

3. Research Activities (Apr.1997-Mar.1998)

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 1997, a total of seven themes were adopted :

Scientific Research (A)	: 2,
Scientific Research (B)	: 2,
Scientific Research (C)	: 1,
JSPS Fellows	: 1,
International Scientific Research	: 1.

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

Scholarship Contribution	: 7,
Entrusted Research	: 2,
Joint Researches with private enterprises	: 1.

Joint-Use Research, Education, Publication

During the fiscal year of 1997, 41 Joint-Use Researchers (Teachers from national and private universities) were attached to the Center. The number of students as of March, 1998 is 80 (14 Ph.D. Students, 28 Master Students, 34 Undergraduate Students, 2 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 7th seminar of Joint Research was held on December 11, 1997 at Tottori Prefectural Kenmin Bunka Kaikan. One keynote lecture and thirteen lectures were presented.

(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 four Doctoral students, five Master's students and four undergraduate students in the fiscal year of 1997.

Dr. Ito, K., the 3rd year doctoral student obtained the doctor's degree from the United Graduate School of Agricultural Science, Tottori University on March 1997. He has been assigned as an assistant professor in the Faculty of Agriculture, Gifu University since April 1997.

Mr. Yanagidani, T., the 2nd year master student, started work for the consultant company Tamano consultant after the completion of master course. Mr. Tasumi, M., absented from school for working in IIMI (International Irrigation Management Institute), the United Nations Institute, in Sri Lanka as a visiting researcher.

Ms. Kawamoto, T., 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. Ms. Hinamoto, M., the 4th year undergraduate student, started work for the Asahi Information Systems after the graduation.

In the fiscal year of 1997, the following researches have been conducted in Japan.

(1) MICROCLIMATE Method to estimate evapotranspiration and relationship between soil moisture and radiation balance have been investigated based on the measurement of microclimate and soil moisture in the field of ALRC. Dr. Hayakawa, S. et al. (Faculty of Agriculture, Yamaguchi University), Dr. Miura, T. (Faculty of Environmental Science and Technology, Okayama University) and Dr. Matsuoka, et al. (Faculty of Horticulture, Chiba University) were participated to the joint research of this subdivision "Researches on modification of microclimate of agricultural fields in arid Lands". Basic studies on the modification of temperature using paper mulch were also conducted.

(2) REMOTE SENSING Under the theme "Analysis of Arid Land Surface Conditions by Remote Sensing" for joint research, cooperative works were conducted with, Dr. Ishiguro, E. et al. (Faculty of Agriculture, Kagoshima University), Dr. Honda, Y. et al. (The Center of Environmental Remote Sensing, Chiba University) and Dr. Fujimura, H. (Faculty of Engineering, Tottori University). Diagnosis of the salinity and water stresses of vegetation using remote sensing was investigated with Dr. Fujiyama, Y. (Faculty of Agriculture, Tottori University)

(3) WIND EROSION Wind erosion has been investigated by measuring sand movement every month in the Tottori Sand Dune and studying the relationship with the wind. Dr. Kawamura, T. et al. (Graduate

School of Humanities and Sciences, Ochanomizu University) and Dr. Yajima, H. (Faculty of Engineering, Tottori University) were cooperated in this studies.

(4) RECYCLING USE OF WATER VAPOR The researches “Design of fixation of atmospheric water vapor in arid lands” supported by Monbusho Grants-in-Aid were conducted

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

(6) MEASUREMENT OF LOCAL CLIMATE Temperature distribution in the downtown and suburb of Tottori city was investigated by measuring air temperatures using twenty-four portable data-loggers installed in the primary schools in Tottori city. Relationship between lightning and precipitation was researched with Weather News under the cooperative research program with private company.

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

(1) Prof. Kamichika visited Australia for “Research on the effect of farming on the surrounding environment in the arid land in Australia” during November 30- December 6, 1997.

(2) Assoc. Prof. Otsuki visited Israel to investigate the interrelation among water, salt and nutrition to the plant growth during August 3-18, 1997. He also visited Australia as a leader of the student research trip of Japanese Society of Irrigation, Drainage and Reclamation Engineering and researched the environmental management of the Murray River Basin.

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, five Master's, four undergraduate students and one research student from China.

