

2. Research Activities (Apr.1999-Mar.2000)

2.1 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. The program of the Center of Excellence (COE) funded by the Ministry of Education, Science, Sports and Culture began in 1995 for five years. The title of COE program is 'Researches on the Establishment of Plant Production System using Sea Water in the Coastal Arid Areas'.

Organization, Management, and Funding Subsidies

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

The five divisions are:

- 1) Arid Land Environment: Natural Environment, Water Resources
- 2) Biological Production: Plant Ecophysiology, Plant Production
- 3) Afforestation and Land Conservation: Revegetation and Grassland Development, Land Conservation
- 4) Comprehensive Measures to Combat Desertification
- 5) Arid Land Sciences (Visiting).

The three full-time divisions from 1) to 3) each have two professors and two associate professors. The full-time division of 4) has one professor and one assistant researcher. The Visiting division has two visiting professors and one associate professor from Japan and, one visiting professor from abroad. In addition, two foreign researcher (visiting professor) and four 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. Eight office staff (three clerks and five associate clerks), four technical officers and two research support technicians support the research and education.

With regard to the funding, subsidies for scientific study in the fiscal year of 1999, a total of seven themes were adopted:

Scientific Research (B)	: 3,
Scientific Research (C)	: 2,
JSPS Fellows	: 2,

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

Scholarship Contribution	: 8,
Entrusted Research	: 2,
Joint Researches with private enterprises	: 1.

Joint-Use Research, Education, Publication

During the fiscal year of 1999, 60 Joint-Use Researchers (Teachers from national and private universities) were attached to the Center. The number of students as of March 2000 is 77 (11 Ph.D. Students, 33 Master Students, 25 Undergraduate Students, 4 Trainees and 4 Foreign Research Students).

Seminars were often held by a large number of 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 9th seminar of Joint Research was held on December 8, 1999 at Tottori Prefectural Kenmin Bunka Kaikan. Six research activities of subdivision were introduced. Two keynote lectures and twenty poster presentations were performed.

(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). It was our sorrow that Dr. Otsuki moved to Faculty of Agriculture, Kyusyu University (The Research Institute of Kyusyu University, Forest, Associate Professor) on 1 Nov. 1999, so that the number of the staff was reduced 2. We hope more successful work of Dr. Otsuki in Kyusyu University.

There were two Doctoral students, four Master's students, three undergraduate students and two research students in the fiscal year of 1999. Dr. Okada, S., the 3rd year doctoral student obtained the doctor's degree from the United Graduate School of Agricultural Science, Tottori University on March 2000. He has continued studies in the Arid Land Research Center as a COE researcher since April 1999. Ms. Kawamoto, T. and Ms. Sakoi, T., the 2nd year master's students, started work for the Tottori prefectural office and Sonoda Consultant respectively after the completion of master course. Ms. Maekawa, Y. and Ms. Yogi, I., the 4th year undergraduate students, started work for Computer Graphic Company and continued studying in this subdivision respectively. Mr. Tasumi, M., the research student in this subdivision until August, had entered the graduate school of Idaho University in U. S. A. Dr. Nakamoto, K., also the research student in this subdivision until August, has come back to study in the Arid Land Research Center as a COE researcher since September 1999.

In the fiscal year of 1999, the following researches have been conducted in Japan.

(1) MICROCLIMATE: Energy balance, water balance and CO₂ flux have been observed in a thin sorghum field in the Arid Research Center, and estimation of evapotranspiration with the plant growth have been examined. The simultaneous measurement of atmospheric and soil CO₂ concentration was conducted under the various mulching conditions in a field and the characteristic of diurnal change in CO₂ concentration with respect to the weather condition was examined. The relation between the irrigation intensity and the movement of soil solution in a sand field and the effect of paper mulching on the soil moisture were examined. Dr. Hayakawa, S. et al. (Faculty of Agriculture, Yamaguchi University), Dr. Miura, T. (Faculty of Environmental Science and Technology, Okayama University), Dr. Matsuoka, H. et al. (Faculty of Horticulture, Chiba University), Dr. Inosako, K. (Faculty of Agriculture, Tottori University) and Dr. Nakamoto, K. have continued the joint research of this subdivision 'Researches on modification of

microclimate of agricultural fields in arid lands’.

