azuma, Y. Sakata and M. Sakamoto, Viscous Polysaccharide Present in the Leaves of Mangroves, *Proc. The Fifth Intern. Wood Sci. Symp*, 205-209 (2004)
- b) Conference and seminar papers presented
- 54th Annual Meeting of the Japan Wood Research Society (7 papers in Japanese): (Azuma, J. et al.; Sakamoto, M. et al.)
- The 2004 Annual Meeting of the Japan Society for Bioscience, Biotechnology, and Agrochemistry (1 paper in Japanese) : (Azuma, J., Sakamoto, M. et al.)
- 1st IUPAC International Conference on Bio-based Polymers (ICBP2003): (1 paper in English) (Azuma, J., Sakamoto, M. et al.)
- Annual Meeting of the Japanese Society of Molecular Biology (1 paper in Japanese) : (Sakamoto, M. et al.)
- 51st Annual Meeting of the Japan Society for Food Science & Technology (1 paper in Japanese): (Azuma, J. et al.)

### A-3. Off-campus activities

#### Membership in academic societies (roles)

Jun-ichi Azuma: The Japan Society for bioscience, Biotechnology, and Agrochemistry (Councilor of the Kansai Branch),

Jun-ichi Azuma: Councilor of NPO 'Society of Maintenance of Earth Environment by Recycling'. Masahiro Sakamoto: The Japan Wood Research Society (editorial committee)

#### Research grants

- Monbusho Research Grant: Cooperative Research (B)(2) Reguration of High Sinc Function System of Bamboo (Main, Masahiko Sakamoto, cooperative, Jun-ichi Azuma)
- Monbusho Research Grant: Cooprative Research (Sprouting Research), (Main, Jun-ichi Azuma, cooperative, Masahiko Sakamoto)
- Kankyosho Research Grant : Recycling of Wasted Marine Products (Main, Jun-ichi Azuma, cooperative, Masahiko Sakamoto and others)
- Cooperative Research Grant between University and Others:
- Developmental research on high-performance utilization of waste materials by using Microwave Energy, Wakayama Technical Cluster Research, 2003 (cooperative, Jun-ichi Azuma).
- Innovation Project for Recycling of Marin Products in Heisei 15, Marine Products Systems Association, Ministry of Environment of Japan, 2004 (cooperative, Jun-ichi Azuma).
- Brand Nippon Project: Recycling of Anthocyanins Present in Waste Water, a Byproduct for production of Shiso Pickles, Ministry of Agriculture, Forestry and Fishereies of Japan, 2004 (cooperative, Jun-ichi Azuma).

### A-4. International cooperations and overseas activities

#### International meetings (roles)

- Jun-ichi Azuma: Preparation and properties of cellulosic hydrocolloids : (JSPS Core University Program, Indonesia) September 6-24, 2004 (Indonesia): Inivitation for Rike Yudianti, a young researcher in LIPI.
- Jun-ichi Azuma: Search and utilization of cellulosic hydrocolloids : (JSPS Core University Program, Indonesia) February 20 - March 30, 2004 (Indonesia): Inivitation for Lucia Indrarti, a senior researcher in LIPI.
- Masahiro Sakamoto: Search and utilization of cellulosic hydrocolloids : (JSPS Core University Program, Indonesia) March 7-14, 2004 (Indonesia).

# B. Educational Activities (2004.4-2005.3)

# B-1. On-campus teaching

- a) Courses given
- Undergraduate level: Laboratory course in the basic forest and biomaterials chemistry, (Jun-ichi Azuma, Masahiko Sakamoto), Laboratory course in the biomaterials chemistry I (Jun-ichi Azuma, Masahiro Sakamoto), Laboratory course in the biomaterials science II (Masahiro Sakamoto), Basic Science for Forestry II (Jun-ichi Azuma), Forest biochemistry I (Jun-ichi Azuma, Masahiro Sakamoto), Forest biochemistry II (Masahiro Sakamoto, Jun-ichi Azuma), Seminar in forest and biomaterials science (Jun-ichi Azuma, Masahiko Sakamoto), Forest analytical science (Jun-ichi Azuma)
- Graduate level: Laboratory Course in Forest Biochemistry (Jun-ichi Azuma, Masahiko Sakamoto), Seminars in Forest Biochemistry (Jun-ichi Azuma, Masahiko Sakamoto), Special lecture on Plant Biomass (Masahiko Sakamoto)

## C. Other remarks

### Micellaneous-University level

- Jun-ichi Azuma: Member of Committee of University Students, Kyoto University, Member of Committee of Safe Committee for Radioisotopes and Radiation, Kyoto University Radioisotopes and Radiation
- Jun-ichi Azuma: Member of Committee of Chemistry for University Students, Kyoto University, Member of Committee for Education System of Chemistry of Kyoto University

#### -Faculty level

Jun-ichi Azuma: Member of Safeguard Committee of Faculty of Agriculture for Radioisotopes and Radiation

Masahiko Sakamoto: Member of Transaction of Inorganic Waist Liquor.

# Chair of Agro-ecosystem Science

# 2.5.5 Laboratory of Tropical Agriculture

Staff Professor : Sakuratani, Tetsuo, D. Agric. Sci Associate Professor: Nawata, Eiji, D. Agric. Sci.

Assistant Professor : Higuchi, Hirokazu, D. Agric. Sci.

Students and research fellows

Doctor's program : (9) Master's program : (11) Undergraduates : (3) Research fellow : (1) Reserch students : (1)

# A. Research Activities (2004.4-2005.3)

### A-1. Main subjects

a) Water dynamics in soil-plant-atmosphere continuum

In order to examine the effects of hydraulic lift by trees on crop growth under field conditions, experiments were conducted using mango - groundnut mixed cropping system at a Khon Kaen University experimental farm in Northeast Thailand. Two plots were used: one was natural and another control in which upper lateral roots of mango trees were cut off at the basal part of each root. Sap flow in the lateral roots of mango and dry matter production of groundnut were monitored. There was no significant difference in the dry matter production of the groundnut plants between both plots, though hydraulic lift was observed in the lateral roots of the trees. The results suggested that water competition between the mango trees and the crop plants was offset by hydraulic lift of the tree.

 b) Bio-resources, farming and cropping systems, and sustainability in Mainland Southeast Asia In La Distict, Oudomxai Province, North Laos, the effects of reduced fallow period on fallow

## C. Other remarks

### Micellaneous-University level

- Jun-ichi Azuma: Member of Committee of University Students, Kyoto University, Member of Committee of Safe Committee for Radioisotopes and Radiation, Kyoto University Radioisotopes and Radiation
- Jun-ichi Azuma: Member of Committee of Chemistry for University Students, Kyoto University, Member of Committee for Education System of Chemistry of Kyoto University

#### -Faculty level

Jun-ichi Azuma: Member of Safeguard Committee of Faculty of Agriculture for Radioisotopes and Radiation

Masahiko Sakamoto: Member of Transaction of Inorganic Waist Liquor.

# Chair of Agro-ecosystem Science

# 2.5.5 Laboratory of Tropical Agriculture

Staff Professor : Sakuratani, Tetsuo, D. Agric. Sci Associate Professor: Nawata, Eiji, D. Agric. Sci.

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Students and research fellows

Doctor's program : (9) Master's program : (11) Undergraduates : (3) Research fellow : (1) Reserch students : (1)

# A. Research Activities (2004.4-2005.3)

### A-1. Main subjects

a) Water dynamics in soil-plant-atmosphere continuum

In order to examine the effects of hydraulic lift by trees on crop growth under field conditions, experiments were conducted using mango - groundnut mixed cropping system at a Khon Kaen University experimental farm in Northeast Thailand. Two plots were used: one was natural and another control in which upper lateral roots of mango trees were cut off at the basal part of each root. Sap flow in the lateral roots of mango and dry matter production of groundnut were monitored. There was no significant difference in the dry matter production of the groundnut plants between both plots, though hydraulic lift was observed in the lateral roots of the trees. The results suggested that water competition between the mango trees and the crop plants was offset by hydraulic lift of the tree.

 b) Bio-resources, farming and cropping systems, and sustainability in Mainland Southeast Asia In La Distict, Oudomxai Province, North Laos, the effects of reduced fallow period on fallow vegetation were continuously analyzed in a village of Khamu, living in middle high land. An appropriate method to estimate biomass of bamboos, which rapidly increase in fallow vegetation of shifting cultivation fields in this area. In Namo Disctrict, Oudomxai Province, land use of Pak watershed was analyzed. Changes in land use for these several decades were clarified using various remote sensing data and field surveys. In Khuchinarai District, Karasin Province, Northeast Thailand, the utilization of plant resources was compared between Phuthai, one of ethnic minorities, and Lao, ethnic majority in this area. It is clarified that plant species utilized in home gardens in this area are comparable to those observed in other areas in the tropics, and that there were not clear differences between different ethnicities on plant utilization.

c) Evaluation of agricultural resources and sustainability in upland crop areas, developed on a large scale, in the tropics

In Central Thailand, where large-scale agricultural development occurred after the middle of 20th century, studies on the diversity of farming and cropping systems were carried out. Both farming and cropping systems were diversified mostly under mildly favorable climatic and soil conditions. In addition, maize productivity in Northeast Thailand was mapped after quantitative evaluation of the damages caused by water and heat stress based on a glasshouse experiment.

### d) Distribution and dissemination of tropical crops

Germination characteristics of indigenous varieties in Seinan Islands were studied. The varieties in this area showed light and poikilothermal requirement for seed germination to some extent, suggesting a possibility that these varieties are not fully domesticated.

#### e) Photosynthetic characteristics of mango leaves

To understand the mechanism of drought tolerance of mango tree and to elucidate the characteristics of leaf gas exchanges, a series of experiments were conducted. The mango leaves had an osmotic adjustment mechanism that leaf water content is sustained under dry atmospheric condition. Leaf photosynthesis was higher for young leaves with the age of several months, while it was lower for old leaves with the age of several years, which was considered to be attributable to the difference of chlorophyll content and Rubisco content.

f) Mountainous agriculture in tropics –A case studies in Mbozi and Ulubguru District in Tanzania

In Tanzania, where the most country was under hot and dry climate conditions, the mountainous areas are known to be suitable for agriculture. In the mountainous areas in Mbozi and Uluguru Districts, the agro-ecological survey was conducted. In the Mbozi area, seasonal swamps were utilized for traditional slash and burn finger millet cultivation and newly introduced paddy cropping. The transition of the land utilization in the seasonal swamps told of the agricultural changes in this region. In the Ulurugu area, the homegarden that consisted of various herbaceous and tree crops developed at every homestead, while a large diversity in crops and cultivation patterns were observed at different homegardens.

#### g) Flower visitors to cherimoya, Annona cherimola in Japan

Fauna of Annona flower, the tropical fruit crops cultivated in south-eastern Japan and Okinawa, was studied. The most abundant species was *Cortinicara gibbosa* (Lathridiidae) and the secondary abundant one was a species of the genus *Phloeonomus* (Staphylinidae). *Mimemodes monstrosus* (Rhizophagidae), *Carpophilus marginellus* and *Haptoncus ocularis* (Nitidulidae) were also common. Among these, *Cortinicara gibbosa* and *Carpophilus marginellus* are thought to be

favorable. Most of these beetles have not been reported in tropics as likely pollinators, indicating that new relationships have established between Annona trees, new trees, and indigenous beetles in Japan.

### A-2. Publications and presentations

a) Publications

#### Books and reviews

- Sakuratani, T.: 39 Meteorological disasters (Drought), New Encyclopedia of Agronomy (edited by Yamazaki et al.), pp.1336-1340, Yokendo, Tokyo, 2004 (in Japanese)
- SUA Centre for Sustainable Rural Development (SCSRD): SUA Method -Concept and Case Studies- (pp. 181). Sokoine University of Agriculture, Morogoro, 2004
- F. Rwezimula, B.J. Nkonoki, A. Lubida, J. Ikeno, H. Yasu, M. Takeishi, H. Higuchi, K. Mizuno, A.J.O. Tarimo, A.Z. Matee, and U. Tanaka: The SUA Method: Case Study from the Uluguru Mountains In: Perspectives and Approaches for Sustainable Rural Development in Africa (eds. D.F. Rutatora, A.J.P. Tarimo, A.Z. Matee, E.J. Mtengeti). pp. 358-385, Sokoine University of Africulture Centre for Sustainable Rural Development (SCSRD), Tanzania, 2004

### Original papers

- Watanabe, K., T. Yamamoto, T. Yamada, T. Sakuratani, E. Nawata, C. Noichana, A. Sributta, and H. Higuchi: Changes in seasonal evapotranspiration, soil water content, and crop coefficients in sugarcane, cassava, and maize fields in Northeast Thailand. Agricultural Water Management 67; 133-143, 2004
- Yamamoto, S., H. Inoue, Y. Yonemoto, H. Higuchi and E. Nawata : Isozyme analysis of dragonfruit in Okinawa. Japanese J. Trop Agric. 48; 115-119, 2004 (in Japanese)
- Tsukada M., A. G. Kirejtshuk, H. Higuchi and T. Furukawa: *Epuraea kaszabi* Kirejtshuk, a little-known Nitidulid beetle newly recorded in Japan. Elytra 32; 403-404, 2004
- Rahman, S. M. L., Mackay, W. A., Nawata, E. and T. Sakuratani: Superoxide dismutase and stress tolerance of four tomato cultivars. HortSci. 38; 983-986, 2004
- Sonoe, M., S. Yamamoto and E. Nawata : Analysis of variations in several grain and ecological characteristics among cultivated rice varieties in Northern Laos. Japanese J. Trop Agric. 48; 181-193, 2004 (in Japanese)
- Yamamoto, T., E. Nawata, K. Watanabe, A. Sributta, C. Noichana and T. Sakuratani: Simple models of cassava attainable yield estimation for regional-level productivity analysis in Northeast Thailand. Japanese J. Trop Agric. 48; 166-172, 2004
- Yamamoto S. and E. Nawata: Morphological characters and numerical taxonomic study of *Capsicum frutescens* in Southeast and East Asia. Tropics 14; 111-121, 2004
- Nawata, E., Y. Nagata, Y. Kono, K. Iwama, T. Yamamoto, K. Watanabe, S. Tomita, A. Sributta, C. Noichana, and T. Sakuratani: Mapping cassava productivity by GIS in Northeast Thailand. Japanese J. Trop Agric. 48; 211-219, 2004
- Nawata E., Y. Nagata, A. Sasaki, K. Iwama and T. Sakuratani: Mapping of climatic data in Northeast Thailand: Temperature and solar radiation. Tropics 15; 179-190, 2005
- Nawata E., Y. Nagata, A. Sasaki, K. Iwama and T. Sakuratani: Mapping of climatic data in Northeast Thailand: Rainfall. Tropics 15; 191-201, 2005
- Yamamoto S. and E. Nawata: Capsicum frutescens L. in Southeast and East Asia, and its

dispersal routes into Japan. Economic Bot. 59; 18-25, 2005

b) Conference and seminar papers presented

95th meeting, Japan. Soc. Trop. Agric. (6)

96th meeting, Japan. Soc. Trop. Agric. (2)

48th meeting, Japan. Soc. Appl. Ento. Zool. (1)

41th meeting, Japan. Soc. African Studies (1)

2004 annual meeting, The Chugoku-Shikoku-Kinki Chapter of Soc. Agric. Meteor. Japan (1)

#### A-3. Off-campus activities

### Membership in academic societies

- Sakuratani, T.: The Society of Agricultural Meteorology of Japan (Awards committee member), The Kinki Chapter of the Society of Agricultural Meteorology of Japan (Regional director), Japanese Society for Tropical Agriculture (Board member).
- Nawata, E.: Japanese Society for Tropical Agriculture (Board member, Editorial board member, Secretary for public relations).

