1.2 Research Projects

(1) JSPS-CAS Core-University Program

1) Aims

Desertification is a form of land degradation caused by climatic changes and human activities in arid land. Desertification in China is especially severe. The annual losses of land to desertification are the same size as Japan's Shikoku island. These environmental changes in China have great effects on the whole of Asia. For example, Japan has suffered from sand-bearing wind blowing to its islands from inland China, leading to the deposition of sand and dust and decreased sunshine.

Because ALRC is a National Joint-use Research Facility, ALRC initiated the Core-University Program with support from JSPS to focus on international efforts to combat desertification and develop sustainable land utilization in inner areas of China in cooperation with China's Water and Soil Conservation Research Institute (part of CAS) in 2001.

2) Research Areas

This research project aims to develop a synthetic model of desertification prevention and development that is broadly applicable to many areas of the world based on practical research in the prevention of desertification in a benchmark area in arid inland China. The project is carried out in close collaboration with China.

The period from FY2001 to FY2005 represents the first phase of this project, and the following five research tasks were established during this phase:

1. Analysis of the effects and progress of desertification
2. Development of a framework for combating desertification
3. Development of appropriate technologies and alternative systems
4. Planning of community participation and environmental education
5. Comprehensive study of afforestation and conservation of the environment

During the second phase of the project, from FY2006 to FY2010, the five subjects from the first phase were reorganized into three subjects:

1. Analysis of processes and factors that influence desertification—fundamental process research
2. Development of appropriate technology and alternative systems to prevent desertification
3. Development of a comprehensive approach to combat desertification, and generalization of these three subjects

3) Project Organization

The core university for this project in Japan is Tottori University, and the organization of the project and its participants are described in the following table.

Organization of the JSPS–CAS Core-University project in Japan

Organization	Tottori University
Representatives of the Host Organization	Masanori MICHIUE, President (FY2001 to FY2004) Takayuki NOSE, President (FY2005 to present)
Coordinators	Shinobu INANAGA, Professor, ALRC (FY2001 to FY2004) Atsushi TSUNEKAWA, Professor, ALRC (FY2005 to present)
Participating	University of Tokyo, Kyushu University, Kyoto University, Chiba University,

Universities	Yamaguchi University, Tokyo Seitoku University, Research Institute for Humanity and Nature, National Institute for Environmental Studies
Administration	Administration Bureau Research and International Cooperation Department, International Exchange Division, International Exchange Section ALRC Office
Steering Committee	Atsushi TSUNEKAWA, Chairperson Norikazu YAMANAKA, Vice-Chairperson 10 others
Advisory Board	4 persons

The core university for this project in China is the Institute of Soil and Water Conservation, CAS, which has implemented the organization structure shown in the following table.

Organization of the project in China

Organization	Institute of Soil and Water Conservation, CAS
Representative of the Host Organization	Rui LI, Director
Coordinator	Junliang TIAN, Professor, Institute of Soil and Water Conservation, CAS
Cooperating Universities	Northwestern Sciences-Tech University of Agriculture and Forestry, Beijing Normal University, China Agricultural University, Xi'an University of Technology, Xinjiang Agricultural University, Shanxi Institute of Desertification Control, Department of WB's Finance Project Office of the Yanhe Drainage Area, Yan'an City, Shaanxi Province, Department of Water Resources, Shaanxi Province, Institute of Genetics and Developmental Biology (CAS)

4) Results of Exchanges

A seminar is held every year, alternating between sites in Japan and China. As shown in the table below, 447 Japanese participants and 166 Chinese participants have attended these seminars. Moreover, an international exchange for young researchers has been emphasized, so Japanese graduate students and Japanese postdoctoral researchers have been able to perform longer studies during their stay in China. Through this enterprise, young Chinese researchers have also been invited to Japan, where they have learned observation and analytical methods. As a result, many collaborative papers have been produced by Japanese and Chinese researchers. Chinese researchers who have earned their degree in Japan came out, and the effect of exchange has shown up.

