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AAINews

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From Tottori Sand Dunes to Deserts in the World

This time I would like to talk more details about the Arid Land Research Center of Tottori University, which I mentioned briefly in the previous issue (AAINews Vol.20). This center was established in June 1990 for the purpose of "conducting comprehensive research in the field of prevention of desertification and agricultural development in arid land and for providing necessary facilities for faculty members and researchers of national universities working in this field". The center was developed from its former body, the Sand Dune Utilization Research Center attached to the university's department of agriculture, which had conducted research regarding the agricultural utilization of sand dunes.

Let me first discuss the history of agricultural activities in the sand dunes in Tottori. Tottori Sand Dunes lie along the coast of the Japan Sea, extending 16km from east to west and 2km north to south. Before starting agriculture in the sand dunes, it was necessary to prevent movements of sand caused by the wind. For this purpose, Japanese black pine and some acacia species suitable for this sandy environment were planted to serve as a windbreak in the early Showa era. In those days the fields were watered using the so-called system of hama-ido which are cone-shaped pit-wells bored into the sand. Every field had this kind of well, and farmers would carry water from the well in a pair of wooden buckets hanging from a balancing pole carried on their shoulders. This was mainly a woman's task, and in summer these women would have to carry as much water as, say 50 bathtubs for each 10 are of land. They had to spend two hours in the morning and another two hours in the evening watering their farm land in this way, and this hard labour was called the "wife killer". However, in 1952, when Tottori Prefecture started establishing irrigation facilities in the sand dunes as part of its irrigation project, sprinklers, which had been tested at the above Sand Dune Utilization Research Center for the first time in Japan, were also introduced to local farmers and they were finally freed from the laborious business of watering. Since then research and studies at the research center have contributed to the increase in farming areas and agricultural productivity of various products such as shallots, yams, and grapes. Today one third of the total sand dune area in the prefecture, or 8,500ha, is utilized for agriculture.

The period of agricultural development of Tottori's sand dunes as described above corresponded with the period of Japan's rapid economic growth, at the end of which the country successfully joined other developed industrialized countries. Given this background context, the Sand Dune Utilization Research Center was restructured to form the Arid Land Research Center, based on the idea that, although there is no real arid land in Japan, it is the developed country's responsibility to help and contribute to the prevention of desertification and the development and utilization of arid land in the world. With this development goal in mind the research for sand dune utilization and agriculture in Tottori has been expanded and applied to studies of deserts elsewhere in the world, and research activities have started in countries such as Iran, China, Egypt, Mexico and Kazakhstan. This center is divided into six sections, namely natural environment, water resources, physiology and ecology, plant production, arid-land greening, and grassland and soil conservation. There are 23 faculty members including overseas visiting scholars and 80 students including foreign students (as of March 1998). In 1998 the center celebrated the completion of a large-scale environment control facility - the Arid Dome. This facility consists of a central dome 15m in height and 39m in diameter and several different laboratories. Such a large-scale and comprehensive lab facility for arid land studies is very unique in the world. However, actual fieldwork is still crucial in the area of agricultural studies, as it always requires extensive applied research. Therefore, while I wish for further development of this new research center in its own way, I also hope young researchers and students seize every opportunity to go abroad and study deserts elsewhere in the world. It is also expected overseas researchers work in this research facility, so that we can promote cooperative and supplementary research activities. (By Iiyama in Tottori, February 1999)

Experimental Field

Arid Dome

Coexistence of Nature and Humans - Towards the 21st Century (3)

Part 3: Permaculture in Zimbabwe

The word 'permaculture' is a combination of the words 'permanent' and 'agriculture', and was suggested by Bill Morrison, an Australian (and his colleagues) who defined the word as a system designed to create an environment which can be eternal and sustainable for humans with great consideration given to the concept of coexistence with nature and the global environment. With the baseline notion of obedience to nature rather than forceful conquest, permaculture aims to construct a system which is ecologically healthy, economically viable and able to sustain itself in the long term.