#### Research grants

JSPS Research Grant: Research (A); Evaluation of agricultural resources and sustainability in upland crop areas, developed on a large scale, in the tropics (leader Nawata, collaborator Sakuratani, Higuchi), JSPS Research Grant: Research (B); Ecological study on reducing crop environmental stress under agroforestry system (leader Sakuratani, collaborator Nawata, Higuchi) and JSPS Research Grant: Research (B); Inter-regional comparison of ecological resources management, based on the construction of integrated database in Southeast Asia (leader Kono, Center for Southeast Asian Studies, coolaborator Nawata)

Else:

# A-4. International cooperation and overseas activities

### International meetings (roles)

- Nawata, E.: International Society of Food, Agriculture and Enivironment (Editorial board member)
- Nawata, E.: International Workshop "Multi-scale governance of forests, village and water in the upper Ping River Basin, Northem Thailand" (Chiang Mai, Thailand, Chairperson)

### International joint researches, overseas research surveys

- Sakuratani, T.: Water balance of field crops in Northeast Thailand (Thailand, Khon Kaen University),
- Nawata, E.: Evaluation of agricultural resources and sustainability in upland crop areas, developed on a large scale, in the tropics (Thailand, Kasetsart and Khon Kaen Universities), Evaluation of vegetation resilience in shifting cultivation in northern Laos (Laos, National Lao University), and Utilization of bio-resources in home gardens in Phuthai people in Northeast Thailand and Laos (Thailand, Khon Kaen University and Laos, National Agriculture and Forestry Research Institute)
- Higuchi, H.: Sustainable water use by mango tree in tropical semi-arid area (Thailand, Khon kaen University), The Integrated Research on African Way of Rural Development based on Area Studies; Towards the Endogenous Development through the Thoroughly Understanding of the Reality of the Areas and the Appreciating a New Value of the

Indigenousness -

# B. Education Activities (2004.4-2005.3)

# B-1. On-campus teaching

a) courses given

- Undergraduate level: Outline of Bioresource Science IV (Sakuratani, Nawata), Resource, Environment and Technology Factors and World Rice and Food Production (Nawata), Introduction to Tropical Agriculture (Sakuratani, Nawata), Environmental Stresses for plants (Nawata, Sakuratani), Laboratory Course in Bioresource Science I • II (Nawata, Higuchi), Seminar in Tropical Agriculture (Sakuratani, Nawata)
- Graduate level: Seminar in Tropical Agronomy (Sakuratani, Nawata), Special Laboratory Work in Tropical Agronomy (Sakuratani, Nawata)

# B-2. Off-campus teaching

# Part-time lecturer

Sakuratani, T.: Faculty of Agriculture, Gifu University Sakuratani, T.: Faculty of Agriculture, Iwate University Nawata, E.: Faculty of Bio-Resource Science, Shimane University

# B-3. Overseas teaching

Students and research fellows from abroad Foreign research fellow: Foreign research student 1 (Thailand)

# 2.5.6 Laboratory of Soil Science

Staff Professor : Kosaki, Takashi, Dr. Agric. Sci. Associate Professor: Funakawa, Shinya, Dr. Agric. Sci. Assistant Professor : Yanai, Junta, Dr. Agric. Sci. Assistant Professor : Shinjo, Hitoshi, Dr. Agric. Sci. Students and research fellows Doctor's program : (10)

Master's program : (10) Undergraduate : (4) Research student : (2)

# A. Research Activities (2004.4-2005.3)

### A-1. Main subjects

a) Soil characterization, development of the soil management and environment conservation in the tropics and arid regions:

The laboratory of soil science widely concerns soil management strategies for sustainable use and conservation of environment in the tropics and the arid regions. In Central Asia (Kazakhstan, Ukraine, Hungary), researches on soil degradation due to continuous cereal cropping in the steppe region were conducted. In Southeast Asia (Thailand and Indonesia), soil processes under traditional shifting cultivation systems were investigated with special reference to soil organic matter dynamics and the agro-ecological degradation due to excessive land use under increasing population pressure was also analyzed to establish a sustainable land use system there. In Africa (Burkina Faso, Tanzania), human-environment relationship was investigated through the research on the response of soils to the soil management practices under conventional farming systems by small-scale farmers.

b) Dynamic pedology on the soil acidification processes:

The acid-buffering and/or storing capacity of the amorphous sesquioxides in the course of pedogenetic acidification of soils derived from several parent materials were studied in the cool and warm temperate forests in Japan and in the tropical forests in Southeast Asia. Conditions for formation and weathering of expandable 2:1 type soil clay minerals in leaching environments were investigated and electro microscopic investigation were carried out for examining the response of soils in Japan and Tropical Asia to addition of acids.

c) Studies on the remediation of polluted soils:

With expansion of human activities, soil pollution with heavy metals such as Cd has been one of the serious problems, and establishment of the method to remediate polluted soils is urgently required. In this study, the dynamics of <sup>137</sup>Cs were investigated based on the kinetic study on adsorption/desorption experiments. Research on the phytoremediation of Cd contaminated soils with the hyperaccumulator plant was also carried out.

d) Studies on the mechanisms of nitrate leaching:

Excessive application of chemical fertilizers and manures has caused nitrate leaching, which would lead to the groundwater pollution. To elucidate the mechanisms of nitrate leaching, the nitrate adsorption capacity was investigated in eastern Hokkaido, including the experimental forest of Kyoto University.

### A-2. Publications and presentations

a) Publications

#### **Books**

- Shinjo, H. and T. Kosaki: Chapter 3 Carbon cycle and soil organic matter in forest ecosystems, Pedosphere and Global Warming (edited by Kimura et al.), pp. 51-70, Nagoya University Press, Nagoya, 2005 (in Japanese)
- Shinjo, H. and T. Kosaki: Chapter 4 Seasonal variation in soil respiration and carbon budget in some Japanese forests, Pedosphere and Global Warming (edited by Kimura et al.), pp. 71-82, Nagoya University Press, Nagoya, 2005 (in Japanese)

#### **Original** papers

- Moritsuka, N., J. Yanai, K. Mori and T. Kosaki: Biotic and abioitc processes of nitrogen immobilization in the soil-reisdue interface. Soil Biology and Biochemistry 36; 1141-1148, 2004
- Sano, S., J. Yanai and T. Kosaki: Evaluation of soil nitrogen status in Japanese agricultural lands with reference to land use and soil types. Soil Science and Plant Nutrition 50; 501-510, 2004
- Funakawa, S., I. Nakamura, K. Akshalov and T. Kosaki: Soil organic matter dynamics under grain farming in northern Kazakhstan. Soil Science and Plant Nutrition 50; 1211-1218, 2004
- Funakawa, S., I. Nakamura, K. Akshalov and T. Kosaki: Water dynamics in soil-plant systems under grain farming in northern Kazakhstan. Soil Science and Plant Nutrition 50; 1219-1227, 2004
- Karbozova-Salinikov, E., S. Funakawa. K. Akhmetov and T. Kosaki: Soil organic matter status of Chernozem soil in north Kazakhstan: effects of summer fallow. Soil Biology and Biochemistry 36; 1373-1381, 2004
- Moritsuka, N., J. Yanai and T. Kosaki: Possible processes releasing nonexchangeable potassium from the rhizosphere of maize. Plant and Soil 258; 261-268, 2004
- Yanai, J., N. Mabuchi, N. Moritsuka, and T. Kosaki: Distribution and forms of cadmium in the rhizosphere of *Brassica juncea* in Cd contaminated soils and implications for phytoremediation. Soil Science and Plant Nutrition 50; 423-430, 2004
- Moritsuka, N., J. Yanai, M. Umeda and T. Kosaki: Spatial relationships among different forms of soil nutrients in a paddy field. Soil Science and Plant Nutrition 50; 565-573, 2004

### Reports

- Kosaki, T. and H. Shinjo: Mapping risk of groundwater pollution with nitrate An example of dairy farmig area in east Hokkaido –, Report for Nissay Foundation, 2005
- b) Conference and seminar papers presented
- Annual meeting of Japanese Society of Soil Science and Plant Nutrition (Fukuoka, 2004. 9.14-9.16): 14 papers
- Regional meeting of Japanese Society of Soil Science and Plant Nutrition (Kyoto, 2004.12.3): 2 papers
- The 6th International Symposium on Plant-Soil Interactions at Low pH: 2 papers

### A-3. Off-campus activities

### Memberships in academic societies (roles)

Kosaki, T.: Japanese Society of Soil Science and Plant Nutrition (council member), Japanese Society of Pedology (council member, Head of editorial committee)

Funakawa, S.: Japanese Society of Pedology (Editorial committee member)

Yanai, J.: Japanese Society of Pedology (Editorial committee member)

Shinjo, H.: Japanese Society of Pedology (Editorial committee member)

### Research grants

Monbusho Research Grant:

- Grant-in-Aid for Scientific Research (A)2, Evaluation of agricultural resources and sustainability in the tropical upland fields under the large-scale development (Funakawa, member). Grant-in-Aid for Scientific Research (A)2, Development of the technology for sensing the yield controlling factors, and the fertilization system at the variable rate in fields under irrigated paddy rice and upland crop rotation system (Kosaki, Yanai, member). Grant-in-Aid for Scientific Research (B)2, Proposal of optimized land use in irrigated area by large-scale salt dynamics model using geographical information – Case study in irrigated farming area in Syr Dar'ya river in southern Kazakhstan – (Funakawa, chief; Shinjo, member)
- Entrust Research Fund by Japanese International Research Center for Agricultural Sciences: Studies on the relationship between the fragility of Sahel farmers and soil degradation (Shinjo), Characterization of the natural resources in the sandy soils in the semiarid tropics of Africa (Shinjo)
- Nissay Foundation: Mapping risk of groundwater pollution with nitrate An example of dairy farmig area in east Hokkaido (Kosaki, chief; Shinjo, member)
- Sumitomo Foundation: Assessment and prediction of soil degradation processes using the archive of soil monoliths. (Kosaki, chief)
- Toyota Foundation: Self-dependent and evironmentaly harmonized rehabilitation of grain farming system in Central Asia through participatory approach. (Kosaki, member)

### A-4. International cooperation and overseas activities

#### International joint researches, overseas research surveys

- Kosaki, T.:Establishment of ecologically sustainable land use in continental temperate regions. (Argentine) Assessment and prediction of soil degradation processes using the archive of soil monoliths. (Russia) Study on extension activities of organic farming for environment conservation and efficient water use. (Jordan)
- Funakawa, S.: Study on agricultural ecosystems in tropical Asia. (Thailand, Indosesia); Study on agricultural ecosystems in East Africa. (Tanzania); Study on agricultural ecosystems in South America (Brazil)
- Yanai, J.: Study on the mechanism of soil nutrient supply in sandy Tropical soils. (Thailand)
- Shinjo, H.: Study on desertification in West Africa. (Niger); Study on desertification risk assessment by remote sensing. (France)

### Scholars from aboroad

Invited researcher: 1 person (Research Institute for Soil Science and Agricultural Chemistry of the Hingarian Academy of Sciences, Senior Researcher)

# B. Educational activities (2004.4-2005.3)

# B-1. On-campus teaching

a) Courses given

Undergraduate level: Outline of Biological and Environmental Science, Science of Biosphere-Life, Environmental Sciences A, Resource, Environment and Technology and World Food Production, Environmental Information Processing, Soil Science- Part I (Kosaki); Basic Laboratory Cousrse in Biological and Environmental Science II, Soil Science- Part II (Funakawa); Practice in University Forest III, Livestock Production Techniques and Practice, Introduction to Plant Investigations, Laboratory Course in Biological and Environmental Science IV, Seminar in Soil Science, (Kosaki, Funakawa, Yanai, Shinjo).

Graduate level: Research in Soil Science, Seminar in Soil Science (Kosaki, Funakawa, Yanai); Biogeochemistry (Funakawa)

# B-2. Off-campus teaching

- Kosaki, T.: Special lecture (Soil Analysis and Improvement, Agricultural and Rural Development with Environmental Conservation, Forage Production and Utilization Technologies, Envrionment oriented rural development in Peru) in Japan International Cooperation Agency, Special lecture in Nihon University, Special lecture (Biological production) in Tokyo University of Agriculture and Technology, Special Lecture (Studying Soil in Tamba) in Tamba Forest College, Special Lecture (What is the eco-friendly food production?) in the Symposium of Soil Diagnosis Association in Tokachi Agricultural Cooperative, Special Lecture in Ibaraki high school
- Funakawa, S.: Part-time lecture (Engineering for Ecological Environment) in Faculty of Life and Environmental Science, Simane University

# B-3. Overseas teaching

### Students and research fellows from abroad

Doctor course student: 2 (Indonesia, New Zealand)

# 2.5.7 Laboratory of Environmental Mycoscience

Staff Professor : Futai, kazuyoshi, D.Agric.Sci Associate Professor: Tanaka, Chihiro, D.Agric.Sci

Students and research fellows

Doctor's program: (8) Master's program: (7) Undergraduate : (5)

# A. Research Activities (2004.4-2005.3) A-1. Main subjects

a) Ecological Studies on the Microorganisms-mediated interactions

The causal mechanism of the Pine Wilt Disease, the most serious forest epidemic in east Asian countries, has been studied histochemically and ecophysiologically. The resistance genes and chemical responses expressed after the infection with the Pine Wilt Disease were also investigated with some progresses.

Field survey on the Pine Wilt Disease at coastal sand dune has been conducted, especially from two view points; i) how has ecto-mycorrhizal relationship between pine roots and mycorrhizal fungi been influenced by the eutrophication after forest devastation, and ii) how do the asymptomatic carrier trees play a role in epidemic spread of pine wilt disease.

To establish biological control procedures for another forest epidemic, the Japanese Oak Wilt, candidate fungi which can be antagonistic to pathogenic fungus, or to bait yeasts of the vector beetle have been examined. Candidate fungi obtained were applied to dead oaks to prevent further development of this forest epidemics. Phylogenetic relationship of several yeast isolates which were supposed to be involved in this disease were also studied.

b) Biochemical and ecological genetics on fungi

Our previous studies on the mutants of *Cochliobolus het*erostrophus showing dicarboximideand phenylpyrrole- fungicide resistance revealed that the histidine kinase (HisK) signal-transduction system is involved in their fungicidal activities. For further elucidations of their mode of actions, MAPK signal-transduction system which accepts signals from HisK system was studied. At first, the gene encoding MAPKKK (BmSSK2) was cloned.

Activations of the MAPK, homologue of the yeast HOG1, were studied in the plant pathogens *C. heterostrophus, Colletotrichum lagenarium* and *Botorytis cinerea.* The MAPK is phosphorylated under high osmotic conditions, indicating activation of the MAPK by high osmotic stress. Importantly, treatment of dicarboximides and phenylpyrroles also activates phosphorylation of the MAPK, suggesting that improper activation of the MAPK by these compounds has negative effects on fungal growth. The results strongly suggest that these compounds act as a fungicide, in part, through activation of the MAPK cascade in fungal pathogen.

To examine the herbicidal mechanism of *Exserohilum monoceras*, we have cloned a putative non-ribosomal peptide synthetase (NPRS) gene, named *EmMaa1*. *EmMaa1* mutant had reduced colonial growth on the media and host plant. However, the mutant was fully pathogenic to the host. These results suggest that *EmMaa1* plays a house-keeping role but not involved in the

pathogenesity of this fungi.

### A-2. Publications and Presentations

### a) Publications

#### Original papers

- Hasegawa, K., Futai, K., Miwa, S. and Miwa, J.: Early embryogenesis of the pinewood nematode *Bursaphelenchus xylophilus*. Develop. Growth Differ. 46; 153-161, 2004
- Hirose, D., Kikuchi, J., Kanzaki, N., and Futai, K.: Genet distribution of sporocarps and ectomycorrrhizas of *Suillus pictus* in a Japanese white pine plantation. New Phytologists 164; 527-541, 2004
- Kanzaki, N. and Futai, K.: Cylindrocorpus anoplophorae n. sp. (Nematoda: Cyrindrocorporidae) isolated from the white-spotted longicorn beetle, Anoplophora malasiana (Coleoptera: Cerambycidae). Jpn. J. Nematol. 34; 11-19, 2004
- Kojima, K., Takano, Y., Yoshimi, A., Tanaka, C., Kikuchi, T. and Okuno, T.: Fungicide activity through activation of a fungal signalling pathway. Molec. Microbiol. 53; 1785-1796, 2004
- Oda, T., Tanaka, C. and Tsuda, M.: Molecular phylogeny and biogeography of the widely distributed Amanita species, A. muscaria and A. pantherina. Mycol. Res. 108; 885-896, 2004
- Ono, M., Nishigori, C., Tanaka, C., Tanaka, S., Tsuda, M. and Miyachi, Y.: Cutaneous alternariosis in an immunocompetent patient: analysis of the internal transcribed spacer region of rDNA and *Brm2* of isolated *Alternaria alternata*. British Journal of Dermatology, 150; 773-775, 2004
- Yoshimi, A. Tsuda, M. and Tanaka C.: Cloning and characterization of the histidine kinase gene Dic1 from Cochliobolus heterostrophus that confers dicarboximide resistance and osmotic adaptation. Mol. Gen. Genom.271; 228-236, 2004
- b) Conference and seminar papers presented

The 115th Annual Meeting of the Japanese Forestry Society: 6 papers

The 12th Annual Meeting of the Japanese Nematological Society: 3 papers

The 48th Annual Meeting of the Japanese Society of Applied Zoology and Entomology: 1 paper

The Annual Meeting of the Phytopathological Society of Japan, 2004: 3 papers

The Kansai-branch meeting of the Phytopathological Society of Japan: 5 papers

### A-3. Off-campus activities

#### Memberships of Academic Societies

- Futai, K.: Japanese Society of Nematology (President), Japanese Forestry Society (member of editorial board).
- Tanaka, C.: Japanese Society of Pesticide Science (committee member of Pesticide Bioscience), The Mycological Society of Japan (Councilor, member of editorial board).

