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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 Joint-use Research Institute of the Ministry of Education. 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 by 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 2 professors and 2 associate professors. The Visiting division has 2 visiting professors and 1 associate professor from Japan and, 1 visiting professor from abroad. In addition, 1 foreign researcher (visiting professor) and 2 part-time researchers are stationed at ALRC through the COE program (one program of the Center of Excellence funded by the Ministry of Education) beginning in the 1995 fiscal year.12 office staff (3 secretaries, 3 technical officials and 6 assistant secretaries) support research and education.

With regard to the funding subsidies for scientific study in the fiscal year of 1995, a total of 8 themes were adopted : 1 ; General Research B, 1 ; General Research C, 1 ; Incentive Research, 4 ; Tentative Research and 1 ; International Sciences Research. With regard to other research funding a total 9 themes were accepted : 4 ; Scholarship Contribution, 1 ; Entrusted Research, 4 ; Joint Researches with private enterprises.

Joint-Use, Education, Publication

During the fiscal year of 1995, 31 Joint-Use Researchers (Teachers from national and private universities), and 86 students (12 Ph.D. Students, 30 Master Students, 38 Under graduate Students, 3 Trainees and 3 Foreign Research Students) were attached to the Center.

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 15, 1995 at Tottori Prefectural Kenkin Bunka Kaikan. Two key note lecture and thirteen lectures were presented.

The second International Symposium on “Development of Basic Technology for Sustainable Agriculture under Saline Conditions” wasl be held by ALRC on December 12, 1996.

(2) Divisions

Division of Arid Land Environment

Subdivision of Natural Environment

This subdivision 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.

Staff The staff in the subdivision consists of Dr. M. Kamichika (Professor), Dr. K. Otsuki (Associate Professor), and Mrs. Y. Tsunoda (Associate Clerk, also assigned for the subdivision of Water Resources).

Students There are three Doctoral, five Master's (two in the second year and three in the first year), six

undergraduate students (three in the 4th year and three in the 3rd year). Mr. Zhou, Jian-zhong, one of the doctral student, received the docter's degree of agriculture on March 1996; the title of the thesis is "*Climatological Studies on Productivity of Livestock Farming and Agriculture in the Inner Mongolia Autonomous Region of China*". He has continued his studies on the climatological evaluation of plant productivity as a research student in this subdivision; . One graduate student entered the doctor's course of graduate school of Tohoku University, and the other student has continued his study as a research student in this subdivision after finishing the master's course. All the undergraduate student in the 4th year entered the master's course of the graduate school of Tottori University.

Studies in Japan In the fiscal year of 1995, the following research has been conducted in Japan.

REMOTE SENSING : (1)Field measurement of concentration of ???, (2)diagnosis of the salinity stress and water deficit stress of vegetation, and (3)spectral reflectance features of the mixed surfaces of salt, sand and vegetation were investigated. Under the theme "Analysis of arid land surface conditions by remote sensing" for joint research, cooperative works were conducted with, Dr. T. Ishida (Fac. of Agr., Kagawa Univ.), Dr. T. Kojima (Fac. of Agr., Saga Univ.) and Dr. E. Ishiguro (Fac. of Agr., Kagoshima Univ) . Evaluation of the moisture condition of plants using multi band remote sensing was studied with Dr. H. Tani (Fac. of Agr., Yamaguchi Univ.) related to the joint research on "Studies on Water and Salt Management on Woody Plants in Arid Areas.

AERODYNAMICS : Evaluation of aerodynamical parameters and the effects of the fetch were examined conducting microclimatorogical observations in the tanukimame field(1 ha) of the Arid Land Research Center. Simulation of evapotranspiration using fluid mechanical analysis was investigated with Dr. T. Kawamura (Fac. of Eng., Chiba Univ.) related to the joint research on "Measurement of Evapotranspiration and Photosynthesis on the Crop Canopy"

RECYCLING USE OF WATER VAPOR : Recycling of water vapor by distillation using solar energy and the earth-air temperature difference was studied. Possible recycling amounts of atmospheric water vapor along cool coastline desert of the west coast of the continents were evaluated.

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

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

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

ACID RAIN : The characteristics of acid rain along the Japan Sea coast was studied by measuring the electric conductivity and pH of the rain in the Center and comparing this with other meteorological factors. Prof. K. Kimura of the Research Institute for Bioresources, Okayama University and Associate Prof. H. Suzuki of the Faculty of Agriculture, Kagawa University cooperated in this work.

Studies Overseas Overseas research in the fiscal year of 1992 were as follows.

Iran : Prof. Kamichika visited Iran to investigate sustainable development of irrigated agriculture in arid land.