(2) REMOTE SENSING: Under theme ‘Analysis of Arid Land Surface Conditions by Remote Sensing’ for joint research, cooperative works have been still continued with Dr. Honda, Y. et al. (The Center of Environmental Remote Sensing, Chiba University), other researchers from the Faculty of Agriculture, Gifu University and Kagoshima University and the Faculty of Engineering, Tottori University. Other several studies on remote sensing was conducted in our subdivision, effects of the incident angle of solar radiation and the sensor angle on the backward scattering by using the spectral radiometer, and the prediction of the salt damage in the mouth region of Yoshinogawa River from the analysis of the land cover classification, using the satellite images.

(3) WIND EROSION: Wind erosion has been investigated by measuring sand movement every month in the Tottori Sand Dune and studying the relationship with wind which has been measured automatically by two of wind speed and direction detect systems in a sand dune. Dr. Kawamura, T. et al. (Graduate School of Humanities and Sciences, Ochanomizu University) and Dr. Yajima, H. (Faculty of Engineering, Tottori University) cooperated in this study.

(4) MEASUREMENT OF NATURAL ENERGY: The observations of meteorology and electric power by solar radiation have been started in Inner Mongolia, China as a cooperative study with Dr. Hayashi, T. (Faculty of Engineering, Tottori University).

Overseas research in the fiscal year of 1999 was as follows: Assoc. Prof. Otsuki visited Spain to be invited to the 17th meeting and the 50th international board of directors of ICID (International Congress of Irrigation and Drainage) from Sep. 8 to 22. Prof. Kamichika visited Inner Mongolia, China to conduct ‘Study on solar energy in a desert environment, using the Arid Land Dome’ from Oct. 22 to Nov. 2.

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), one Doctoral, nine Master's, and five undergraduate students (three 4th grade and two 3rd grade). Mr. Akiba, N., Mr. Tanaka, K., Mr. Higaki, E. and Mr. Yang, S. L., second year students of the Master's Course (MS), completed the course and the first three joined to Water Resources Development Public Corporation, Nihon-Giken Co. and Nihon Shinko Co. as engineers, respectively. Mr. Yang went on to the Doctoral Course. Among three undergraduate students (4th grade), Mr. Kageyama, H. and Mr. Mizufune, H. 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 sustainable agricultural utilization of arid lands.

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 conducted researches on water management method for reuse of drainage water in agricultural lands equipped with subsurface drainage system under arid and semi-arid climate. In respect of a research on the development of technology for the rehabilitation of soils with salt accumulation in the Central Asia conducted as a main theme of the subdivision until 1998 fiscal year, a variety of analyses were carried out based on the observed field data and the results were presented in several papers.

Overseas Research: Overseas research in the fiscal year of 1999 were as follows: A research on the ‘Land and agricultural system in West African small watersheds’ was commenced under the financial

support of Monbusho Grant-in-Aid for Scientific Research A(2). In line with this research, Dr. Kitamura visited five West African countries, i.e. Ghana, Burkina Faso, Niger, Benin and Nigeria, to conduct field survey on water resources and ecosystem in Sahel and Sudan Savanna Zones in July/August. He also visited Kenya as a short-term JICA expert to conduct technical cooperation for the research on water and soil conservation in the Jomo Kenyatta University of Agriculture and Technology in October. Dr. Kitamura attended the 8th ICID International Drainage Workshop and presented the paper titled 'Irrigation-induced salinization of agricultural lands and its remedial measures in the Aral Sea Basin' which was a part of the results of researches on the development of technology for the rehabilitation of soils with salt accumulation in the Central Asia.