### Research grants

- Futai, K.: Grant-in-Aid for Scientific Research from the Ministry of Education, Science and Culture, Japan, Survey and Application of antagonistic fungi in controlling of a forest epidemic, Japanese Oak Wilt.
- Futai, K.: Grant-in-Aid for Scientific Research from the Ministry of Education, Science and Culture, Japan, The expression pattern of resistance genes of Japanese black pine, *Pinus*

thunbergii, infected with pinewood nematode.

Tanaka, C.: Grant-in-Aid for Scientific Research from the Ministry of Education, Science and Culture, Japan, Population-ecological studies on interactions of mushrooms and their mycovorous insects.

# A-4. International cooperation and overseas activities

## International meetings (roles)

- Futai, K.: The 15<sup>th</sup> International Conference of Plant Protection (China) (a session coordinated, 2 papers presented)
- Futai, K.: The 27<sup>th</sup> Meetings of European Society of Nematologists (Italy) (a session coordinated, 5 papers presented)

Futai, K.: Symposium on Pine Wilt Disease (Korea) (2 papers presented)

Tanaka, C.: XXIII Fungal Genetics Conference (USA) (3 papers presented)

### International joint researches, overseas research surveys

Tanaka, C.: A study on fungal flora in a tropical and monsoon South-East Asia (Malaysia).

Tanaka, C.: Biogeographical studies on mushrooms (New Zealand).

# B. Educational Activities (2004.4-2005.3)

# B-1. On-campus teaching

a) Course given

- Undergraduate level: Microbes in Ecosystem (Futai), Seminar in Environmental Microbiology (Futai, Tanaka), Laboratory course in Biological and Environmental Science III,IV (Futai, Tanaka), Outline of Bioresource Science IV (Futai), Microbiology (Futai, Tanaka), Pocket Seminar (Futai), Pesticide Science (Tanaka).
- Graduate level: Special Lecture on Environmental Mycoscience (Futai), Seminar in Environmental Mycoscience (Futai, Tanaka), Research in Environmental Mycoscience (Futai, Tanaka).

# B-2. Off-campus teaching, etc.

# Part-time lecturer

Futai, K.: Kyoto Institute of Technology (Environmental Biology), Minami Kyushu University (Conservation Biology).

# 2.5.8 Laboratory of Ecological Information

Staff Professor : Takafuji, Akio, Ph. D.

Associate Professor: Osakabe, Masahiro, Dr. Kyoto Univ. (Agric. Sci.) Assistant Professor : Yano, Shuichi, Dr. Agric. Sci.

Students and research fellows

Doctor's Program: (7)Master's Program: (3)Research Student: (1)Foreign Visiting Scientist : (1)

# A. Research Activities (2004.4-2005.3)

# A-1. Main subjects

The central research topic in this laboratory is the ecological, molecular and biochemical analysis of the interactions among plants, herbivors and predators, along with basic ecological and genetical studies of individual components comprising of these systems.

a) Inter- and intra-specific variations in the ecological performance of spider mites

Phytophagous mites of the family Tetranychidae occur in a variety of environments, while their adaptive traits such as diapause, dispersal and host plant range vary within species and between them. We have studied experimentally and theoretically, the genetic basis of this variation, and the ecological factors responsible for and the significance of the variation.

b) Management of spider mites in orchards

We have compared the abundance of spider mite populations in pear and persimmon orchards that have different cultural and control programs, and determined the artificial factors responsible for outbreaks of the mites. Based on this survey, we proposed strategies for controlling the mites, including the use of natural enemies, such as phytoseiid mites, and the development of new cultural management techniques.

c) Ethological interactive studies of spider mites and their predators

In general, herbivors and their predators are connected with diffuse food webs. Moreover, members within a trophic level also interact through inter-specific competition and/or intra-guild predation. We have investigated direct and indirect consequences of these interactions on the population dynamics of herbivors.

d) Evolutionary ecology of plant-herbivore interactions

Diverse interactions between plants and herbivors are maintained by the balance between herbivore defense of plants and counter adaptation by herbivors. From this viewpoint, we have examined the reason why host ranges of phytophagous insects and mites are generally restricted to the small fraction of the plants available to them. We also investigated proximate factors responsible for the interactions such as secondary metabolites of host plants.

e) Meta-population structure and maintenance of genetic variation in spider mites

Neutral mutations are frequently lost or fixed by genetic drift within a finite population. Nevertheless, genetic variations in pesticide susceptibilities are maintained in a selection free, wild population of spider mites. Such variations may be maintained by the meta-population structure of spider mites. We have analyzed the structure using molecular markers such as DNA polymorphism, and discussed the maintenance mechanism of the genetic variations.

### A-2. Publications and Presentations

### a) Publications

### Original papers

- Hinomoto, N. and A. Takafuji: Evaluation of mitochondrial cytochrome oxidase subunit I sequences in *Tetranychus kanzawai* Kishida (Acari: Tetranychidae) for phylogeographic studies. Journal of the Acarological Society of Japan 13 (1); 47-55, 2004
- Kasai, A., S. Yano and A. Takafuji: Prey-predator mutualism in a tritrophic system on a camphor tree. Ecological Research 20 (2); 163-166, 2005
- Komeda, K., H. Maewgawa, M. Inoue and A. Takafuji: Evaluation of spraying adhesion state in table shaped persimmon trees with a senior simulator. Japanese Society of Farm Work Research 39 (4); 205-211, 2004 (in Japanese)
- Kotsubo, Y., K. Ohashi and A. Takafuji: Ecological performance of *Tetranychus takafujii* (Acari: Tetranychidae), a species found from Kinki district, Japan. Journal of the Acarological Society of Japan 13 (1); 71-76, 2004 (in Japanese)
- Mizutani, N., M. Osakabe, K. Honda and S. Moriya: Labor-saving technology for controling insect pests attacking soybean seeds. Farming System Research 5; 22-34, 2004 (in Japanese)
- Ohashi, K.: Food records of two rare ladybirdbeetles (Coleoptera: Coccinellidae). Entomology Review, Japan 59 (1); 131-132, 2004
- Oku, K., S. Yano and A. Takafuji: Nonlethal indirect effects of a native predatory mite, *Amblyseius womersleyi* Schicha (Acari: Phytoseiidae), on the phytophagous mite *Tetranychus kanzawai* Kishida (Acari: Tetranychidae). Journal of Ethology 22 (1); 109-112, 2004
- Santoso, S., A. Takafuji, H. Amano and A. Ozawa: Species composition of phytoseiid mites (Acari: Phytoseiidae) in tea fields with different management practices in Shizuoka Prefecture, Japan. Journal of the Acarological Society of Japan 13 (1); 77-82, 2004
- Yano, S.: Does *Tetranychus urticae* (Acari: Tetranychidae) use flying insects as vectors for phoretic dispersal. Experimental and Applied Acarology 32 (4); 243-248, 2004

#### Reviews

- Kawakami, Y. and K. Ohashi: Geographic variation of elytral spots polymorphism in the lady beetle *Cheilomenes sexmaculata* (Fabricius) and its seasonal variation in Osaka, Japan. Nature Study 50 (8); 102-104, 2004 (in Japanese)
- Kawakami, Y., K. Ohashi and N. Inahata: Marine coleopteran fauna along the coast of Harima-nada and Kii straits, central Japan with some consideration on the relationships between species composition and environmental conditions. Bulletin of the Osaka Museum of Natural History 58; 19-46, 2004 (in Japanese)
- Takafuji, A. and K. Ohashi: Spider mites recently found in Japan and their distribution. Plant Protection 58 (5); 212-215, 2004 (in Japanese)

b) Conference and seminar papers presented

XXII International Congress of Entomology : 4 papers

49th Annual Meeting of Japanese Society of Applied Entomology and Zoology: 11 papers

52th Annual Meeting of the Ecological Society of Japan : 4 papers

13th Annual Meeting of the Acarological Society of Japan : 6 papers

1st International Symposium of COE Entomomimetic Sciences : 3 papers

### A-3. Off-campus activities

#### Membership in academic societies (roles)

- Takafuji, A.: Japanese Society of Applied Entomology and Zoology (Councilor), The Acarological Society of Japan (President), The Society of Population Ecology (Editor), The Kansai Plant Protection Society
- Osakabe, M.: Japanese Society of Applied Entomology and Zoology (Councilor, Editor), The Genetics Society of Japan, Pesticide Science Society of Japan, The Society of Population Ecology, The Acarological Society of Japan (Editor)
- Yano, S.: Japanese Society of Applied Entomology and Zoology, The Society of Population Ecology, The Acarological Society of Japan, The Ecological Society of Japan

#### Research grants

- Monbu-Kagakusho Research Grant: Basic Research (B) Ecological and molecular phylogenetic analysis of the distribution expansion process of spider mites in South-east and East Asia (Takafuji, Head)
- Monbu-Kagakusho Research Grant: Encouragement of Young Scientists (B): Conformism determining the group characteristics of spider mites (Yano, Head)
- The 21<sup>st</sup> Century COE Program: Innovative food and environmental studies pioneered by entomomimetic sciences (Partial: Takafuji and Osakabe)
- Research Project funded by the Japan Ministry of Agriculture, Forestry and Fisheries: Development of new biorational techniques for sustainable agriculture (Partial: Osakabe and Yano)

#### A-4. International cooperation and overseas activities

#### International meetings (roles)

Osakabe, M.: XXII International Congress of Entomology (August 15-21, 2004, Brisbane, Australia)

Yano, S.: XXII International Congress of Entomology (August 15-21, 2004, Brisbane, Australia)

#### Membership in international academic societies

Takafuji, A.: Experimental and Applied Acarology (Chapman and Hall; Editorial board), International Congress of Acarology (Executive committee)

#### Oversea joint research surveys

Takafuji, A.: Ecological and genetic divergence of spider mites in South-east and East Asia. (Nanjing Agricultural University, China; Bogor Agricultural University, Indonesia; National Institute of Plant Protection, Vietnam; Department of Agriculture, Thailand, National Chung-Hsing University, Taiwan-China)

#### B. Educational Activities (2004.4-2005.3)

#### B-1. On-campus teaching

a) Courses given

Undergraduate level: Ecology (Takafuji), Ecological Management (Osakabe), Seminar in Ecological Management (Takafuji and Osakabe), Basic Bioresource Science II (Takafuji), Outline of Bioresourse Science IV (Osakabe), Fundamentals of the Experiments of Bioresource Science (Yano), Laboratory Course in Bioresource Science I · II (Osakabe and Yano)

Graduate level: Special Lecture in Ecological Management (Osakabe), Seminar in Ecological Information and Management (Takafuji and Osakabe), Research in Ecological Information and Management (Takafuji, Osakabe and Yano)

# B-2. Off-campus teaching

### Part-time lecturer

Takafuji, A.: Kyoto Institute of Technology (Environmental Ecology), Nagoya University (Biology of spider mites), Kyusyu University (Applied Entomology)

#### Open seminar

Yano,S.: 5th meeting of regional ecosystem joint research project (Osaka Women's University)

#### B-3. Overseas teaching

Takafuji, A.: Bogor Agricultural University (Lecture), Thailand Deaprtment of Agriculture (Seminar)

#### Research fellow from abroad

Ronpaku research fellow: 1 (Thailand)

# Chair of Environmental Development Engineering

# 2.5.9 Laboratory of Agricultural Facilities Engineering

Staff	Professor	: Aoyama Shigeyasu, Dr. Agric. Sci.	
	Associate Profe	essor: Kobayashi Akira, Dr. Eng. Sci.	
	Assistant Professor : Kiyama Shouichi, Dr. Agric. Sci.		
	Assistant Profe	essor : Yamamoto Kiyohito	

Students and research Fellows

Doctor's Program : (1) Master's Program : (10) Undergraduate : (7) Research Fellow : (1) Research Student : (1)

### A. Research Activities (2004.4-2005.3)

#### A-1. Main subjects

a) Non-destructive method for long used hydraulic facilities for irrigation

To make the strategy for the maintenance of long used hydraulic facilities for irrigation activity, non-destructive method to investigate the status of the structure is developed.

b) 3-dimensional dynamic behavior of central core type embankments

Many embankment dams for irrigation use are the central core type and the variation of the core thickness and the material stiffness ratio of core to shell zone widely ranges depending on

Bioresource Science (Yano), Laboratory Course in Bioresource Science I · II (Osakabe and Yano)

Graduate level: Special Lecture in Ecological Management (Osakabe), Seminar in Ecological Information and Management (Takafuji and Osakabe), Research in Ecological Information and Management (Takafuji, Osakabe and Yano)

# B-2. Off-campus teaching

### Part-time lecturer

Takafuji, A.: Kyoto Institute of Technology (Environmental Ecology), Nagoya University (Biology of spider mites), Kyusyu University (Applied Entomology)

#### Open seminar

Yano,S.: 5th meeting of regional ecosystem joint research project (Osaka Women's University)

#### B-3. Overseas teaching

Takafuji, A.: Bogor Agricultural University (Lecture), Thailand Deaprtment of Agriculture (Seminar)

#### Research fellow from abroad

Ronpaku research fellow: 1 (Thailand)

# Chair of Environmental Development Engineering

# 2.5.9 Laboratory of Agricultural Facilities Engineering

Staff	Professor	: Aoyama Shigeyasu, Dr. Agric. Sci.	
	Associate Profe	essor: Kobayashi Akira, Dr. Eng. Sci.	
	Assistant Professor : Kiyama Shouichi, Dr. Agric. Sci.		
	Assistant Profe	essor : Yamamoto Kiyohito	

Students and research Fellows

Doctor's Program : (1) Master's Program : (10) Undergraduate : (7) Research Fellow : (1) Research Student : (1)

### A. Research Activities (2004.4-2005.3)

#### A-1. Main subjects

a) Non-destructive method for long used hydraulic facilities for irrigation

To make the strategy for the maintenance of long used hydraulic facilities for irrigation activity, non-destructive method to investigate the status of the structure is developed.

b) 3-dimensional dynamic behavior of central core type embankments

Many embankment dams for irrigation use are the central core type and the variation of the core thickness and the material stiffness ratio of core to shell zone widely ranges depending on

the local conditions. Also the mean slope of abutment canyon varies wildly.

In this study, 3 dimensional dynamic behaviors of embankments were investigated taking account of above 3 parameters. In this year, addition to this, the effects of foundation constraint of dam body was investigated.

c) Validation of the coupled mechanical, hydraulic and thermal analysis

By applying the simulation method for the coupled mechanical, hydraulic and thermal phenomena, the numerical method is tried to be validated.

d) Mechanics of solute transport through ground sea water intrusion

To understand the environmental problem near coast area, the solute transport through the area having sea water intrusion is investigated by the 2-D tank and numerical approach.

e) Stability problems of wetted geomaterials and mechanical modeling of post-failure behavior

Proposing an elasto-plastic model to describe collapse during process of ground, develop a numerical simulator to predict the hazard.

f) Mechanical Property change in rocks and concrete due to degradation

For long use of irrigation structure, mechanical characteristics of degraded rock and concrete are investigated. Mechanical characteristics of degraded mortal are grasped using compression strength test. Analysis model of damage mechanism is examined.

g) Failure mechanism of irrigation ponds in AWAJI Island due to heavy rain

In 2004 autumn, more than 100 of irrigation ponds were destroyed and failed down due to the heavy rain. Investigating the ruins of the typical dam, collecting the available data of the pond, we will devote to clarify the failure mechanism.

