

1.3 Joint Research

(1) List of joint research

Title of Joint Research Project

** A representative of joint research to carry out each project*

Focused Research

Development and characterization of drought-stress tolerant plants using genetically engineering and arid-land simulator system.

Kiichi FUKUI, Hisashi TSUJIMOTO, Sachihito MATSUNAGA, Wataru TSUJI, Hisashi TOMEMORI, Tsutomu KOHINATA and Atsushi TSUNEKAWA*

Establishment of Japan-China-Korea Collaborative Research Center for Combatting Desertification in Ningxia District in the Loess Plateau, China.

Kyoichi OTSUKI, Masaharu KITANO, Osamu TADAUCHI, Kaoru KASHIMA, Ma Yongqing, Ryunosuke TATENO and Norikazu YAMANAKA*

General Research

Urban Developments and its Character in Arid Land of North America

Hiroki YAMASHITA and Masato SHINODA*

The effect of Asian dust storm on human health

Youichi KUROZAWA, Haosheng Mu, Kazunari ONISHI and Masato SHINODA*

Hydrological cycle in grassland ecosystem in Mongolia and Kazakhstan

Yoshihiro IJIMA and Masato SHINODA*

Future risk assessment of dzud in Mongolia using CMIP3 multi-model dataset

Kaoru TACHIIRI, Gomboluudev Purevjav and Masato SHINODA*

Stoss side slope angles of transverse ridges in sand dunes

Yoshinori KODAMA and Masato SHINODA*

Analysis of seasonal and interannual variation of rainfall in Mongolia in summer with its mechanism

Keiji KIMURA and Masato SHINODA*

Quality control and utilization of zoo-meteorological data of Mongolia for mitigating a disaster impact

Yuki MORINAGA and Masato SHINODA*

Research on the atmosphere-ground surface interaction in arid region.

Masao MIKAMI, Yutaka YAMADA, Masashide ISHIDUKA and Masato SHINODA*

Estimation of plant biomass and soil moisture in Mongolian semiarid grassland

Tomoko NAKANO and Masato SHINODA*

Estimation of soil moisture and evapotranspiration for yellow-dust monitoring

Masahiro TASUMI, Emi KANDA and Reiji KIMURA*

Decadal trends of spatial distribution of threshold wind speed of wind erosion in Mongolia

Dai MATSUSHIMA, Yasunori KUROSAKI and Reiji KIMURA*

Water management in Southern Tunisian Oasis

Erina IWASAKI, Hiroshi KATO, Nobuhiro MATSUOKA, Haruyuki FUJIMAKI and Reiji KIMURA*

A study on small Vertical Axis Wind Turbines for the purpose of utilizing wind energy at Arid Lands of the world

Yutaka HARA and Reiji KIMURA*

Irrigation system in Lower Egypt: Multi-Disciplinary research of area study collaborated with archeology and natural sciences

Hiroshi KATO, So HASEGAWA, Erina IWASAKI, Nobuhiro MATSUOKA and Reiji KIMURA*

Prediction of surface soil moisture under Caragana stands by meteorological data

Nobuhiro MATSUOKA, Satoshi NAKANO and Reiji KIMURA*

The Results and the Problems of the Chinese Policy of Reverting Forests and Grasslands to Farmlands and grazing lands

Jianzhong Zhou and Reiji KIMURA*

Conservation and management of fresh water resources in a sandy coastal aquifer

Yuji ITO, Kei NAKAGAWA, Takayuki KAWAI and Hiroshi YASUDA*

Relationships between global climate change and local hydrological features inherent in arid and semi-arid regions

Koji NISHIYAMA and Hiroshi YASUDA*

Comparative study of growth pattern of Mesquite (*Prosopis* sp) seedlings among different soil water regimes.

Kiyotsugu YODA, Buho HOSHINO, Ahmed Eldoma and Hiroshi YASUDA*

Analysis on soil moisture and solute transport to improve agricultural products in arid area

Tadao AODA and Hiroshi YASUDA*

Effects of fertilizer distribution on greenhouse gas emissions with drip irrigation

Kosuke NOBORIO, Hiroyuki OCHIAI, Shinpei OHTA and Hiroshi YASUDA*

Development of remote sensing system in aridland farming (3) -Development of highly reliable adhoc multihop communication technology in aridland-

*Kensuke MURAKAMI**, *Satoru KISHIDA*, *Kentaro KINOSHITA* and *Atsushi TSUNEKAWA*

Comparative study on soil factor affected to biological production at desert. Influence of form of organic matter.

*Kazuhisa HASEGAWA**, *Kensuke KONDO* and *Atsushi TSUNEKAWA*

Development of remote sensing system in aridland farming (1) -basic examination concerning improvement of performance and reliability of solar photovoltaic system in aridland-

*Satoru KISHIDA**, *Kentaro KINOSHITA*, *Kensuke MURAKAMI* and *Atsushi TSUNEKAWA*

Development of remote sensing system in aridland farming(2) -Development of highly reliable and environmental monitor on aridland-

*Kentaro KINOSHITA**, *Satoru KISHIDA*, *Kensuke MURAKAMI* and *Atsushi TSUNEKAWA*

Evaluation on stability of soil organic matter fractions by stable carbon isotope analysis through soil profile

*Kenji TAMURA**, *Takashi KANDA*, *Humika ISA* and *Atsushi TSUNEKAWA*

Bio-stimulators improving dryland crop production

*Eiji NISHIHARA**, *Van der Watt*, *Elmarie* and *Mitsuru TSUBO*

Estimation of grassland production in Loess Plateau China

*Shohei SHIBATA** and *Mitsuru TSUBO*

Physiology and biochemistry of noxious plants in semi-arid regions

*Yukihiro SUGIMOTO**, *Masaharu MIZUTANI*, *Kotomi UENO* and *An PING*

Physiological evaluation and linkage disequilibrium analyses on drought tolerant-related characters in synthetic wheat lines

*Hisashi TSUJIMOTO**, *Hiroyuki TANAKA* and *An Ping*

Improvements of drought tolerance in wheat via enhancement of water absorption capability in the root systems

*Junichi KASHIWAGI** and *An PING*

Physiological mechanisms of salt tolerance in higher plants

*Mariko OKA** and *An PING*

Molecular physiological researches on enhancement of drought tolerance in silicate-treated sorghum

*Kiyoshi TANAKA**, *Yin Lina* and *Wataru TSUJI*

Study on eco-physiological properties of infertile land crops

*Jun ABE**, *Eiichi TANIMOTO* and *Wataru TSUJI*

Mechanisms of salt tolerance and ozone tolerance in the transgenic tobaccos that have high capacity to scavenge reactive aldehydes

*Junichi MANO** and *Wataru TSUJI*

Researches on water use and water stress resistance of shrub species grown in semiarid land

*Hideyuki SHIMIZU**, *Shoko KOBAYASHI*, *Hiroshi SASAGAWA* and *Wataru TSUJI*

Mechanisms of tolerance to environmental stress of millets and collection both of culture method and genetic resources in China

*Asana MATSUURA**, *Kohei MURATA* and *Wataru TSUJI*

Establishment of a measurement system on carbon balance in crops under over-optimal temperature

*Hideki ARAKI** and *Wataru TSUJI*

The effects of slope position on soil-plant interaction in a semi-arid forest ecosystems

*Ryunosuke TATENO**, *Du Sheng* and *Norikazu YAMANAKA*

Studies on mycorrhizal fungi that facilitate drought resistance of Japanese black pine

*Kazuyoshi FUTAI**, *Yuko TAKEUCHI*, *Takeshi TANIGUCHI* and *Norikazu YAMANAKA*

Experimental studies on relationships between drought and salt tolerances and the ability of osmotic adjustment in economically-important plants in semi-arid region of China

*Fukuju YAMAMOTO**, *Yoshikazu OKADA* and *Norikazu YAMANAKA*

Estimating salt tolerance from the oxygen and carbon isotope compositions in arid plants

*Naoko MATSUO**, *Rina KOYAMA*, *Keitaro HUKUSHIMA* and *Norikazu YAMANAKA*

Studies on Social Development in the Loess Plateau

*Hiroshi NAWATA** and *Norikazu YAMANAKA*

Changes of xylem hydraulic conductivity and stomatal regulations of water loss in response to water stress in ring-porous and diffuse-porous species.

*Naoko MIKI**, *Ken YOSHIKAWA*, *Lingli YANG*, *Mayumi OGASA*, *Maria OKAMOTO*, *Yuki MURAKAMI* and *Norikazu YAMANAKA*

Specific characteristics for salt tolerance mechanism of halophilous plants

*Shingo TANIGUCHI**, *Kento UCHIURA*, *Kanae KENMOTSU* and *Norikazu YAMANAKA*

Experimental studies on the salt tolerant characteristics of halotolerant plant and remediation and conservation of the saline soil

Kenji IWAMA and Norikazu YAMANAKA*

Evaluation of pore-air behavior in unsaturated soil

Kohji KAMIYA and Mitsuhiro INOUE*

Study of sandponics bet system using capillary uptake method

Naotaka MATSUZOE, Kazuhumi ZUSHI, Kensuke KONDO, Takahiro WAJIMA and Mitsuhiro INOUE*

Technological development for on-site measurement of air permeability and continuous air content in sand soil using sound resonance

Kimihito NAKAMURA, Kotaro HUKADA and Mitsuhiro INOUE*

Research on groundwater management using plant transpiration and water uptake

Yoshinobu KITAMURA, Takayuki ANDO, Katsuyuki SHIMIZU, Miki FUKUSHIMA and Mitsuhiro INOUE*

Contribution of zero flux plane on salt accumulation of irrigated field under semi-arid condition

Taku NISHIMURA, Chihiro KATO and Mitsuhiro INOUE*

Research on Non-destructive measurements of soil hydraulic properties of unsaturated soils by using Ground-penetrating radar

Yuji TAKESHITA, Taku YAMASHITA, Yasunori TAKINO, Seiichiro KURODA and Mitsuhiro INOUE*

Experimental study on water saving irrigation by using capillary barrier of soil

Toshihiro MORII and Mitsuhiro INOUE*

Two dimensional measurement of water content and EC in surface area with TDR system

Hiroyuki CHO, Hideki MIYAMOTO and Mitsuhiro INOUE*

The Challenge of Reducing Phosphorus Escape from the Agricultural Lands to Protect Environment

Sadahiro YAMAMOTO, AHMAD ZAHOOR, Tsuneyoshi ENDO and Mitsuhiro INOUE*

Establishment of restoration method for salt-damaged fields using a rice husk underdrainage system

Koji INOSAKO, Tadaomi SAITO and Mitsuhiro INOUE*

The evaluation on soil environment affected by irrigation at arid land

Teruo HIGASHI, Takuma ORIOKU, Yoshie YAGETA and Mitsuhiro INOUE*

The Utilization of Indigenous Technology for Water and Eco Resources and Rural Socio-Economic Development in West Asia and North Africa Regions

Ryuich HARA and Takayuki ANDO*

Incentive Research by Young Scientists

Stock and dynamics of pedogenic carbonate carbon under cold desert

Maki ASANO and Atsushi TSUNEKAWA*

Physiological studies on drought and salt tolerance of apple and pear rootstock species.

Kazuhiro MATSUMOTO and Wataru TSUJI*

Geographical variation and distribution pattern of small to medium sized carnivores in arid area

Naoko KUROSE and Norikazu YAMANAKA*

Contribution of buried seeds to natural revegetation after vehicle track formation in Mongolian steppe

Toshihiko KINUGASA and Norikazu YAMANAKA*

Controlling Vapor Transport in Soils using Thermal Energy in Arid Region

Hirota SAITO and Mitsuhiro INOUE*

Development of method for accurate soil moisture measurement using dielectric probes in arid land environments

Tadaomi SAITO and Mitsuhiro INOUE*

Effects of Social Capital on Environmental Behavior in Arid Lands

Yohei KATANO and Takayuki ANDO*

Research Meeting

The International Symposium on the Long-term Monitoring of KOSA (Aeolian Dusts) and Desertification in East Asia

Kaoru KASHIMA, Kyoichi OTSUKI, Kohei MATSUNAGA, Aleksandr ORKHONSELENGE, Hiroki TAKAMURA and Masato SHINODA*

Forest Policy in China and Tree-planting Cooperation

Hideki KITAGAWA, Takehiko HOB0, Jun Rong GUO, Yuichiro HIRANO and Norikazu YAMANAKA*

Seminar on development and utilization of renewable energy for combating desertification and greening the desert in arid land

*Kotaro TAGAWA**, *Tsutomu HAYASHI*, *Reiji KIMURA*, *Katsumori MATSUSHIMA*, *Yoshihiro MIZUBAYASHI*, *Hiroyoshi KAMATA*, *Yutaka HASEGAWA*, *Koji TANABE*, *Tetsuya KAWAMURA*, *Yuko SATO*, *Akihumi KUTANI* and *Mitsuhiro INOUE*

Workshop on environmentally conscious remediation and prevention of desertification in semi-arid regions considering mass and energy circulation in soil

*Taku NISHIMURA**, *Masaru NISHIMURA*, *Ken KAWAMOTO*, *Kimihito NAKAMURA*, *Hirozumi WATANABE*, *Kazuhiro NISHIDA* and *Mitsuhiro INOUE*

(2) Summary of Joint Research

Focused Research

Development and characterization of drought-stress tolerant plants using genetically engineering and arid-land simulator system.