Cooperative researches have been conducted with the following researchers: Prof. Nishiyama, S. (Faculty of Agric., Yamaguchi Univ.), Dr. Momii, K. (Faculty of Agric., Kagoshima Univ.), Dr. Odani, H. (Univ. of Shiga Prefecture) and Dr. Aota, T. (Faculty of Agric., Niigata Univ.). Five new research projects were started with Prof. Wakatsuki, T. (Faculty of Life and Environmental Science, Shimane Univ.), Prof. Murakami, M. (Kochi University of Technology), Chikushi, J. (Kyushu Univ.) and Yamamura, Y. (Faculty of Agriculture, Miyazaki Univ.). The titles for these research projects are listed in the joint research section of this Annual Report.

Prof. Yano invited Prof. Miyamoto, S. from the Texas A&M University and conducted joint research on reclamation of salt-affected soils during 16 Feb. - 9 March 2000. Prof. Miyamoto presented his idea and strategies about 'Research on salinity problem in arid regions' before a large audience in the two-day open seminar organized specially for him.

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. Fukunaga, M. (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, physiological response of soybean on salt stress, effect of root zone temperature on root growth, differences in the response to soil moisture depletion among wheat cultivars, search for germination stimulant of parasitic weed *Striga* (Monbusho Grant-in-Aid C), control of parasitic weed by inducing suicidal germination (Monbusho Grant-in-Aid B) and search for potential plants from semi-arid regions (entrusted by Tottori Industrial Technology Association). Joint researches have been conducted with Drs. Abe, J. (Univ. of Tokyo), Tanabe, K. (Tottori Univ.), Tanimoto, E. (Nagoya City Univ.), Morita, S. (Univ. of Tokyo), Tamura, J. (Tottori Univ.), Nakata, N. (Tottori Univ.), Kobata, T. (Shimane Univ.), Takahashi, H. (Yamaguchi Univ.), Takeuchi, Y. (Utsunomiya Univ.) and Nakajima, H. (Tottori Univ.). In addition, Drs. I. A. Ali from Sudan and Y. Ma from China joined this subdivision as JSPS postdoctoral fellows. Ms. Qiman Younusi from China also joined this subdivision as a foreign researcher.

Studies abroad: Dr. Inanaga visited China to attend the 2nd Focal Point Meeting of Asian Region, to conduct field investigation in Loess Plateau and to discuss agriculture in arid regions in China with researchers at Northwestern Institute of Soil and Water Conservation, Chinese Academy of Sciences. The Agricultural Research Corporation in the Sudan awarded Dr. Inanaga a degree of fellow because of his contribution to the ARC. Dr. Sugimoto visited Australia to conduct field investigation and discuss control of parasitic weeds with researchers at the Australian National University and CSIRO.

Students: There were two Ph.D. students (one 3rd grade from Sudan and one 1st grade from China), seven MSc students (four 2nd grade and three 1st grade), four undergraduate students (three 4th grade

and one 3rd grade). One of the two Ph.D. students graduated in March 2000, and is currently an assistant professor at Al Neelain University, Sudan. A MSc student and an undergraduate student are continuing their studies up to Ph.D. and MSc levels at this subdivision. Two MSc graduates were employed as public officers. One undergraduate is employed by a private sector company and another joined a technical school.

Additional assignments: Dr. Inanaga was acting 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 committee member under Prime Minister's Council for Science and Technology, a member of the committee for establishing Institute of Earth Environmental Sciences under the Ministry of Education, Science, Culture and Sports, a member of desertification division under the committee for planning research projects on global environmental issues, Environmental Agency, an expert of international division under the committee of irrigation and drainage, the Ministry of Agriculture, Forestry and Fisheries, JICA advisory committee for the Middle East and so on. Overseas Environmental Cooperation, Japan, appointed Drs. Inanaga and Sugimoto as committee members of investigation for technologies to combat desertification.

Subdivision of Plant Production

The subdivision is composed of Dr. Hamamura, K. (Professor), Dr. Toyama, M. (Associate Professor), Ms. Fukunaga, M. (Associate Clerk), 4 students in the master course, 4 senior and 3 junior students (Undergraduates) and 2 research students from Oman and China, and the student from Oman entered in October to the three year doctoral course of the United Graduate School of Agricultural Sciences.