#### A-2. Publications and presentations

a) Publications

## **Original Papers**

- Goda K., Kobayashi A. & Aoyama S.: Fundamental effectiveness of structural damage identification using genetic algorithm. J. Materials, Concrete Structures & Pavement, JSCE 760/V-63; 269-278,2004
- Goda K., Kobayashi A. & Aoyama S.: Structural damage identification of concrete specimen in progressive failure. J. Materials, Concrete Structures & Pavement, JSCE 760/V-73 ; 279-288, 2004
- Shen B., Stephansson O., Rinne M., Lee H-S. & Kobayashi A.: FRACOD for continuum,discontinuum and fracture modeling of rocks.EUROCK 2004 & 53<sup>rd</sup> Geomechanics Colloquium (Schubert ed. CD-ROM), 2004
- Goda K., Kosugi H., Aoyama S. & Kobayashi A.: Defect detection using impact acoustic method in concrete models. Trans. JSIDRE 230; 29-35, 2004
- Kobayashi A., Kamiya T., Inoue K. & Aoyama S.: Fundamental experiment of solute transfer in saltwater intrusion condition. Engineering Practice and Performance of Soft Deposits IS-Osaka 2004; 361-366, 2004
- Kobayashi A., Tsukada Y., Aoyama S., Kawakami S., Stephansson O. & Hee-Suk Lee : Numerical analysis of hydraulic fracturing test by fracture mechanics and continuum mechanics.Proc. of the ISRM Int. Symposium 3<sup>rd</sup> ARMS (Ohnisi & Aoki ed.); 457-462, 2004
- Yamamoto K., Kobayashi A. & Aoyama S.: Numerical analysis with damage mechanics for

degraded rocks. Proc. of the ISRM Int. Symposium 3<sup>rd</sup> ARMS (Ohnisi & Aoki ed.); 1047-1052, 2004

- Kobayashi A., Kondo S., Aono T. & Aoyama S.: Measurement of landslide by 3-Ddisplacement observation. Trans. JSIDRE 232; 27-34, 2004 (in Japanese)
- Kurikami H., Chijimatsu M., Komine H., Kobayashi A & Ohnishi Y.: Coupled thermal hydraulic and mechanical analyses to evaluate swelling characteristics. J. Geotechnical Eng. JSCE 771/III-68; 21-31, 2004 (in Japanese)
- Kobayashi A., Aono T., Yamamoto K. & Aoyama S.: Nondestructive examination method of concrete structure with electric exploration. Trans. JSIDRE 234 ; 89-96, 2004 (in Japanese)
- Kosugi H., Kobayashi A., Aoyama S & Goda K.: Application of impact acoustic method for the estimation of thickness and degraded part of concrete structure. Symposium of Geoenvironmental and Measurement techniques, Kansai branch JGS ; 9-14, 2004 (in Japanese)
- Shemsu K. A., Kiyama S., Aoyama S. & Kobayashi A.: Collapse potential and its mechanism in unsaturated granular soils. Annual Rep. of DPRI Kyoto University 47B; 161-170, 2004
- Yamamoto K., Kobayashi A. & Aoyama S. : Change in mechanical properties of mortal due to organic substance mixing. Proc. of 23<sup>rd</sup> West Japan Symposium on Rock Eng.; 99-108, 2004 (in Japanese)
- Aoyama S.: A desirable feature of our journal—from the viewpoint of editorial board. J. JSIDRE V72(4); 9-11, 2004 (in Japanese)
- Ogata H., Hattori K., Nonaka T., Natuska I. & Aoyama S.: Examination of thermal stress analysis in concrete gravity dam by block layer construction method. Trans. JSIDRE 232; 75-81, 2004 (in Japanese)

#### Reports

- Kobayashi Akira : Feasibility to apply probability method for LCC examination. Annual Meeting of Materials & Construction board of JSUIDRE 43 ; 55-60, 2004 (in Japanese)
- Aoyama Shigeyasu : Effects of foundation restriction on 3-dimensional vibration characteristics of embankment dams. Res. Rep. to the committee of Design of Embankment Dams JSIDRE ; 19-40, 2005 (in Japanese)
- Aoyama S., Kawachi T., Tanaka T. & Kimata T.: Res. Rep. on failures of irrigation ponds in AWAJI island during the attack of the typhoon 16, 2004. Res. Committee in KYOTO branch JSIDRE ; p41, 2005 (in Japanese)
- Kiyama Shoichi & Shimomura Yasusi : Sighting of KATSURA river basin "HIYOSHI". Citizen network project on environment of waterfront, Kyoto ; 19-20, 2005 (in Japanese)
- b) Conference and seminar papers presented
- H-16 National conference of JSIDRE: 8 papers
- H-16 Kyoto regional conference of JSIDRE: 4 papers
- 39th National conference of JGS: 2 papers
- H-16 National conference of JSCE: 1 paper
- The ISRM Regional Symposium EUROCK 2004 & 53rd Geomechanics Colloquium: 1 paper
- Engineering Practice and Performance of Soft Deposits, IS-Osaka 2004: 1 paper
- The ISRM International Symposium 3rd ARMS: 2 papers
- Symposium on Groundwater and Geoenvironment 2004:1 paper

Symposium on Geoenvironmental and Measurement techniques: 1 paper

10<sup>th</sup> Meeting on contamination of groundwater and soil and its countermeasure: 1 paper

Meeting on performance design method: 1 paper

Meeting of DPRI Kyoto University on interaction between void water and ground: 1 paper

Meeting of DPRI Kyoto University on recent development and application to disaster prevention

### of unsaturated soil dynamics: 1 paper

Annual Meeting of DPRI Kyoto University: 1 paper

The 23<sup>rd</sup> West Japan Symposium on Rock Mechanics: 1 paper

The 54<sup>th</sup> National Congress of Theoretical & Applied Mechanics: 1 paper

### A-3. Off-campus activities

#### Membership in academic society

- Aoyama Shigeyasu: Japanese. Soc. of Irrigation, Drainage and Reclamation Eng. (Director, Chairman of Kyoto branch, member of task committee on Dam Eng.), Japanese Geotechnical Soc., Japan Soc. of Civil Eng. (Squad leader of Kansai-branch), Japan Rainwater Catchments System Association.
- Kobayashi Akira: Japanese Society of Irrigation, Drainage and Reclamation Eng. (member of committee of long term usage of dam), Japanese Geotechnical Society (member of ATC8, member of technical committee of soil and groundwater pollution and countermeasure in Kansai branch), Japan Soc. Civil Eng. (member of committee of nondestructive inspection method of concrete), Japanese Association of Groundwater Hydrology, J. Soc. Computational Eng., Int. Soc. of Rock Mechanics, Japan Rainwater Catchments System Association.
- Kiyama Shoichi: Japanese Society of Irrigation, Drainage and Reclamation Eng. (member of Committee of education organization of agricultural engineers, Kinki branch, JSIDRE.), Japanese Geotechnical Society, Japan Soc. of Civil Eng.
- Ymamamoto Kiyohito: Japanese Society of Irrigation, Drainage and Reclamation Eng., Japanese Geotechnical Soc. (Committee member on the shearing & application of geotechnical information, Kansai branch), Japan Soc. of Civil Eng., Japanese Soc. of Experimental Mechanics.

### Research grants

Monbusyo Grants-in-Aid for Scientific Research

- (A)(2) : Soundness diagnostic of agricultural facilities and evaluation of environmental impact assessment. (Aoyama, head researcher)
- 2. (A)(2) : Optimal Design and management of small-scale irrigation schemes with rainwater harvesting (Aoyama, co-researcher and T Kawachi, head researcher)

### A-4. International cooperation and oversea activities

#### International meeting (role)

Kobayashi Akira: International meeting of ACT8. Taiwan (presentation), International symposium of engineering Practice and Performance of Soft Deposits. Osaka (presentation), The ISRM International symposium 3<sup>rd</sup> ARMS. Kyoto (presentation), DECOVLEX Workshop in China (presentation).

Aoyama Shigeyasu: Activities in Ghana by the Research Grant No.2 (Planning and design of the

micro dam), Seminar on Irrigation & Drainage in Japan in Dept. of Agricultural Engineering, Seoul National University.

# B. Educational Activities (2004.4-2005.3) B-1. On-campus teaching

a) Courses given

- Undergraduate level: Planning and Design of Rural Facilities (Aoyama), Structural Analysis (Aoyama), Seminar in Rural Facility Engineering (Aoyama and Kobayashi), Applied Mechanics (Kobayashi), Soil Mechanics and Concrete Engineering (Kobayashi), Laboratory Course in Soil Mechanics, Concrete Engineering and Environmental Geotechinique (Kobayashi), Exercise in Information Processing, Basics (Kobayashi), Introduction to Agricultural and Environmental Engineering I (Aoyama shear), Seminar in Agricultural and Environmental Engineering (Aoyama, Kobayashi shear).
- Graduate level: Planning and Design of Rural Facilities (Aoyama), Numerical Science of Structural Design (Kobayashi), Laboratory Course in Agricultural Facilities Engineering (Aoyama and Kobayashi), Advanced Course of Data Processing for Design I (Aoyama and Kobayashi), Advanced Course of Data Processing for Design II (Aoyama and Kobayashi)

## B-2. Off-campus teaching, etc.

### Part-time lecturer

Aoyama Shigeyasu: SHIGA prefectural university (Structures for Environmental Water Use), KOBE University (Special lecture for productive environment)

Kobayashi Akira: Tokyo Institute of technology (Underground environment)

### B-3. Overseas teaching

### Students from abroad

JSPS postdoctoral foreign research fellow: 1 (Ethiopia) Foreign research student: 1 (Kenya)

# C. Other Remarks

- Aoyama Shigeyasu: Member of the Council of Food, Agriculture and Rural Area, Policies., Member/Chairman of the council for engineering problems in design and construction of dams for irrigation use, Member of the council for engineering problems in design and construction of structures of agricultural use, Chairman of the committee on the preservation of facilities in YAMATO-KI'I plain projects, Chairman of the evaluation committee of national projects conducted by KINKI regional office of ministry of agriculture, forestry & fisheries, Evaluation committee member of public projects conducted by Kyoto prefectural government, Watch committee member for bids in KINKI regional office of ministry of agriculture, forestry & fisheries.
- Kobayashi Akira: Member of council for engineering problems in design and construction of dams for irrigation use, JIID, Member of committee on long use of dams for irrigation use, JSIDRE Member of the committee on cooperative research with university, Japan Nuclear Cycle Development Institute, Member of the committee on the research activity of geological disposal, Japan Nuclear Cycle Development Institute, Member of the

committee on the HLW disposal technology, Nuclear Safety Research Association, Member of the committee on the HLW disposal R&D program, Radioactive Waste Management Funding and Research Center

Kiyama Shoichi: Party organizer KATSURA river network (voluntary organization), Committee member of lake planning of HIYOSHI dam water resource region, Ministry of land, infrastructure and transport, Committee member of environmental planning of HIYOSHI dam water resource region.

# 2.5.10 Laboratory of Water Resources Engineering

Staff Professor : Kawachi, Toshihiko, Dr. Agric. Sci. Associate Professor: Unami, Koichi, Dr. Agric. Sci. Assistant Professor : Maeda, Shigeya, Dr. Agric. Sci. Assistant Professor : Takeuchi, Junichiro

Students and research fellows

Doctor's program : (3) Master's program : (8) Undergraduate : (4)

# A. Research Activities (2004.4-2005.3) A-1. Main subjects

### a) Hydraulic and environmental modeling

Numerical strategies for prediction and control of water quality affected by water resources utilization are explored standing on environmental hydraulics. Major research effort is focused on developing tough, versatile and efficient models for simulating flow and/or substance transport in a wide variety of bodies of water (water conveyance system (open channels or pipelines), rivers, embayment, lakes, etc.), with the ultimate aim of offering hydraulic engineers an integrated family of powerful computation tools that encompasses all possible water quality problems encountered.

b) Optimum management and control of water resources systems

Optimum strategies for management and control of water resources systems are fundamentally investigated to give better answers for tasks of water resources development, management and conservation. For storage systems (dam reservoirs, lakes, groundwater, etc.), reliability problems with input/output uncertainties, problems of designing robust controllers to determine the release strategy of reservoirs or optimum fertilizer application strategy in open fields using genetic algorithm, etc. are being tackled. For water conveyance systems (canals, rivers, etc.), the focus of interest is put on the way of optimally controlling discharge, water level and/or water quality in streams. Automatic management of a water resources system based on the linear control theory is also one of the major subjects.

### A-2. Publications and presentations

## a) Publications

### Original papers

- Kawachi, T. and S. Maeda: Optimal management of waste loading into a river system with nonpoint source pollutants. Proceedings of the Japan Academy, Ser. B, 80(8); 392-398, 2004
- Kawachi, T. and S. Maeda: Diagnostic appraisal of water quality and pollution control realities in Yasu River using GIS-aided epsilon robust optimization model. Proceedings of the Japan Academy, Ser. B, 80(8); 399-405, 2004
- Xu, Y.-Q., K. Unami, T. Kawachi, and S. Yoshimoto: Hybrid runoff model using 1-D Richards equation and linear output generator. Journal of Rainwater Catchment Systems 9(2); 21-24, 2004
- Maruyama, T. and T. Kawachi: Entropy aspects of runoff and flow regulations in a river basin. Journal of Rainwater Catchment Systems 10(1); 15-19, 2004
- Unami, K., T. Kawachi, and M. Yangyuoru: Optimal water management in small-scale tank irrigation systems. Energy 30; 1419-1428, 2005
- Fazal, M.A., M. Imaizumi, S. Ishida, T. Kawachi and T. Tsuchihara: Estimating groundwater recharge using the SMAR conceptual model calibrated by genetic algorithm. Journal of Hydrology 303/1-4; 56-78, 2005

b) Conference and seminar papers presented

61th Kyoto-Branch Conf. of Irri. Drain. Recl. Eng.: 5 articles

12th Congress of Jap. Rain. Catch. Sys. Associ.: 6 articles

2004 JSIDRE Workshop of Applied Hydraulics : 3 articles

# A-3. Off-campus activities

#### Membership in academic societies

Kawachi, T.: Rainwater Catchment Systems Association (President, Executive)

Unami, K.: Rainwater Catchment Systems Association (Secretary General, Councilor)

#### Research grants

Monbusho Grant-in-aid: Basic Research (A) (2) Optimum Design and Management of Small-scale Irrigation Scheme with Rainwater Harvesting (Kawachi, Unami, Maeda)

Monbusho Grant-in-aid: Young Scientists (B) Developing Decision Support System for River Water Quality Management Using Integrated GIS-optimization Model (Maeda)

### A-4. International cooperations and overseas activities

### International meetings (roles)

Kawachi, T.: Member of the Steering Committee of 2005 PAWEES International Symposium

### Membership in international academic societies

Kawachi, T.: International Water Resources Association/IWRA (Member of Peer-reviewers Committee)

### International joint researches, overseas research surveys

Kawachi, T., K. Unami and S. Maeda: Pilot Study on Rainwater Harvesting in Ghana/West Africa (Ghana)

Kawachi, T.: Technical and Research Co-operation with Rural Research Institute, Korea

# B. Educational Activities (2004.4-2005.3)

# B-1. On-campus teaching

a) Courses given

- Undergraduate level: Applied Mathematics (Unami), Hydraulics (Unami), Water Resources Utilization (Kawachi), Water-Use Systems Engineering (Kawachi), Seminar in Computational Hydraulics (Kawachi, Unami), Laboratory Course in Hydraulics (Kawachi, Unami), Introduction to Agricultural and Environmental Engineering I (Kawachi), Seminar in Agricultural and Environmental Engineering (Kawachi)
- Graduate level: Water Resources Engineering (Kawachi), Seminar-I in Water Resources Engineering (Kawachi, Unami), Seminar-II in Water Resources Engineering (Kawachi, Unami), Laboratory Course in Water Resources Engineering (Kawachi, Unami)

# B-2. Off-campus teaching, etc.

# Part-time lecturer

Kawachi, T.: Japan Rainwater Catchment Systems Association Symposium 2004 (Speaker) Kawachi, T.: Symposium on Irrigation Tanks in Shiga (Keynote Speaker)

# B-3. Overseas teaching

# Students and research fellows from abroad

Students: Doctoral course/3 (Bangladesh, China)

# C. Other remarks

Kawachi, T.: Member of the Japan National Council on Food, Agriculture and Rural Policies, Chair of the Consultation Committee for Restoration of Irrigation Tanks in Shiga, Chair of the Council for Environmentally Sound Rural Developments in Fukui, Member of the Council for Local Community Use of Irrigation Water in Yasu River Area, Chair of the Council for Environmentally Sound Kuzuryu-Project Implimentation, Member of the Council for Building Flood-Proof Towns in Southern Biwa-Lake Areas, Member and Subcommittee General of Information Security Organizers Committee of Kyoto University, Member of the Council of the Academic Center for Computing and Media Studies (Kyoto University), Member of the Information Security Chairman of the Steering Committee of KAIS-Information System, Head of Information Technology Service Office

Unami, K.: Member of the Library Committee

# Chair of Land and Water Resources Management

# 2.5.11 Laboratory of Irrigation, Drainage and Hydrological Environment Engineering

Staff Professor : Mitsuno, Toru, Dr. Agric. Sci.
 Lecturer : Nakamura, Kimihito, Dr. Agric. Sci.
 Students and research fellows
 Master's program : (7)
 Undergraduate : (6)

### A. Research Activities (2004.4-2005.3)

### A-1. Main subjects

a) Hydrological evaluation of multipurpose functions of agricultural lands and irrigation ponds (Sennan, Osaka and Kibogaoka, Shiga). Meteorological studies on controlling air temperature rising by agricultural lands and ponds (Sennan, Osaka and Kibogaoka, Shiga). Evaluation of hydrological and meteorological characteristics in forested catchments (Oshinohara, Shiga and Kamigamo, Kyoto).

b) Prevention of nitrogen contamination of hydro-geological environment.