Dates and participation in annual seminars under the JSPS–CAS Core-University Program

FY	Dates	Venue	Number of Participants		
			Domestic	Tottori Univ.	Abroad
2001	14–15 November	ALRC	81	—	16
2002	15–16 November	Institute of Soil and Water Conservation	17	11	25
2003	14–15 November	Institute of Soil and Water Conservation	21	15	25
2004	4–5 November	ALRC	90	76	18
2005	3–4 September	Institute of Soil and Water Conservation	32	26	38
2006	28–29 August	ALRC	177	142	14
2007	24-25 September	Institute of Soil and Water Conservation	29	26	30

5) Results of Research Activities Under this Program

As a result of research activities performed under this program, 340 peer-reviewed papers have been published thus far. Several other key developments have resulted from the program: (1) A method for predicting the distribution of precipitation likely to cause water erosion was developed using data from a meteorological satellite. The model also predicts the soil water content that results from precipitation, and thereby allows the prediction of the severity of wind erosion that is likely to develop. (2) A technical package for the prevention of desertification, which consists of a suitable combination of traditional technology (e.g., water harvesting using scales pits) for arid lands and ultramodern technology (e.g., the preparation of drought-resistant crop varieties) has been developed. Moreover, the development and improvement of the key engineering components in this package has advanced. (3) A comparison of the original vegetation of an area and artificial plantations has been conducted based on ecophysiological characteristics, forest structure, and biodiversity to clarify whether tree planting is a sustainable approach to support ecosystem recovery.

6) Benefits to Society

The results of research conducted under this program have been provided to Chinese desertification prevention authorities and is being utilized as fundamental knowledge in the struggle to combat desertification. Practical results are already appearing. Moreover, although the results of this research have been published as many journal papers, publication of books resulting from the collaboration between Japanese and Chinese researchers is also planned. It is necessary to introduce results also to society.

7) Intermediate Evaluation

According to a report produced by the Chief Director of JAPS on 20 March 2006, the intermediate evaluation gave ALRC a rating of "B." This rating means that it should be possible to achieve the targets of this program after some modifications, because from the perspective of scientific research and international exchange, ALRC is judged to be carrying out an outstanding program.

(2) Global COE Program

The 21st Century COE Program ended in FY2006, and was replaced by the Global COE Program as of FY2007. Tottori University has applied under the category of interdisciplinary research and new disciplines under the program title Global Center of Excellence for Dryland Science. As a result of our research record and the strength of our proposal, ALRC was one of only 12 proposals (of a total of 105) that received funding under this program. (The overall acceptance rate, including other categories of program, was 63 of 281 proposals.)

- Program title: Global Center of Excellence for Dryland Science
- Departments and graduate schools: ALRC, Department of Bioenvironment Science, United Graduate School of Agricultural Science, Department of Medicine, Graduate School of Medical Sciences, Department of Social Systems Engineering, Graduate School of Engineering
- Cooperating organizations: Division of Earth and Ecosystem Sciences, Desert Research Institute (DRI, Las Vegas and Reno, Nevada, USA); the Integrated Gene Management Institute of the International Center for Agricultural Research in the Dry Areas (ICARDA, Aleppo, Syria).

1) Aims of Establishing the COE

Tottori University:

- believes that ALRC can meet the world's highest standards to create a unique research base,
- educates competent students who will play an active part in the United Nations, in other international organizations, and in overseas research facilities that focus on arid land science and combating desertification,
- focuses on research into strategies to combat desertification and ameliorate the global environmental problems that originate in arid lands (e.g., cross-border transport of dust), and
- is developing a base for education and research that will be a world leader in arid land research (i.e., a Global COE).

The objectives for developing this base are:

1. Developing world-class researchers, improving the education system, and training graduates who will be employed by U.N. organizations, other international organizations, and overseas research institutions.
2. Propelling world-class research, improving research systems, and translating and disseminating technologies and knowledge developed at Tottori University, as well as systematizing information on dryland health and medicine and contributing solutions to environmental problems such as Aeolian dust transport.
3. Establishing a global academic network by improving systems for cooperation and supporting the Global COE by the development of a world research network and linkages between this network and other related domestic Japanese networks.

