

Building a Global Arid Lands Information System: A Collaborative Approach

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ABSTRACT

For nearly all of its more than thirty year history, the Office of Arid Lands Studies (OALS), through its various divisions, has been involved in the research, collection, and dissemination of information about the drylands of the World. This has included interdisciplinary applied research programs in economic botany and natural product development, the application of remote sensing and geographic information systems to natural resources development and management, water conservation and water reuse, desertification monitoring, economic development, and, more recently, health issues in arid environments. In addition, and integral to this work has been a complementary program for bringing the results of this and other drylands research to people around world in the most cost-effective manner. To this end, the Arid Lands Information Center, a division of OALS, has been active in the generation and publication of a variety of outreach materials using multiple formats and drawing on computer and communications technologies. Beginning its dissemination efforts with print bibliographies, directories, and information papers, the Center quickly saw the advantage of moving into the realm of computerized databases to increase information access and currency. In the 1970s, this meant using punch cards and a mainframe computer and, later, with stand-alone desktop microcomputers. In recent years, the Center has turned to the Internet as the preferred dissemination tool, becoming a major producer of quality Web sites dealing with arid lands and agriculture-related themes. Building on the experience gained during the past ten years, and using as a guide the model developed over time for collaborative Web site projects, the Center's team of Web and Information Specialists are now proposing to create a portal to drylands information that will meet multiple user needs. This paper documents the need and the opportunity for developing such a portal through an international collaboration. It also presents a view of what a "Drylands of the World" portal might look like and how it might be populated.

INTRODUCTION

Throughout this conference and workshop, we have seen many innovations in the use of technology to organize and disseminate information. To conclude the event, I will focus not on such activities already completed by the University of Arizona's Arid Lands Information Center, but rather on what we hope to accomplish in the future.

The context for a global arid lands information system is closely related to the history of formalized arid lands research. At the University of Arizona, this focus began as early as 1891 with faculty publications on rangeland management and desert living issues. Soon after this, the Carnegie Institution established the Desert Botanical Laboratory in Tucson "for the purpose of ascertaining how plants perform their functions under the extraordinary conditions existing in the deserts" (McGinnies, 1981, p.1). The Lab is currently affiliated with both the University of Arizona (UA) and the U.S. Geological Survey, and is still in operation, maintaining nearly 100-year-old study plots. Following WWII, interest in arid regions grew, culminating with UNESCO

forming the Arid Zone Advisory Committee as the world's first attempt at a coordinated attack on the fundamental problems of living in arid and semi-arid regions. Building on this momentum, the American Association for the Advancement of Science took up the cause through a series of meetings organized by its Southwestern and Rocky Mountain Division. These began in 1955 in New Mexico with the University of Arizona playing a key role through the presence of a former president of the UA (Paylore, 1985).

Out of that particular meeting came the University of Arizona's determination to pull together a multidisciplinary approach for solving problems of aridity. Thus, in 1957, the University of Arizona president appointed an Arid Lands Research Advisory Committee "to consider the integration of ideas from all areas of the University and formulate programs designed to learn more about the problems and possible solutions to them" (Paylore, 1985). This Committee prepared a report on the subject which became the basis for the program and which eventually was financed under a three-year grant from the Rockefeller Foundation in 1958. The results of the Committee's collaborative efforts led to another grant from the Army Research Office in 1963 to conduct the first comprehensive inventory of desert environments throughout the world. At \$250,000, this was the largest grant the University of Arizona had received up to that time; it led to the creation of the Institute of Arid Lands Research, now named the Office of Arid Lands Studies (OALS).