Water management of paddy fields as wetland in order to reduce nitrogen load to Lake Biwa (Omihachiman, Shiga). Optimal water management for the environmental agriculture (c.f. the physical and chemical consideration of cyclic irrigation system in paddy field district and groundwater level control for the reduction of nitrogen load) (Konohama, Shiga). Management of manure application into fields in dairy regions in California, USA.

c) Functions of agricultural lands in the resources recycling system
 Fates of fermentation manure liquid nitrogen and carbon in paddy fields (Yagi, Kyoto)

### A-2. Publications and presentations

a) Publications

#### Books

Mitsuno, T.: Innovative Changes and Water in 21 century (edited by K. Tanbo), 223p., Sankaido, 2004

#### Original papers

- Mitsuno, T.: Evolution of agricultural policy for environment conservation and feature of Irrigation, Drainage and Reclamation. Hour. JSIDRE 72(11); 1-2, 2004 (in Japanese)
- Onishi, T., H. Horino and T. Mitsuno: A case study on storage property of terraced paddy fields, Trans. JSIDRE 230; 53-59, 2004 (in Japanese with English abstract)
- Takeshita, S and T. Mitusno: Secular variation in the property of daily rainfall at Kyoto basin, J. Japan Soc. Hydrol. & Water Resour. 18(2); 106-115, 2005
- Nakamura, K., T. Harter, Y. Hirono, H. Horino, and T. Mitsuno: Assessment of Root Zone Nitrogen Leaching as Affected by Irrigation and Nutrient Management Practices. Vadose Zone Journal 3; 1353-1366, 2004

#### Reports

- Mitsuno, T. and K. Nakamura: Annual report of "Research for revise of design criteria -estimation method of irrigation water requirements-", 2004 (in Japanese)
- Mitsuno, T.: Annual report of "Research on mechanisms of water-use adjustment", 2004 (in Japanese)
- Mitsuno, T. and K. Nakamura: Annual report of "Research for estimate of multipurpose functions of agricultural lands and irrigation ponds - Sennan, Osaka -", 2004 (in Japanese)
- Mitsuno, T. and K. Nakamura: Annual report of "Research on establishment of water management engineering for the reduce of environmental loads", 2004 (in Japanese)
- Mitsuno, T. and K. Nakamura: Annual report of "Research on functions of forest for water environmental conservation", 99-107, 2004 (in Japanese)
- Nakamura, K: Annual report of "Research on multifunctionalities of paddy agriculture Multifunctionalities of paddy fields and agricultural water –", 2004 (in Japanese)
- b) Conference and seminar papers presented
- Annual Meeting of the Japanese Society of Irrigation, Drainage and Reclamation Engineering in 2004: 10 papers
- The 61st Annual Meeting of the Japanese Society of Irrigation, Drainage and Reclamation Engineering Kyoto Branch: 2 papers
- The 12th Annual Meeting of Japan Rainwater Catchment Systems Association: 1 paper
- The 85th Annual Meeting of the Japanese Society of Irrigation, Drainage and Reclamation Engineering Kyushu Branch: 1 paper
- The 25th Asian Conference on Remote Sensing (ACRS) : 1 paper

### A-3. Off-campus activities

#### Membership in academic societies

- Mitsuno, T.: Japanese Society of Irrigation, Drainage and Reclamation Engineering (President, Director, Member of the study committee on the vision of JSIDRE), The association of rural planning (Director)
- Nakamura, K.: Japanese Society of Soil Physics (Member of editorial board of Journals, Councilor), Japanese Society of Irrigation, Drainage and Reclamation Engineering (Member of editorial board of Journals)

#### Membership in Science Council of Japan, etc.

Mitsuno, T.: Science Council of Japan (Member of the research committee on IDRE)

#### Research grants

- Mitsuno, T. and K. Nakamura: Research (B)(1) Functional analysis and estimate of irrigation and drainage system as social common foundation for the coexistence of rural and urban areas (Head: Mitsuno, T., Co-researcher: Nakamura, K.)
- Mitsuno, T.: Research on mechanisms of water-use adjustment, Research on revise for design criteria, Research on enhancement of multipurpose functions, Research on establishment of water management engineering for the reduce of environmental loads (The Ministry of Agriculture, Forestry and Fisheries Entrust Research), Analyzing of the effect of agricultural reclamation and community which consists of farmers and non-farmers on water and mass balance in small catchments (National Institute of Rural Engineering), Research on functions of forest for water environmental conservation (Shiga Prefecture)

Nakamura, K.: Recycling use of organic resources by methane fermentation liquid fertilizer application system (Ministry of Agriculture, Forestry and Fisheries) (Co-researcher: Nakamura, K.)

# B. Educational Activities (2004.4-2005.3)

# B-1. On-campus teaching

a) Courses given

- Undergraduate level: Agricultural Hydrology (Mitsuno), Irrigation and Drainage (Mitsuno), Practice in Irrigation and Drainage Planning (Mitsuno), Fundamentals of Agricultural and Environmental Engineering (Mitsuno), Soil Physics (Nakamura), Laboratory Course in Soil Physics and Hydrological Environment Engineering (Nakamura), Science of Soil, Practice in Data Processing I (Nakamura)
- Graduate level: Seminar in Irrigation, Drainage and Hydrological Environment Engineering I (Mitsuno and Nakamura), Seminar in Irrigation, Drainage and Hydrological Environment Engineering II (Mitsuno and Nakamura), Laboratory Course in Irrigation, Drainage and Hydrological Environment Engineering (Mitsuno and Nakamura), Irrigation, Drainage and Hydrological Environment Engineering (Mitsuno)

## B-2. Off-campus teaching, etc.

### Part-time lecturer

Mitsuno, T.: Symposium on Multifunctionalities of Agriculture and Agricultural Areas (Lecturer and Coordinator)

### C. Other remarks

- Mitsuno, T.: Member of the council of food, agriculture, and rural area policies in the Ministry of Agriculture, Forestry and Fisheries, Chairman of the planning council of agricultural and rural development division in the Ministry of Agriculture, Forestry and Fisheries, Member of the committee of policies and researches at Agriculture, Forestry and Fisheries Research Council in the Ministry of Agriculture, Forestry and Fisheries, President and Director of the Upland Agricultural Development Association, Researcher of Association for Disaster Prevention Research, Specialty division chairman of the committee of public projects evaluation (Osaka Prefecture), Member of the oversight commission of public projects (Shiga Prefecture), Member of the scientific research committee on the integral conservation of Biwa Lake (Shiga Prefecture), Member of the council of water resources development in the Ministry of Land, Infrastructure and Transport, Member of the council of land in the Ministry of Land, Infrastructure and Transport
- Nakamura, K.: Encouraging prize (Japanese Society of Irrigation, Drainage and Reclamation Engineering Kyoto Branch)

# 2.5.12 Laboratory of Rural Planning

Staff Professor : Takahashi, Tsuyoshi, Dr. Agric. Sci. Associate Professor: Ushino, Tadashi, Dr. Agric. Sci. Assistant Professor : Kuki, Yasuaki, Dr. Agric. Sci.

Students and research fellows Doctor's program : (2) Master's program : (9)

> Undergraduate : (5) Research fellow : (2)

# A. Research Activities (2004.4-2005.3)

### A-1. Main subjects

a) Studies on the planning method of the integrated rural development

In rural areas, not only to accomplish the high rate productivity of agriculture and the comfortable residential environment but also to consolidate the rural community with natural landscape and environment are required. Rural land use in good order is also required for these purposes. For these purposes, the field studies on the planning methods for the rural land use, farmland consolidation and the development of residential environment are carried out from the point of the conservation of rural landscape and natural environment in the hilly and mountainous rural area of Miyama, Ibaraki city, Osaka Prefecture.

The population dynamics of rural area was studied as a base of this research. The application of GIS to the rural planning is also one of the targets of this research.

b) Studies on making a comprehensive district plan in rural areas by inhabitants.

In case of implementating land consolidation project in order to mobilization of land for agricultural use and formation of land use order, it is desirable to make a comprehensive district plan in Meiji administrative village scale. It is effective to use "Kande Method" as planning method. In order to examine the above assumption, the following six points had been studied; ① historical review of a comprehensive district plan, ②the effectiveness of a conflict model as a rural planning system, ③planning units of a comprehensive district plan, ④planning method of a comprehensive district plan, ⑤planning organization of a comprehensive district plan, ⑥ planning composition of a comprehensive district plan.

"Kande Method" has been applied to Jindaiminami district (Mihara town, Hyogo prefecture), Kitaama district (Nandan town, Hyogo prefecture), Oozo district (Kobe city, Hyogo prefecture), Ogawa district (Kanaya town, Wakayama prefecture), Osakatobu district (Osaka town, Gihu prefecture) and Mikanohara district (Kamo town, Kyoto prefecture) since 1997. And this study points the actual conditions of the applied examples of the "Kande Method" and makes clear the issues of its applications.

Moreover, we made a municipal border map, a Meiji administration border map, an agricultural community border map and extensive municipal sphere border map in Kyoto prefecture by using GIS technology and grasp land use conditions, structures and relationship of each municipality and Meiji administrative village. c) Consideration of measures to use practically uncultivated farmland and to prevent animal attacks in mountainous areas

In this study in mountainous area, the spatial factors of animal attacks on the agricultural land are clarified. The scope and trail of wild boar are revealed by hearing and field survey, as well as the spatial structure of settlements and land use, especially uncultivated farmland. The study also uncovers three conditions which are location, acreage and land category control the measure of using uncultivated farmland under the valley level. The advices of land use and land maintenance plans of typical rural settlement of this study are noted from the view of defence against animal attacks.

d) Study on the measures to manage suburban farmland in the UK

The purpose of this study is to get information about conservation and management of farmland and brown field in suburban areas in the UK. The fact that the Greenbelt project surrounding urban area has been providing good conservation and management settings of farmland is a suitable case for this study. Especially Letchworth provides a successful case of using waste areas as Greenbelt and an example of conservation and management of prime farmland in suburban areas. For making the specific plans of using the waste farmland, it is important to know not only about geographical features and farmers who own the farmland but also the social and historical background such as the farmland owing system, agricultural policy and economic. Meanwhile, another movement, project of community gardens and city farms, is focused in this study. Although the federation of city farms and community gardens mainly helps these projects, each community garden and city farm has a wide-ranging role and is maintained by strong commitment of local communities. This study aims to reveal structure of continuity and success of the project.

#### A-2. Publications and presentations

a) Publications

### Original papers

- Maekawa, H., Hayashi, N. and T. Takahashi: A Study of characteristics and support of a neighbourhood association in rural area. Journal of JSIDRE 72(10); 27-30, 2004 (in Japanese)
- Iida, Y., T. Takahashi and N. Hayashi: Effects on regional activation and farming incentive by farmers' market. Trans. of Rural Planning 6; 211-216, 2004 (in Japanese)
- Hayashi, N. S. Saitoh and T. Takahashi: Migration of the young and mature people in rural region. Trans. of Rural Planning 6; 295-300, 2004 (in Japanese)
- Takeyama, E., Y. Kuki and Y. Miyake: Development of multi-functionality of agricultural field by growing rape; A case study in Goshiki Town, Hyogo Prefecture. Journal of JSIDRE 72(8); 19-22, 2004 (in Japanese)

#### Reviews

- Takahashi, T.: From rural sewerage to rural resources recycling. Journal of rural resource recycling solutions.78, 7, 2004 (in Japanese)
- Takahashi, T.: National university corporation, Objectives and issues. Journal of JSIDRE 72(12); 3-6, 2004 (in Japanese)
- Kuki, Y.: Communities' commitment to the green setting and argument about garden city in the UK. Journal of rural planning association 23(4); 301, 2005 (in Japanese)

#### Reports

- Takahashi, T., Kuki, Y. et al: Rural development planning of Miyama in Ibaraki City, Osaka. 1-170, 2005 (in Japanese)
- Ushino, T.: Making a comprehensive district plan of Mikanohara in Kamo town(master plan). 1-124, 2004(in Japanese)
- Ushino, T.: Some problems and provisions for the north area of Yamato kogen, the Upland Agricultural Development Association, 54-103, 2005(in Japanese)
- Ushino, T.: The master plan of the north area of Kyoto city Oomi village– (proposal), Kyoto City, 1-33, 2005(in Japanese)
- Kuki, Y.: Study on the measures to manage suburban farmland in the UK. Kyoto university education and research promotion foundation, 2004
- Kuki, Y.: Surveys for mountainous area improvement planning in Hidaka River Area. Kinki regional agricultural administration office, 2005
- b) Conference and seminar papers presented

2004 annual meeting of JSIDRE.: 5 papers

61th annual meeting of the Kyoto Branch of the JSIDRE.: 4 papers

2004 autumn conference of the Association of Rural Planning: 2 papers

2004 spring conference of the Association of Rural Planning: 1 paper

# A-3. Off-campus activities

#### Membership in academic societies

- Takahashi, T.: The JSIDRE (Chairman of the Natural Resources Recycle Research Group, Chairman of the Committee on the Revision of Design Standard (Integrated Rural Development)), The Rural Planning Association (Adviser), Research Institute of Environmental Technology (Director)
- Ushino, T.: The Japanese Society of Landscape (Director), The Japanese Society of Landscape (Sub Chairman of the Editor Committee), The Association of Rural Planning (Board member), The Japan Association for Social Informatics (Conductor of the Kansai Branch)

Kuki, Y.: The Rural Planning Association (Member of Academic Exchange Committee)

#### Research grants

- Takahashi T. and Y. Kuki: Grant-in-Aid for Scientific Research B (1), Studies on the planning method of rural development in hilly and mountainous area. (Head: Matsumoto)
- Takahashi, T.: Mountainous area improvement planning survey (Kinki Regional Agricultural Administration Office), Rural spatial improvement planning survey (Osaka Prefecture)

# A-4. International co-operations and overseas activities International joint researches, overseas research surveys

Kuki, Y.: Research survey on the measures to manage suburban farmland in the U.K. (United Kingdom)

## B. Educational Activities (2004.4-2005.3)

#### B-1. On-campus teaching

a) Courses given

Undergraduate level: Rural planning (Takahashi), Land consolidation engineering (Ushino),

Surveying (Ushino), Rural planning and practice (Takahashi), Practice in surveying (Ushino)

Graduate level: Planning of rural landuse (Ushino), Special seminar in rural planning I (Takahashi and Ushino), Special seminar in rural planning II (Takahashi and Ushino), Laboratory course in rural planning (Takahashi and Ushino)

# B-2. Off-campus teaching, etc.

# Part-time lecturer

Ushino, T.: Kyoto Prefectural College of Agriculture (Rural planning)

# C. Other Remarks

- Takahashi, T: Dean of Graduate School/Faculty of Agriculture, Kyoto University, Member of the university evaluation committee of National Institution for Academic Degrees, Chairman of the Committee on Rural Land Use Planning in Kobe City, Member of the specialist committee of the Japanese Association of Rural Sewerage, Member of the research committee of the Advice Center for Rural Environment Support, Chairman of the Committee of Surveys for Mountainous Area Improvement Planning in Hidaka River Area
- Ushino, T.: Member of the Research Committee for Rural Environment Projections (Japanese Center for Rural Environmental Projections), Member of the JSIDRE Committee of Consideration of Japanese Rural Beauty, Member of the Meeting of Making Villages with Water, Green and Beauty of Kinki Regional Agricultural Administration Office, Member of the Council of Environmental Information of Comprehensive Rural Improvement Project in Nanndann District, Member of the Council of Environmental Information of Improvement Projects of Agriculture and Rural Area(Kyoto Prefecture), Member of Conservation of Rural Region-Water and Soil- (Shiga Prefecture), Member of the Council on Environment in Hirakata City, Chairman of the Planning Committee on the North Area of Kyoto City, Chief Planner of Making a Comprehensive District Plan of Mikanohara in Kamo, Kyoto Prefecture
- Kuki, Y.: Member of the Committee of Surveys for Mountainous Area Improvement Planning in Hidaka River Area, Member of the JSIDRE Committee of Consideration of Japanese Rural Beauty

# **Chair of Bioproduction Engineering**

# 2.5.13 Laboratory of Agricultural Systems Engineering

Staff Professor : Oida, Akira, D. Agric. Sci. Associate Professor: Nakashima, Hiroshi, D. Agric. Sci. Assistant Professor : Miyasaka, Juro, M. Agric. Sci. Assistant Professor : Ohdoi Katsuaki, D. Agric. Sci.