'Fields' made according to the permacultural design appear to be 'jungles' at first sight, as they do not look so simple and organized as ordinary fields. Permaculture aims at achieving a desirable balance within the ecosystem of the field by creating diversity in cultivation, for example by growing perennial plants (trees, bushes, vegetables and grasses), fungi and root crops. Permaculture also tries to make full use of biological resources to reduce the amount of chemical fertilizers and pesticides replaced by, for example, using green manure and leguminous plants, and by predators. Permaculture does not, however, simply promote organic farming or self-sustaining compound agriculture only. It should be felt rather 'a way of life' than another method of agriculture so that, for example, lans scape, wind direction and even waterflow in the event of flooding are considered in making decision on building a house. Therefore no system can be the same under this idea of permaculture.

Today permaculture is getting more popular in many parts of the world in various ways which are suitable for the local natural environment, landscape and social environment. In Zimbabwe, NGOs such as Natural Farming Network (NFN), Participatory Ecological Land-Use Management (PELUM) Association are trying to practice permaculture and promote the concept through training. One of the NFN members, Fambidzanai Permaculture Center, has a training center of 40ha in the suburbs of Harare. Here 1-2 week training courses are held in sustainable agriculture, pest control without pesticides, participatory rural appraisal, organic farming, bee keeping, and Holistic Resource Management. The center has accommodation facilities and participants on these courses come from both inside and outside the country.

Another NGO, PELUM, was established in 1992 as a networking NGO which aims at participatory sustainable resource management, and it now has branches in ten countries in eastern and southern Africa. The network has several NGO members who are working to realize community-based sustainable agriculture and rural development. PELUM places great emphasis on educational activities such as workshops and training, and two years ago it has opened a 2-year course on 'sustainable agriculture' at the University of Zimbabwe, called 'PELUM College'. This course is unique in that teaching staff consist of people not only from academic institutions but also from NGOs and the Ministry of Agriculture (AGRITEX).

Permaculture field

Chicken tractor ('weeding & manuring' by chickens)

Agriculture & Forestry in Pakistan (3)

Part 3: Flood Farming in the Sulaiman Range

The land along the Sulaiman mountain range is losing its vegetation and becoming devastated as a result of years of over-grazing. This area tends to receive torrential rainfalls, as a result of which the ground surface gets badly eroded and a large amount of soil is carried away down-stream by the flood. The course of such floods is called a 'Hill Torrent' in this area, and there are a number of alluvial fans at the foot of the mountains which have been formed by the Hill Torrents. In these alluvial fans, since ancient times, people have been practicing irrigation farming, which depends on flooding for its only source of water supply. We have already mentioned this method of farming in the 'Agriculture and Irrigation in Arid Regions' series (AAINews Vol.8). By contrast, at the end of the alluvial fans lies the irrigation channel land of the Indus Plains, which in turn has often suffered destruction of channels and inundation damage to agriculture due to flooding. Therefore, there is a need to design a comprehensive water management scheme, aiming at controlling erosion and floods in the upper basin, expanding secure flood farming in the alluvial fans, while minimizing the flooding damage in the irrigation channel land of the lower basin.

In the river basin of Mitawan-Hill Torrent in the west of Dera Ghazi Khan in central Pakistan, a pilot project of community-based river basin conservation is under way. Here activities such as plantation and vegetation improvement are conducted, in addition to construction of stone check dams for controlling soil discharge and construction of small structures such as contour terracing or crescent terracing on slopes. In the nursery attached to the project office, not only seedlings for plantation but also shrubs for animal feed and seedlings of fruit trees are grown for distribution. Revitalization of the vegetation in the river basin along with storing of water and soil on the slopes along the river leads to a higher farming capacity of the river basin as a whole, thus improving peoples' lives and the agricultural environment. The conservation of the river basin is directly related to lifestyle improvement of the local community, and local participation is essential for such activities. Therefore, educational and publicity activities, such as support for formation of farmers' organizations and activities headed by group promoters, form one of the important components of the project. Such local community support activities faced various difficulties at first, but an increasing number of people are taking part in cotton cultivation and pasture management by rotation scheme, and recently villagers have started taking the initiative in new activities. If such a movement becomes widespread in the whole river basin, the effect of the project would be enormous.

Stone cairn for soil conservation and seedling protection

Check dam for rainwater reservoir and crescent terracing for plantation

Seedlings grown inside stonewall

Technical improvement of flood control and resource utilization along the Hill Torrents, which relates to sustainable resource management in the river basins, will not only lead to improvement of river basin management and agricultural productivity in arid land in other parts of the world including Central Asia, Middle East and western China, but also it will make a great contribution to lifestyle improvements of local communities in such areas.

