

3. Research Activities (Apr.1996-Mar.1997)

3.1 Outline of Activities

(1) Center

Arid Land Research Center (ALRC) is an independent department of Tottori University and at the same time is a National Joint-use Research Institute of the Ministry of Education, Science, Sports and Culture. The mission of the ALRC is to conduct research on desertification and to develop sustainable agricultural practices in arid and semi-arid areas. The door is open to all teachers of national universities who are engaged in this field of study.

Organization, Management, and Funding Subsidies

ALRC is managed by the Director, a Conference (which is composed of professors and associate professors), a Board of Management (which is composed of members from outside as well as professors of ALRC), four research divisions and two office sections (the general affairs section and the joint research section). In practice the Conference and the Board of Management operate our Center.

The four divisions are :

- Arid Land Environment,
- Biological Production,
- Afforestation and Land Conservation,
- Arid Land Sciences (Visiting).

The three full-time divisions each have two professors and two associate professors. The Visiting division has two visiting professors and one associate professor from Japan and, one visiting professor from abroad. In addition, one foreign researcher (visiting professor) and two part-time researchers are stationed at ALRC through the COE program (one program of the Center of Excellence funded by the Ministry of Education, Science, Sports and Culture) beginning in the 1995 fiscal year. Ten office staff (four clerks, two technical officers and four associate clerks) and two research support technicians support research and education.

With regard to the funding subsidies for scientific study in the fiscal year of 1996, a total of eight themes were adopted :

General Research B	: 1,
General Research C	: 1,
Incentive Research	: 1,
Tentative Research	: 4,
International Sciences Research	: 1.

With regard to other research funding a total nine themes were accepted :

Scholarship Contribution	: 4,
Entrusted Research	: 1,
Joint Researches with private enterprises	: 4.

Joint-Use, Education, Publication

During the fiscal year of 1996, 30 Joint-Use Researchers (Teachers from national and private universities) were attached to the Center. The number of students as of March, 1997 is 90 (10 Ph.D. Students, 35 Master Students, 38 Undergraduate Students, 5 Trainees and 2 Foreign Research Students).

Seminars were often held by internal and external experts. The foreign visiting professors periodically give seminars.

Annual report has been published since the establishment of ALRC, which provides a brief overview of the activities in its various divisions and also summarizes our research and education.

The 6th seminar of Joint Research was held on December 13, 1996 at Tottori Prefectural Kenmin Bunka Kaikan. Two key note lectures and thirteen lectures were presented.

The second International Symposium on "Development of Basic Technology for Sustainable Agriculture under Saline Conditions" was held by ALRC on December 12, 1996. at Tottori Prefectural Kenmin Bunka Kaikan.

(2) Divisions

1) Division of Arid Land Environment

Subdivision of Natural Environment

Subdivision of Natural Environment conducts research on evaluation of the natural environment and the exploitation of natural resources and energy for the development of arid and semi-arid areas from the point-of-view of meteorology and climatology.

The staff in the subdivision consists of Dr. Kamichika, M. (Professor), Dr. Otsuki, K. (Associate Professor), and Ms. Yonehara, A. (Associate Clerk, also assigned for the subdivision of Water Resources).

There were two Doctoral, six Master's (three in the 2nd year and three in the 1st year), five undergraduate students (three in the 4th year and two in the 3rd year) and two research students in the fiscal year of 1996.

Mr. Ito, K., the 2nd year doctoral student, was assigned as a research assistant during the fiscal years of 1996. Mr. S. Gu and Mr. Okada, S., the 2nd year master students, entered the doctor's course of the graduate school of Tottori University after the completion of the master course, and have continued studying in this subdivision. Mr. Hatsuta, T. and Ms. Matsubara, Y., the 4th year undergraduate students, entered the master's course of the graduate school of Tottori University after the graduation, and have continued studying in this subdivision.

Mr. Ezuka, T., the second year master student, started work for the consultant company Nihon-Giken after the completion of master course. Mr. Iwao, S., the 4th year undergraduate student, has worked for the consultant company Crown Engineering after the graduation.