Kiichi FUKUI¹, *Hisashi TSUJIMOTO²*, *Sachihiro MATSUNAGA¹*, *Wataru TSUJI³*,
Hisashi TOMEMORI³, *Tsutomu KOHINATA¹*, *Joyce CARTAGENA¹* and *Atsushi TSUNEKAWA³*

1: Graduate School of Engineering, Osaka University

2: Faculty of Agriculture, Tottori University

3: Arid Land Research Center, Tottori University

To test drought stress tolerance of *Jatropha* (*Jatropha curcas*), we performed a water withholding experiment at the ALRC, Tottori University. Three lines of *Jatropha* (Philippines, Thailand, and Tanzanian origin) were subjected to the experiment. The *Jatropha* seedlings were planted in 1/5,000a Wagner pots and were placed in two subtropics desert simulators (30°C, RH: 40%, 14/10 h (day/night), light intensity: 80,000 Lux). The photosynthesis rate and the transpiration rate of eight individual plants were measured. The water contents in the pots were measured by electronic balances during the experiment.

In the first 3 days of the experiment, both transpiration rate and photosynthesis rate decreased severely, however, chlorosis and defoliation were not observed. From these results, it was suggested that such a quick response may make *Jatropha* resistant to the drought stress condition.

Meanwhile, to achieve high photosynthesis rate even under the drought stress condition, we produced transgenic *Jatropha* plants which overexpress the drought stress genes such as NF-YB, PPAT or glycinebetaine synthases at Osaka University. We will test the drought stress tolerance of these transgenic plants in the same method developed as above.

Moreover, in January, 2011, we held the 4th International Environmental Biotechnology Seminar at Osaka University. At the seminar, Hisashi Tsujimoto (Tottori University), Sachihiro Matsunaga, Joyce A. Cartagena, and Tsutomu Kohinata (Osaka University) gave oral presentations about their *Jatropha* researches.

**Establishment of Japan-China-Korea Collaborative Research Center for Combatting Desertification
in Ningxia District in the Loess Plateau, China.**

*Kyoichi OTSUKI¹, Masaharu KITANO¹, Osamu TADAUCHI¹, Kaoru KASHIMA²,
Yongqing MA³, Ryunosuke TATENO⁴ and Norikazu YAMANAKA⁵*

1: Faculty of Agriculture, Kyushu University

2: Faculty of Sciences, Kyushu University

3: Institute of Soil and Water Conservation, Chinese Academy of Science

4: Faculty of Agriculture, Kagoshima University

5: Arid Land Research Center, Tottori University

1. Fiesibility Study

Members of the joint research visited the Institute of Soil and Water Conservatrion, Ningxia University and related field sites and discussed the future research plan in the salinized desrets aroud Ningxia Autonomous Region and Shaanxi Province. We finally decided to conduct integrated joint research on combatting desertification in Dingpian, Shaanxi Province.

2. Symposium

Dr. Kaoru Kashima, the member of the joint research, held the international symposium mainly funded by Arid Land Research Center. The other members of the joint research attended the symposium and presented our activities as follows:

The International Symposium on Combating Desertification in East Asia

Host: Research Inst. East Asia Environment, Kyushu University

Co-host: Arid Land Res. Center, Tottori University et al.

DATE: February 27, 2011

LOCATION:International Hall, Kyushu University

Presented title of the joint research

Kyoichi OTSUKI (Fac. Agr., Kyushu Univ., Japan)

"Outline of the activities of the combating desertification group of RIEAE"

Kyoichi OTSUKI (Fac. Agr., Kyushu Univ., Japan)

"Ecohydrological aspects of exotic plantations in Loess Plateau, China"

Masaharu KITANO (Fac. Agr., Kyushu Univ., Japan)

"Sustainable Control of Soil Salinity in Irrigated Crop Fields under Desertification"

Osamu TADAUCHI (Fac. Agr., Kyushu Univ., Japan)

"Wild bee fauna and pollination biology for combating desertification and planting campaigns in Asian arid areas"

Kaoru KASHIMA (Fac. Sci., Kyushu Univ., Japan)

"The long-term monitoring of environmental changes and desertification at Central and East Asia"

Noriyuki YASUFUKU(Fac. Eng., Kyushu Univ., Japan)

"Project Research on Application of Medical Plant Licorice at Semi-arid Area in Mongolia"

Norikazu YAMANAKA (Arid Land Res. Center, Tottori Univ., Japan)

"Desertification and its Combating Measures in East Asia"

3. Workshop

Dr. Ma Yongqing, the member of the joint research, was invited to Kyushu University and Tottori University. The workshop for developing the joint research was held as follows:

Workshop: RIEAE Open Workshop for Combatting Desertification

Theme: "Bioenergy Plants & Traditional Chinese Medical Plants for Combatting Desertification"

Host: Research Institute of East Asia Environment, Kyushu University

Co-host: Arid Land research Center, Tottori University

Presenter: Dr. Yongqing Ma (Professor of Institute of Soil & Water Conservation, Chinese Academy of Science)

DATE

March 4, 2011

LOCATION

Large Conference Room, No.1 Building-6F, Fac.Agric., Kyushu Univ.

SCHEDULE

- 13:30 Induction Orobanche seeds germination by Switchgrass
- 14:30 Allelopathic effect of Switchgrass and its chemical basis
- 15:30 Parasitism of Cistanche on Tamarix and their production in Shaanxi province
- 16:30 General Discussion

General Research

Urban developments and its character in arid land of North America

Hiroki YAMASHITA¹ and Masato SHINODA²

1: Faculty of Regional Sciences, Tottori University

2: Arid Land Research Center, Tottori University

I researched about Urban Developments and its Character in Arid Land of North America. I analysed the 47 cities in 6 states, California, Nevada, Arizona, Utah, Colorado, and New Mexico, in the view points of population change, urban structure, and their economic existence basis. The results of my analysis are following. (1)There are many cities and metropolitan areas in California state, but other states has a few cities, which has over 100,000 population. (2)Such as Las vegas and Phoenix metropolitan area in the 5 states, a few cities have grown up the population rapidly after 1990's. (3)It is the serious problem of local government that the city area have been sprawled in Phoenix Metropolitan area and so. (4)There are many gohst town in arid land of USA. These cities were finished thier function of the gold ore, trafic point and so. (5)It is important that urban development of arid land demands careful consideration in the view point of sustainability.

The effect of Asian dust storm on human health

Youichi KUROZAWA¹, Haosheng MU¹, Kazunari ONISHI¹ and Masato SHINODA²

1: Faculty of Medicine, Tottori University

2: Arid Land Research Center, Tottori University

The occurrence of Asian dust events is a frequent problem, with associated health issues throughout Northeast Asia. However, the effects of Asian dust on human health are not well known in Japan. We evaluated the association between daily symptoms and dust events in Yonago, Japan. The subjects were 54 healthy individuals who were distributed survey sheets on nasopharyngeal, ocular, respiratory, and skin symptoms, which were quantified in February 2009.

We investigated the symptoms of the subjects on Asian dust days and control days, and compared the symptom scores with measures of suspended particulate matter (SPM), which is the indicator of Asian dust. The scores for symptoms were significantly higher on Asian dust days than on control days ($p = .020$). The skin symptom scores were positively correlated with the SPM level ($p < .001$). These results provide preliminary evidence that Asian dust influence the symptoms of healthy subjects, although the symptoms are not severe.

Hydrological cycle in grassland ecosystem in Mongolia and Kazakhstan

Yoshihiro IJIMA¹ and Masato SHINODA²

1: Japan Agency for Marine-Earth Science and Technology

2: Arid Land Research Center, Tottori University

We set up new observational plots for field experiment of snow removal in spring and rainfall in autumn at Kazakhstan Steppe. Atmospheric conditions were continuously assessed using automatic weather system (AWS) at the observation field nearby the Baraev Institute since November 2009. Observation items are as follows: Air temperature, relative humidity, global solar radiation, wind speed and direction, atmospheric pressure, rainfall, snow depth. Sets of measurements were installed to assess the soil temperature and moisture content at November 2010 by boring holes up to 2 m in these 3 plots. Using the observational data, soil moisture at rain removal plot showed earlier and deeper reduction than at control plot. Then the above- and below-ground biomass also exhibited remarkable reductions at snow removal plot as the first year response. We analyzed stable isotope ratio of water from snow and rainfall, and preliminarily got the seasonal variation of the ratio.

Future risk assessment of dzud in Mongolia using CMIP3 multi-model dataset

Kaoru TACHIIRI¹, Gomboluudev PUREVJAV² and Masato SHINODA³

1: Japan Agency for Marine-Earth Science and Technology

2: Institute of Meteorology and Hydrology , Mongolia
3: Arid Land Research Center, Tottori University

We have examined whether the existing approach of identifying snow disaster (dzud) in Mongolia is likely to be effective in a future where climate change will proceed. We applied a conventional dzud index, which is calculated using seasonal anomalies of temperature and precipitation to the outputs up to 2100 of the Phase 3 Coupled Model Inter-comparison Project (CMIP3) models for the Special Report on Emissions Scenarios (SRES) A1B scenario. This showed an increased dzud frequency mainly due to drought-like (i.e., high temperature with relatively small increase in precipitation) conditions in summer. We also investigated the effect of this summer condition on vegetation. We used the climate model outputs to assess future drought and dzud risk using a process-based vegetation model. This demonstrated a robust increase in leaf area index and a decrease in dzud risk. We recommend to use a process-based model rather than a conventional index for the future dzud risk assessment.

Stoss side slope angles of transverse ridges in sand dunes

Yoshinori KODAMA¹ and Masato SHINODA²

1: Faculty of Regional Sciences, Tottori University
2: Arid Land Research Center, Tottori University

It is well known that lee side slope angles of the transverse sand dunes are around 32 degree, an angle of repose of fine sand particles, but unclear as for stoss side slope angles. The objectives of the study was i) to clarify a characteristics of the stoss (windward) side slope angles of the transverse sand dunes by readings and measuring of topographic maps of various dune fields, and ii) to get some hints to consider how the stoss side slope angles of the transverse sand dunes are determined through wind duct experiments with mobile bed.

We measured stoss side slope angles with top maps of Tottori Sand Dunes (Tottori, Japan), Shonai Sand Dunes (Yamagata, Japan), Ohhara Sand Dunes(Kume Island, Okinawa, Japan), Imperial Sand Dunes (CA, USA), Kelso Dunes (CA, USA) and Great Sand Dunes(CO,USA). The results showed the mode of 4 to 10 degrees in frequency distributions and the most dominant angle of stoss side slopes in transverse dunes was 7degrees.

We also made wind duct experimental apparatus, which was 9 cm wide, 70 cm deep and 210 cm long, of coated plywood board and transparent acrylic plate. Miniature models of transverse sand dunes were constructed one by one with the Toyoura fine sand (0.2 mm) which had triangular forms of 29 cm high, 32 degrees of lee side slope and 4 types of stoss side slope: 32, 24, 16, 8 degrees respectively. A constant wind speed 7.0m/sec and no sand supply were maintained for all experiments. On 4 case experiments, cross sectional shapes of the sand dune models were measured every 5 to 20 minute and we conducted experiments totally 70 to 110 minutes in each case.

Results of the wind duct experiment were as follow: i) on 32 degree case of stoss side slope angle, the initial sand dune was separated into two ridges and both ridges became lowered. ii) On 24 and 16 degree cases, the initial sand dune was separated into two ridges and the downstream side ridge grew up with 4 to

9 degree straight stoss side slopes. iii) On 8 degree case, upper stream side and top parts of the sand dune were eroded by wind, as a result, a convex upward slope was formed in stoss side of the dune. If we conducted sand supply, straight stoss side slope could have maintained.

Seven degree angle is dominant in the stoss side slope of transverse sand dunes. Considering from these duct experiments, flow conditions are favorable for sand deposition on the lee side slope of the dunes when stoss side slope angles are around 7 degrees.

Analysis of seasonal and interannual variation of rainfall in Mongolia in summer with its mechanism

Keiji KIMURA¹ and Masato SHINODA²

1: Graduate School of Information Science and Technology, Hokkaido University

2: Arid Land Research Center, Tottori University

1. Trace of cyclone tracks

Center of cyclone was defined a point of the local minimum of atmospheric pressure with a weather chart of Sea Level Pressure (SLP). The centers of cyclones were traced every day in the period. The traces over Mongolia were picked up. Every trace has the information of the month. All cyclones moved from west to east because of westerly. For example, 17 cyclone tracks ran over Mongolia in the summer of 2002. 5 cyclones passed over Mongolia in May, 6 cyclones in June, 2 cyclones in July and 4 cyclones in August. Next, the precipitation distribution maps were made with CPC data. It was compared with the cyclone tracks, and the cyclones with precipitation in Mongolia were picked up. Then, only 8 cyclones of 17 cyclone tracks in summer of 2002 brought precipitation in Mongolia. The cyclones with precipitation were found twice in May, three times in June, twice in July and once in August. The number of the cyclone in 2002 was fewest in the study period. The interannual variability of the number of cyclones was not changed in the study period. But the cyclones with precipitation over Mongolia decreased until 2002 and slight increased after 2002.

2. Precipitation distribution and water vapor transportation

In this study, the pentad precipitation data was used because the CPC pentad precipitation data was homogeneous around Mongolia. Eastern Mongolia had lots of precipitation and west of Mongolia had a little precipitation at the 39th pentad (from July 10 to 14) in 1999. Water vapor transportation in Eastern Mongolia came from Japan Sea and the convergence was seen at the same area where it rained. Precipitation in west of Mongolia was not connected with the precipitation in Eastern Mongolia. This precipitation was caused by the water vapor transportation from another western cyclone.

3. Cyclone moving east and changing the water vapor transportation mechanism

The direction of water vapor transportation was different in Mongolia. There were few cases that water vapor transportation from Japan Sea reached to western Mongolia. In the other hand, there were many cases that water vapor transportation from not only Japan Sea but also north-western Mongolia reached to eastern Mongolia. We continue to analyze the relationship between the change of water vapor transportation mechanism and precipitation distribution when cyclones move eastward.