CHINA : Assoc. Prof. Otsuki went to Mu Us Shamo Desert in China during August-September in 1995 for research on the prevention of desertification.

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

Subdivision of Water Resources

The staff of the subdivision of Water Resources consists of Dr. T. Yano (Professor), Dr. M. Narioka (COE Researcher; Oct.-Dec., 1995), Dr. T. Aoda (COE Researcher; Jan.-Mar., 1996), Ms. Y. Tsunoda (Associate Clerk, also assigned for the subdivision of Natural Environments), three Doctoral, eight Master's and two undergraduate students as of March 31. Dr. Y. Kitamura of the Japan International Research Center for Agricultural Sciences, Ministry of Agriculture, Forestry and Fisheries (MAFF) will be appointed as an associate professor on April 1 to take over the post of Professor K. Momii who was transferred to Kagoshima University last year. Dr. Kitamura graduated from Tottori University in 1971 and became a government official

for MAFF. He has 10 years' and 15 years' experience respectively respectively as an administrative officer and as a researcher and is expected to usher in a new phase for research in our Subdivision. Ms. Y. Tsunoda who contributed to our office for a long time resigned on March 31 for family reasons

Mr. Y. Sagawa and Ms. N. Hayashi, second year students of the Master Course became an engineer of Sanyu Consultants International Co. Ltd. and Crown Engineering Co. Ltd., respectively. Mr. K. Miyamoto joined as a new member of Kitai Sekkei Co. Ltd. Mr. Melkamu Regea Feyisa, a foreign student from Ethiopia is supposed to enter the Doctor's Course of Tottori University. Mr. T. Oba, one of two undergraduate students decided to go into the Master's Course. Mr. H. Miki became a member of Fukui Prefectural Office.

Mr. El-Said Mohamed Ahmed Khalifa, a Doctor's Course student from Tanta University, Egypt, who was on leave from the Egyptian Government as a scholarship student went back to Egypt in April after two years stay, obtained the Doctor's degree. The title of his doctoral dissertation is "Performance of Different Irrigation Equipment - Design and Performance of Lateral Lines in Drip Irrigation System" -. Professor Yano was invited to join the committee to confer the Degree as one of the committee members.

Prof. Yano visited Mexico in May as a short-term expert for Japan International Cooperation Agency to obtain the necessary information about water-saving irrigation in a sandy desert. Furthermore, he visited Kazakhstan in August for a preliminary survey to decide a counter-agency and the location to conduct research on rehabilitation of desertified lands in the Aral sea basin in Central Asia under the fund from the Environment Agency. Prof. Yano visited there in November for a preliminary survey. Also, he visited Kenya in February as a short-term expert for JICA project for Department of Agricultural Engineering, Jomo Kenyatta University of Agriculture and Technology.

Research has been conducted for efficient water and soil management for water saving irrigation and saline water irrigation for the purpose of protecting land from desertification and for the agricultural utilization of arid lands has focused both on the experimental approach and on a simulation approach. Research on the measurement of stem flow through herbaceous plants and arboreous plants was conducted to establish the measurement technology for the stem heat balance method and the heat pulse method. Furthermore we started new 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 from the Volcani Center, Israel who has been staying since January, 1996 as a visiting professor.

Cooperative research have been conducted with the following researchers : Prof. S. Nishiyama from Kagawa University, Prof. T. Amaya from Gifu University, Prof. H. Odani from Shiga Prefectural Junior College, Prof. R. Kawaharada and Mr. S. Takeuchi from the Faculty of Technology, Kyushu Kyoritu University, Prof. M. Katsumata from the Faculty of International Studies, Meiji Gakuin University, Prof. S. Watanabe of Faculty of Agriculture, Tottori University. Three new research projects started with Prof. M. Shiraishi from Ehime University, Prof. K. Momii from Kagoshima University and Mr. K. Inosako of Faculty of Agriculture, Tottori University. The titles for these research projects are listed in the joint research section of this Annual Report.

Division of Biological Production

Subdivision of Plant Ecophysiology

The staff consisted of Dr. S. Inanaga (Professor), Dr. Y. Sugimoto (Associate Professor), Dr. K. Murota (COE Research associate) and Mrs. E. Yamada (associate clerk, also assigned for the Subdivision of Plant Production). The staff was in charge of four phD students (two 3rd, one 2nd and one 1st grade, respectively), three MS students (one 2nd grade and two 1st grade) and eight undergraduate students (four 4th grade and four 3rd grade), a foreign researcher and two research students from China. A phD student graduated and was employed as a COE research associate in this center. A MS student and four undergraduate students graduated at the end of the 1995-96 fiscal academic year. An undergraduate student promised to continue her research at this subdivision as a MS student. A MS student and three undergraduate students were employed at several companies.