Dr. J. Zhou had continued studying in this subdivision as a short-period special foreign researcher of the Japan Society for the Promotion of Science (JSPS) during March-June 1996 and as a research student during July 1996 - March 1997. He has worked for Tottori Woman's college as a lecturer since April 1997. Mr. Ishikawa, M., the research student, conducted the research on "Recycling of water vapor by distillation" till March, 1997, then became an engineer of the consultant company Taiyo Consultant.

In the fiscal year of 1996, the following researches have been conducted in Japan.

(1) REMOTE SENSING Measurements of plant canopy structure and diagnosis of the salinity and water stresses of vegetation using remote sensing were investigated. Under the theme "Analysis of Arid Land Surface Conditions by Remote Sensing" for joint research, cooperative works were conducted with, Dr. Ishida, T. (Fac. of Agric., Kagawa Univ.), Dr. Kojima, T. et al. (Fac. of Agric., Saga Univ.) and Dr. Ishiguro, E. et al. (Fac. of Agric., Kagoshima Univ). Evaluation of the moisture condition of plants using multi band remote sensing was studied with Dr. Tani, H. et al. (Fac. of Agric., Yamaguchi Univ.) related

to the joint research on "Studies on Water and Salt Management on Woody Plants in Arid Areas.

(2) **MICROCLIMATE** Evapotranspiration and profiles of CO₂ concentration were investigated with Dr. Hayakawa, S. (Fac. of Agric, Yamaguchi University), a visiting professor of ALRC, by measuring microclimatic factors in the sorghum field of ALRC. Simulation of evapotranspiration using fluid mechanical analysis was investigated with Dr. Kawamura, T. (Fac. of Science., Ochanomizu Woman's Univ.) related to the joint research on "Measurement of Evapotranspiration and Photosynthesis on the Crop Canopy"

(3) **RECYCLING USE OF WATER VAPOR** Recycling of water vapor by distillation using solar energy was studied. Possible recycling amounts of atmospheric water vapor along cool coastline desert of the west coast of the continents were also evaluated.

(4) **MECHANISM OF DEW FORMATION** Micrometeorological observations were conducted in order to understand the mechanism of dew formation under natural conditions.

(5) **WIND EROSION** Wind erosion was investigated by measuring sand movement every month in the Tottori Sand Dune and studying the relationship with the wind.

(6) **CLIMATIC RESOURCES AND PLANT PRODUCTIVITY** Climatic resources and net primary productivity in Iran and Inner Mongolia, China were investigated, and the relation to livestock farming and agriculture was examined.

(7) **ACID RAIN** The characteristics of acid rain along the Japan Sea coast was studied by measuring EC and pH of the rain in the Center and comparing this with other meteorological factors. Dr. Kimura, K. (the Research Institute for Bioresources, Okayama Univ.) and Dr. Suzuki, H. (Fac. of Agric., Kagawa Univ.) cooperated in this work.

Overseas research in the fiscal year of 1996 were as follows.

(1) Prof. Kamichika visited Niger, Ghana and Kenya to investigate sustainable development of irrigated agriculture in arid land during October 7-29, 1996.

(2) Assoc. Prof. Otsuki visited Faisalabad, Punjab State in Pakistan during August 25 - September 4 1996 to create the Agricultural Land and Water Resources Management Monitoring System as a member of Japanese Institute of Irrigation and Drainage (JIID) Research Mission.

Subdivision of Water Resources

Staff and Students: The staff consists of Dr. Yano, T. (Professor), Dr. Kitamura, Y. (Associate Professor), Ms. Yonehara, A. (Associate Secretary, also assigned for the Subdivision of Natural Environment), three Doctoral, six Master's, three undergraduate students and one research student from China.

Mr. Guo Yu Qiu, one of the doctoral students, received the doctor's degree of agriculture and finished the course in September 1996; the title of the thesis is "A New Method for Estimation of Evapotranspiration". He was employed as a STA research associate in October and started a research on environmental control for crop production in green houses in the Department of Land Improvement, National Research Institute of Agricultural Engineering (NRIAE), Ministry of Agriculture, Forestry and Fisheries (MAFF).