The research is focused on crop production problems pertaining to arid and semi-arid lands, and an additional attention is put on Xerophyte and Halophyte studies. Crop production systems under dry conditions were studied with emphasis put on crop tolerance against water deficiency and salinity. The major subjects studied were the advantages of sub-surface irrigation method, the effects of waste water treated with photosynthetic bacteria on crop growth and soil properties, the effects of VA mycorrhizae inoculation to improve drought tolerance of cowpea, the effects of 5-ALA on growth and salt tolerance of lettuce, salt tolerance of peonies, root system formation under different ground water levels, the response of *Salicornia* plants to extremely high salt concentrations and the correlation between survival of cuttings and drought tolerance. Additional studies were made on the compensation effects of soy bean plants after insect damage and the effects of calcium to decrease salt damages.

Dr. Hamamura attended the 6th International Conference on Development of Drylands in Cairo, Egypt. He visited the Xinjiang Institute of Ecology and Geography in Urumqi, Xinjiang, China. 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 with encouraging results. He also visited China, Oman and Egypt to study on the same subject.

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), 3 Master's, and 4 undergraduate students. 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 dynamics of plants on sand dunes, (5) the salt tolerance of woody plants.

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. This investigation aims 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. Salinity effects on the growth of *Populus alba* and *Casuarina equisetifolia* are investigated.

From 1999, studies on the ecological characteristics of salt tolerant plants and soil improvement in salt accumulated areas along the Yellow River in China were started with a financial support of the Nippon Life Insurance Foundation.

Studies on afforestation of hardwood in pine forests damaged by pine wilt disease on coastal sand dunes, funded by Monbusho Grant-in-Aid for scientific Research, were also started. Ecological researches of 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 taken on.

Dr. Tamai visited Brazil in February and March 2000 for research on conservation of sand dunes and semi-arid areas in northeast Brazil. In June 1999, Dr. Tamai visited China, in response to invitation from the Liaoning Academy of Forestry, to research growth characteristics of *Pinus sylvestris* and *Pinus tabulaeformis* in Liaoning Province. He also visited China in August, requested by JICA, to research semi-arid ecosystem of Inner Mongolia. Dr. Tamai visited Korea in October, in response to invitation from the ecological society of Korea, to attend International Symposium.

Dr. Yamanaka visited Inner Mongolia of China to research ecological characteristics of plants in semi-arid areas in August and September.

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. Degradation of soil and water due to irrigated agriculture were also studied in order to promote research on the mechanism and control of desertification under arid land conditions. The staff is made up of Dr. Yamamoto, T. (Professor), Dr. Inoue, M. (Associate Professor), Dr. Wen, G. (JSPS fellowship for foreign researcher), Mrs. Hamamoto, N. (Associate Clerk assigned to the entire Division) and fourteen students. Four students are enrolled in the doctoral course at the United Graduate School of Agricultural Sciences, six as master course students and four as undergraduate students in the Faculty of Agriculture.

The main domestic research titles are discussion on soil degradation mechanism and efficient irrigation schedules in irrigated arid land supported by Monbusho Scientific Research, effect of water pollution on clogging of emitters and filters of micro-irrigation system supported by Ministry of Agriculture, Forestry and Fisheries since 1992, effect of artificial zeolite on soil salinity improvement cooperated with the Kimura Chemical Plants Co. since 1996, effect of coated fertilizer and recycling materials on crops growing in sand fields, planning for sustainable agriculture in Ghana using tank irrigation, and mechanism of soil erosion and salinization using the three dimensional soil water erosion

analyzing system and monitoring system for water flow and solute transport introduced in Arid Land Dome since 1998.