Students and research fellows

Doctor's program : (4) Master's program : (9) Research student: (1) Undergraduate : (7)

# A. Research Activities (2004.4-2005.3)

# A-1. Main subjects

a) Terramechanics

The Distinct Element Method is applied to elucidate the interaction between machine parts and soil. In order to simulate the discrete behavior of soil such as crack and separation caused by machine actions, we suppose that soil should be an assembly of discrete particles and try to find the soil behavior and reaction by computer calculation according to equations of motion of each particle. We are now simulating the soil behavior by a tire, a rotary blade and a subsoiler. An effective method is also developed, combining DEM and FEM. Experimental researchs on tire mobility by using a in-door soil bin and bionics study to reduce the draft of cutting blade are also conducting.

b) Development of electric agricultural vehicle using microwave power transmission

A no-emission vehicle is under development in order to contribute the environmental conservation. A test electric vehicle, which has no battery but only electric motors which are driven by electricity transmitted in form of microwave, is designed, made and tested. In order to improve the transmission efficiency a parabola anntena, direction control of antennae and a radio data transmission method are tried. Furthermore, the effect of microwave on plant growth is studied.

c) Systems engineering study on farm management, mechanization and rural development

An appropriate mechanization system is searched on agriculture in Indonesia and Mexico, gathering in-situ data and applying a neural network and a data envelopment analysis.

The management state of agriculture company are surveyed in order to find frontiers among companies by the data envelopment analysis.

Questionaire study is done to get the optimum allocation of so-called Klein Garten in order to activate rural areas.

The optimum cultivation system is studied to maximize the income of competitive vegetable farmer by means of a simulated annealing method.

#### d) Biomass energy

It is clear that the fossil energy resources will be exhausted and the energy production by way of recycling agricultural wastes will be one of the necessary technologies in future. We are now investigating the following technologies; (i) Efficient production of methane gas, (ii) Methane gas production from biodegradable plastics.

e) Fundamental study on precision farming

We are now trying to develop a sensing technology of soil crushing degree by a rotavator using optical sensors and/or image processing technology in order to contribute to the future precision farming.

f) Root growth simulation by cellular automaton

A simulation of plant root growth in soil is conducting by cellular automata in order to find a relation between various soil conditions and growth of plant roots.

### A-2. Publications and presentations

a) Publications

#### Books

- Oida, A.: Terramechanics. New Agricultural Informatics Perspectives for 21<sup>st</sup> Century (edited by Japanese Society for Agricultural Informatics), 246-247, Yokendo, Tokyo, 2004 (in Japanese)
- Oida, A.: Agricultural tractor. Agricultural Encyclopedia, 1303-1305, Yokendo, Tokyo, 2004 (in Japaneese)
- Oida, A.: Tractor. Handbook of Mechanical Engineering, Applications gamma-1 (edited by Japan Society of Mechanical Engineers), 162-168, Maruzen, Tokyo, 2005 (in Japanese)
- Nakashima, H.: Soil-machine interface. New Agricultural Informatics Perspectives for 21<sup>st</sup> Century – (edited by Japanese Society for Agricultural Informatics), 234-235, Yokendo, Tokyo, 2004 (in Japanese)
- Miyasaka, J.: Scheduling for farm work. New Agricultural Informatics Perspectives for 21<sup>st</sup> Century – (edited by Japanese Society for Agricultural Informatics), 112-113, Yokendo, Tokyo, 2004 (in Japanese)
- Miyasaka, J.: Shape of paddy fields. Encyclopedia of Science on Form, 882-884, Asakura Publishing Company, Tokyo, 2004 (in Japanese)

### Original papers

- Nakashima, H., A. Oida: Algorithm and implementation of soil-tire contact analysis code based on dynamic FE-DE method. Journal of Terramechanics 41(2/3); 127-137, 2004
- Kanamori, H., S. Aoki, H. Nakashima: Terramechanics of a micro lunar rover. Proceedings of 9th ASCE Aerospace Division International Conference on Engineering, Construction, and Operations in Challenging Environments; 123-130, 2004
- Nakashima, H.: Discrete Element Method (DEM) and its possible application. Proceedings SICE 2004, Sapporo; 1104-1107, 2004
- Nakashima, H., Y. Kawase, M. Momozu, A. Oida: Soil-wheel interaction simulation by a cyclic parallel DEM. Proc. of 7th Asia-Pacific ISTVS Conference, Changchun; 132-140, 2004
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- Izumi, T., A. Oida, H. Nakashima, J. Miyasaka, H. Itoh: Measurement of soil clod fineness by using laser sensor and polygon mirror. J. KBJSAM 97; 38-41, 2005 (in Japanese)
- Itagaki, T., J. Miyasaka, H. Nakashima, A. Oida,: Simulation of disease incidence and scattering by spores - CA modeling introducing gap between indivisuals -. J. KBJSAM 97; 50-53, 2005 (in Japanese)
- Miyasaka, J., A. Oida, H. Nakashima, K. Ohdoi, M. Watanabe, H. Miyanaga, H. Matsumoto, K. Hashimoto, N. Shinohara and T. Mitani: Study on control for microwave-driven agricultural vehicle and effects of microwave exposure on radish seed germination. Technical Report of IEICE SPS2004-19, 2005 (in Japanese)
- b) Conference and seminar papers presented
- 63rd Annual Meeting of Japanese Society of Agricultural Machinery: 2 papers

112th Meeting of Kansai Branch of JSAM: 4 papers

- 113th Meeting of Kansai Branch of JSAM: 7 papers
- 2<sup>nd</sup> International Symposium on Sustainable Energy System: 2 papers
- 3<sup>rd</sup> Meeting of SPS Technical Group: 1 paper
- SICE2004: 1 paper
- 7<sup>th</sup> Asia-Pacific ISTVS Conference: 2 papers
- 2<sup>nd</sup> International Symposium on Machinery and Mechatronics for Agriculture and Bio-systems Engineering (ISMAB): 4 papers
- 9th Int. Conf. Aerospace Division, ASCE: 1 paper

ATOE2004: 1 paper

CIGR2004: 1 paper

## A-3. Off-campus activities

#### Membership in academic societies

- Oida, A.: JSAM (Director, Councilor, Vice Chairman of Steering Committee for 63rd Annual Meeting), Kansai Branch of JSAM (President)
- Nakashima, H.: JSAM (Councilor, Branch Member of Editorial Committee, Member of Steering Committee for 63<sup>rd</sup> Annual Meeting, Member of Program Committee), Kansai Branch of JSAM (General Secretary), Japanese Society for Terramechanics (Director)

Miyasaka, J.: Japanese Society of Farm Work Research (JSFWR) (Regional Secretary)

#### Research grants

Monbusho Research Grant: Scientific Research (B)(2): Study on electric drive of agricultural machinery by microwave power transmission (Project Leader: Oida, Project Members: Nakashima, Miyasaka), Scientific Research (A)(1): Bioinstrumentation of plant and XML soft-sensing in speaking plant approach (Project Leader: Murase, Osaka Prefectural University, Project Member: Nakashima)

### A-4. International cooperation and overseas activities

#### International meetings (roles), etc.

Oida, A.: 2<sup>nd</sup> ISMAB, Kobe (Organizing Committee Member, Presentation) Nakashima, H.: 7<sup>th</sup> Asia-Pacific ISTVS Conference, Changchun, China (Chairman, Presentation) Miyasaka, J.: 2<sup>nd</sup> ISMAB, Kobe (Executive Committee Member)

### Membership in international academic societies

Oida, A.: ISTVS (National Secretary, Japan), AAAE (Vice President)

### International Journals

Oida, A.: Journal of Terramechanics (Associate Editor, Editor for Special Issue), Agricultural Engineering Journal of AAAE (Editorial Board Member, Editor for Special Issue), Agricultural and Biosystems Engineering (Advisory Board Member)

Nakashima, H.: Agricultural Engineering Journal of AAAE (Editorial Board Member)

### International Symposium

Oida, A., H. Nakashima, J. Miyasaka, K. Ohdoi<sup>:</sup> 2004 Korea-Japan Joint Seminar on Agricultural Systems and Biomechatronic Engineering at SungKyunkwan University, Suwon, Korea (Presentations)

Oida, A.: National Agricultural Mechanization Research Institute, Suwon, Korea (Invited Speech)

# B. Educational Activities (2004.4-2005.3)

# B-1. On-campus teaching

- a) Courses given
- Undergraduate level: Practice in Fundamental Data Processing (Nakashima, shared), Pocket Seminar: Engineering Approach to Food, Environment and Energy Problems (Oida, shared), Synthetic Practice in Education (Oida, shared), Introduction to Agricultural and Environmental Engineering II (Oida, shared), Applied Mechanics (Nakashima, shared), Strength of Materials (Nakashima), Mathematical Programming (Oida), Energy and Prime Movers in Agriculture (Oida), Laboratory Course in Agricultural Machinery I (Nakashima, Miyasaka, Ohdoi, shared), Practice in Data Processing (Nakashima and Miyasaka, shared), Seminar in Agricultural Machinery (Oida, Nakashima, Miyasaka, Ohdoi, shared), Practice in Data Processing (Nakashima, Miyasaka, Ohdoi, shared), Practice in Data Processing (Oida, Nakashima, Miyasaka, Ohdoi, shared), Practice in Data Processing II (Nakashima, Miyasaka, Ohdoi, shared), Practice in Data Processing II (Nakashima, Miyasaka, Ohdoi, shared), Practice in Data Processing II (Nakashima, Miyasaka, Ohdoi, shared), Practice in Data Processing II (Nakashima, Miyasaka, Ohdoi, shared), Practice in Data Processing II (Nakashima, Miyasaka, Ohdoi, shared), Practice in Data Processing II (Nakashima, and Ohdoi, shared)
- Graduate level: Agricultural Systems Engineering (Oida), Special Seminar in Agricultural Systems Engineering I and II (Oida and Nakashima), Laboratory Course in Agricultural Systems Engineering (Oida and Nakashima)

# B-2. Off-campus teaching, etc.

### Part-time lecturer

Oida, A: Kobe University (Design of Off-road Vehicles) Nakashima, H.: Osaka Prefectural University (Engineering for Energy Utilization)

# B-3. International activities

### Students and research fellows from abroad

Students: Doctor's program: 2 (Mexico and Indonesia), Master's program: 1 (Jordan)

# C. Other remarks

### Members

Oida, A.: Education Committee in the Faculty of Agriculture (Member), International Exchange Committee in the Faculty and Graduate School of Agriculture (Member)

Nakashima, H.: Maintenance Committee for Academic Information System, Kyoto University (Member)

### Awards

Oida, A.: Best Paper Award at 7<sup>th</sup> Asia-Pacific ISTVS Conference Nakashima, H.: Best Paper Award at 7<sup>th</sup> Asia-Pacific ISTVS Conference

# 2.5.14 Laboratory of Field Robotics

Staff	Professor	: Umeda, Mikio	Dr. Agric. Sci.
	Associate Profess	or: Iida, Michihisa	Dr. Agric. Sci.
	Assistant Professo	or : Suguri, Masahiko	M. Agric. Sci.
	Assistant Professo	or : Masuda, Ryouhei	M. Agric. Sci.

Students and research fellows

Teaching assistant: (3)Doctor's program: (1)Master's program: (9)Research fellow: (1)Undergraduate: (5)

# A. Research Activities (2004.4-2005.3) A-1. Main subjects

It is afraid that a un-balance of the material cycle due to increase in the food import deteriorates environment in Japan.

This laboratory studies mainly on precision agriculture and field robot based on the thought with "Food should be produce within the country to preserve an environment of the country" and "Agriculture has always adopted the most advanced technology of the age."

a) Precision agriculture based on the field map and variable rate fertilizer application.

Precision agriculture is the information-orientated agriculture that the field is separated imaginary into small fields, and fertilizer is implicated based on the soil condition, plant growth and yield on those small plot, and cope with stabilization of the yield and the quality of the products and protection of the environment.

In order to decide the amount of fertilizer, the nutriment in the soil and the amount of growth must be measured. This laboratory in cooperation with Laboratories of Plant Production Systems and Soil Science starts research on precision agriculture in 1997. In 2004, the field tests were conducted in Sakurai, Yagi and Takatsuki.

b) Estimation of nitrogen contents of rice plant using remote sensing.

The ideal amount of topdressing fertilizer is the amount possess subtracts from the necessity.

Plant growth sensor is required to estimate the nitrogen possessed by the plant. In 2004, both basal- and top-dressing were applied at the prescribed variable rate in a paddy field (0.5ha) of the Takatsuki Experimental Farm, Osaka, Japan. After that, the airborne images were taken using hyperspectral and multispectral meter in order to estimate the plant growth.

c) Estimation of nitrogen contents of tea plant using remote sensing.

Tea cultivation requires a lot of nitrogen fertilizer. Therefore, it is important to analyze the relationship between the amount of applied nitrogen and the quality of tea leave. Information of tea leave was collected using the portable plant growth measuring device and satellite images in order to measure the quality of tea leave.

#### d) Development of grain yield monitor for head-feeding combines

A grain yield monitor for head-feeding combine has been developing with Mitsubishi Agricultural Machinery Co., Ltd. It consists of two impact sensors, GPS, and a grain moisture sensor. The monitor has another sensor to compensate the return flow of grain. In 2004, a new combine installed the grain yield monitor was developed. This combine was tested to measure the spatial variability of grain yield in several fields.

e) Automatic control of separation mechanism for head-feeding combine

It is important for combine harvester to separate and clean the grain from chaff and straw at the high quality. Therefore, in order to enhance the quality of separation, the automatic control system of separation mechanism using two grain flow-rate sensors was proposed and tested in bench.

#### f) Harvest system by unmanned combine

The group control system means the system that unmanned farm machine follows up automatically a leading machine controlled by an operator. In this system, a farmer can utilize small, mass-produced and low-price farm machines to run the large farm effectively. In 2004, an unmanned combine was developed to harvest automatically using RTK-GPS and IMU.

g) Direct yaw moment control of tractor

The steering system of 4WS, steer by wire vehicle was developed with model following control, and tested on the cultivated and irrigated field in 2002. In 2004, the control system that can brake left rear wheel and right rear wheel independently was tested using a 4WD tractor with electro-hydraulic brake system.

h) Variable rate applicator for wheat seeding and fertilizing in crop rotation paddy.

It is important to improve the food self-sufficiency in Japan. For the purpose, it is necessary to increase the production of not only rice but also wheat and soybean. Therefore, crop rotation, that grows rice, wheat and soybean for two years, is applying in Japan. In this study, a variable rate applicator for wheat seeding and fertilizing has been developed in order to improve the efficiency of wheat cultivation. This machine can apply variable amounts of wheat seeds and granular fertilizers at the same time in the field after harvesting rice. A field test was conducted to seed and fertilize according to the map that prescribed the amounts of seeds and fertilizers in advance.

i) Development of float type autonomous robot for paddy fields

Multi Agent System has been studied. The system can do some tasks, i.e. weeding, scouting and so forth in paddy fields. An autonomous robot that constitutes the Multi Agent System was developed. The basic performance was evaluated and Q-learning was applied to the robot for the purpose of having the robot acquire the obstacle avoidance behavior.