Quality control and utilization of zoo-meteorological data of Mongolia for mitigating a disaster impact

Yuki MORINAGA¹ and Masato SHINODA²

1: School of Commerce, Meiji University

2: Arid Land Research Center, Tottori University

A network of zoo-meteorological migratory observations was established in the end of the 1970s in Mongolia by the National Agency for Meteorology, Hydrology and Environment Monitoring (NAMHEM). The observations was aimed at understanding of environmental conditions affecting animal husbandry and at providing a basic information for a better livestock management. However, since the collapse of the socialism at the end of 1980's, the quality of the observation deteriorated due to the lack of instruments and technological assistance. For the purpose of the mitigation of meteorological disasters, authors have been working on the improvement of the observation, and also the quality control of the data.

As the pilot study of establishing the new zoo-meteorological observation network, the micrometeorological observations were carried out at the winter and summer camps of Mr. Chuluun, a herder who lives in Bulgan prefecture in Mongolia. The dzud (cold season disaster) have occurred just then, and more than 20% of livestock have died at the winter of 2009/2010. Observed hourly temperature was lower and hourly wind speed was larger on the monthly basis during the dzud winter compared with the former winter, 2008/2009.

The approximation formula $y = 0.4x + 12.3$ was applied on the scatter diagram of air temperature and gust speed in winter camp and summer camp for the dzud year, and the former year. The formula which was derived from the Mongolian zoo-meteorological studies, indicates the criteria for the difficulty in grazing for sheep. During the two winters, the summer camp condition exceeding the criteria, was observed 50.7% and 30.8 in the dzud year and the former year, respectively. For the winter camp, 29.3% and 20.8%, respectively. The results indicate that during winter time, the winter camp's meteorological condition is better than the summer camp's condition. Comparison of the winter meteorological conditions in the dzud year 2009/2010 and the former year 2008/2009 quantitatively showed that the dzud year was harsher in both summer and winter camp than the former year.

Research on the atmosphere-ground surface interaction in arid region.

Masao MIKAMI¹, Yutaka YAMADA², Masashide ISHIDUKA³ and Masato SHINODA⁴

1: Meteorological Research Institute, Japan Meteorological Agency

2: Rapid Engineering Team, The Institute of Physical and Chemical Research

3: Faculty of Engineering, Kagawa University

4: Arid Land Research Center, Tottori University

We have settled a 10 m tower for the observation of vertical dust flux from semi-arid region in Mongolia and made an observation on June 2010. It was confirmed that the vertical dust flux using gradient method is useful for the evaluation of vertical dust flux. This technique is used for the verification of dust emission

scheme. And we have reviewed the issues on observation of dust emission processes on a semi-arid region under dead brown grass surface condition and submitted the review to a scientific journal.

Estimation of plant biomass and soil moisture in Mongolian semiarid grassland

Tomoko NAKANO¹ and Masato SHINODA²

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CO₂ exchanges between the atmosphere and terrestrial ecosystems are highly related to the amount of growing plant and the soil moisture. We aim at estimating temporal and spatial variations in aboveground plant biomass and soil water content in semiarid grassland ecosystems using satellite remote sensing images. In the present study, we compute five vegetation indices (NDVI, EVI, LSWI, SAVI, and GR) from reflectance data of the Moderate Resolution Imaging Spectral radiometer (MODIS) and examine the relationships between those indices and values of aboveground plant biomass which were measured in semiarid grasslands of Mongolia. The result indicated that the NDVI and SAVI were highly related to aboveground plant biomass, suggesting that these indices are good proxies for estimating the plant biomass.

Estimation of soil moisture and evapotranspiration for yellow-dust monitoring

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This research focuses on a large-scale soil moisture estimation using satellite remote-sensing as a tool of monitoring water environment for yellow-dust production areas in arid and semi-arid lands. In this year, we evaluated the accuracy of soil moisture estimation via a surface temperature index (MTVDI), by the depth, using volumetric soil water content, land surface temperature and meteorological data measured at Shenmu, China. The result of estimation indicated that MTVDI estimated soil moisture very well (RMSE=0.028) at the general root zone of the local vegetation (i.e. 0-25cm) during 2004-2006 (except the winter time). The estimation accuracy of volumetric soil water content is the highest at near-land surface (RMSE=0.026 at 2cm depth), and degraded as the depth is increased (RMSE=0.035 at 25cm depth). While the MTVDI estimated the soil moisture availability of the root zone well, the computation of MTVDI still requires actual weather measurements at area of interests, and it prevents the large-scale application using satellite. We are currently researching on the method of computing MTVDI by radiation data obtainable solely from satellite images, instead using actual measured weather data. We have made three presentations at conferences in this year.

Decadal trends of spatial distribution of threshold wind speed of wind erosion in Mongolia

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We planned to parameterize the threshold wind speed of dust outbreak as a function of two variables which are the thermal inertia and the NDVI, using on-site observation data at Bayan Unjuul, Mongolia in 2008. However, we were not able to obtain necessary observation data because the data acquisition system did not drive very well. Hence, we will address the parameterization and estimations of spatio-temporal distribution of the threshold wind speed in the next fiscal year.

In this fiscal year, we estimated spatial distribution of the threshold wind speed in an area including Bayan Unjuul (45-48degN, 102-110degE) in the spring season of 2008, using an empirical formula of thermal inertia and the threshold speed relationship, found in the collaborative research performed in the fiscal year of 2009. Additionally, we compared the results of the threshold wind speed to the real wind speed and the dust storm data of the routine meteorological observations. As a result, we found that the dust storms occurred in two third of the cases that the real wind speed exceeded the estimated threshold speed.

Water management in southern Tunisian oasis

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(Participation to the symposium) Tunisia-Japan Symposium "Regional Development and Water Resource – A New Vision for Sustainable Society-" (Nov.28 - Dec.1 2010)(Alliance for Research on North Africa (ARENA), University of Tsukuba)

A study on small Vertical Axis Wind Turbines for the purpose of utilizing wind energy at arid lands of the world

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Wind power is clean and renewable energy; it is one of the promising energy sources useful for people in arid lands. However, small wind turbine has some problems, e.g., high introductory cost, low energy efficiency, and low durability. This study aims to elucidate the problems about small wind turbines and to obtain effective knowledge for development of practical small wind turbines. For these purposes, rotational speed variation of the vertical axis wind turbine (VAWT) placed at the Arid Land Research Center (ALRC) was investigated regarding the specific patterns of natural wind speed variation as the inputs. And simulation of the rotational speed variation was tried assuming some artificial wind speed patterns. As wind tunnel experiments, velocity field measurements at the wake of a small straight-bladed VAWT were carried out by using an ultrasonic anemometer under the constant wind speed condition. And the experimental results were compared with the results of the blade element momentum (BEM) theory, which is computationally low-cost and is often used for design and performance prediction of wind turbines.

As the conclusions, the rotational speed change width of the VAWT in field test tended to increase with increasing the initial wind speed of the input wind pattern. The rotational speed variation of the VAWT placed at the ALRC was able to be simulated with about 4 % error by introducing the effective wind speed ratio (EWSR), which was estimated to be 63.4 % for the present study. The wind tunnel experiments demonstrated the existence of great secondary flow, i.e., downwash and upwash, at the wake of the turbine rotor. The counter flow region was observed in the mainstream direction under the high rotational speed conditions. The computational results by the BEM theory gave the same tendency as the experimental results as for the wake speed distributions. However, large differences in the thrust coefficient and the power coefficient were shown between the theory and the experiment. The BEM theory might need to be improved for application to small VAWTs.

Irrigation system in Lower Egypt: Multi-disciplinary research of area study collaborated with archeology and natural sciences

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Egypt has been a typical hydraulic society. So, in Egypt, many histories have been piled up since the age of Egyptian civilization. This is an interdisciplinary research to explain the piling up of many histories in Egypt, focusing on the technique of irrigation, being based on various kinds of source materials such as archeological, historical, geographical and social data and information.

Prediction of surface soil moisture under *Caragana* stands by meteorological data

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To calculate the potential evapotranspiration of *Caragana*, we developed Makkink type equation with variables of solar radiation, air temperature, relative humidity and leaf area. We also revealed that the CWSI of *Caragana* which shows water stress of plants was denoted by the volumetric soil water contents. This result shows information of evapotranspiration and CWSI induces soil moisture contents. We also checked the possibility of application of stem heat balance method to *Caragana* to separate transpiration from evaporation from soil surface. Estimated transpiration with soil moisture depletion method has linear relation with that of stem heat balance method and energy balance method and their coefficient of determination was 0.87.

The results and the problems of the Chinese policy of reverting forests and grasslands to farmlands and grazing lands

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One of the factors of the problem of desertification in dry semi-arid areas in China, as well as pastoralists, and the increase in demand for sheep meat and livestock products in urban and rural areas the vast economic benefits to the market expansion stimulation of production by pursuing livestock is considered that a factor to increasing desertification. Economic growth in China came to have a top-ranked foreign exchange reserves. Taking advantage of this resource, if you take measures such as market economy lamb imports of livestock products from countries considered to help improve and prevent desertification in mainland China.

In the future, to reduce the area of desertification, as the economic development, immigration from areas of relatively good regional harsh natural environment, the development of modern large-scale farms, the development of socio-economic development and urbanization elements can be expected to effect the measures. And seems to be possible by the construction of large-scale tourism and animal husbandry farms in the area also maintain a good natural conditions and cultural tradition of nomadism.

Conservation and management of fresh water resources in a sandy coastal aquifer

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To understand a layer thickness of fresh water and salinization of the water in a coastal aquifer, we examined measurement methods of groundwater level and fresh-water/salt-water interface level based on time domain reflectometry (TDR). In this study, we developed the coaxial TDR probe which can be directly sunk into the sand layer and tested the probe for measurements of the water level and the interface level in laboratory experiments. In the experiments, groundwater level fluctuations were produced by injecting or draining fresh water from the bottom of the experimental column, where Tottori dune sand was packed and the probe was vertically laid under the ground. For the experimental measurement of fluctuations of fresh-water/salt-water interface level, salt water was injected or drained from the bottom under saturated condition in soil moisture. We could find through the experiments that groundwater level and fresh-water/salt-water interface level in a sand layer can be measured with the newly developed TDR probe.

Relationships between global climate change and local hydrological features inherent in arid and semi-arid regions

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This study investigated relationships between globally-affected climate indices and monthly rainfall at 32 observation stations during 40 years (1961-2000) in the Yellow river basin affected by recent serious problems linking to water resources and water environment. In the first analysis, it was found that the Yellow river basin is characterized by large annual variation (several years to inter-decadal variation) in monthly rainfall during the warm season (June-September). The correlation analysis of average monthly rainfall in the warm season and climate indices (PDO, IOD, AO, ENSO) showed that the average monthly rainfall is inversely correlated with ENSO. In other words, this feature shows that positive (negative) SST anomaly in the tropical eastern Pacific Ocean causes weak (strong) rainfall in the Yellow river basin. Moreover, the remarkable feature is that the significant correlation coefficient gives high value of -0.5 (significant level of 1%). The high correlation means that the variation of water vapor inflow into the Yellow river basin in a warm season, which plays an important role in the occurrence of rainfall, is closely related to that of ENSO.

Comparative study of growth pattern of Mesquite (*Prosopis* sp.) seedlings among different soil water resumes.

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Mesquite (*Prosopis juliflora* (Swartz) DC, Leguminosae), one of the most economically and/or ecologically important tree species in arid and semi-arid regions of the world., was introduced into Sudan in early 20th century, and succeeded in controlling the expansion of desert. Recently, however, this species distributes widely and rapidly in eastern Sudan, and induces many problems in human subsistence. To clarify the mechanism of rapid invasion of Mesquite, we investigated the response of seedling roots to different soil moisture conditions.

Mesquite seedlings were experimentally grown twice (seven weeks each) in Desertification Mechanism Analysis System (air temperature 27°C, relative humidity 40%, wind speed 0.85m/s) of Arid Land Research Center, Tottori University. In the first experiment, seedlings with four to five leaves were cultivated in columns (1m height, 0.45m diam.) filled with sandy soils, under dripping irrigation once per day. The second experiment was done using thinner columns (1.3m height, 0.15m diam.) with four different drip irrigation (top, top and middle, middle and bottom, or bottom of columns). Seedlings after the cultivations were carefully collected under running water, and then dry weight and root distribution of saplings were analyzed.

Results were (1) Mesquite seedlings expanded horizontal roots just below the top surface of columns, and penetrated thin tap roots beyond 1m depth in less than two months, (2) water supply on top surface increased dry weight of seedlings and lengths of both horizontal and tap roots, (3) seedlings developed lateral roots vigorously at higher moisture area under un-even soil moisture condition. These results suggest that Mesquite seedling responds sensitively to the increase of soil moisture as rain fall, and develops root system flexibly against patches of soil moisture. These properties may enable Mesquite to invade easily into new habitats and distribute widely and rapidly in eastern Sudan.

Analysis on soil moisture and solute transport to improve agricultural products in arid area

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We designed saturated-unsaturated flow experiment model, which V;1000mm, H;1000mm and D;300mm. And we planned to measure pressure head, water content and electric conductivity under various condition of hydraulic gradient and solute concentration. However, delay of delivery of experiment model, then we

analyze in numerically. We used Spread sheet i.e. Excel to solve saturated-unsaturated solute movement. One can realize unsaturated solute movement by using Spread sheet Fluid Dynamics (SFD) in straightfoward. Also we describe 2-D and /or 3D imediately.

Finally we succeed to calssify the area of solute movemnet and the area of solute non-movement in unsaturated zone.