As joint research with other divisions in universities, the staff carried out studies on farm land conservation in arid land, together with Dr. Fukada, M. (Yamaguchi Univ.), Dr. Nishimura, T. (Tokyo Univ. of Agric. and Tec.) and Dr. Kitani, O. (Nihon Univ.), studies on analysis of surface conditions in arid land by remote sensing, together with Dr. Torii, S. (Kyoto Univ.), studies on salt accumulation and leaching using by monitoring system for water flow and solute transport, together with Dr. Kihara, Y. (Shimane Univ.), Dr. Akae, T. (Okayama Univ.), Dr. Chikushi, J. (Kyushu Univ.), Dr. Toride, N. (Saga Univ.), Dr. Yamamura, Y. (Miyazaki Univ.) and Dr. Honna, T. (Tottori Univ.), Free subject on arid land studies, together with Dr. Morii, T. (Niigata Univ.), Dr. Hara, R. (Daitobunka Univ.), Dr. Cho, H. (Saga Univ.), Dr. Takeshita, U. (Okayama Univ.), Dr. Suzuki, K. (Yamaguchi Univ.), Dr. Mori, Y. (Shimane Univ.) and Dr. Takahashi, K. (Tottori Univ.)

Open seminars with our active support were shown as follows. Seminar on 'Tundra Soils in Relation to Global Warming' by Dr. Mizoguchi, M. (Graduate School of Agricultural and Life Sciences, Tokyo Univ.) were held on 18th in October and 'Soil Water Measurement by TDR in Highly Saline Soils' by Mojid, Md. A. (Faculty of Agriculture, Saga Univ.) on 7th in December and 'Some Topics on the Study of Paddy Soil, - Special Attention on the Large Scale Paddy Field -' by Dr. Toriyama, K. (Hokuriku National Agricultural Experiment Station) and 'Soil Erosion Prediction for Farmland Conservation' by Dr. Roy, K. (College of Bioresource Sciences, Nihon Univ.), 'Analysis of Rill Erosion' by Photogrammetry by Mr. Otoshi, M. and 'Effect of Artificial Zeolite on Soil Erosion Control of Salinity Soils' by Mr. Yuya, A. on 25th in February.

Dr. Yamamoto attended the 1999 ASAE meeting held in Toronto of Canada during July 18-21 and presented on the title 'Analysis of Soil Degradation due to Irrigated Agriculture and Sustainable Water Management in Arid Land Areas'. After meeting, he visited to the Saskatchewan University in Saskatoon during July 22-26 and collected valuable information of the soil degradation under the condition of prairies agriculture in the Saskatchewan Province of Canada.

Dr. Inoue presented 'New simultaneous estimation of soil water and solute transport parameters by inverse method using a sand column with four electrode sensors' at 24th General Assembly of European Geophysical Society on 19 - 23 April in the Hague, Netherlands. This co-operated research program was supported with Dr. Simunek of Salinity Laboratory, USDA. Dr. Inoue also presented 'Parameter estimation of solute movement by the inverse techniques' in August at annual meeting of JSHWR, from the data of experiments which infiltration rate and solute concentration are changed immediately after steady state infiltration condition. He reviewed recent research on new estimation of soil hydraulic properties such as multi-step outflow method, transient evaporation method, multi-step extraction technique, and in-situ permeability test using pressure infiltrometer in October at the fall meeting of JSIDRE. He presented in-situ inverse estimation of hydraulic function between unsaturated hydraulic conductivity and volumetric soil water content using variation of infiltration rate and soil pressure head data by a pressure infiltrometer, at annual meeting of ASA, CSSA, SSSA on 31 Oct. - 5 Nov. in Salt Lake City, USA. This result also presented in symposium of Japan Soil Science Society on 12 Nov. He developed 'An automatically operated system of measuring soil water flux, downward flow from root zone', with Dr. Dirksen, COE foreign researcher from June 1999 to March 2000.

Mr. Ikeura, H. who was the third grade in the doctoral course, took doctorate on the title 'Sustainable Irrigation Scheduling Using Goundwater Resource in the Mu Us Shomo Desert of China' on March 2000. Also, Miss Arai, M. who was the first grade in the doctoral course, is studying as an exchangeable student under leadership of Dr. Keren, R. for one year since Dec. 1999, at the Institute of Soil, Water and Environmental Sciences Volcani Center in Israel.