Mr. Takagi, S. and Mr. Oba, T., second year students of the Master's Course (MS), completed the course and joined to the Ministry of Agriculture, Forestry and Fisheries (MAFF) as a technical official and the consultant company Elico Co. as an engineer, respectively. Among four undergraduate students, Mr. Higaki, E. and Ms. Ito, M. entered the Master's Course, and Mr. Nagatani, joined as a new member of Nishitani Engineering Co. Ltd. after their graduation. Mr. Yang, S. L., research student from China, entered the Master's Course.

Research: 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 1997 were as follows:

A research on the development of technology for the rehabilitation of soils with salt accumulation in the Central Asia has been conducted 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 May for conducting the research on water management to mitigate and prevent secondary salt accumulation in agricultural lands based on the field survey of water and salt balance in an irrigated area. Prof. Yano also visited the site three times successively in June/July, August, and September/October to carry out field experiment for making clear physical and chemical characteristics of highly saline soils in abandoned farmlands for the development of reclamation method of those degraded lands. Three students, i.e. Mr. Oba, T., 2nd year of MS, Ms. Iwata, S., 1st year of MS and Mr. Higaki, E., 4th year of undergraduate, participated in the field study in the research site for two to three months.

Dr. Kitamura visited Israel to investigate the interrelation among water, salt and nutrition to the plant growth during August 3-18, 1997. He also visited Kenya during February - March (30 days) as a short-term expert of JICA project for research cooperation in a field of soil and water conservation.

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 COE foreign visiting professor from the Volcani Center, Israel. Special study on water management practices for reuse of drainage water in tile drainage project area was commenced in cooperation with Dr. Rai, Niaz Ahmad who was a JSPS Fellow from the University of Agriculture Faisalabad, Pakistan.

Cooperative researches have been conducted with the following researchers: Prof. Nishiyama, S. (Fac. of Agric., Yamaguchi Univ.), Prof. Momii, K. (Fac. of Agric., Kagoshima Univ.), and Prof. Odani, H. (Univ. of Shiga Prefecture). Two new research projects were started with Prof. Sakuratani, T. (Graduate School of Agricultural Science, Kyoto University) and Prof. Takahashi, K. (University Farms, Faculty of Agriculture). 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 plant production system using sea water, which was supported by Monbusho Grants-in-Aid, effect of root zone temperature on root growth, development of non-destructive measuring systems for root growth based on AE method, physiological mechanism of wheat on deep-sowing tolerance, search for germination stimulant of parasitic weed *Striga*, search for potential plants from semi-arid regions (Tottori Industrial Technology Association), selection and characterization of salt-tolerant plant cells (Saneyoshi Scholarship Foundation) and isoquinoline biosynthesis in *Menispermum* root cultures (Kampou Science Foundation). Joint researches have been conducted with Drs. Abe, J. (Univ. of Tokyo), Yamauchi, A. (Nagoya Univ.), Kobata, T. (Shimane Univ.), Takahashi, H. (Yamaguchi Univ.), Morita, S. (Univ. of Tokyo), Takabe, T. (Nagoya Univ.), Nakajima, H. (Tottori Univ.) and Tanimoto, E. (Nagoya City Univ.). Moreover, Drs. M. Luxova from Slovakia and I. A. Ali from Sudan joined this subdivision as a foreign researcher and a JSPS postdoctoral fellow, respectively.

Studies abroad: Dr. Inanaga visited Sudan, in response to invitation from Dr. O. A. Ageeb, Director of Agricultural Research Corporation, Sudan, to survey desertification in Sudan in collaboration with Profs. A. G. T. Babiker and H. A. Fadul. He also discussed future collaboration with Minister of Agriculture, Sudan.

Students: There were four Ph.D. students (two 3rd, one 2nd and one 1st grade), six MS students (two 2nd grade and four 1st grade), six undergraduate students (three 4th grade and three 3rd grade). A Ph.D. student, who graduated in March 1998, joined International Institute of Tropical Agriculture, as a post doctoral fellow. Two MS students and an undergraduate student were employed at private companies. Two undergraduate students continue their study for MS degree, one at this subdivision and another at Fac. of Agriculture, Tottori Univ.

Additional assignments: Dr. Inanaga acted as a councilor of Crop Science Society of Japan, the Japanese Society of Sand Dune Research and the Japanese Association for Arid Land Studies. He was also

assigned as a member of the committee on establishing Institute of Earth Environmental Sciences under the Ministry of Education, Science, Culture and Sports and a member of the committee on planning education system for Tottori University of Environmental Sciences.