Effects of fertilizer distribution on greenhouse gas emissions with drip irrigation

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It is needed to simultaneously satisfy mitigating the emission of greenhouse gases (GHGs) in farmland and maintaining food production. As trip irrigation is superior in the efficiency of water and nutrient uses, we thought that drip irrigation might be useful to mitigate nitrous oxide (N₂O), which is originated from nitrogen fertilizer, emission. In the proposed research, we develop a appropriate fertilizer management practice to mitigate N₂O emission and maintain crop yield by regulating liquid N fertilizer application rates.

Development of remote sensing system in aridland farming (3) -Development of highly reliable adhoc multihop communication technology in aridland-

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It is necessary to develop two-dimensional remote sensing system which can be used as a stand-alone and long-term maintenance-free system in order to support sustainable agriculture in dryland making use of two-dimensional environment information. In this study, we examined highly reliable ad-hoc multi-hop communication technologies which is one of the necessary elemental technologies.

For this purpose, we investigated the short-range communication system. As a communication system to meet requirements such as low power consumption and mesh networking, ZigBee communication system has been found to meet the requirements. The experimental system using ZigBee communication module was fabricated, and we confirmed the stable operation even at high-temperature (30~40°C) environment for about one week. To collect long-term reliable data using ZigBee communication in dryland, we developed a prototype model of a stand-alone two-dimensional remote sensing system which consists of two

measurement terminals and one relay terminal, using ZigBee communication module. This system is connected to the Internet via a mobile phone, and observed data can be viewed by a web-browser. In February 2010, we installed this system in the site of Arid Land Research Center and the data is being collected until now.

In the next phase of the study, we will try to establish a highly reliable ad hoc multi-hop communication technology based on the results of this evaluation.

Comparative study on soil factor affected to biological production at desert. Influence of form of organic matter.

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Liquid of 100times dilution of Noto pyroligneous acid have an effect on growth injury due to continuous cropping at upland rice cultivation on alkaline soil.

This of 200times is efficacious to death of the pine.

Root spread of pine, cabbage and flower was promoted by application of Noto charcoal 2%(w) on alkaline soil.

Development of remote sensing system in aridland farming (1) -basic examination concerning improvement of performance and reliability of solar photovoltaic system in aridland-

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It is necessary to develop two-dimensional remote sensing system which can be used as a stand-alone and long-term maintenance-free system in order to support sustainable agriculture in dryland making use of two-dimensional environment information. We examined the reliability and performance of photovoltaic systems technology which has to be developed as one of the required elemental technologies.

After a result of verification of solar panels in arid environment, we found that CIS-based solar panels which have characteristics of wide operating light wavelength range and temperature stability is promising.

For this verification, the evaluation system which has CIS-based solar panels and silicon-based solar panels for comparison was constructed. This system is connected to the Internet via a mobile phone and measured data can be viewed by the web-browser. In February 2010, we installed this system in the site of Arid Land Research Center, and data is collected until now. In order to improve the amount of power generated, it is important to enable the system to track the sun so that 0 degrees of incidence of solar

photovoltaic panels. For this purpose we developed low-cost tracking mechanism and designed a draft specification.

In the next year, the configuration of high reliability and high performance solar power system in arid environments will be revealed through a development of prototype solar tracking mechanism and collection of comparable data on solar panels.

Development of remote sensing system in aridland farming(2) -Development of highly reliable and environmental monitor on aridland-

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It is necessary to develop two-dimensional remote sensing system which can be used as a stand-alone and long-term maintenance-free system in order to support sustainable agriculture in dryland making use of two-dimensional environment information. In this study, we examined a highly reliable environmental monitoring unit which is one of the required elemental technologies.

We have investigated various sensing devices. As a result, the sensor-board which can monitor temperature, humidity and atmospheric pressure simultaneously and can be connected directly to the microcontroller board is selected. Environmental monitoring unit using this sensor-board (temperature, humidity, atmospheric pressure and CO₂ concentration can be measured) was fabricated. We confirmed stable operation even at a high-temperature (30~40°C) environment for about one week. To collect long-term reliable data of this sensor-board under arid environment, we developed a prototype model of a stand-alone two-dimensional remote sensing system which consists of two measurement terminals and one relay terminal using this sensor-board. This system is connected to the Internet via a mobile phone, and observed data can be viewed by a web-browser. In February 2010, we installed this system in the site of Arid Land Research Center and the data is being collected until now.

In the next phase of the study, we will try to further improve highly reliable environmental monitoring system based on this evaluation and the expected needs for environmental sensing.

Evaluation on stability of soil organic matter fractions by stable carbon isotope analysis through soil profile

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Soil organic matter dynamics has received great attention in recent years because this is a major source

and sink of atmospheric carbon in the global carbon cycle. Soil organic matter consists of various functional pools that are stabilized by specific mechanisms. For the development of our understanding about soil organic matter dynamics, it is necessary for these pools to be quantified and characterized.

In general, $\delta^{13}\text{C}$ values of soil organic matter appears to be a useful tool for reconstructing the relative productivity of C3 versus C4 species. Much of the carbon isotope studies have focused on C3 versus C4 plant dynamics because of the difference in ^{13}C discrimination in these photosynthetic pathways. However, there are few studies to assess the stability of soil organic matter using stable carbon isotopic technique.

So, our object was to evaluate the stability of soil organic matter using physical fractionation method and stable carbon isotopic technique.

The study sites were located at Hulunbeier grassland, Inner Mongolia, China. Soil survey was conducted at 8 sites in 2006 and 2009. Soil samples were obtained from each horizon of soil profile in each site. In this year, we used bulk samples of A1 horizon for isotopic analysis. Inorganic carbon was removed from soil samples prior to isotopic analysis by pretreatment with 1M HCl.

The results of $\delta^{13}\text{C}$ values showed between -21.3‰ and -24.8‰. The C3 plants and C4 plants have $\delta^{13}\text{C}$ values ranging from approximately -28‰ to -26‰ and from -14‰ to -12‰, respectively (Yoneyama, 2002). Therefore, vegetation in this region was dominated by C3 plants. In addition, $\delta^{13}\text{C}$ values decreased with increasing plant biomass, which suggested relatively more C4 plants in disturbed land in this region.

As the stability of soil organic matter, we clarified that there is positive correlation between organic carbon content and clay content in A1 horizons. This indicated that organic carbon associated with clay is important for stability of soil organic matter. For the next step, we should try to measure the $\delta^{13}\text{C}$ values of particle size fractions of soil organic matter.

Bio-stimulators improving dryland crop production

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Bio-stimulators extracted from plant leaves have recently become a widely used tool for improving crop production under different climate conditions, such as drought and cold conditions in arid regions. Though bio-stimulator application has been shown to be very effective in increasing crop yield on site, the mechanism of crop response to bio-stimulator application is still largely unknown. The present study was designed to understand from a viewpoint of photosynthesis and using two different crops; maize and soybean the interactions and effects of application of two different bio-stimulators (CC and SS) on crop growth under drought and non-drought conditions.

The photosynthetic rate of maize and soybean more or less increased under both drought and non-drought conditions. The rate of increase under drought conditions was especially high in maize leaves, rising at day 2 to 5 after application of low concentration (0.5mg/L and 0.15ul/L,) of CC and SS respectively when compared to that of control; the CC application showed the highest rate of increase (19%). The same phenomenon, which showed a 27% rate of increase to that of the control, occurred in soybean leaves after

application of CC only. However, the increase in photosynthetic rate was detected two times (at day 2 and 7) during 14 days after applying CC to soybean leaves. By contrast, SS application to soybean leaves worked well in increasing rate at day 7 after application and not at day 2 as in CC application. Although dry matter content of both top and root increased after bio-stimulator application, the influence of T/R ratio in the two applications was different. CC showed more effectiveness in improving top dry matter, while SS influenced the increase of root dry weight of the two different crops.

In this study, CC and SS application showed improvement of photosynthetic rate and dry matter content of each crop. Thus, application of CC and SS might lead to increased crop yield under drought conditions. The mechanism of crop response however still needs further investigation.

Estimation of grassland production in Loess Plateau, China

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A simulation was conducted to estimate the net primary production (NPP) of alfalfa (*Medicago sativa* L.) during the year of 2007 to 2008 around the Shenmu observational station located in the northern Loess Plateau region. The meteorological data set used for the simulation was downscaled with the Regional Atmospheric Modeling System (RAMS). The minimum vertical grid size was 90 meter to reflect the hilly topography of Loess Plateau region.

The output of RAMS (hourly solar radiation and air temperature) were validated with the observed meteorological data derived by Tottori university. The simulated air temperature reproduced the diurnal and monthly variation of the observed air temperature, but the value was about 10 degree centigrade higher. The reason of the difference is not isolated yet. Otherwise we certified that the simulated air temperature could be corrected technically by the simple linear regression based on the air temperature which is observed in the area of the simulation. And it was clarified that the simulated solar radiation had enough accuracy for the plant production model.

The biomass of alfalfa was reproduced very well during 2007 to 2009 by air temperature and solar radiation with plant efficiency model (PEM). In this study the limiting factor of plant production during 2007 to 2008 was not soil moisture but the low air temperature at the early stage of growth during April to June.

The horizontal distribution of alfalfa biomass was simulated with the PEM and the output of RAMS. The grid size was 90 meter. The horizontal resolution was 29 X 29. The area of simulation was 2.52 X 2.52 km. The center of simulation was the weather station of Tottori university settled at Shenmu field site. As the result, the difference of air temperature in the area was small. But the distribution of solar radiation was comparatively larger and that made the distribution of biomass become larger. We could estimate concretely the biomass of alfalfa became larger at the southward slope than the northward slope and the bottom of the valley.

Physiology and biochemistry of noxious plants in semi-arid regions

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Based on germination inducing activity toward *Striga hermonthica* seeds, germination stimulants and inhibitors were purified from cowpea root exudates and mesquite leaf extracts, respectively. Results suggest that cowpea roots exude a novel germination stimulant. Structure determination of the stimulant and the inhibitors are going on.

Physiological evaluation and linkage disequilibrium analyses on drought tolerant-related characters in synthetic wheat lines

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The diversity of drought tolerance in wheat (*Triticum aestivum* L.) is limited; few genes have been identified that can be used to develop drought-tolerant cultivars. One way to create diversity is to produce synthetic hexaploid wheat (SW) lines. SW lines were produced by crossing diploid wild wheat species (*Aegilops tauschii*) with tetraploid wheat (*Triticum durum* cv. Langdon). These SW lines have the same A and B genomes but different D genomes. We grew the 50 SW lines in well-watered and drought conditions to compare the expression of characters encoded in the different genomes, to study the applicability of the use of *Ae. tauschii* in the breeding of drought-tolerant wheat, and to correlate the expression of drought-related traits of *Ae. tauschii* lines with their corresponding SW lines. Most traits were not correlated. Some SW lines were more drought tolerant than the standard cultivar, Cham 6. We conclude that the traits of wild wheat are not clearly expressed in hexaploid wheat, and that wild relatives of wheat cannot be used to evaluate the traits of SW lines. SW lines should be produced for breeding programs regardless of the performance of the wild parent, because the parents have no correlation with SW.

Improvements of drought tolerance in wheat via enhancement of water absorption capability in the root systems

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The objective of this study was to improve the drought tolerance in wheat through the root characteristics improvements for soil water uptake. In the last season (2010), the drought tolerance of 6 wheat lines was

evaluated based on the transpiration responses to soil water deficit.

The experiment was conducted in a rain out shelter set at Hokkaido University where drought environment was created. Total 6 wheat lines were used. Out of which, the 3 lines were evaluated on their field performances under drought environments at International Center for Agricultural Research in the Dry Areas (ICARDA), Syria and Arid Land Research Center, Tottori University (ALRC), Japan; Cham6 (good performance under irrigated condition, as control), SW10 (drought tolerant line), and SW15 (poor performances under either irrigated and drought conditions). The remaining 3 lines were developed at Hokkaido, Japan; Harukirari (high yielding line via large biomass), Haruyokoi (high yielding line via large harvest index), and Haruyutaka (relatively less line compared to the former two lines).

The seeds of each line were sown in 4.5L capacity pots covered with polyethylene bags to prevent the soil water loss through evaporation on 28 April 2010. The plants were cultivated in randomized block design with 7 replications. The daily transpiration was calculated by subtracting the pot weights in the previous day from the present pot weights during the experimental period. From 34 days after sowing, irrigation treatments where optimal soil water content would be maintained, and drought treatment set by withholding irrigation were put on each line. The relative transpiration ratio (RTR) was calculated as the ratio of the transpiration between in the drought and irrigation treatments. As the drought index, the fraction of transpirable soil water in the root zone (FTSW) was computed by Muchow and Sinclair's method (Muchow and Sinclair, 1991). The FTSW threshold value where the RTR was sharply dropped would be the soil water contents at which the wheat plants couldn't uptake adequate soil water. The magnitude of drought tolerance among the wheat lines was evaluated by FTSW threshold value. The shoot biomass, leaf area and root biomass was measured periodically, and the climatic conditions were monitored throughout the experimental period.

Based on the results, the wheat lines tested in this study could be characterized as follows;

SW10 showed significantly smaller FTSW threshold value than the other 5 lines, and which was consistent with the result from preliminary trials in 2009. This indicates that SW10 could uptake the soil water in parched soil where the other 5 lines wouldn't utilize the soil water. In addition, SW10 had smaller daily transpiration per unit root, which indicates lower water permeability. These results supported the observations at ICARDA and ALRC, that SW10 could have conservative soil water use throughout the growth period, and which resulted in some seed yield secured.

The principle component analysis (PCA) in terms of the traits relating water use could classify the lines into 3 groups; Group I: SW10, II: SW15 and Cham6, III: Hokkaido lines. The PCA indicated the close relationship between total transpiration and total biomass production, and between FTSW threshold value and magnitude of transpiration reduction in drought treatment.