4) Division of Arid Land Science

Foreign Visiting Researchers

The 13th foreign visiting professor, Dr. Kafkafi Uzi (The Hebrew Univ., Israel), arrived on April 1, 1999 and stayed for six months until September 30, 1999. He conducted his study on 'Response of crop plants to variable soil temperatures'. Besides his own research, he taught students with great zeal, and gave seminars in ALRC.

The 14th foreign visiting associate professor, Dr. Ahmed, Nafisa Elmahi (Crop Protection Center, Agricultural Research Corporation, Sudan), arrived on October 1, 1999 and stayed for one year until September 30, 2000. She conducted her study on 'Basic studies on control of root parasitic weeds in semi-arid regions'. Besides her own research, she taught students with great zeal, and gave seminars in ALRC. Furthermore, she participated Research Meeting in U.S.A. and gave her presentation.

Internal Researchers

As internal visiting professors to ALRC, Professor Ishi, Hiroyuki (Graduate School of Frontier Sciences, The University of Tokyo), Professor Chiba, Kyozo (Faculty of Agriculture, Okayama Univ.), Associate Professor Honda, Yoshiaki (Center for Environmental Remote Sensing, Chiba Univ.) took their posts on April 1, 1999 and had conducted joint researches until March 31, 2001.

5) Researchers under COE, Center of Excellence program (COE Researchers)

Foreign Researchers

The COE foreign visiting researcher, Professor Fadul, Hassan M. (Land and Water Research Center, Agric. Res. Corp., Sudan) arrived on December 1, 1998 and stayed for six months until May 31, 1999. He conducted 'Basic studies on analytical method of soil degradation and methodology of its rehabilitation in Sudan, Africa'.

After that, the COE foreign visiting researcher, Professor Dirksen, Christiaan (Wageningen Agricultural Univ., The Netherlands) arrived on June 1, 1999 and stayed for ten months until March 31, 2000. He conducted 'Measurement and prediction of water flow, solute transport, and root water uptake in the vadose zone'.

The COE foreign visiting researcher, Professor Ibrahim, Hassan S. (Gezira Res. Station, Agric. Res. Corp., Sudan) arrived on April 1, 1999 and stayed for one year until March 31, 2000. He conducted the research on 'Response of crop plants to soil drying'.

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

Internal Researchers

Dr. Abe, Y., Dr. Shimotashiro, T., Dr. Tomemori, H., and Dr. Fujimaki, H. conducted 'Researches on the Establishment of Plant Production System using Sea Water in the Coastal Arid Areas' based on their specialized knowledge.

(3) Administration

From April 9, 1998, Administration office changed to belong to Research Support Dept. of the Headquarters, Tottori University. And two sections, Research Cooperation Section and Joint Research Section, were placed.

Research Cooperation Section

Research Cooperation Section is the administrative section which deals with the general affairs for the management of the ALRC.

There are two clerks (Chief Clerk : Mr. Sakane, M. and Clerks : Mr. Shimizu, K.) and four associate clerks (Ms. Yamada, E., Ms. Yonehara, A. <Division of Arid Land Environment>, Ms. Fukunaga, M. <Division of Biological Production>, Ms. Hamamoto, N. <Division of Afforestation and Land Conservation>) in this section.

The former chief clerk, Mr. Taniguchi, K. moved to the Finance Division of the Headquarters.

Joint Research Section

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

There are one clerk (Chief Clerk: Mr. Kitamoto, H.), and one associate clerk (Ms. Matsuoka, M.) in this section.

Technical Section

The Technical Section is taking charge of the maintenance management of the experimental facilities and equipments and assistance on joint use of ALRC.

There are four technical officials (Mr. Kodani, S., Mr. Ueyama, I., Dr. Murota, K., and Mr. Shimizu, T.) and two research support technicians (Mr. Takata, T. and Mr. Anyoji, T.) in this section.