International relationship: Dr. Inanaga exchanged opinion about scientific collaboration with Ambassadors of Israel, Tunisia and Sudan.

Subdivision of Plant Production

The subdivision is composed of Dr. Hamamura, K (Professor, since June,1997), Dr. Toyama, M. (Associate Professor), Ms. Yamada, E. (Associate clerk), 4 students in the master course, 4 senior and 3 students(Undergraduates).

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 subject studied was water saving crop cultivation with an auto-irrigation system utilizing water holding substances. Other subjects included : relationship between leaf color and water potential of melon leaves, salt tolerance of fig and rice with special emphasis put on alleviation effects of K and Ca, growth promoting effects of extract from scallions and the control of flower bud abortion in *Cymbidium*.

Dr. Toyama undertook several field experiments in Mongol 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 for the Subdivision of Land Conservation), 4 Master's, 1 undergraduate students and one research student from China. Our research focuses on afforestation in semi-arid areas, especially on the plant communities and their 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 depend 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 by 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 April 1997 for research on conservation of sand dunes in northeast Brazil. Prof. Tamai also visited China with Dr. Yamanaka on June and Aug. 1997 for joint research with Beijing Forestry University on the Land Use and Vegetation of Semi arid areas of eastern China.

Subdivision of Land Conservation

The main studies in this subdivision were on the dynamic movement of moisture and salt in the soil and measures to control salinity problems. Soil conservation and water pollution under irrigated fields were also studied in order to conduct research on the mechanism and control of desertification under arid land conditions. The staff is made up of Dr. T. Yamamoto (Professor), Dr. M. Inoue (Associate Professor), Mrs. N. Hamamoto (Associate clerk assigned to the entire Division) and fourteen students. Three students are enrolled in the doctoral course at the United Graduate School of Agricultural Sciences, five as master course students and six as undergraduate students in the Faculty of Agriculture.

The main domestic research titles are development of efficient irrigation schedules and soil salinity monitoring system in productive green land supported by Monbusho Scientific Research since 1995, measures against problems of water pollution under drip irrigation supported by Ministry of Agriculture, Forestry and Fisheries since 1992, soil salinity improvement using artificial zeolite by the Kimura Chemical Plants Co. since 1997, dynamics of water and salt movement under condition of soil temperature gradient in sandy soil, two dimensional water and salt movement in sloped soil column under drip irrigation, 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 studies on farm land conservation in arid land, together with Dr. K. Hosoyamada (Fac. of Agr., Miyazaki Univ.), Dr. H. Cho (Fac. of Agr., Saga Univ.), Dr. U. Takeshita (Fac. of Env., Okayama Univ.) and studies on analysis of surface conditions in arid land by remote sensing, together with Dr. S. Torii (Fac. of Agr., Kyoto Univ.) on the title of compiling of desertification by using geographic information system (GIS). studies on in-situ measurement of unsaturated hydraulic properties with Dr. T. Morii (Fac. of Agr., Niigata Univ.), dynamics on soil moisture variation by temporal underground irrigation for saving water with Dr. S. Shibusawa and A. Sasao (Fac. of Agr., Tokyo Univ. of Agric. and Tec.) and studies on historical agricultural manuscripts in Islamic World with K. Shimizu (Fac. of Civilization, Kyushu Univ.). As part of the cooperative experimental facilities, the monitoring systems of water flow and solute transport as well as dynamic water erosion for saline soils were installed in the Arid Land Dome. A lot of our subdivision staff helped to check the accuracy of each sensor and to calibrate various sensors.

Open seminars with our active support were often held by some internal and external experts. Major open seminars were shown as follows. Seminar on 'studies on salinity tolerance in crops' was held by Dr. T. Tobita (Japan International Research Center for Agricultural Science, JIRCAS), Dr. M. Shono (JIRCAS) and Dr. S. Yanagihara (JIRCAS) on 17th July 1997. Seminar on 'mechanism of water erosion in marine saline soil' was held by Dr. M. Takayama (Fac. of Agr., Kyusyu Univ.), Dr. M. Ootsubo (Fac. of Agr., Kyusyu Univ.) and Dr. M. Fukada on 7th Jan. 1998. Seminar on 'measurement of soil water movement in a field' was held by Dr. M. Tominaga (National Research Institute for Earth Science and Disaster Prevention) and Dr. M. Inoue (ALRC) on 27th Jan. 1998.