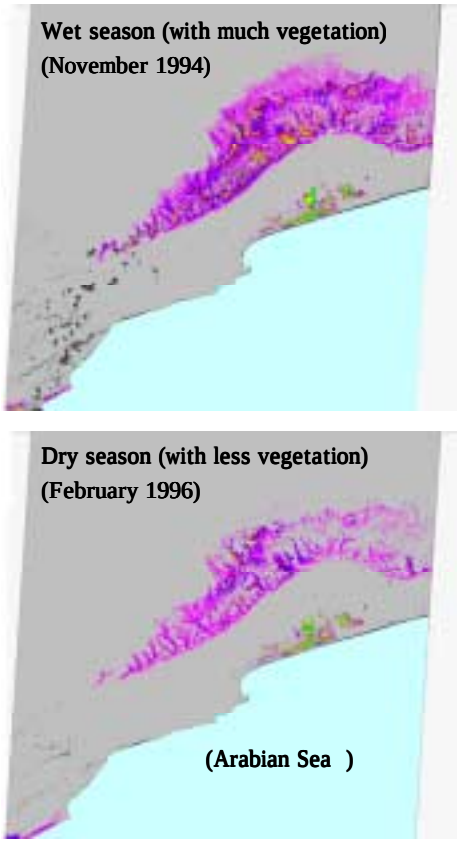
Mini-Series: AAI's Database Management (3)

Part 3: Geographic Information System (GIS)

GIS is a system with which spatial data (e.g. maps) and numerical data (e.g. statistical information) can be linked and analyzed at the same time, using the combined functions of map processing / display and the database. Today it is widely used in various fields, including urban / regional planning, environmental resources management, disaster prevention planning, marketing management and so forth. Satellite images used in remote sensing analysis with GIS is one of the most typical forms of spatial digital data collection. In the field of agriculture and forestry, for example, satellite images are used for land use surveys (e.g. classification of agricultural, forestry and residential areas), survey of forest cover / status (e.g. extent of forest destruction or plantation), monitoring of desertification processes (e.g. vegetation changes), etc. There are a number of GIS softwares, and at AAI we have been mainly using MapII, MFWorks (for grid maps), IDRISI (for remote sensing analysis) and ArcView.

We have been engaged in various projects of development studies and dispatch of expert in the agricultural field. For such activities, for example, when we conduct survey of land uses and vegetation distribution, satellite imaging often proves to be very useful to spatially and comprehensively grasp the situation of the survey area, and we have made full use of it as needed. Among the various uses of satellite imaging, as discussed in AAINews Vol. 6, with grid maps we can overlay different theme maps and apply these according to requirements. MapII was a software designed originally for Macintosh, but a Windows version was released as MFWorks.

With IDRISI, images from satellites such as LANDSAT and SPOT can be analyzed in full, and it can also be used for land use analysis and biomass evaluation with vegetation index (NDVI). The figures on the right show JERS image of NDVI of Salalah regions of Oman in two seasons. The area with relatively high vegetation (denoted in purple) is a mountain range called the Jabal Al Qara, where the decrease in vegetation due to overgrazing has been a major problem in recent years. However, little quantitative surveying has been carried out and no specific measures for environmental conservation have been set up to counter this problem. Some formulas to calculate/quantify vegetation from NDVI have been proposed, and such methods are expected to make it possible to grasp seasonal and yearly vegetation changes in quantitative and spatial terms, which would lead to the development of rational pasturage management plans.



NDVI analysis results of Salalah region

Arc View is a GIS software which links and processes statistic data, maps and photographs comprehensively, and it can visualize and display complicated figures such as agricultural production on a map. We have used this software for studying plantation management in UAE, agricultural information in Syria, cereal production and the accompanying movement of water in the world etc.

Let us end this mini-series by giving our general thoughts on using GIS and various databases at AAI. Depending on their types and the ways they are utilized, such softwares can achieve a great deal. But, sometimes handling can be very complicated and special operators may be necessary, making it rather costly. However, there should be some easy ways for everybody to use the softwares and apply them to an individual's work according to his/her field. At AAI we consider GIS and database softwares as handy daily tools, or useful means applicable to our field work, and we hope to carry on developing various databases as 'thinking tools'.