Interesting results were obtained in this experiment, which encouraged us to continue these research activities. I really appreciate the Arid Land Research Center that kindly accepted me as a collaborator in 2010, and expect to continue this collaborative research in the next year very much.

Physiological mechanisms of salt tolerance in higher plants

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Salicornia herbacea L. is a typical halophyte, and the stem elongation is promoted by NaCl 100-300 mM treatment. The genes up-regulated by NaCl were isolated by subtractive hybridization. The genes related to photosynthesis, light-harvesting, chromosome, elongation or antioxidant were identified. The photosynthesis rate promoted in *Salicornia* treated with NaCl 100 mM or 200 mM compared to control. In addition, the extensibility of the hypocotyl cell wall increased as a result of the decrease of viscosity in *Salicornia*.

Molecular physiological researches on enhancement of drought tolerance in silicate-treated sorghum

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Salinity is one of major factors in limiting crop production in the world, and improving plant salt tolerance is very crucial and urgent. Silicon (Si) is the second most abundant element on the surface of the earth, and many studies have shown its beneficial effect for plant growth and development and as well as stress tolerance. To test the function of Si in salt stress, we applied Si on sorghum under hydroponic condition. We found that Si could maintain both shoot and root growth under salt stress significantly. To further explore the mechanism of Si-induced salt tolerance, we investigated the effect of Si on polyamines (PAs) and ACC (1-amino- cyclopropane-1-carboxylate) accumulation, and also the expression of *SbSAMDC* (*S*-adenosylmethionine decarboxylase) gene. With Si, PAs level was increased, especially putrescence and spermidine which increased 2-4 times, while ACC content was decreased under salt. Moreover, the expression of *SbSAMDC* was up-regulated by Si. It suggests that Si-induced improvement of salt tolerance is related with the regulation of PAs and ethylene synthesis, and PAs which are essential for plant growth and survival may play an important role in this process.

Study on eco-physiological properties of infertile land crops

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Morphological and anatomical features of roots in *Erianthus*, which is expected as a bio-ethanol material crop cultivable in degraded lands, were investigated. The surface of *Erianthus* nodal roots was covered by soil sheath with dense root hairs. The outer three layers of root cortex formed hypodermis with lignified cell wall, and the mid-cortex formed aerenchyma. The soil sheath and hypodermis are expected to protect

the inner root tissues from soil physiological/chemical stress. X-ray microanalysis demonstrated that Erianthus root accumulate silicon in particular in endodermal cell walls. Silicon-rich aggregate structures on the endodermal cell walls were observed; the silicon-rich aggregate are similar to those in sorghum roots in appearance, which contribute to drought tolerance of sorghum plants. ESEM observation showed high accumulation of starch in the stele of Erianthus roots during the winter season. The deposit of starch in roots may contribute to the cold tolerance and vigorous spring growth of Erianthus plants.

Mechanisms of salt tolerance and ozone tolerance in the transgenic tobaccos that have high capacity to scavenge reactive aldehydes

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Environmental stresses such as soil salinity and ozone lead to oxidative injury in plants. Transgenic tobaccos that overproduce the enzyme 2-alkenal reductase (AER) shows tolerance to various environmental stresses, suggesting that the α,β -unsaturated aldehydes mediated cell injury. In this study, we aimed at identifying the aldehyde species involved in the ozone stress in leaves. AER-overproducing tobaccos and the wild type, 4 week-old, were exposed to 0.4 ppm O₃. Visible injury in leaves appeared in 24 h, which was less in AER-overproducers. Leaves for aldehyde analysis were collected at the timing before any visible symptoms appeared, and are now under chemical analysis.

Researches on water use and water stress resistance of shrub species grown in semiarid land

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Desertification is a serious problem progressing in semi-arid grasslands in North-East Asia, whereas there have been few experimental studies on the responses of native plant species growing in these area. Therefore, we should investigate the impacts of water stress, a most important environmental factor in semi-arid regions, on growth, morphology and physiology of these plants, and clarify the tolerance to water stress of each species in order to present the suitable species for combating desertification.

We conducted the environment-controlled experiments on some *Artemisia* species (*A. frigid*, *A. halodendron*, *A. ordosica*, *A. sphaerocephala*), which are key shrub species distributed widely in semi-arid grasslands, to analyze the growth responses to water stress. Seedlings grown in naturally-lit glasshouses for several weeks after sowing were brought to artificially-lit environment-controlled growth cabinets, and were treated to four watering regime (30, 60, 90 or 120 mm/month, i.e. average water potential; -25.2, -9.7, -3.4 or -2.7 kPa, respectively) for four weeks. Then effects on growth (leaf area and dry weights of root,

stem and leaf) of water regime were analyzed.

The biomass growth of all species decreased with decreasing water supply (i.e. increasing water stress), while the impact degree differed in each species. When the RGR, NAR and other growth parameters (LAR, LWR, SLA, and R/S ratio) to water stress were compared and cluster analysis was performed, the following characteristics were extracted. *A. sphaerocephala*, which decrease in RGR and NAR remarkably while did not change any other parameters, seemed to be vulnerable to water stress. *A. ordosica*, which also showed a remarkable growth reduction by water stress, increased R/S ratio that might be an adaptable response to survive at semi-arid area. The water tolerance of *A. frigid* was intermediate, and an adaptation to thicken leaf was observed. *A. halodendron* showed a high tolerance to water stress, and indicated the useful shrub species to rehabilitate desertificated grasslands.

In addition, we measured some morphological characteristics of *A. halodendron* periodically under an averaged environmental condition of semi-arid area and analyzed its biomass growth under several water stress conditions as mentioned above. Then, we developed a plant growth model (3D simulation model) using L-studio having both functional and structural characteristics, which could reflect the influence of water stress.

Mechanisms of tolerance to environmental stress of millets and collection both of culture method and genetic resources in China

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I . Studies for interspecific differences of environmental stress in millets.

It is not clear that how yields of millets will change after global warming. There are reported here yields of *Setaria italica* and *Panicum miliaceum* at mountainous area in Kumamoto prefecture from 2003 to 2007., drought tolerance of millets, salt tolerance of millets, water logging tolerance of millets.

Average air temperature was not change in 2003, however, those were 0.7~1.3 higher than that of ordinary year. Total precipitation markedly changed during June and October compared to ordinary year. High yield variety showed highest yield when the total precipitation was around 1200mm.

Interspecific difference of drought postponement was investigated. The yield of millets decreased when drought stress was subjected during vegetative period. Drought postponement was strong in the order as follows; *Setaria italica* > *Setaria glauca* > *Panicum miliaceum* > *Panicum sumatrense*. This interspecific difference was brought about the difference of development of roots before heading. Dehydration tolerance was strong in the order as follows; *Setaria italica* > *Panicum miliaceum* > *Panicum sumatrense* > *Setaria glauca*. Yield of plant that half leaf area was cut was increased under dehydration stress in *Setaria italica* and *Setaria glauca*. Water logging tolerance was strong in the order as follows; *Panicum sumatrense* > *Panicum miliaceum* > *Setaria glauca* > *Setaria italica*. Water logging stress decreased yield of *Panicum sumatrense* and *Setaria italica* when the stress was subjected before heading, however, decreased yield of *Panicum miliaceum* and *Setaria glauca* when the stress was subjected after heading. This interspecific difference was strong in order as follows; *Panicum sumatrense* > *Panicum*

miliaceum > *Setaria glauca* > *Setaria italica*. This interspecific difference was attributed from the difference of root growth. The aerenchyma was developed in cortex of crown root in *Panicum sumatrense*. Salt tolerance was strong in ordered at 200mM NaCl as follows; *Brachiaria ramosa* > *Panicum miliaceum* > *Panicum sumatrense* > *Setaria glauca* > *Setaria italica*. There was no yield in *Setaria italica*. Ion content of Na in leaf in was high in *Setaria italica* than *Brachiaria ramosa* and there is no interspecific difference of ion content of K.

II. Collection of information of culture method and genetic resources of millets in China.

I visited China from October 29 to November 1st. I visited Loess Plateau and collect culture method of several crops including millets. All my schedule was managed Dr. Ma he is a professor of Institute of Soil and Water Conservation, The Chinese Academy of Sciences and Northwest Sci-Tech University of Agriculture and Forestry properly. I appreciate all of Chinese people who I met in China, especially to Dr. Ma and staffs of arid land research center in Tottori University especially Dr. Tsuji.

Establishment of a measurement system on carbon balance in crops under over-optimal temperature

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The present study examined carbon assimilation rate and respiration rate under high and low temperature for matured tomato plants in the growth chambers that equipped with a CO₂ balance monitoring system. In the experiment, we carefully measured CO₂ balance the growth chambers in which seven to eight tomato plants of two varieties, cv. House-Momotaro and Matrix, were individually enclosed. The tomato plants were grown till sixth flow cluster flowered in the experimental farm of Yamaguchi University, and then, transferred to the chambers. After 2 weeks acclimation, the assimilation rate and respiration rate were determined in successive 5 days as followed: the 1st day in moderate temperature (daytime/nighttime 25/20C), the 2nd and 3rd day in high temperature (35/25C), the 4th and 5th day in moderate temperature.

There was no genotypic difference in assimilation rate and respiration rate. The assimilation rate per unit leaf area was 0.6 $\mu\text{mol}/\text{m}^2/\text{min}$ in the first day, and reduced to 0.35 $\mu\text{mol}/\text{m}^2/\text{min}$ and 0.50 $\mu\text{mol}/\text{m}^2/\text{min}$ in the 2nd and 3rd day, respectively. The assimilation rate was recovered to 0.6-0.7 $\mu\text{mol}/\text{m}^2/\text{min}$. The respiration rate per unit dry weight was raised by high night temperature. However, the rising of respiration rate unlikely affected carbon availability of tomato plants, since it just accounted for less than 10% of the assimilation rate.

The effects of slope position on soil-plant interaction in a semi-arid forest ecosystems

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The aim of this study is to evaluate the differences in soil condition, forest structure, water and nitrogen use of trees, and nutrient cycling among the slope positions. In 2010, we established nine study plots on upper, middle and lower slope positions in Mt. Gonglu experimental forest near Yan'an City, China. We conducted tree census, soil sampling and leaf sampling. Additionally we started to collect litterfall at each study plot.

Studies on mycorrhizal fungi that facilitate drought resistance of Japanese black pine

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The trees of Japanese black pine, *Pinus thunbergii*, planted at the higher part of the slope apt to be exposed to desiccation and therefore developed root system with ectomycorrhizal symbiosis. Ectomycorrhizal symbiosis is considered to facilitate host water relation, and thereby enhance host survivability under water stress. We have been studying the ability of water supply of ectomycorrhizal fungi detected at Japanese black pine forest in coastal sand dune. We also studied fungal flora of ectomycorrhizae at three heights of a slope in Japanese red pine, *Pinus densiflora*, forest using "Hyphal in-growth bag method".

Experimental studies on relationships between drought and salt tolerances and the ability of osmotic adjustment in economically-important plants in semi-arid region of China

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The relationship between the accumulation of soluble sugars as compatible solutes in leaves and changes in water potential was studied in *Artemisia ordosica*, *Salix psammophila*, *S. matsudana*, and *Caragana korshinskii* plants before dawn and around noon in Mao-us desert, China. Among those species, *Artemisia ordosica* indicated a close relationship between the increase in sucrose content and the reduction of water potential. Hourly changes in water potential and sucrose content in leaves of *Populus alba*, *Ulmus pumila*,

U. Americana, *Pinus tabulaeformis* and *P. sylvestris* L. var. *mongolica* were also studied. The concentration of sucrose in three broadleaf species increased during the day time, whereas those in coniferous species did not. Effects of NaCl in rhizosphere on growth and stress tolerance of *S. psammophila* and *S. matsudana* cuttings were studied using hydroponic culture technique in Tottori University, Japan. The tolerance to salinity stress in *S. psammophila* cuttings was greater than that of *S. matsudana* cuttings. The application of 0.5mM methyl jasmonate on leaves tend to increase stress tolerance in both species. However, 5mM inhibited plant growth, especially in *S. psammophila* cuttings.

Estimating salt tolerance from the oxygen and carbon isotope compositions in arid plants

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Carbon and oxygen isotope ratios in leaf organic matter are known to reflect the long-term trends in its intrinsic water-use efficiency and transpiration rate, respectively. Carbon and oxygen isotope ratios of leaf organic matter were measured in seedlings of *Tamarix ramosissima* grown under a variety of salinity conditions to develop an index of salt tolerance of desert plants. Carbon isotope ratio of leaf organic matter increased with increase in salinity from 0 to 400 millimolar NaCl. Though salt treatment decreased transpiration rate, there was no difference in transpiration rate between 200 and 400 millimolar NaCl. These results suggested that intrinsic water-use efficiency was enhanced by salt treatment through decrease in transpiration rate. Oxygen isotope ratio showed no difference between salinity, which was inconsistent with the results of transpiration rate. This suggested that salt stress may change the relationship between transpiration rate and oxygen isotope ratio of leaf organic matter. For this reason, we made two hypotheses: the isotope discrimination may occur during salt secretion through salt glands and the change of leaf structure due to salt stress may change the relative effect of advection and back diffusion between unenriched water in leaf vein and enriched water at evaporative site.

Studies on Social Development in the Loess Plateau

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The purpose of this study is to analyze the 'Grain for Green' project and social development in the Loess Plateau, by making cooperative research networks between the researchers of Arid Land Research Center, Tottori University, and Research Institute for Humanity and Nature Initiative for Chinese Environmental Issues.

We published one reviewed article, two book chapters, and two oral presentations. We are invited to make an oral presentation at China-Japan Interdisciplinary Academic Salon for Young Scientists: Forestry Environment and Sustainable Development, Co-hosted by China Association for Science and Technology (CAST) and Japan Science and Technology Agency (JST) at Fuzhou, China in November 2-6, 2010.