Dr. Inoue visited Hebrew University in Israel from 4th to 18th in August for the international academic research on 'water, salt and nutrient interaction in plant growth' funded by Monbusho Grant-in-Aid for Scientific Research, and investigated water management and cultivation technique under water saving irrigation in arid area. He also visited the U.S. Salinity Lab. USDA and Department of Soil & Environment Sciences University of California, Riverside in USA from 9th Oct to 19th Nov. for the 1997's

creative and development research program on 'development of non-destructive measurement of salt movement during salt accumulation and leaching and soil texture, water level and cultivation interaction in arid area' funded by Monbusho Grant-in-Aid for Scientific Research, and investigated non-destructive measurement of soil salinity using four electrode sensor and carried out co-operative research on the numerical simulation of two dimensional water flow and salt transport. He presented 'in-situ estimation of soil hydraulic functions using a multi-step soil-water extraction technique' at the poster session of international workshop 'characterization and measurement of the hydraulic properties of unsaturated porous media' at Riverside on 22-24th Oct, 1997. He presented 'simulation of water and salt transport in soils' in the seminar of mechanism of water and salt transport in porous media and deterioration by salt action at the Tokyo National Research Institute of Cultural Properties on 25th Nov.

4) Division of Arid Land Science

Foreign Visiting Researchers

The 11th foreign visiting professor, Dr. Cohen, Yehezkel (The Volcani Center, Israel), arrived on January 1, 1997 and stayed for ten months until October 31, 1997. His research title here was "Studies on characteristics of transpiration of arid-zone plants".

The 12th foreign visiting professor, Dr. Ben-Asher, Jiftah (Ben-Gurion Univ. of the Negev, Israel), arrived on January 1, 1998 and will stay for fifteen months until March 31, 1999. He conducted his studied on "Use of saline water for irrigation".

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

Internal Researchers

As internal visiting professors to ALRC, Professor Takao Amaya (Fac. of Agric., Gifu Univ.), Professor Ryoza Sakiyama (Graduate School of Agricultural and Life Sciences, the Univ. of Tokyo), Associate Professor Nobuo Toride (Fac. of Agric., Saga Univ.) arrived at their posts on April 1, 1997 and has been conducting joint researches until March 31, 1999.

5) COE Researcher

Foreign Researchers

The 4th COE foreign visiting researcher, Associate Professor Salih, A. A. (Gezira Res. Station, Agric. Res. Corp., Sudan), arrived on December 1, 1996 and stayed for one year until November 30, 1997. His research title was "Studies on the characteristics of nutrient and water uptake of crops under arid lands conditions".

The 5th COE foreign visiting researcher, Associate Professor Lux, A. (Comenius Univ. Bratislava, Slovak), arrived on May 1, 1997 and stayed for 6 months until October 31, 1997. He conducted "Studies on morphological characteristics of plants grown in arid lands".

The 6th COE foreign visiting researcher, Professor Shainberg, I. (The Volcani Center, Israel), arrived on November 1, 1997 and stayed for 3 months until January 31, 1998. He conducted "Soil and water properties for effective water management".

The 7th COE foreign visiting researcher, Professor Babiker, A.G.T. (Gezira Res. Station, Agric. Res. Corp., Sudan) arrived on December 1, 1997 and stayed for one year until November 30, 1998. He conducted "Basic studies on the control of semi parasitic weeds, *Striga* species in arid land"

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

Internal Researchers

Dr. Murota, K., Dr. Matsuura, A. and Dr. Ji., B. conducted “Researches on the Establishment of Plant Production System using Sea Water in the Coastal Arid Areas based on their specialized knowledge.

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

The former clerk Mr. Doi, H., moved to the General Affairs Dept. of the Headquarters.

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. Kitamoto, H.<newly appointed>), two technical officers (Mr. Kodani, S. and Mr. Ueyama, I.), one associate clerk (Ms. Matsuoka, M.) and two research support technician (Mr. Takata, T. and Mr. Anyoji, T.) in this section.

The former chief clerk, Mr. Tanmatsu, S., moved to the Student Affairs Dept. of Headquarters.