Mr. Hiroshige, H., Mr. Yamaguchi, Y., Mr. Yamada, M., and Mr. Yamamoto, T., second year students of the Master's Course (MS), became an engineer of Pacific Consultants International Co. Ltd., Naigai Engineering Co. Ltd., Wesco Inc., and Nikka Engineering Co. Ltd., respectively. Ms. S. Iwata, one of three undergraduate students decided to go into the Master's Course. Mr. Kamo, H. joined as a new member of Elico Co.

Research has been conducted in Japan and abroad on efficient water and soil management for water saving irrigation and saline water irrigation from the view point of protecting lands from desertification

and for the agricultural utilization of arid lands.

Overseas Research: Overseas research in the fiscal year of 1996 were as follows:

A research on the development of technology for the rehabilitation of soils with salt accumulation in the Central Asia has newly been commenced as a main theme of the subdivision with a financial support of the Global Environment Research Fund by the Environment Agency. Dr. Kitamura visited the research site in Kzyl-Orda, Kazakstan in August for conducting this research. Prof. Yano also visited the site successively in September and carried out field observation. Three students, i.e. Mr. Yamaguchi, Y., 2nd year of MS, Mr. Oba, T., 1st year of MS and Mr. Nagatani, A., 4th year of undergraduate, participated in the field study in the research site for two to three months.

Prof. Yano visited Oman in May as a member of study team of the Japan International Cooperation Agency (JICA) for implementing a study on development and effective utilization of water resources. He visited Israel also in November for the international academic research on water, salt and nutrient interaction in plant growth funded by Monbusho Grant-in Aid for Scientific Research.

Dr. Kitamura visited China as a member of IPTRID (International Program for Technology in Irrigation and Drainage) Study Mission to investigate the current situation of drainage for providing guidelines and manuals for agricultural land drainage in South China. He visited Kenya during January - March (50 days) as a short-term expert of JICA project for research cooperation in a field of soil and water conservation. Furthermore, he visited India in March as a member of JALDA (Japan Agricultural Land Development Agency) Study Mission to carry out a study on environmental impact of paddy-based agriculture in India.

Studies in Japan: Our efforts in Japan have been made to carry out research themes on water and soil management for water saving irrigation and saline water irrigation based on a simulation approach as well as an experimental approach. Research on the measurement of stem flow through herbaceous plants and arboreal plants was also conducted to establish the measurement technology for the stem heat balance method and the heat pulse method. Furthermore we continued research on soil and water properties for effective irrigation management and prevention of soil erosion in furrow irrigation with the cooperation of Dr. Isaac Shainberg, who was a visiting professor from the Volcani Center, Israel.

Cooperative researches have been conducted with the following researchers: Prof. Nishiyama, S. (Fac. of Agric., Yamaguchi Univ.), Prof. Watanabe, S. and Mr. Inosako (Fac. of Agric., Tottori Univ.), Prof. Momii, K. (Fac. of Agric., Kagoshima Univ.), Prof. Odani, H. (Univ. of Shiga Prefecture). One new research project was started with Dr. Cho, H. (Fac. of Agric., Saga University). The titles for these research projects are listed in the joint research section of this Annual Report.

2) Division of Biological Production

Subdivision of Plant Ecophysiology

STAFF The staff consisted of Dr. Inanaga, S. (Professor), Dr. Sugimoto, Y. (Associate Professor) and Ms. Yamada, E. (Associate Clerk, also assigned for the Subdivision of Plant Production).

STUDIES IN JAPAN Research projects undertaken domestically were: development of non-destructive measuring systems for root growth based on AE method, development of plant production system using sea water, improvement of plant sensitivity to salinity, which were supported by Monbusho Grants-in-Aid, effect of root zone temperature on root growth, physiological mechanism of wheat on deep-sowing tolerance, improvement of fertilizer application under salinity condition, search for germination stimulant of parasitic weed *Striga*, and isoquinoline biosynthesis in *Menispermum* root cultures. Joint researches have been conducted with Drs. Morita, S. (Visiting Associate Professor), Abe, J., Yamagishi, J. (Fac. of

Agric., the Univ. of Tokyo), Yamauchi, A. (Fac. of Agric., Nagoya Univ.) and Kobata, T. (Fac. of Agric., Shimane Univ.).