Changes of xylem hydraulic conductivity and stomatal regulations of water loss in response to water stress in ring-porous and diffuse-porous species.

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Generally, ring-porous species holding less number of wider vessels appear greater xylem hydraulic conductivity under wet condition, instead, the conductivity would be lost highly when vessel cavitation occur under progressive drought. By contrast, diffuse-porous species holding numerous numbers of vessels appear lower hydraulic conductivity because of narrower size of vessels so that the loss of the conductivity would be smaller if cavitation occurs. In this study, we studied whether such different hydraulic conductivities associated with wood porosity might be maintained under drought by regulating water loss from the leaves.

Under various drought conditions by stopping water supply to the plants, we obtained the relationship between water potential (Ψ_{xylem}) and hydraulic conductivity (Ks) of xylem. In addition, the transpiration rate (E) and leaf mass with decreased Ψ_{xylem} were also measured in three ring-porous species of *Zelkova serrata*, *Quercus serrata*, and *Melia azedarach*, and in three diffuse-porous species of *Carpinus tschonoskii*, *Betula platyphylla* var. *japonica*, and *Cerasus jamasakura* exposed to controlled drought conditions.

For ring-porous *Z. serrata* and *Q. serrata*, the E showed lower values in wet conditions, and both E and Ks were reduced with Ψ_{xylem} decrease. For *M. azedarach*, after reduced leaf mass and no decrease of E were observed under higher range of Ψ_{xylem} , E of remaining leaves was decreased under more negative Ψ_{xylem} . All diffuse-porous species showed similar patterns of which Ks was decreased following clear depression of E. These results shows that throughout the drought, ring-porous species would maintain their high conductivity by means of lower E, and of defoliation especially for *Z. azedarach*, and that diffuse-porous species would keep from loss of conductivity by means of obvious stomatal closure and accordingly depression of E. As the next step, we will assess the association of the recovery of lost hydraulic conductivity (conducted in 2011) and water loss regulation (obtained in 2010) in relation to conservation of the adequate hydraulic conductivity.

Specific characteristics for salt tolerance mechanism of halophilous plants

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The purpose of this research is to attempt to elucidate from the standpoint of tree physiology the salt resistance mechanisms and specializations for high salt resistance acquired by mangrove tree varieties that excrete internally accumulated salts through salt glands on their leaf surfaces.

Salt secreted by *Avicennia marina* was collected at differing tide levels during both high and low tides. Time and seawater flooding frequency were examined to determine their effects on differences in daily and seasonal changes in the composition and volume of secreted salt. At the same time, an examination was conducted on how the volume of salts contained in interstitial groundwater affects the change patterns of excreted salt volumes from the leaf's salt gland.

Salts secreted by the salt gland were collected by washing the outermost surface of the leaves with 50ml of distilled water. In other words, sets of two healthy leaves each were collected from the apical ends of lateral branches and apical modules of the first nodes of the test specimens, and each leaf was evenly washed front and back with distilled water for 15 seconds for a combined total of 30 seconds for both leaves. The sodium(Na⁺), potassium(K⁺), calcium(Ca⁺) and magnesium(Mg⁺) in the collected liquids were then analyzed using an atomic absorption photometer. Secreted salt volumes were calculated as dry weights per single leaf. At the same time secreted salt was collected, interstitial groundwater was collected using a simple porous cup and the volume of salt present was quantified. Salts were collected primarily during high and low tides during the spring and neap tides in May, June, July, August, September and October in six hour cycles for 36 continuous hours. When collecting the secreted salts, temperature, humidity and tide level measurements were taken.

Salts secreted by the salt gland contained large amounts of sodium(Na⁺) regardless of the time at which the sample was collected, and magnesium(Mg⁺), calcium(Ca⁺) and potassium(K⁺) were present only in trace amounts. From this it was understood that sodium(Na⁺), a substance harmful to plants, was selectively secreted from the salt glands while elements useful to the plant were used internally. The salt concentration in the interstitial groundwater was greater during high tide than it was during low tide, and a tendency towards lower secreted salt concentrations was seen when salt concentrations in the interstitial groundwater increased. From this result it was suggested that the root system as well selectively absorbed salts. Additionally, a tendency was observed in which the volume of salt secretion increased as the temperature rose. Among the environmental factors, it was seen that humidity and changes in secreted salt volumes were uncorrelated, but a relationship was suggested between temperature and salt secretion. As a result of this research, the following was made clear regarding *Avicennia marina*: (1) salt is selectively secreted from the salt glands, (2) seawater is selectively absorbed through the root system, and (3) salt secretion is affected by the temperature.

Experimental studies on the salt tolerant characteristics of halotolerant plant and remediation and conservation of the saline soil

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It is important to evaluate the salt absorption of *Tamarix Austromongolica* N., which grows naturally in arid regions, and its growth in order to utilize it for the improvement of halomorphic soil. To clarify relations between the amounts of salt in soil and growing conditions of *Tamarix* for 2 years, a greenhouse cultivation experiment was conducted. Soil, in 45L containers in four experimental sections of 9 containers each, was saturated for a week with saline water in concentrations of 0% (tap water), 1%, and 4%, and *Tamarix* cuttings were transplanted in each container. The growths of maximum shoot lengths were stopped at the end of the first year in 0% containers, and in August of the second year in 1% containers, but continued during two years 4% containers. After these experiments, all samples were dug up to determine the dry weights and Na contents of leaves, branches, trunks and roots. The maximum sodium absorptions by samples were maximum in the first years in 1% containers, whereas in the second years in 4% containers. And leaves and branches accumulated more than 90% of sodium absorption in every container.

Evaluation of pore-air behavior in unsaturated soil

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For the evaluation of the rainfall seepage behavior into the ground, it is an important to understand the influence of the pore-air behavior on the water seepage in the unsaturated soil. In this research, the pore-air behavior during wetting process in an unsaturated soil is examined by the artificial rainfall infiltration tests in one-dimension. In this test, the pore-air pressure, the pore-water pressure and the volumetric water content in the unsaturated soil column were measured during the wetting process at the constant rainfall intensity. When the rainfall intensity was greater, the pore-air was trapped and the pressure was increased. After the rainfall, the negative pore-air pressure was generated during drying process.

Study of sandponics bet system using capillary uptake method

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The sandponics bed system is a type of soilless culture and was developed in 1980. The sandponics bed system was put into practical use along with sand culture, whose theory was proposed in the 1960s. The objective of this study is to document the development of a new irrigation method using the capillary uptake method to simplify irrigation and reduce the cost of the sandponics bed system. It was found that capillary wicks could use irrigation to cultivate Komatsuna with the sandponics bed system. The bed of soil moisture distribution could differ with installation density, interval, and position of the capillary wicks, and water head difference between capillary wicks and surface of water supply. Furthermore, the amount of irrigation per day with capillary wick is considered to change depending on weather conditions. In the future, we will work toward practical use of the sandponics bed system using capillary uptake method by the following experiments:

1. Study of the relationship between soil moisture distribution and water head difference between capillary wicks and surface of water supply.
2. Study of the relationship between soil moisture distribution and installation density and interval of the capillary wicks.
3. Study of the relationship between soil moisture distribution and materials of the capillary wicks.
4. Study of the relationship between amount of irrigation per day and weather conditions.
5. Study of a long term experiment with long term cultivation plants, like tomatoes, using the capillary uptake method.

Technological development for on-site measurement of air permeability and continuous air content in sand soil using sound resonance

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Several studies have been done for estimating the volumetric content and the permeability of air in soil. However, none succeeded in estimating the air permeability with acceptable accuracy. In addition, the fact that the acoustic impedance for sample with high moisture content cannot be understood by the acoustic theory for porous media which have homogeneous air phase, have been recognized. Therefore, we examined the effects of water on the acoustic properties of sand using samples with regulated several moisture contents. As a result, we succeeded in estimating both the volumetric content and the permeability of air in sand with relatively low moisture content using the acoustic theory for porous media which have homogeneous air phase. We also indicated the possibility for understanding the value of the air content and the permeability obtained by the traditional method in terms of the air connectivity, by introducing the air connectivity to explain the phenomena which the air phase in sample with relatively high moisture content appear to be inhomogeneous.

Research on groundwater management using plant transpiration and water uptake

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In this research, based on the detailed observation of soil moisture movement, we could obtain accurate transpiration data of a jatropha tree under the existence of roots for a long period of 50 days. We could also clarify the effect of initial groundwater level on the lowering of groundwater level as well as the relationship between groundwater level and transpiration of a jatropha tree.

We confirmed the applicability of the HYDRUD_1D for simulating soil moisture movement and transpiration of a jatropha tree. By applying an additional model considering the hysteresis of soil moisture, there is a possibility of improvement of reproducibility and closeness of approximation to the theoretical model.

Through this research, we decided that a jatropha tree is one of an inappropriate species for biodrainage purposes.

Contribution of zero flux plane on salt accumulation of irrigated field under semi-arid condition

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Based on experiences of type and amount of salt accumulated on surface of agricultural lands at Tunisia, Northeast china and Uzbekistan, laboratory column experiment with multi-salts application has been conducted. Initially, soil, ground water and irrigation water had different type but similar diffusion coefficient salt. Irrigation and evaporation experiment and numerical simulation suggested surface precipitated salt is governed by salt in irrigation water when ground water level of the region is relatively deep while under shallow ground water condition salt supplied from ground water would dominate as surface accumulated salt.

Research on Non-destructive measurements of soil hydraulic properties of unsaturated soils by using Ground-penetrating radar

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The potential of surface ground-penetrating radar (GPR) for measuring unsaturated seepage flow in sandy soils was evaluated. It is shown from field infiltration experiments performed in homogeneous unsaturated dune sands. Non-steady behavior of the wetting front caused by two-dimensional seepage flow from the infiltration tests was non-destructively measured by using GPR in profile survey modes with the antennas on the surface. The utility of our proposed GPR profile survey was demonstrated by using seepage flow analysis of field infiltration experiments. There was good agreement between computed and measured wetted zone movements in two-dimensional unsaturated seepage flow.

Experimental study on water saving irrigation by using capillary barrier of soil

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A simple soil layer system which is composed of a fine soil layer underlain by a coarse soil layer has a characteristic property of capillary barrier. Water infiltrated into soil is stored just above an interface between the fine and coarse soil layers due to a physical difference in water retention characteristics of the fine and coarse soils. As their roots can easily utilize the water stored in the upper soil layer, plants grow effectively even under water saving irrigation. In the study, an effect of water stored in the upper soil layer by the capillary barrier of the soil layer system on the plant growth was investigated in the sand soil field. Six experiment plots, each 70 cm wide and 90 cm long, were excavated into the depth of 40cm and veneer sheets were placed to retain soil wall, then the sand soil was filled back into the first two of six experiment plots along all the depth. A gravel layer 10 cm in thickness was placed at depth of 10 cm in other two experiment plots and at depth of 20 cm in the remaining two experiment plots. Potherb Mustard was seeded and thinned after about three weeks in all the experiment plots. Soil water changes in the experiment plot were measured after the plant seeding. At about 35days after the plant seeding, Potherb Mustard was harvested to measure plant height as well as dry mass of plant. It is found that the infiltration water was effectively stored in the upper soil layer by the capillary barrier of the soil layer system, and the water stored in the upper soil layer affects significantly the plant growth. Further studies are required to examine the effect of the capillary barrier of soil on the plant nutrition and to investigate the barrier property against salt concentration caused by capillary rise of groundwater.

Two dimensional measurement of water content and EC in surface area with TDR system

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To measure water content and electrical conductivity of soil surface in the area scale of a field directly, the TDR measurement system with a one-meter-long, multiple-rod probe was developed. The multiple-rod probe was composed of several three-rod probes but each side rod was used in common as an electrical earth guide, therefore there was no space between adjoining two three-rod probes. It enables this TDR system to measure all over the surface area of a field. As a result of laboratory experiment, the dielectric constant measurements were affected by the inserting depth from the surface depending on the air volume existed within the effective range of the magnetic wave density. However, if the calibration was performed at a fixed depth, a cubic expression like Topp's equation was possible to decide the relation between the average water content of the surface area and dielectric constant. Moreover, the average EC values can be measured directly in an area scale, not point.

The Challenge of Reducing Phosphorus Escape from the Agricultural Lands to Protect Environment

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Introduction:

In the developed countries most of the waste is recycled and managed properly. But in developing countries are still lacking in having proper solid waste management system. The ignorant and blind applications of bio-waste, such as animal waste and sewage sludge, to agricultural lands are posing severe threats to the environment. Non point source of phosphorus (P) contamination is endangering shallow ground water and drinking water bodies in many part of the world. Most of the waste management strategies focused on to prevent the soils to become polluted but our knowledge is very scarce about the soils which are already polluted. Therefore, it was needed to work out new strategies to protect the environment from the soils which are already polluted. In this study some waste materials (Blast furnace slag (BFS), water treatment residues (WTR) and chemicals (Hydrotalcite (HYD)) was tested for their effects on the P retention capacity under soil plant system and their potential effect on plant growth and nutrient uptake.

Materials and Methods:

To achieve the goals, a greenhouse pot experiment was conducted to evaluate the effect of BFS, WTR and HYD on the maize (*Zea mays* L.) plant growth, nutrients uptake and DRP concentration in leachate. Two soil types (Tohaku and Masa soils) were amended with WTR and BFS each at the rate of 5g per 100g soil while HYD was applied at the rate of 0.25g per 100g soil. Animal compost and chemical fertilizer (KH₂PO₄) were applied at the rate of 300 kg of total P ha⁻¹. During the seven weeks growth of

maize crop, leaching was collected at one week interval from each pot and analyzed for the dissolved reactive P (DRP) concentration. At harvest, plant roots were recovered from the pots, shoot and root dry matter yield was recorded, and plant tissues were analyzed for nutrient uptake.