### A-2. Publications and presentations

#### a) Publications

#### Books

Umeda M.: Edited by Japanese Society of Agricultural Informatics, Field Robotics p198-199, Variable Rate Applicator p232-233, Agricultural Informatics, Yokendo, 2004

#### Original papers

- Nishiike, Y., M. Umeda, Model-following control system for four-wheel steering farm vehicle (Part 4), Journal of the Japanese Agricultural Society, 66(1), pp55-65, 2004
- Ryu, C.S., M. Suguri, M. Umeda, T. Inamura, Estimation o nitrogen content of rice plant using remote sensing technology, Journal of the Japanese Agricultural Society, 66(2), pp85-96, 2004
- Mo'taz Khilael, M. Iida, M. Umeda, Metering device for variable rate granular fertilizer applicator, Journal of the Japanese Agricultural Society, 66(2), pp123-129, 2004
- Ryu, C.S., Iida, M. Suguri, M. Umeda, T. Inamura, H. Inoue, H. Shinjo, N. Moritsuka, Effect of variable rate fertilizer application aimed at reducing the spatial variability of grain yield on rice taste, Journal of the Japanese Agricultural Society, 66(5), pp49-62, 2004
- Mo'taz Khilael, M. Iida, M. Umeda, Development of a metering device for organic and chemical fertilizers applicator, Journal of the Japanese Agricultural Society, 66(5), pp142-153, 2004
- Iida, M., Y. Yao, K. Nonami, A. Kimura, T. Kaho, M. Umeda, Impact type grain flow rate sensor for combine, Journal of the Japanese Agricultural Society, 66(6), 145-151,2004
- Moritsuka, N., Yanai, J., Umeda, M., Kosaki, T.,Spatial relationship among different forms of nutrients in soil and plant in a Japanese paddy field, Soil Science and Plant Nutrition, 50, 565-573, 2004
- Inamura, T., Goto, K., Iida, M., Nonami, K., Inoue, H., Umeda, M., Geostatical Analysis of Yield, Soil Properties and Crop Management Practices in Paddy Rice Fields", Plant Production Science,7(2),230-239,2004
- Yao, Y., Iida, M., Umeda, M., Control of grain return flow for head-feeding combine, Proceedings of the October 2004, pp192-200, Conference, Automation Technology for Off-road Equipment, Kyoto University, Japan
- Ryu, C., Suguri, M., Umeda, M., Estimation of biophysical parameters using hyperspectral remote sensing, Proceedings of the October 2004 Conference, pp209-219, Automation Technology for Off-road Equipment, Kyoto University, Japan
- Nishiike, Y., Umeda, M., Yukifuji, M., Shiozaki, M., Iida, M., Suguri, M., Direct yaw moment control by braking force distribution for handling and stability of agricultural tractors, Proceedings of the October 2004 Conference, pp305-311, Automation Technology for Off-road Equipment, Kyoto University, Japan
- Sakai, S., Osuka, K., Umeda, M., On robust control of agricultural vehicles without velocity signals, Proceedings of the October 2004 Conference, pp312-320, Automation Technology for Off-road Equipment, Kyoto University, Japan
- Sakai, S., Osuka, K., Umeda, M., Heavy material handling agricultural robot for watermelons, Proceedings of the October 2004 Conference, pp321-331, Automation Technology for Off-road Equipment, Kyoto University, Japan
- Oido, N., Iida, M., Umeda, M., A combine-mounted NIR spectroscopy-based sendor for single rice

kernel protein content measurement, Proceedings of the October 2004 Conference, pp380-386, Automation Technology for Off-road Equipment, Kyoto University, Japan

- SUGURI, M., K. Karita Y. Nishiike, RTK-GPS based autonomous crawler wagon control., Proceedings of the Automation Technology for Off-road Equipment 2004, pp360-369, 2004
- Nishiike, Y., Umeda, M., Fujii, M., Shiozaki, S., Iida, M., Suguri, M., Braking force distribution control for an agricultural tractor, Proceedings of the 2004 CIGR Conference, 50-063A, 2004 CIGR International Conference, Beijing, China
- Umeda, M., Introduction of the Project Research at Kyoto University for Utilizing Methane Fermentation Digested Sludge as Liquid Fertilizer for Paddy, Proceedings of the 2004 CIGR Conference, 30-089A, 2004 CIGR International Conference, Beijing, China
- Umeda, M., Iida, M., Karita, K., Fundamental Study for Utilizing Methane Fermented Digested Sludge as Liquid Fertilizer for Paddy in 2003, Proceedings of the 2004 CIGR Conference, 30-090A, 2004 CIGR International Conference, Beijing, China
- Lee, C. K., Lee, Y. B., Jung, I. G., Sung, J. H., Chung S. O., Kim, S. C., Park, W. P., Umeda, M., Spatial and temporal variability in rice yield collected from multiple small sized paddy fields in multiple years, Proceedings of the 2004 CIGR Conference, 30-100A, 2004 CIGR International Conference, Beijing, China
- Ryu, C., Umeda, M., Iida, Influence of Nitrogen Fertilizer Application Rate on the Taste of Rice, Proceedings of the 2004 CIGR Conference, 30-099A, 2004 CIGR International Conference, Beijing, China
- Sakai, S., K. Osuka, T. Maekawa, M. Iida, M. Umeda, System construction of heavy material handling robot for agriculture, The 9<sup>th</sup> Robotics Symposia, 449-455,2004
- Iida, M., Y. Yamada, M. Umeda, Development of control system for autonomous combine, Report of Kansai Branch of Japanese Society of Agricultural Machinery, 96,5-6, 2004
- Iida, M., Y. Yamada, M. Umeda, Autonomous combine harvester using GPS and FOG, JSME ROBOMEC'04 (CD-ROM), 2P2-L2-17, 2004
- Oido, N., M. Iida, Y. Matsumura, Measurement of protein content of single kernel of rough rice using improved Kjeldahl method, Proceedings of the 5th Annual Meeting of Japanese Society of Food Engineering, 55, 2004
- Iida, M., Y. Yao, N. Oido, M. Umeda, A. Kimura, M. Nishikori, Development of grain yield monitor software, Report of Kansai Branch of Japanese Society of Agricultural Machinery, 97, 42-45, 2005
- Umeda, M., M. Suguri, T. Terada, An Approach for Estimation of Nitrogen Content Distribution with Remote Sensing. Report of JSAM Kansai Branch, 96, 21-22, 2004
- Umeda, M., M. Suguri, H. Isobe, Discrimination of Monkeys using Motion Image Analysis for Monkey Damage Protection. Report of JSAM Kansai Branch, 96, 75-76, 2004
- Minami, Y., R Masuda, M Umeda, Development of float type autonomous robot for paddy fields. -Development of the structures and evaluation of the basic behaviors-, Report of JSAM Kansai Branch, 96, 17-18, 2004
- b) Conference and seminar papers presented

#### International

CIGR session IV Budapest/ Hungary: 1 presentation

ATOE2004, Kyoto/Japan: 6 presentations

CIGR2004, Beijing/China: 3 oral presentations, 2 poster presentations

### Domestic

63rd Annual Meeting of JSAM (Japanese Society of Agricultural Machinery): 3 presentations 111th Regular Meeting of Kansai Branch of JSAM: 2 presentations 112th Regular Meeting of Kansai Branch of JSAM: 5 presentations

# A-3. Off-campus activities

### Membership in academic societies (roles)

- Umeda, M.: JSAM (Councilor, Vice Chairperson of Future Planning Committee), JSAI (Japanese Society of Agricultural Informatics) (Director)
- Iida, M.: JSAM (Councilor, Member of JABEE Committee, Member of Technical Series Committee, Member of Symposium Executive Committee), Robotic Society of Japan, Japanese Society of Agricultural Informatics

#### Research grants

- Research Grant of Japanese Sciece Promotion Society (JSPS): Scientific Research (A)(2)
  "Development of Sensing technology for Grain Yield Variability and Variable Rate Application System in Crop Rotation Field" (Representative: Umeda. M., Participant: M. Iida, M. Suguri, R. Masuda), Scientific Research (B)(2) "Development of crop management in consideration of soil, crop growth and grain yield variation." (Participant: M. Iida)
- Accepted Research from Ministry of Agriculture, Forestry and Fisheries: "Evaluation of effect of methane-fermentation digester application as liquid fertilizer" (Representative: Umeda. M., Participant: M. Iida, M. Suguri, R. Masuda)
- Accepted Research from National Agricultural Research Organization: "Variable rate applicator for wheat seeding and fertilizing in crop rotation fields" (Representative: Umeda. M.)
- Research Grant from Kyoto Chamber of Tea "Measurement of tea quality and yield by using precision agriculture technique" (Representative: Umeda. M.)
- Industry-University Co-operation Project: "Evaluation of ECO-DAN performance" Yanmer (Representative: Umeda. M., Participant: M. Suguri), "Development of moisture content meter for single kernel for Precision Agriculture" Satake Co., Ltd. (Representative: Umeda. M.), "Control of separating and cleaning mechanism for combine" Mitsubishi Agricultural Machinery Co., Ltd. (Representative: Iida. M.)

# A-4. International cooperation and overseas activities

#### International meetings (roles)

Umeda, M.: ATOE2004 (Conference Chairperson), ISMAB2004 (Co-chairperson),

Iida, M.: ATOE2004 (Member of Conference Organization Committee, Member of Scientific Review Committee, Editors)

#### Membership in international academic societies

Umeda, M.: International Commission of Agricultural Engineering (CIGR) (Board member of Section IV), Asian Conference on Precision Agriculture (ACPA) (Chairperson of Management committee), Asian Association for Agricultural Engineering (AAAE) (Vice chairperson)

# B. Educational Activities (2004.4-2005.3)

# B-1. On-campus teaching

- a) Courses given
- Undergraduate level: Field Robotics (Umeda), Introduction to Foreign Literature in Agricultural Machinery (Umeda), Design of Machine Elements (Umeda), Practice in Computer Aided Design (Umeda and Masuda), Vibration (Iida), Automatic Control (Iida), Applied Mathematics (Iida and others), Laboratory Course in Agricultural Machinery I (Iida, Suguri, Masuda and others), Laboratory Course in Agricultural Machinery II (Iida, Suguri, Masuda and others), Practice in Data Processing II (Iida, Masuda and others), Seminar in Agricultural Machinery (Umeda, Iida, Suguri, Masuda and others), Science of Life Sphere (Umeda and others), Selected Technologies of Food and Agriculture (Umeda and others), Seminar in Agricultural and Environmental Engineering (Umeda, Iida, Suguri, Masuda and others)
- Graduate level: Field Robotics (Advanced course) (Umeda), Advanced Seminar in Field Robotics I (Umeda and Iida), Advanced Seminar in Field Robotics II (Umeda, Iida, Suguri and Masuda), Field Automation (Iida), Laboratory Course of Field Robotics (Umeda, Iida, Suguri and Masuda)

# B-3. Overseas teaching

## Lectures and seminars

Umeda: Lecture "Introduction to Precision Agriculture" in JICA Course of low input production system.

### Students and research fellow from abroad

Doctor's program 1 (China), Master's program 2 (China and Korea), Research student 1(Korea) Post-doctoral teaching assistant 2 (Korea and Jordan)

# C. Other Remarks

- Umeda, M.: (On-campus)Experimental Farm (Member of council), Physical Subject Section (Member), Subcommittee for Safety and Hygiene of Kyoto University (Member), Subcommittee for Safety and Hygiene of Graduate School of Agriculture of Kyoto University (Chairperson) (Off-campus) Special committee for recycling system of bio-waste-materials of Technical committee of Japan Organics Recycling Association (Chairperson),
- Iida, M.: (On-campus) Member of Annual Report Editorial Committee, Member of Student Life Committee, Member of Space Collaboration System Committee

Suguri M: (On-campus) Member of KAIS Steering Committee

Masuda R: (On-campus) Observer of Experimental Drain from the Facility of Bio-production Engineering

# 2.5.15 Laboratory of Agricultural Process Technology

Staff Professor : Ikeda, Yoshio, Dr. Agric. Sci. Associate Professor: Kato, Koro, Dr. Agric. Sci. Assistant Professor : Nishizu, Takahisa, Dr. Agric. Sci. Students and research fellows Foreign research associate: (1) Doctor's program: (1) Master's program: (5)

Undergraduate : (4)

# A. Research Activities (2004.4-2005.3)

# A-1. Main subjects

a) Automatization of Quality Control Technology for Post-harvest Produce

The research and development of the quality control technology by the image and optical information are the nucleus of the present main subjects. The machine vision system is applied to develop the judging system for the outside appearance of the flower, especially the degree of curvature of the rose stem, in order to realize the quick and correct discrimination of the flower quality. This system is constructed on the PC and combined with the image analysis system. The chemical constituents of the fruits are estimated with the spectral characteristics of the transmitted and reflected near infrared ray and confirmed with the high performance liquid chromatography (HPLC). The new model for the reflectance spectra are proposed and the algorithm for estimating the coefficients involved in this model are developed, and detection of the defects on the mango surface are now being tried.

For the basic research of automatization of milling process, the acoustic monitoring system of the sound produced in test mill is developed. As the basic research result, it was clarified that the lower frequency component of about 1000 Hz moved to the higher frequency as milling process. At the present time, the sound in the milling facility for Japanese SAKE is being analyzed.

b) Automatization for Breeding and Controlling the Cattle

In order to recognize the individual cattle and breed it, we are developing the technologies through which the individual cattle is identified with its vocalization. The voice spectra of the cattle are estimated with the maximum entropy method to characterize the vocalization in the frequency domain. The parameters involved in the estimated power spectra are utilized to identified the individual cattle through the discriminant analysis. In the present step of this research, the judgment of the cattle's physiological conditions is the target.

The black-and-white pattern on the milking cow (Holstein) is analyzed to recognize the individual animal. And the image of the face of cow is analyzed to identify the individual. The image of the iris pattern is analyzed for individual recognition of the cattle.

c) Development of Harvesting Robot System for Tropical Fruits

The visual sensor for detecting the fruits in the tree is now investigated.

d) Nondestructive Measurement of Internal Information of Agricultural Products and Living Bodies by Electrical physical Properties

The change of electrical properties based on growth and senescence of tissue is being studied,

using a wide range of frequencies. The nondestructive inspection method of the freshness of vegetables and fish using the decrease of the resistance based on senescence of cell membranes; the study on the measurement of moisture gradient of internal grain using frequency characteristics of electrical capacitance are being studied. Image formation of the temperature distribution in living body using multi-frequency microwave computer tomography and monitoring of rice cooking process by  $300 \text{kHz} \sim 3 \text{GHz}$  impedance using reflection method are also being studied.

e) Application of Physical Properties to Quality Evaluation of Farm Products- Electrical Density Sorting of Fruits

We developed a precise measuring method of fruit volume using electrical capacitance and developed a new density sorting method. The method was put into practice to evaluate the sugar content, ripeness and hollowness for watermelons and melons at new packing houses. Recently, the electrical density sorting machines have suddenly spread in many packinghouses. As for the melon, prediction of softening using density and transmitted light and further applications of the electrical sorting method to other fruits such as citrus fruits are being studied.

f) Visualization of Component Distribution of Agricultural Products by Near-Infrared Spectroscopy

In individuals and in the individual, component distribution of the farm and marine product is not uniform. In measurement of grain moisture and nondestructive quality assessment of fruit sugar content, often the distribution becomes problem. Then, a multi wavelength near infrared spectroscopy imaging system using supersensitive monochrome chilled CCD camera and interference filter was constructed.

Transmitted light and reflected light of fruit and grain layer were photographed, and using the absorbance image, visualization on component distribution of agricultural products such as the moisture distribution of grain layer and visualization on fruit maturity are being studied. As for egg, nondestructive measurement of freshness by near-infrared transmission spectroscopy is being studied.

### g) Development of Solar Desiccant System for High Quality Grain Drying

We are developing solar desiccant drying methods to realize the low cost and high quality paddy drying process using entirely natural energy. We developed a new drying system with both solar battery ventilation and solar desiccant drying method using zeolite. The ventilating and circulating air is controlled by computer according to the air conditions of both the inside of the drying glass house and atmospheric. This system has a temporary energy storage function for a cloudy time or a night operation, and it can dry the grain by natural clean energy, keeping the grain at high quality.

h) Clarification of formative mechanism of uneven grain moisture in silo and the monitoring

Unevenness of grain moisture forms during storage, even if the silo were charged with uniform moisture grain. In order to elucidate the formative mechanism of the uneven grain moisture layer, the moisture transfer and dew condensation in grain silo caused by temperature difference and the measurement of moisture distribution in grain layers using time-domain reflectometry (TDR) and TDT are being studied.

#### i) Nondestructive Quality Evaluation of Food Stuff by Ultrasound

The effects of the chemical constituents and the non-homogeneous structure of the agricultural products to their physical properties are investigated systematically in order to apply

these physical properties to obtaining the internal information of the agricultural products and the foods nondestructively. Currently, the liquified foods and starch gel are used as the samples to evaluate the state of the water contained in the food and to measure the concentration of emulsion with the non-linear acoustic parameter B/A which is one of the acoustic characteristics of the material. And the influence of intercellular space or air bubbles in the agricultural products and food materials on their acoustic properties is being studied.

j) Measuring of Volume/density of Agricultural Products and Foodstuffs by Acoustic Resonance

We developed a volume/density measuring system using a Helmholtz resonator. This system enables us to measure volume/density of not only solid food or liquid food but also solid-liquid mixture food. Further experiments will be made for applications to determine void fraction of the porous food in the future. Now we are developing a new type resonator for on-line measuring of volume, a monitoring system of cream whipping process and a fuel meter of orbit transfer vehicle in space by utilizing Helmholtz phenomena.

k) Porousness Estimation for Foodstuffs by Acoustic Resonance

Porousness is one of physical properties related to texture of foodstuff. We started to develop application of Helmholtz resonance phenomena to porousness estimation for foodstuffs. Now we investigate relations between Helmholtz resonant frequency and airflow resistance of grain layer used as a porous sample.