STUDIES ABROAD Dr. Inanaga had a talk entitled "The role of climate and cultural practices on land degradation and desertification with reference to rainfed agriculture in the Sudan" at the fifth Intl. Conference on Desert Development. Dr. Sugimoto joined Prof. Zwanenburg, Univ. of Nijmegen, the Netherlands, and took part in research program entitled "Molecular aspects of the germination of seed of the parasitic weeds *Striga* and *Orobancha*", from March 1 to Dec 20.

STUDENTS There were four PhD students (two 3rd, one 2nd and one 1st grade), four MS students (two 2nd grade and two 1st grade), seven undergraduate students (four 4th grade and three 3rd grade) and two research students from China and Sudan. A PhD student, who graduated in March 1997, will join this subdivision from July 1997 as a foreign researcher sponsored by JSPS. Two MS students and two undergraduate students were employed at several companies. Two undergraduate students continue their study for MS degree, one at this subdivision and another at NAIST.

ADDITIONAL ASSIGNMENTS Dr. Inanaga acted as a councilor, and a chairman of Symposium Committee, of Crop Science Society of Japan, a councilor of the Japanese Association for Arid Land Studies. He was also assigned as a member of a Monbusho committee "Working group for establishing the Key Institute of Earth Environmental Science", and professor of the University of Tokyo (University Farm).

GUESTS FOREIGNERS Dr. Zwanenburg (Professor, Nijmegen University, The Netherlands), Dr. El-Mulki (General director of Jordanian Academy of Sciences), and Dr. Riu (Director of Institute of Agriculture Modernization at Shijiazhuang, Chinese Academy of Sciences) called on this subdivision to discuss about chemical control of parasitic weeds, agriculture in arid land, and crop science in arid land, respectively.

Subdivision of Plant Production

The subdivision is composed of Dr. Takeuchi, Y. (Professor), Dr. Toyama, M. (Associate Professor), Ms. Yamada, E. (Associate clerk), 7 students in the master course, 5 senior and 5 students (Undergraduates). In addition, the subdivision accepted 3 researchers from Ikari Disinfectants, NOK Corporation and Sumitomo Elec. Engineering for cooperative research.

A specific research was funded by Monbusho Scientific Research Program (Monbusho Grant-in-Aid for Scientific Research).

The research is focused on crop production problems pertaining to arid and semi-arid lands. Crop production systems under desert conditions were studied with emphasis put on crop tolerance to water deficiency and salinity. The major subjects studied were : a) development of an auto-irrigation system for the establishment of water saving cultivation in arid and semi-arid lands, using water holding substances and b) development of a system for controlling crop cultivation via telecommunications.

Dr. Takeuchi conducted studies on present and future development of agricultural use of arid lands in the United States of America. Dr. Toyama undertook several field experiments in Mongol and in the United Arab Emirates, on the use of water holding substances in desert areas. Special emphasis was laid on the effect of these substances on desert afforestation and on water saving-cultivation. So far, experimental results are encouraging.

3) Division of Afforestation and Land Conservation

Subdivision of Revegetation and Grassland Development

The present staff of this subdivision consists of Dr. Tamai, S. (Professor), Dr. Yamanaka, N. (Lecturer), Mrs. Hamamoto, N. (associate Clerk, also assigned to the entire Division), 5 Master's and 4 undergraduate students. Our research focuses on afforestation in semi-arid areas, especially on the plant communities and its specific characteristics. The research mainly includes: (1) the distribution of plants in semi-arid land and its specific characteristics, (2) the maintenance mechanisms of plant communities in arid areas, (3) the relationships between water and nutrient dynamics, and the growth of trees, (4) the effects of salt spray from the sea on tree growth, and (5) the dynamics of plants on sand dunes.

The most important research in this subdivision is the prevention of desertification and afforestation in semi-arid areas by native plants and we are analyzing vegetation of China and Northeast Brazil.