2) Outline of Establishing the COE

(a) Targets for human resource development and measures to achieve these targets:

1. Increasing the number of students: Increasing the number of students registered in PhD and other graduate studies will be achieved by characterizing and enhancing the educational curriculum for researchers and practical engineers, introducing and implementing a dual-degree system, and financially supporting PhD students.
2. Increasing research outcomes: Research outcomes such as conference presentations and journal articles will be increased by fostering an independent research environment and providing funds to support research by excellent assistant professors, establishment of research-oriented assistant professorships, and provision of incentives for oral presentations or the publication of papers.
3. Enhancing proficiency in English: Enhancing proficiency in English will be attained by means of a mandatory English test and provision of financial support for learning the language, implementation of an English training program, and sending young researchers abroad.
4. Increasing employment of graduates by the Unite Nations, international organizations, and international cooperation organizations: Increasing the opportunity for the employment of graduates by international organizations will be achieved by providing the needed support, including financial support, to obtain jobs at such institutions after completion of a PhD, training in language and presentation skills, and systematic collection of job information.
5. Increasing the employment of graduates by research institutions, especially foreign institutions: This goal will be achieved by the establishment of a joint educational program with the DRI (Las Vegas and Reno, Nevada, USA) and establishment of a new division at ALRC (i.e., the Division

of Health and Medicine), and by the appointment of new faculty members in this Division.

(b) Targets of research activities, and measures for reaching these targets:

1. Activation of research activities: Goals include producing world-class research articles based on original research of the highest standard, increasing the number of peer-reviewed articles (especially in journals included in the Web of Science database), and transferring research achievements to society and contributing to the improvement of communities in drylands by supplying fundamental knowledge and useful solutions produced through the COE's research and development to prevent desertification and promote the sustainable utilization of drylands.
2. Targets in research infrastructure: Goals include creating an international research environment where young researchers can flourish and develop their skills and an international career, coordinating a research environment where excellent young researchers can devote themselves to research by forging new and innovative directions, and providing financial support and unique research facilities and equipment for excellent young researchers through alliances with other centers of excellence.
3. Promotion of research and cooperation: This program will involve the establishment of five research groups:
   a. The Environmental Restoration Group aims to prepare a manual on preventing salinization and to disseminate technology to prevent and reverse salt accumulation.
   b. The Agricultural Production Group aims to use organic matter and salt-tolerant plants to restore soils that have experienced a substantial accumulation of salt and to improve their productivity in arable drylands.
   c. The Molecular Breeding Group aims to permit the cultivation of salt- and drought-resistant strains in drylands within 5 years.
   d. The Dryland Health and Medicine Group aims to investigate the relationship between the health and economic status of residents of China's Loess Plateau and analyze changes over time to identify the effects of regional policies on their health. It also plans to study diseases endemic to drylands with the aim of developing effective countermeasures.
   e. The Global Environmental Group aims to develop a biogeophysical model for simulating the processes that lead to the development of dust storms so as to predict dust events and evaluate the impact of land use on these processes.

(c) Plan for international cooperation

Tottori University will develop its COE in collaboration with DRI and ICARDA. DRI is recognized for its world-class studies in dryland earth science. It is the core institution in the Global Network of Dryland Research Institutions (GNDRI). Through collaboration with DRI, Tottori University aims to raise the standards of its research in dryland earth science, enhance its international linkages through GNDRI, and expand educational activities at its graduate school. ICARDA is one of 15 centers around the world supported by the Consultative Group on International Agricultural Research (CGIAR). It is well known for its world-class studies in dryland agricultural science. ICARDA is currently implementing an initiative, the "CWANA-Plus Partnership," with the United Nations University, Japan. CWANA-Plus aims to strengthen research and development in countries with large dryland areas prone to desertification. These include the vast CWANA region (Central and West Asia, North Africa), as well as large parts of China, South Asia, and sub-Saharan Africa. By collaborating with ICARDA, Tottori University aims to improve its research in dryland agricultural science,

enhance its international linkages through the CWANA-Plus Partnership, and promote practical application and dissemination of technologies developed there to dryland countries, especially in Asia and Africa.