Research projects undertaken domestically were: development of a non-destructive measuring method for root systems based on AE method and effect of root zone temperature on plant growth, which were supported

by a Monbusho Grant-in-Aid, development of plant production systems using seawater (co-operative research with Toray Industries, Inc.), differences in the response to soil moisture depletion among several crops, selection of salt-tolerant cultured cells, biosynthesis of bisbenzylisoquinoline alkaloids and some other projects.

The staff has also conducted joint research with Dr. Y. Inoue (Fac. of Sci. and Tech., Sci. Univ. of Tokyo), Dr. T. Kobata (Fac. of Agr., Shimane Univ.),Drs S. Morita and J. Abe (Fac. of Agr., Univ. of Tokyo) and Dr. A. Yamauchi (Fac. of Agr., Nagoya Univ.).

In addition, Prof. Inanaga has taken part in the research project "Regulation and adaptation of crops to environmental stresses" (Monbusho Grant-in-Aid for Co-operative Research A, conducted by Dr. K. Nakaseko, Professor of Hokkaido Univ.).

As for overseas activities, Prof. Inanaga joined the research project "Functional studies on development of technology for sustainable biological production in East Asia" (Monbusho Grant-in-Aid for Creative Basic Research), conducted by Dr. S. Sasaki, Professor of the Univ. of Tokyo. Dr. Sugimoto studied chemical control of growth of parasitic plants in Nijmegen University in The Netherlands as a visiting reseacher.

Subdivision of Plant Production

The subdivision is composed of Dr. Y. Takeuchi (Professor), Dr. M. Toyama (Associate Professor), Ms. E. Yamada (Associate clerk), a student in the doctor's course , six students in the master's course , five senior and four students (under-graduates). In addition, the subdivision has four researchers from JA, IKARISYOUDOKU Inc, NISSHOKU Ins and NOK Corpora-tion for cooperative research.

Host of the research is funded by Monbusyo Scientific Research Program (Monbusyo Grant-in-Arid for Scientific Research).

The reaserch is focused on crop production ploblems pertaining to arid and semi-arid lands. Beside research on crop production systems under dessert conditions, with emphasis on crop tolerance to water deficiency and salinity which is ongoing as fundamental studies, the main areas of ressearch are : 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 and research on presents and development of agricultural utilizing the present and future development of agricultural land in arid lands in the United States OF America. Dr. Toyama undertook several field experiment in the People's Republic of China and in the United Arab Emirates, on the use of water holding substances in desert areas. Special emphasis was laid on the effect of the these substances on desert afforestation and on water saving-cultivation. Dr.Toyama paid several visits to the experimental sites and the results are encouraging.

Division of Afforestation and Land Conservation

Subdivision of Revegetation and Grassland Development

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

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. Thus research on water and nutrients dynamics of trees and in the soil with the growth of trees has been conducted.

The investigation is to understand 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 lands sometimes becomes a

hazard for the germination, establishment and growth of trees, and salt attached on the above gnand 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 research 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 scientists for joint research of the Center.

Prof. Tamai went to Brazil from Nov. to Dec. 1995 for research on conservation of sand dunes in northeast Brazil. Dr. Yamanaka went to Brazil from Jun. to Jul.1995 for research on sand dune ecosystems in northeast Brazil.

Prof.Tamai and Dr.Yamanaka also visited China from Jul. to Aug.1995 for research on revegetation in Inner-Mongolia.

On October 18. 1995 we had a Seminar "Vegetation of Semi-Arid Areas and Social Systems" at ALRC. The name of the speakers and their topics are as follows.

1.Present state and management of semi-arid vegetation.
Sumiji Kobashi (Kyoto University)

2.Plants of semi-arid areas in China and its use.
Syouzou Tokuoka (Kyoto Prefecture University)

3.Ecological analysis and social background of the Aral Sea Crisis.
Tatuaki Kobayashi (Chiba University)

4.Juniper forests in the Kingdom of Saudi Arabia.
Ken Yosikawa (Okayama University)