While the distribution and growth of trees in semi-arid areas mainly depends upon water conditions of the soil, nutrients connected with water also play an important role on the growth of trees. Then research on water and the nutrients dynamics of trees and in the soil with the growth of trees has been conducted.

The investigation is to clear the dynamics of nutrients in the soil with changing soil water potential using six large scale lysimeters in vinyl houses. Salinity of the soil in semi-arid land sometimes becomes a hazard for the germination, establishment and growth of trees, and salt attached on the above part of the plant also affects the growth of trees. We are investigating salinity from the sea and its effect on the growth, shape and form of Japanese black pine on the sand dune, Tottori.

Ecological researches on plants on sand dunes and studies on growth and reproductive characteristics of woody plants in arid areas have also been conducted.

Cooperative research on the drought stress tolerance of trees was conducted with the scientists for joint research of the Center. And a number of trainees from abroad were took on.

Prof. Tamai went to Brazil on Oct. 1996 for research on conservation of sand dunes in northeast Brazil. Prof. Tamai also visited China on Sep. 1996 for the special lecture on forest ecology at Beijing Forestry University.

Dr. Yamanaka visited China on June 1996 for research on maintenance mechanisms of semi-arid woody plants in Inner-Mongolia.

Subdivision of Land Conservation

The main studies in this subdivision were on the dynamic al movements of moisture and salt in the soil and measures against salinity troubles, as well as soil conservation and water pollution under irrigated fields, in order to conduct research on the mechanism and control of desertification under arid land conditions. The staff includes Dr. Yamamoto, T. (Professor), Dr. Inoue, M. (Associate Professor), Ms. Hamamoto, N. (Associate clerk assigned to the entire Division) and twelve students, one of whom are enrolled in the doctoral course at the united graduate school of agricultural science, seven as master's course students, three as undergraduate students and the other are four foreign researchers, one of whom is Monbusho Fellowship for Foreign Researcher from Ghana and three as JICA participants from Myanmar and Slovak.

The main domestic research titles are 1) development of efficient irrigation schedules and soil salinity monitoring system in productive green land and 2) development of soil moisture management for cultivation and its practical use supported by Monbusho Scientific Research, 3) measures against troubles by water pollution under drip irrigation supported by Ministry of Agriculture, Forestry and Fisheries, 4) soil salinity improvement using artificial zeolite by the Kimura Chemical Plants Co., including 5) dynamics of water and salt under condition of soil temperature gradient in sandy soil, 6) two dimensional soil

moisture movement in two layers under condition of drip irrigation, 7) simultaneous measurement of soil moisture and solute by using soil water pressure gauges and four electrode sensors.

As joint research with other divisions in universities, the staff carried out 1) studies on farm land conservation in arid land, together with Dr. Hosoyamada, K. (Fac. of Agric., Miyazaki Univ.), Dr. Toride, N. (Fac. of Agric., Saga Univ.), Dr. Takeshita, U. (Fac. of Env., Okayama Univ.) and 2) studies on in-situ measurement of unsaturated hydraulic properties with Dr. Morii, T. (Fac. of Agric., Tottori Univ.), 3) dynamics on soil moisture variation by temporal underground irrigation for saving water with Drs. Shibusawa, S. and Sasao, A. (Fac. of Agric., Tokyo Univ. of Agric. and Tech.) and 4) studies on historical agricultural manuscripts in Islamic World with Shimizu, K. (Fac. of Civilization, Kyushu Univ.).

As an international joint research project, Monbusho international scientific research was second year on the title on sustainable development of irrigated agriculture in arid lands. The field works were carried out in steppe and savanna areas in the Republics of Niger, Ghana and Kenya in Sahelian zone of Africa, together with Dr. Torii, S. (Fac. of Agric., Kyoto Univ.) on the title of compiling of desertification by using geographic information system (GIS). In case of the field work in Ghana, we carried out useful joint research with Dr. Agodzo, S. who was JSPS Post Doctoral Fellowship for Foreign Researchers in 1995. The cooperative research with foreign researcher carried out by Dr. Mucha, I. and Mr. Bakes, V. in Slovak on development of water resources for ten days, by Mr. U. Ne. Win in Myanmar on irrigation method for 56 days and by Mr. F.K.Amu-mensah in Ghana on application of GIS in environmental assessment, monitoring and evaluation of the state of industrial and agricultural effluent and pollutions in water courses in the Accra/Tema metropolis of Ghana for nine months.