#### A-2. Publications and presentations

### a) Publications

#### Books

Nishizu, T.: "Ultrasound, Physical properties of agricultural products, Internal gas volumetrics for agricultural products" New Agricultural Infomatics (edited by Japanese Society of Agricultural Infomatics), 154-155, Yokendo, Tokyo, 2004(in Japanese)

#### Original papers

- Kato, K. and M. Matuda: Prediction of Melon Fruits Softening using Density and Transmitted Light, Journal of Key Engineering Materials, Trans Tech Publications Ltd (SCI indexed journal) Vol.270-273, "Advances in Nondestructive Evaluation"; 1064-1070, 2004
- Kato, K: Recent trend around Intellectual Property Right, Journal of the Society of Irrigation, Drainage and Reclamation Engineering, Vol.72, No.10; 3-6, 2004
- Kawada, S., Ikeda, Y., Kim H. and T. Nishizu: Identification of Japanese black cattle by the faces. Kansai Branch Report of JSAM, No.96; 73-74, 2004
- Matsuda, M. and K. Kato: Transmitted Light Image Measurement during Ripening and Softening Process of Melon Fruit. Kansai Branch Report of JSAM, No.96; 77-78, 2004
- Takashima, Y. and K. Kato: Impedance Measurement of Rice by Reflection Method and Four Terminals Pair Method during Rice Cooking and Ageing Process- Electronic Characteristics of Rice in Electric Rice Cooker by Reflection Method (0.3M~3GHz) and Four Terminals Pair Method (1kHz~13MHz)-, Kansai Branch Report of JSAM, No.96; 79-80, 2004
- Kim, H., Ikeda, Y. and T. Nishizu: Identification algorithm of Korean cattle (HanWoo) with their face for the precision livestock farming. Kansai Branch Report of JSAM, No.97; 26-29, 2004
- Kim, H., Ikeda, Y., Nishizu, T. and I. Lee: Identification of Japanese black cattle by the faces for

precision livestock farming. Journal of Biosystems Engineering, 29(4); 341-346, 2004

- Kim, T. and H. Choi: Development of drying system for swine waste slurries using the heat pump. Journal of Biosystems Engineering, 30(1); 32-37, 2005
- Kim, T., Ikeda, Y. and H. Choi: The Identification of Japanese black cattle by their faces. Asian-Australasian Journal of Animal Sciences, 18(6); 868-872, 2005
- Nishizu, T., Torikata, Y., Yamashita, T. and A. Nakano: Technique for measuring liquid volume in a closed container. JASMA, 21; 44, 2004
- Nakano, A., Torikata, Y., Yamashita, T., Tateno, A. and T. Nishizu: Liquid volume measurement for cryogen. JASMA, 21; 45, 2004
- Nishizu, T.: Volume measurement for single rice kernel by acoustic method. Journal of Japanese Society of tasty technology, 6; 4-8, 2005

### Patents

- Application number PCT/JP2005/005272 "Implement and Method for Measuring Volume", Inventors: Nishizu, T., Nakano, A., Torikata, Y. and T. Yamashita, Applicants: President of Kyoto University, National Institute of Advanced Industrial Science and Technology, Japan Space Forum and Mayekawa MFG.Co.,Ltd., application date: Mar. 23, 2005
- Application number 2005-94571 "Implement and Method for Measuring Volume", Inventors: Nakano, A., Nishizu, T., Torikata, Y. and T. Yamashita, Applicants: National Institute of Advanced Industrial Science and Technology and Mayekawa MFG.Co.,Ltd., application date: Mar. 29, 2005

b) Conference and seminar papers presented

The 63nd Annual Meeting of Japanese Society of Agricultural Machinery: 1 paper

The 5th Annual Meeting of Japan Society for Food Engineering: 1 paper

The 112nd Annual Meeting of Kansai Branch of JSAM: 1 paper

The 113rd Annual Meeting of Kansai Branch of JSAM: 6 papers

The 2nd Precision Livestock Farming: 2 papers

The 3rd international workshop on smart sensors in livestock monitoring: 2 papers

AgEng2004 Leuven Conference: 1 paper

JASMAC20: 2 papers

## A-3. Off-campus activities

### Membership in academic societies (roles)

- Ikeda, Y.: Japanese Society of Agricultural Machinery (Director); Kansai Branch of Japanese Society of Agricultural Machinery (Member of Board)
- Kato, K.: The Society of Agricultural Structures, Japan (Executive director, Chairman of selection committee of institute prize); Japanese Society of Agricultural Machinery (Councilor,);
  Kansai Branch of Japanese Society of Agricultural Machinery (Member of Board); Japan Society for Food Engineering (Councilor, Member of executive committee of the 6 th annual meeting, Member of the editorial staff of Food Engineering handbook)
- Nishizu, T.: Japanese Society of Agricultural Machinery (Member of international exchange committee, Member of executive committee of the 63rd annual meeting, Member of executive committee of ISMAB2004); Japan Society for Food Engineering (Member of executive committee of the 6th annual meeting)

### Research grants

- Kato, K.: Grant for fundamental equipment of education and study, "Discrimination method of internal quality of fruit" (Kansai TLO)
- Nishizu, T.: JSPS Grant: Encouragement of Young Scientist(B), "Development of non-destructive measurement method for foodstuff's porousness by using Helmholtz resonance phenomena" (Head), Grant2004 by Japanese Society of tasty technology, "Development of volume measurement system for single rice kernel by acoustic method" (Head)

## A-4. International Cooperation and overseas activities

### International meetings (roles)

Ikeda, Y.: the 3rd international workshop on smart sensors in livestock monitoring, Leuven, Belgium (Invited Speaker)

Ikeda, Y.: the 2nd Precision Livestock Farming, Pingtung, Taiwan (Invited Speaker)

#### Scholar from abroad

Kyoto University guest professor: 1 (Prof. P. Chen, UC Davis)

Foreign research associate: 1

# B. Educational Activities (2004.4-2005.3)

### B-1. On-campus teaching

a) Courses given

Undergraduate level: Introduce to Agricultural and Environmental Engineering II (Ikeda, shared), Outline of bio-production systems (Ikeda, shared), Farm Processing Machinery (Ikeda), Thermodynamic and Heat transmission (Kato), Measurement Science (Kato), Laboratory Course In Agricultural Machinery I and II (Kato and Nishizu, shared), Practice in Data Processing II (Nishizu, shared), Seminar in Agricultural Machinery (Ikeda, Kato, and Nishizu, shared), Seminar in Agriculture and Environmental Engineering(Kato and Nishizu, shared)

Graduate level: Agricultural Process Engineering (Ikeda), Special Seminar in Farm Processing Technology I and II (Ikeda and Kato, shared), Laboratory Course in Farm Processing Technology (Ikeda, Kato and Nishizu, shared)

# B-2. Off-Campus teaching

## Part-time lecturer

Kato, K.: Faculty of Bioresource, Mie University (Electronic Measurement Science for Environment)

### B-3. Overseas teaching

### Students and research fellow from abroad

Graduate Student: (Thailand 1)

# C. Other Remarks

Kato, K.: Special committee member for intellectual property right of Oska district court and Osaka high court, Special investigator of National Institute of Science and Technology Policy, Special committee member for evaluating upgrade business using advanced

# Chair of Nuclear Science and Engineering (Research Reactor Institute)

# 2.5.16 Laboratory of Radiation Safety Control

Staff Professor : Fukui, Masami, Dr.Eng., Dr. Agric. Sci. Assistant Professor : Yamasaki, Keizo, M.Eng., Assistant Professor : Takahashi, Tomoyuki, Dr.Eng., Assistant Professor : Yashima, Hiroshi, Dr.Eng.,

Students

Master's program : (3)

# A. Research Activities (2004.4-2005.3) A-1. Main subjects

a) Behavior of <sup>41</sup>Ar in the nuclear facilities and its reduction of discharge into the environment

The radioactive gas,  $^{41}$ Ar has been produced at high concentration by neutron activation near the reactor core in the Kyoto University Research Reactor. A pipe line for anexhaust stream, so-called sweep gas, was fabricated at the construction of the reactor in 1964 in order to exhale  $^{41}$ Ar from the facilities above to the environment. Other exhaust lines with decay tanks were established separately from the sweep line for both the cold neutron source in 1986 and the heavy water tank in 1996, respectively, because a higher amount of  $^{41}$ Ar was thought to be produced from these facilities due to the improvement. As a result, a slight change in the flow rate of the exhaust was found to have a great deal of influence on both the  $^{41}$ Ar concentration in the reactor room and the rate of emission from the stack. By setting the flow rate suitably in the exhaust line, the rate of  $^{41}$ Ar emission from the biological shielding into both the work place in the reactor room and the environmental has been controlled as low as reasonably achievable.

b) Estimating the concentration of HTO in waters in the environment

A great amount of tritium is likely to be released from the operation of the nuclear reprocessing plant in Rokkasho, Aomori Prefecture. The discharge of tritium in the environment is concerned for the radiation exposure on the public near the facilities. For the above, the environmental impact assessment is required to make sure the safety by measuring the concentration of tritium in the environment. As a first step of an analogical research, the concentrations in moisture in air and fresh waters near the Kyoto University Research Reactor which releases a small quantity of tritium, has been measured and compared with those in water samples that are not contaminated artificially.

c) Environmental behavior and dose assessment of radon and its progeny

Natural radiation exposure is one of the constraints for radiation exposure to general publics and workers. Not only the behavior and the property of the radon and its progeny in the indoor

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# A. Research Activities (2004.4-2005.3) A-1. Main subjects

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c) Environmental behavior and dose assessment of radon and its progeny

Natural radiation exposure is one of the constraints for radiation exposure to general publics and workers. Not only the behavior and the property of the radon and its progeny in the indoor and outdoor environment, but also the standardization of the aerosol attached radon progeny size distribution measurements in a building made of thick concrete using some low pressure cascade impactors and the generation process of radioactive aerosols by attachment between the radon progeny and standard aerosols, are now proceeding on to assess the natural radiation dose.

d) Research and development of models for behavior of substances loaded in terrestrial biosphere

For evaluation of the effects of environmental-load substances such as radioactive ones from nucliear facilities, it is important to understand the behavior of substances in terrestrial biosphere. In 2004 FY, our main theme in this category are as follows; (1) research and development on dynamic compartment model for behavior of contaminants in paddy field, (2) research and development of management system on environmental parameters such as distribution coefficients measured for the soils obtained from cultivated fields in Japan.

e) Residual activity estimation in the nuclear and accelerator facilities

The nuclide-production cross-sections are required to estimate the radioactivities in the nuclear and accelerator facilities. In this study, the nuclide-production cross-sections induced by charged particle and neutron have been measured and residual activities have been evaluated from measured results.

f) Remediation of the water environment contaminated with refractory organic matter (ROM), endocrine disruptors, and arsenic

Application of soil percolation and phytoremediation techniques were studied to renovate the water environment contaminated with ROM and endocrine disruptors. The distribution of OM in the soil-water environment as well as the effect of plants on the behavior of OM were studied by monitoring dissolved OM by colour, dissolved organic carbon concentration and COD measurements, and sequential fractionation techniques. Analyses of endocrine disruptors using gas-chromotograph- mass specgrometry are now under way. Performance of a manganese sand processed from manganese and bismuth metals was tested to develop an inexpensive arsenic sorbent.

### A-2. Publications and presentations

#### a) Publications

#### Original papers

- Fukui, M. : Twenty years experience in monitoring <sup>41</sup>Ar in a research reactor and decrease of its discharge into the environment. Health Phys. 85; 384-396, 2004
- Yashima, H., Y. Uwamino, H. Iwase, H. Sugita, T. Nakamura, S. Ito and A. Fukumura : Cross sections for the production of residual nuclides by high-energy heavy ions. Nuclear Instruments and Methods B226; 243-263, 2004
- Yashima, H., Y. Uwamino, H. Sugita, S. Ito, T. Nakamura and A. Fukumura: Induced radioactivity in Cu targets produced by high-energy heavy ions and the corresponding estimated photon dose rates. Radiatation Protection Dosimetry 112; No.2, 195-208, 2004
- Fujikawa Y., M. Fukui, T. Baba, T. Yoshimoto, E. Ikeda, M. Saito, H. Yamanishi, T. Uda: Variation of terrestrial gamma radiation in Toki, Japan – Comparison between gamma-ray spectrometry using Ge semiconductor and ICP-MS measurement. High levels of natural radiation and radon areas: Radiation Dose and Health Effects. International Conference Series 1276, Elsevier, 415-417, 2005

Yamasaki,K., Y. Oki, Y. Yamada, S. Tokonami and T. Iida: Optimization of measuring methods on

size distribution of naturally occurring radioactive aerosols, International Congress Series 1276, Elsevier, 297-298, 2005

- Takahashi, T., Y. Nakamaru, S. Uchida, N. Ogiu, M. Terakado, K. Tomita, H. Ikeda and N. Kurosawa: Development of management system on environmental parameters Development of mapping system-, Environmental & Sanitary Engineering Research 18; 161-165, 2004 (in Japanese)
- Fukutani, S. and T. Takahashi: Horizontal and vertical distribution of cesium-137 concentration in paddy field. Environmental & Sanitary Engineering Research 18; 219-222, 2004 (in Japanese)
- Tsukada, H., A. Takeda, T. Takahashi H. Hasegawa, S. Hisamatsu and J. Inaba: Uptake and distribution of <sup>90</sup>Sr and stable Sr in rice plants, Journal of Environmental Radioactivity 81; 221-231, 2005

#### Reports

- Fukui, M.: Promotion of research on prevention and restoration for environmental contamination with radioactive materials. Science Council of Japan (Partial contribute), 23 Mar. 2005 (in Japanese)
- Fukui, M.: Tritium around a research reactor, 39th scientific meeting, Kyoto University Research Reactor Institute, 249-254, 2005 (in Japanese)
- Fukui, M.: Report of Workshop on "Subsurface Radionuclide migration Case Studies", Miringen, Swizland. Japan Atomic Energy Society 46; 573-575, 2004 (in Japanese)
- Fukui, M.: Concentrations of HTO in the environment related to accidental releases from nuclear facilities. Reports of LHD collaborating research meeting, 62-68, Sept. 2004
- Yamasaki, K., Y. Oki, Y. Yamada, S. Tokonami and T. Iida: Some Problems on Measurement of Activity Size Distributions with Cascade Impactors, Proceedings of the Fifth Workshop on Environmental Radioactivity, KEK, 180-183, 2004
- b) Conference and seminar papers presented
- 2004 autumn meeting of the Atomic Energy Society of Japan: 1 presentation

2004 annual meeting of Japan Health Physics Society: 3 presentations

2004 symposium of Japan Association of Aerosol Science and Technology: 1 presentation

### A-3. Off-campus activities

### Membership in Science Council of Japan, etc.

Fukui, M.: Science Council of Japan (Member of the research committee)

### Research grants

Monbusho Research Grant: The study on the optimal design of water purification systems utilizing natural attenuation mechanism for reduction of COD in the water environment (Fukui, Partial charge)

### A-4. International cooperation and overseas activities

#### Editorial board of the International journal etc.

Fukui, M. : J. Contam. Hydrol. (Elsevier, Associate Editor)

# B. Educational Activities (2004.4-2005.3)

# B-1. On-Campus teaching

# a) Course given

Undergraduate level: Behavior of Contaminant in the Environment (Fukui)

Graduate level: Environmental Radiation Protection (Fukui), Seminar in Environmental Radiation Control I, II (Fukui), Applied Environmental Radiation Technology (Fukui), Experimental Radiation Control in the Environmental (Fukui)

# C. Other remarks

# Safety Management

Fukui, M.: Director of Radiation Control, Member of Nuclear Safety Committee, Member of Health Physics Committee, Member of Radiation Committee on Medical Usage

Takahashi, T.: Member of Health Committee of Kumatori Campus

# Off-campus activities

- Fukui, M.: Japan Atomic Energy Research Institute (Scientific member for (1) Nuclear Fuel Cycle Committee, (2) Waste Management Committee and (3) Research Commission), Environmental Science Institute (Scientific Member for Environmental Inpact Assessment Committee in soil system), Nuclear Waste Management Organization of Japan (NUMO: Technical Advisor), Central Research Inst. of Electric Power Industry (Member of Environmental Impact Assessment Committee for Decommission of Power Plant), National Institute of Fusion Science (Collaborating researcher)
- Yamasaki, K.: National Institute of Radiological Sciences (Correspondence Member of Japan Expert Panel for UNSCEAR), National Institute of Radiological Sciences (Visiting researcher),
- Takahashi, T.: Nuclear Safety Research Association (Member of committee on network for radiation emergency medicine in Osaka), Nuclear Safety Technology Center (Member of sub-group on making of teaching materials for nuclear disaster preventation), Atomic Energy Society of Japan (Member of level 3 PSA working group in standards committee), National Institute of Radiological Sciences (Visiting researcher), National Institute of Fusion Science (Collaborating researcher).

### Awards

Yashima, H.: Promising Endeavor Award, Atomic Energy Society of Japan Award