Results:

Results of the study revealed that total mean plant dry matter yield was not significantly affected by the two soil types. However, fertilizer types significantly affected the plant dry matter yield in each soil type. In both soils, plant dry matter yield was higher in the pots amended with inorganic P fertilizer as compared to the compost. Effects of the soil amendments on dry matter yield also varied under the two soil types. In the Masa soil, plant dry matter yield was slightly lower in pots amended with BFS, WTR and HYD as compared to control but in Tohaku soil dry matter yield was slightly higher in BFS, lower in WTR and equal in HYD amended pots as compared to the control treatment.

Analysis of leachate collected over the time shows that DRP concentration significantly varies with soil type. Overall DRP concentrations were higher from Masa soil as compared to the Tohaku soil. In Masa soil, DRP concentrations were slightly higher from Inorganic P amended pots at the start of the experiment, but at third week DRP concentration reduced in leachate as compared to the compost amended pots. All the soil amendments significantly reduced the DRP concentration in leachate collected from Masa soil. In Tohaku soil, DRP concentrations were slightly higher from compost amended pots as compared to the chemical P amended pots. While, the effects of soil amendments on P leaching were not obvious in Tohaku soil.

Experiment is under way to get the data on nutrient uptake by maize plant and draw the final conclusion.

Establishment of restoration method for salt-damaged fields using a rice husk underdrainage system

Koji INOSAKO¹, Tadaomi SAITO¹ and Mitsuhiro INOUE²

1: Faculty of Agriculture, Tottori University

2: Arid Land Research Center, Tottori University

A rice husk underdrainage system (RHUD) is one of the reasonable systems using on-site available materials. In this study, the phenomenon in the water and solute movement in a farmland with the underdrainage system was reproduced in a laboratory. We focused on identification of the parameters to establish a rational design method through theoretical analysis of the monitoring results.

At first, leaching experiment using a soil tank with dimensional of 0.5 m length, 1.0 m height and 0.1 m width, was performed to obtain validation data for a numerical model. Salt accumulation was artificially occurred by a evaporation method. A 0.1-m surface layer was tilled manually. Next, 8.0×10^{-3} m³ of tap water with EC 0.1 dS/m was poured into the surface. The intensity was 2.0×10^{-3} m³/h. After flooding the water for a day, it was discharged and the water and solute fluxes were measured.

Using a simulation model HYDRUS2D/3D code, numerical experiments were conducted in two phases, the first step was to supply water to the salt accumulated soil and left for 24 hours. An upper boundary condition was given infiltration rate as a variable flux condition to soil surface. The lower boundary was kept constant at -0.1 m.

Soil water pressure head was – 10 m and the salinity of the surface soil was 0.1 mmol/cm³ as the initial condition. Then, the second step was to stop the water from the open an outlet of the drain after 24 hours. It assumed there was not water movement at the upper boundary and the bottom boundary condition was kept constant at -0.1 m in the second phase. Moreover, soil water distribution at the end of the first phase was used as the initial condition in the first phase. The results of simulation were in good agreement with observation of laboratory experiments.

Some numerical experiments were conducted under the various conditions, for example, difference height of a rice husk zone and with or without tillage. As a result, it cleared that the water supplied into RHUD quickly moved from a surface layer to a rice husk zone with dissolving salt and was discharged from an outlet. On the other hand, most of water and salt in the untilled soil zone did not move from it and were not discharged from soil.

As a conclusion, it is the most important for effective desalinization in the RHUD to keep the connection between tilled soil layers and rice husk zones.

The evaluation on soil environment affected by irrigation at arid land

Teruo HIGASHI¹, Takuma ORIOKU¹, Yoshie YAGETA² and Mitsuhiro INOUE³

1: Graduate School of Life and Environmental Sciences, University of Tsukuba

2: School of Life and Environmental Sciences, College of Agro-Biological Resource Sciences, University of Tsukuba

3: Arid Land Research Center, Tottori University

- ① We estimated the effect of past rice cultivation for salt accumulation in Vertisols at the Nile Delta.
- ② we analyzed soil physical and chemical properties, water chemical properties and clay mineralogy, and we discussed the effect of above items on soil quality.
- ③ we compared the soil from four experimental farm which is different cultivation system, and we discussed the relationship between salt accumulation and cultivation system.

The utilization of indigenous technology for water and eco resources and rural socio-economic development in West Asia and North Africa regions

Ryuich HARA¹ and Takayuki ANDO²

1: Faculty of International Relations, Daito Bunka University

2: Arid Land Research Center, Tottori University

The field survey has conducted in 2010 fiscal year, From 6 March to 21, 2011 for 16 days in North Africa, the Desert of Sahar Oasis, South of Algeria, Chardaia region and Timimoun region.

At Chardaia region, M'zab Wadi (dry river), We could have a chance to observe the big flooding water running into the Wadi, and The local people use it for irrigation water of date palm garden using a draw

water well. At Timimoun region, We could observe the Foggara (the traditional underground water system, as Qanat), which also use irrigation water for date palm garden.

Two research presentation has conducted in 2010 fiscal year. The first, "The Utilization of Water and Rural Social Changes for 30 years in Iran" (At Tottori University, Workshop for International Agricultural Development Studies in 2010, June 25). Secondary, "The Utilization of Water Resorces and Rural Development- The Case Study of Marvdasht Oasis in Southern Iran" (At Tottori University Arid Land Research Center, Joint Research Workshop, 2010, December 4).

Incentive Research by Young Scientists

Stock and dynamics of pedogenic carbonate carbon under cold desert

Maki ASANO¹ and Atsushi TSUNEKAWA²

1: Graduate School of Life and Environmental Sciences, University of Tsukuba

2: Arid Land Research Center, Tottori University

We analyzed change in soil particle size distribution and soil chemical properties to clarify the effect of sand transport by wind on surface soil. In this study site, 200-2000 μ m fraction was significantly increased by saltation transport. Correlation coefficients between each fraction of soil particle size and soil chemical properties showed significant negative correlation between 200-2000 μ m fraction and SOC, TN content respectively ($r=-0.6$). In contrast, there was a positive correlation between 200-2000 μ m fraction and EC value ($r=0.7$). SEM-EDS image of coarse sand samples shows particles were aggregated, and EPMA analysis indicates that they attached relatively large amount of K, Ca, Na, Mg, Fe, and Al compared with the parent samples. These results show clay minerals and salts attached to coarse sand particles.

Physiological studies on drought and salt tolerance of apple and pear rootstock species.

Kazuhiro MATSUMOTO¹ and Wataru TSUJI²

1: Faculty of Agriculture and Life Science Teaching and Research Center for Bio-coexistence, Hirosaki University

2: Arid Land Research Center, Tottori University

We used 6 kinds of apple cultivars and species; 'Fuji', 'Ohrin', 'Golden delicious', 'Jonathan', *Malus prunifolia* and *Malus baccata* for the experiment. The shoots of each kinds of apple were pick up from the field of Hirosaki Univ. and treated with 0, 50, 100, 125 and 150 mM NaCl solutions in the laboratory. The 'Fuji' apple showed leaf burn symptom at the low concentration of NaCl treatment. Thus, salt tolerance of 'Fuji' apple was lower than other kinds of examined apple species. 'Jonathan' did not show the special symptom of leaf burn at the salt treatments. But, 'Jonathan' concentrated high levels of Na and Cl ion in the leaves at the NaCl treatments. Therefore, salt tolerance of 'Jonathan' apple may lower than other species

because it concentrated a lot of Na and Cl under the salt stresses. It is important to suppress the Na and Cl accumulation in the upper ground organs when we try to cultivate the apple in arid lands. Therefore we have to select a salt tolerance cultivar as well as rootstock species to do the sustainable apple cultivation in arid lands.

Geographical variation and distribution pattern of small to medium sized carnivores in arid area

Naoko KUROSE¹ and Norikazu YAMANAKA²

1: School of Veterinary Medicine, Kitasato University

2: Arid Land Research Center, Tottori University

Contribution of buried seeds to natural revegetation after vehicle track formation in Mongolian steppe

Toshihiko KINUGASA¹ and Norikazu YAMANAKA²

1: Faculty of Agriculture, Tottori University

2: Arid Land Research Center, Tottori University

Vehicle tracks on grassland in Mongolia are one cause of sand storm and Yellow Sand. Natural revegetation at vehicle tracks can largely depend on the germination of buried seeds. We investigated the vertical distribution of buried seeds in Mongolian steppe and evaluated its disturbance by vehicle track formation. Seeds contained in the surface sand and soils at 0-5, 5-10, 10-15, 15-20 and 20-30cm deep were extracted and counted in undisturbed grassland and vehicle tracks.

In undisturbed grassland, most of seeds were found in surface sand. Buried seeds were very few at soil layer below 5cm deep. Seeds in surface sand were fewer in vehicle tracks than in undisturbed grassland, but the number of buried seeds did not differ between them.

In sum, most of seeds in Mongolian steppe were distributed in surface sand and soil shallower than 5cm deep. Vehicle track formation can reduce the possibility of natural revegetation via seed germination in surface sand but little affect revegetation via buried seeds near ground surface. To accurately evaluate the possibility of natural revegetation via buried seeds, their germination potential must be investigated.

Controlling vapor transport in soils using thermal energy in arid region

Hirota SAITO¹ and Mitsuhiro INOUE²

1: Institute of Symbiotic Science and Technology, Tokyo University of Agriculture and Technology

2: Arid Land Research Center, Tottori University

In this project, column experiments were conducted to investigate the effect of thickness and depth of the gravel layer (particle sizes: 0.425-0.850 mm) placed in the 50-cm sand column on capillary rise. The top of the column was open to atmosphere. When setting the sand column, sand particles were allowed to drop into the gravel layer because there was no filter placed between the gravel and sand layers. As a result, capillary rises were suppressed due to capillary barrier at the gravel layer regardless of its location if its thickness was greater than 4-cm.

In the next column experiment, saline water was supplied from the bottom of 15-cm sand layer with 2-cm gravel layer placed on top of sand. A heater needle was inserted 1-cm below the top of sand layer to convert liquid water accumulated near the top by capillary barrier to vapor by raising the temperature to 50 degree C. The experiment was conducted in a constant temperature room at 20 degree C. While vapor transport through the gravel layer was enhanced, most of them were condensed in the gravel layer so that there was only a small amount of water recovered from the top of the gravel layer even after 24 hours.

Finally, the heater was inserted just below the gravel layer which was placed in 50-cm sand column. There was almost no increase in water content in sand above the gravel layer 24 hours after temperature was increased to 50 degree C. Vapor transport was blocked because of decrease in pore spaces in the gravel layer by sand particles. More experiments need to be conducted to find optimum conditions to enhance vapor transport through the gravel layer in such a layered soil system.

Development of method for accurate soil moisture measurement using dielectric probes in arid land environments

Tadaomi SAITO¹ and Mitsuhiro INOUE²

1: Faculty of Agriculture, Tottori University

2: Arid Land Research Center, Tottori University

The objective of this study was development of empirical calibration methods for temperature and salinity dependences of commercial dielectric probes to measure soil water content in arid environments. This study is two year project; temperature calibration was focused in this physical year and salinity calibration will be carried out in the next physical year.

Laboratory experiments were carried out using various commercial dielectric probes: ECH2O probe (model EC5, EC10, EC20, TE: Decagon Device Inc.), Theata Probe ML2X and WET sensor (Delta-T Device) and miniTDR (Campbell scientific Inc.). Acrylic cases were made, the volumes of which were a little larger than the measurement volume sensed by the probes. Each probe was set in the horizontal and vertical center of the acrylic case. Probe outputs were obtained at various soil temperature (T) (5 – 45°C) and water content (θ) (air-dry – near-saturation) using two soils: Tottori sand (Japan) and Loess (China).

The results showed that the outputs linearly responded to T at constant for all tested soil-probe combinations. The slope values of the linear responses to T depended on θ . A calibration equation describing the probe output as a function of θ and T was derived for each soil-probe combination by combining the output– θ function at the reference temperature and the slope– θ function. The derived calibration equations substantially reduced the temperature effects on the probe outputs for all soil-probe combinations. To demonstrate the importance of temperature calibration, the derived calibration equations

were applied to two field observations from arid regions. The results indicate that temperature calibration is important for accurate θ monitoring on both daily and seasonal scales.

Effects of social capital on environmental behavior in arid lands

Yohei KATANO¹ and Takayuki ANDO²

1: Faculty of Agriculture, Tottori University

2: Arid Land Research Center, Tottori University

There has been increasing interest in social capital theory in recent years. Social capital research aims to understand the structures and processes that affect a variety of social and behavioral outcomes. In the past fiscal year, we have focused on the methodology of social network analysis that is often used in the studies of social capital. Social network analysis views social relationships in terms of nodes and ties that connect individuals. Social network analysis has been used in the area of sociology, epidemiology, economics and other related areas to help understand the patterns and structures of human behavior. By attending summer seminar of the Interuniversity Consortium for Political and Social Research (ICPSR) in 2010, we acquired the cutting edge methods of social network analysis for the arid land studies. In the following fiscal year, we will investigate how social capital affects the deforestation in the grasslands and farmlands of Mongolia.