4) Division of Arid Land Science

Foreign Researchers

The 9th foreign visiting professor, Dr. Shainberg, Issac (The Volcani Center, Israel), arrived on January 2, 1996 and stayed for six months until July 1, 1996. His research title here was "Improvement of soil physical properties and crop growth by using water-absorbent polymer". His activities in the ALRC were described in the former annual report of the ALRC.

The 10th foreign visiting professor, Dr. Elrick, D.E. (University of Guelph, Canada), arrived on July 1, 1996 and stayed six months until December 31, 1996. He conducted "Studies on salt movement in soil" and gave many seminars and lectures. The outline of his activities are presented in the latter part of this chapter.

The 11th foreign visiting professor, Dr. Cohen, Yehezkel arrived on January 1, 1997 and has been conducted "Studies on characteristics of transpiration of arid-zone plants". This is second time for him to work as the foreign visiting professor of ALRC.

Besides their own researches, they taught students with great zeal, and gave seminars in ALRC.

Internal Researchers

As internal visiting professors to ALRC, Professor Seiji Hayakawa (Fac. of Agric., Yamaguchi Univ.), Professor Sumiji Kobashi (Fac. of Agric., Kyoto Univ.) and Associate Professor Shigenori Morita (Fac. of Agric., the Univ. of Tokyo) arrived at their posts on April 1, 1995 and has been conducting joint researches until March 31, 1997.

5) COE Researcher

Foreign Researchers

The 2nd COE foreign visiting researcher, Professor Farah, S. M. (Gezira Res. Station, Agric. Res. Corp., Sudan), arrived on February 1, 1996 and stayed for one year until January 31, 1997. His research title was "Studies on root growth of crops under arid land condition". His activities in the ALRC were described in the former annual report of the ALRC.

The 3rd COE foreign visiting professor, Professor Kafkafi, U. (Hebrew University, Israel) arrived on August 1, 1996 and stayed for three months until October 31, 1996. He conducted "Studies on improvement of fertilization and irrigation in dry land farming".

The 4th COE foreign visiting professor, Associate Professor Salih, A. A. (Gezira Res. Station, Agric. Res. Corp., Sudan), arrived on December 1, 1996 and has been conducted "Studies on the characteristics of nutrient and water uptake of crops under arid lands conditions" until November 30, 1997.

Besides their own researches, they taught students with great zeal, and gave seminars in ALRC.

Internal Researchers

Dr. Murota, K. and Dr. Matsuura, A. conducted "Researches on the Establishment of Plant Production System using Sea Water in the Coastal Arid Areas".

6) Administration

General Affairs Section

General Affairs Section is the administrative section which deals with the general affairs for the management of the ALRC.

There are three clerks (Chief Clerk : Mr. Taniguchi, K. <newly appointed>, Clerks : Mr. Doi, H. and Mr. Yokota, H. <newly appointed>) and three associate clerks (Ms. Yonehara, A. <Division of Arid Land Environment>, Ms. Yamada, E. <Division of Biological Production>, Mr. Hamamoto, N. <Division of Afforestation and Land Conservation>) in this section.

The former chief clerk, Mr. Takeuchi, K., moved to the International Affairs Section of the Headquarters. The former associate clerk, Ms. Kitamura, S., moved to the Student Affairs Section of the Faculty of Agriculture. The former technical officer, Mr. Yamane, H., has retired.

Joint Research Section

Joint Research Section is the administrative section which deals with the affairs related to the joint research of the ALRC.

There are one clerk (Chief Clerk : Mr. Tanmatsu, S.), two technical officers (Mr. Kodani, S. and Mr. Ueyama, I.) and one associate clerk (Ms. Matsuoka, M. <newly appointed>) in this section.

The former associate clerk, Ms. Morita, S., has resigned.