5. Mangrove forests in the Middle and Near East.
Fukujyu Yamamoto (Tottori University)

Subdivision of Land Conservation

The main studies in this subdivision were on the dynamic movement of moisture and salt in the soil and measures against salinity problems, as well as soil conservation and water pollution under irrigated fields, in order to conduct research on the mechanism and control of desertification in arid and semi-arid lands. The staff includes Dr. T.Yamamoto (Professor), Dr. M.Inoue (Associate Professor), Dr.S.Agodzo of JSPS Post Doctoral Fellowship for Foreign Researchers (Lecture of Science and Technology University in Ghana), Mrs. N. Hamamoto (Associate clerk assigned to the entire Division) and twelve students, three of whom are enrolled in the doctoral course at the united graduate school of agricultural science, four as master's course students, three as undergraduate students and the other as a foreign researcher from China and a JICA participant from Sri Lanka. The main domestic research titles are ①development of efficient irrigation schedules and soil salinity monitoring system in productive green land and ②irrigation schedules and water management through evapotranspiration monitoring supported by Monbusho Scientific Research, ③measures against problems by water pollution under drip irrigation supported by Ministry of Agriculture, Forestry and Fisheries, ④drip irrigation schedules using ultra-absorbing texture supported by the Toyobo Co., including ⑤efficient water application of supplemental irrigation and two dimensional capillary water supply of drip irrigation in upland fields, ⑥characteristics of plant growth and soil water in artificial bed soil in sparse vegetation areas and ⑦ simultaneous measurement of soil moisture and solutes using soil water pressure gauges.

As joint research with other divisions in universities, the staff carried out ①studies on farm land conservation in arid land, together with Dr.S.Hayashi (Institute of Tropical Agr. Kyushu Univ.), and Dr. A.Tanaka(Fac. of Agr.Saga Univ.), Dr. K.Hosoyamada (Fac. of Agr. Tokyo Agr. Univ.) and ②studies on simultaneous movement of moisture and salt in porous media with Dr. T. Honna(Fac. of Agr. Tottori Univ.)in a joint research program, including ③Monbusho scientific research, together with Dr. N. Toride(Fac. of Agr. Saga Univ.) and Dr. H. Fujiyama(Fac. of Agr. Tottori Univ.).

As an international joint research project, Monbusho international scientific research was started on the area

of sustainable development of irrigated agriculture in arid lands. Field work was carried out in the Mu Us Shamo Desert of China, and in the Provinces of Khuzestan, Fars and Isfahan of Iran, together with Dr. M. Komamura(Fac. of Agr. Tokyo Agr. Univ.), Dr. S. Kai(Fac. of Agr. Kyushu Univ.), Dr. S. Hayashi(Institute of Tropical Agr. Kyushu Univ.), Dr. S. Shinmura(Fac. of Agr. Shimane Univ.), and Dr.S. Torii(Fac. of Agr. Kyoto Univ.). In case of the field work in China, cooperation was carried out for two months by Mr.H. Ikeura who was a first grade MS student. In order to discuss further joint research with Iran, Japanese staff invited Mr. A. Keshavarz who was a director of Agricultural Engineering Research Institute.

Cooperative research with a foreign researcher was carried out by Dr. S. Agodzo on monitoring factor of microirrigation for a year, by Mr. J. Wei on mechanism of water and wind erosion in the Mu Us Shamo Desert of China for six months and by Mr. W. M. Thilakaratna on water management for irrigation chedules for three months.

Dr. Inoue studied for the University of California, Davis from Feb. to Dec.of 1995 as one of the overseas research personal of the Education Ministry for research on soil management of agriculture in arid lands. His research topics are non-linear fitting of soil hydraulic properties,and evaluation of soil properties by experiments in laboratory and in situ. After some intensive courses, he carried out a field experiment at the University of California, Davis from Feb. 19th to Mar. 28th of 1996. and invited J.Simunek from U.S.Salinity Laboratory, USDA, USA by JSPS Postdoctral Fellowship for foreign researchers from Mar. 24th of 1996.

Michio Naruoka and Susumu Yokotsuka, obtained Dr. of Agriculture degrees with titles, "Efficient water application of supplemental irrigation and two-dimensional capillary supply of drip irrigation in upland field" and "Characteristics of Plant Growth and Soil Water on Artificial Bed Soil in Sparse Vegetation Areas ",respectively

Division of Arid Land Science

Foreign Researchers

The 8th foreign visiting professor, Dr. Babikar Abdel Gabbar El Tayeab (GEZIRA Research Station Agricultural Research Corporation, Sudan) carried out his research on “Physiological analysis of drought tolerance at germination and seeding stages of plants grown in arid zones” from November 7, 1994 to October 31, 1995. He continued his research in ALRC from November 1, 1995 to January 31, 1996 as a COE visiting professor (9th foreign visiting professor). His research theme in this time was “Physiological studies on the germination process of the dry land parasitic weed, *Striga*.

The 10th 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”.

The 11th foreign visiting professor, Dr. Farah Saeed Mohamed (GEZIRA Research Station Agricultural Research Corporation, Sudan) arrived on February 1, 1996 and stayed for one year until January 31, 1997. He has been conducting “Studies on root growth of crops under arid land conditions”.

Besides their own researches, they taught students with great zeal, and gave seminars in ALRC. The outline of these activities are presented in the latter part of this chapter.

Internal Researchers

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