Research Meeting

The international symposium on the long-term monitoring of KOSA (aeolian dusts) and desertification in East Asia

Kaoru KASHIMA¹, Kyoichi OTSUKI², Kohei MATSUNAGA³, Aleksandr ORKHONSELENGE⁴, Hiroki TAKAMURA⁵ and Masato SHINODA⁶

1: Faculty of Sciences, Kyushu University

2: Faculty of Agriculture, Kyushu University

3: Initiative for Chinese Environmental Issues, Research Institute for Humanity and Nature

4: Institute of Nature and Environmental Technology, Kanazawa University

5: Faculty of Geo-Environmental Science, Rissho University

6: Arid Land Research Center, Tottori University

The International Symposium on Combating Desertification in East Asia was held on February 7-8 at the International Hall of Kyushu University. After the symposium, the field excursion at Unzen Volcano and Aso Volcano was held for three days. The participants of the symposium were 55 persons including 23 foreign persons from Taiwan, China, Mongolia and Korea. We can discuss a lot of problems for the desertification at East Asia from the views of world-wide scale and using multidiscipline techniques. On 8,

Feb. the special session for the young researchers of environmental studies was held. The graduate students from Japan, Korea, China, and Mongolia took lectures for their present researches.

The field excursion started in the afternoon on Feb.10. 22 persons who were mainly foreign attendances visited Unzen Volcano and Aso Volcano. In the excursion, we discussed together about the preservation of natural environment, ecological education and the relationship between regions, governmental offices and universities on the base of "Earth Environment".

The results of the symposium will be compiled as the proceedings of the symposium.

Program

The International Symposium on Combating Desertification in East Asia

International Hall, Kyushu University

6-10-1, Hakozaki, Higashi-ku, Fukuoka, Japan

Hosted by Research Inst. East Asia Environment, Kyushu Univ.

Arid Land Res. Center, Tottori Univ.

Res. Ins. For Human and Nature, RIHN Initiative for Chinese Environmental Issues

The Arid and Semi-arid Committee, AJG

February 7, 2011 International Hall, Hakozaki, Kyushu University

9:30~9:40 Opening Address (Kyoichi OTSUKI)

Researches on Combating Desertification in Japan & Kyushu University

9:40~9:50 Kyoichi OTSUKI (Fac. Agr., Kyushu Univ., Japan)

Outline of the activities of the combating desertification group of RIEAE

9:40~10:00 Kyoichi OTSUKI (Fac. Agr., Kyushu Univ., Japan)

Ecohydrological aspects of exotic plantations in Loess Plateau, China

10:00~10:20 Masaharu KITANO (Fac. Agr., Kyushu Univ., Japan)

"Sustainable Control of Soil Salinity in Irrigated Crop Fields under Desertification

I . Salt transport driven by roots and proposal for salinity control techniques"

10:20~10:40 Osamu TADAUCHI (Fac. Agr., Kyushu Univ., Japan)

Wild bee fauna and pollination biology for combating desertification and planting campaigns in Asian arid areas

10:40~11:00 --- Coffee Break ---

11:00~11:20 Kaoru KASHIMA (Fac. Sci., Kyushu Univ., Japan)

The long-term monitoring of environmental changes and desertification at Central and East Asia

11:20~11:40 Noriyuki YASUFUKU (Fac. Eng., Kyushu Univ., Japan)

"Project Research on Application of Medical Plant Licorice at Semi-arid Area in Mongolia-Approach toward Development of Ground Improvement Technology for Greening-"

11:40~12:00 Junpei KUBOTA (Res. Ins. for Human and Nature, Japan)

"Interaction between Human activities and the Environment in arid regions of Eastern Eurasia -Outcomes of RIHN's research projects-"

12:00~13:00 --- Lunch ---

Long-term Monitoring of KOSA (Aeolian Dusts) and Desertification in East Asia

13:00~13:20 Norikazu YAMANAKA (Arid Land Res. Center, Tottori Univ., Japan)

Desertification and its Combating Measures in East Asia

13:20~13:40 Masato SHINODA (Arid Land Res. Center, Tottori Univ., Japan)
Recent increases of wind erosion and vegetation degradation over East Asia

13:40~14:00 Yukiya TANAKA (Kyunghee Univ., Korea)
Monitoring of Asian dust in Yeongcheon, Hwasong and Seoul of South Korea

14:00~14:20 Tashpolat TIYIP (President, Xinjian Univ., China)
Remote Sensing Monitoring of Soil Salinization: A Review

14:20~14:30 --- Coffee Break ---

14:30~14:50 Hidehiro SOHMA (Nara Women's Univ., Japan)
Environmental changes remained around the ruins in the Northwest China

14:50~15:10 Yu FUKUMOTO, Kaoru KASHIMA (Kyushu Univ., Japan), A. Orkhonselenge and U. GANZORIG (Geographical Institute, MAS, Mongol)
Holocene Environmental Changes at Khuder Peat Land, Central Mongolia

15:10~15:30 Jiun Chuan, LIN (National Taiwan Univ., Taiwan)
Environmental hazards at Taiwan

15:30~15:50 Kohei MATSUNAGA (Res. Ins. for Human and Nature, Japan)
Erosion and its Prevention on the Chinese Loess Plateau

15:50~16:00 --- Coffee Break ---

16:00~17:00 Panel Discussion
Conference Room at Faculty of Sciences

17:15~18:00 Jiun Chuan, LIN (National Taiwan Univ., Taiwan)
Geopark Lecture

18:30~20:00 Conference Party (Conference Room at Faculty of Sciences)

February 8, 2011 International Hall, Hakozaki, Kyushu University

Session for the Young Researchers of Environmental Studies in East Asia

Opning Address (Kaoru KASHIMA)

9:00~9:20 Takashi OGAMI (Chuo Univ., Japan)

Three dimensional architecture under a Holocene alluvial fan: Reconstruction based on geodatabase of the Arakawa, central Japan

9:20~9:40 U. GANZORIG (Geographical Institute, MAS, Mongol)

Mongolian Mires (Peat Land) : From Taigo to Desert

9:40~10:00 Kenji EBHARA (Kyushu Univ., Japan)

"Sustainable Control of Soil Salinity in Irrigated Crop Fields under Desertification II. A column experiment and modeling of soil salinity"

10:00~10:20 Ardak KELIMU (Xinjian Univ., China)

Study on soil moisture inversion of bare random surface

10:20~10:40 Songhung KIM (Kyunghee Univ., Korea)

Palaeoflood study in the Dong river, Korea

10:40~10:50 --- Coffee Break ---

10:50~11:10 Yoshitoshi, UEHARA (Kyushu Univ., Japan)

Canopy rainfall interception and fog capturing of Pinus Pumila Regal at Mt. Tateyama in the Northern Japan Alps, Japan

11:10~11:30 Ryutaro NARUHASHI and Toshihiko SUGAI (Univ. of Tokyo, Japan)

Burial Model of a Shallow Submarine Active Fault Scarp: An Example of the Kuwana Fault, Central Japan

Closing Address (Masaharu KITANO)

Field Excursion

12:00 Depart to Unzen and Aso

Feb.8-Feb.10, 2011 Field excursion at Unzen and Aso

Feb.10 19:00~21:00 Farewell Party at Recent Hotel, Fukuoka

Forest policy in China and tree-planting cooperation

*Hideki KITAGAWA¹, Takehiko HOB², Jun Rong GUO³, Yuichiro HIRANO⁴
and Norikazu YAMANAKA⁵*

1: Faculty of Law, Ryukoku University

2: International Joint Research Institute of Ningxia University, China and Shimane University, Japan

3: Forest Research Institute in Shangxi Province

4: Forestry and Forest Products Research Institute

5: Arid Land Research Center, Tottori University

Meeting:

Symposium on Forest Policy and Greening Cooperation

Place:

Ryukoku University, Tomoikiso, the second training room

Time table:

Part 1, 9:30-14:20

Theme: "Law and Policy on Forest Conservation and Environmental Protection in China"

Presentation

1. Liu, San; Researcher from China National Forestry Bureau.

"Law Policy and Problem Concerning Forest Conservation in China."

2. Okuda, Shinichi; Associate Professor of Takushoku University.

"Land Law and Policy, and Grass/Forest Resources Conservation in China."

3. Guo, Jun Rong; Sub-Director and Researcher of Forest Research Institute in Shangxi Province.

"Forestry Development Policy of Shangxi Province."

(Rest and Lunch)

4. Seki, Yoshiki; Associate Professor of Takushoku University.

"Result of Program for Conversion of Cropland to Forest and Future Problems."

5. Hirano, Yuichiro; Researcher from Forestry and Forest Products Research Institute.

"Social Background of Woods Rights Reform of China"

(Break)

Part II

Panel discussion

Theme: Forests in China from the Viewpoint of Tree Planting Cooperation.

Panellists:

Yano, Masayuki; Secretary-General of Kouga Forest Tree-planting Network.

Takami, Kunio; Secretary-General of Green Earth Network.

Tanaka, Seiji; Director of Environmental Protection Network Kyoto.

Guo, Jun Rong; Sub-Director of Forest Research Institute in Shangxi Province.

Cordinator:

Yamanaka, Norikazu; Professor of Arid Land Research Center, Tottori University.

Result

Researcher Liu introduced Chinese forests and general government forest policies and researcher Guo introduced the forests and policies of Shangxi Province.

In addition, Assistant Professor Okuda reported the rights over land with relationship to Real Right Law and Nature Resources Protection Law.

In addition, Associate Professor Seki reported the result and the problem of the program for conversion of cropland to forest giving a concrete case, and he pointed out a lack of autonomy among farmers due to prolonged subsidy payments, and a risk of reconversion to farmland.

Researcher Hirano reported about the group's woods right system reform, giving a concrete case. He pointed out the transition from large to small scale, decentralization and abandonment of forest management. He also described decreased the function of forests for the common good.

He also pointed out conditions for circulation and implementation of forest rights, an adjustment to the eco-system, increasing farmers' autonomy by encouragement of the occupation collaboration companies and support of reemployment.

In the latter half of the symposium, three NGOs of Kansai district, who are planting trees in China, introduced their activities and exchanged opinions on the meaning of afforestation. The comment that the water dryness of the river was caused by afforestation was made.

Seminar on development and utilization of renewable energy for combating desertification and greening the desert in arid land

Kotaro TAGAWA¹, Tsutomu HAYASHI², Reiji KIMURA³, Katsumori MATSUSHIMA⁴, Yoshihiro MIZUBAYASHI⁵, Hiroyoshi KAMATA⁶, Yutaka HASEGAWA⁷, Koji TANABE⁸, Tetsuya KAWAMURA⁹, Yuko SATO¹⁰, Akihumi KUTANI¹¹ and Mitsuhiro INOUE³

1: Faculty of Regional Sciences, Tottori University

2: Department of Research, Nagoya Industrial Science Research Institute

3: Arid Land Research Center, Tottori University

4: Graduate School of Engineering, University of Tokyo

5: Graduate School of Human and Socio-Environment Studies, Kanazawa University

6: Tokyo Liaison Office, Tottori University

- 7: EcoTopia Science Institute, Nagoya University
 8: Graduate School of Innovation Management, Tokyo Institute of Technology
 9: Faculty of Science, Ochanomizu University
 10: Information, Media and Education Square, Ochanomizu University
 11: Graduate School of Regional Science, Tottori University

In this joint research, we focus on the development of a novel technological system for the prevention of desertification and the greening the desert. The system is fused by the production of electric power and water resources with renewable energy utilization and the vegetable cultivation with the water-saving irrigation.

We held a joint research seminar on “the development and utilization of renewable energy for combating desertification and greening the desert in arid land” at Tokyo Liaison Office of Tottori University on 26th-27th, January in 2011. The purpose of this seminar was to obtain the technical information for the field test of novel system and to make the networks between the researcher and engineers for the promotion of research project. Participants of the seminar were 15 people. The valuable lecture and profitable discussion were performed by the participants. The main topics given in the seminar were follows:

- Natural environment in arid land
- Current status and issues about the irrigation technology on dry land
- Current status about the development of the renewable energy in arid land
- Technical trend of renewable energy utilization
- Technology management for innovation of renewable energy, and so on

The current situations and issues about the renewable energy technology and the irrigation technology in arid land were able to be understood. Moreover, the information of technological issues for practical system was obtained by the engineer of companies.

Then, The field test of the novel system, which is fused the renewable energy utilization and the vegetable cultivation with the water saving irrigation, is planned by making use of the information and results of this seminar.

Workshop on environmentally conscious remediation and prevention of desertification in semi-arid regions considering mass and energy circulation in soil

Taku NISHIMURA¹, Masaru NISHIMURA¹, Ken KAWAMOTO², Kimihito NAKAMURA³, Hirozumi WATANABE⁴, Kazuhiro NISHIDA¹ and Mitsuhiro INOUE⁵

- 1: Graduate School of Agricultural and Life Sciences, University of Tokyo
 2: Faculty of Engineering, Saitama University
 3: Graduate School of Agriculture, Kyoto University
 4: Institute of Symbiotic Science and Technology, Tokyo University of Agriculture and Technology
 5: Arid Land Research Center, Tottori University

A conference entitled “Alternative direction of research on environmental conservation at arid and semi-arid region” was conducted at the multi-purpose room #1 of Tottori university library. Dr. Kawamoto

presented possible relationship between soil water repellency and soil physical properties. Dr. Nakamura introduced nitrogen accumulation of deep layer soil under arid climate (Nevada, USA). Dr. Watanabe suggested that runoff of agricultural chemicals from upland fields is a serious problem of regional ecosystem even though it does not have distinct toxicity to human being. Ecosystem of arid and semi-arid region is very fragile so that commercial agricultural system which employs agricultural chemicals at semi-arid regions might be a risk for regional ecosystem. Dr. Nishida, presented how salt tolerant weeds can reduce and retard salt accumulation. Dr. Nishimura suggested even in semi-arid condition CO₂ emission from agricultural field might be enhanced agricultural practices especially, irrigation. Drs. Inoue and Mizoguchi depicted deficits of onsite technology to monitor temporal and spatial variation of soil physical conditions. It was concluded among many issues, water and chemical circulation through natural grass land and water-material circulation of agricultural land especially under semi-arid condition considering more detailed process of chemical reactions must be selected to be future research project.