THE OFFICE OF ARID LANDS STUDIES

In its current configuration, the Office consists of various divisions and programs. One of the first to be established was a division to study arid lands plants as potential economic resources. Now called the Southwest Center for Natural Products Research and Commercialization, it also conducts research on the medicinal value of arid lands plants. The Arizona Remote Sensing Center uses remote sensing technology and geographic information systems to solve agricultural and natural resource problems in arid areas, while the Desert Research Unit conducts research on water conservation, wastewater treatment and reuse, reclamation of disturbed lands, policy studies, and environmental assessments. OALS also houses an economic development research program that conducts broad-based studies dealing with economic and demographic change in Arizona, and that provides technical assistance to state agencies. Lastly, but integral to all of the Office's work, has been the Arid Lands Information Center (ALIC) which grew directly out of the original Army Research Office grant. One of the people involved in conducting the research was a librarian and bibliographer, Patricia Paylore. The foundation of the current document collection was built through her initiation of an ambitious international collection development program. Paylore also set the stage for the implementation of a full range of library and publishing services that have been in place for more than 30 years.

THE ARID LANDS INFORMATION CENTER

Currently, the Information Center houses a collection of more than 30,000 documents, including many one-of-a-kind technical reports and manuscripts. It also has special collections that resulted from a number of large development projects, particularly in West Africa. Throughout the years, ALIC has been involved in generating a variety of publications including information papers, proceedings, directories, and the twice-yearly journal, the *Arid Lands Newsletter*. It has also used database management systems to create specialized databases, bibliographies, and online information resources. Demand for technical assistance to create similar capabilities for other information centers has generated contract activities outside the U.S. in such countries as

Chile, Argentina, Mexico, India, Bahrain, Egypt, Kenya, Mauritania, Niger, and the Yemen Arab Republic. In recent years, ALIC has become a major producer of value-added web sites dealing with arid lands and agricultural information.

From the outset, ALIC staff has looked to technology to provide the tools needed to accomplish its mission: to organize, collect, and disseminate arid lands information as widely as possible and in the most cost-effective manner. Thirty years ago this involved a mainframe computer, punch cards, and rudimentary database programming to create the first Arid Lands Information System, or ALIS as it was called. Through this then state-of-the-art system, the first of an irregular *Arid Lands Abstracts* journal series was published. By the end of the 1970s, however, the costs for maintaining the system were prohibitive and other means were considered and evaluated. For a time, this led to an agreement with CAB International to cooperatively publish *Arid Lands Development Abstracts* – an effort that lasted from 1980-1982. Following this came the timely development of the desktop microcomputer. The continuing problem of maintaining the document collection and meeting outreach goals led the Center to purchase one of the first library-oriented database management systems (Micro-Cairs, produced by Leatherhead Industries in the United Kingdom), but when this system proved cumbersome, and much easier to use products became available, the Center quickly moved to a more friendly library system environment in the form of ProCite. For special libraries such as ALIC, these types of migrations from technology to technology are often a necessary fact of life. Thus, when the Internet became widely available, the staff recognized a new opportunity for cost-effectively reaching out to its clientele.

The Internet and the World Wide Web have provided the foundation for pursuing a wide range of projects. Instead of operating as a solitary unit, in the previous paradigm, a new project model emerged based on interdisciplinary and collaborative efforts. Now the Center operates as an information dissemination component for large multi-disciplinary efforts focused on diverse topics. This involves partnering with other departments and colleges, and collaborating with many different agencies and organizations. In most cases, the focus is on disseminating information in a way that can be useful for different levels of users. However, there is also a commitment to preserving information and data, facilitating access, and redesigning the data into practical decision-making tools. One example of this process is the Arid and Semi-Arid Watersheds web site developed in cooperation with the U.S. Forest Service [<http://ag.arizona.edu/OALS/watershed/index.html>]. This site brings to the public 40 years of data collected as part of the Arizona Watershed Program, a project which began in the 1950s. Incorporated under an umbrella of general information about Western watersheds is a searchable database of watershed treatment data, including a GIS interface, which allows users to manipulate the data in new ways.

Similarly, the Arizona Rangelands web site project incorporates many of these same characteristics [<http://rangelandswest.org/>]. Begun as a component of the national Agriculture Network Information Center (AgNIC), the web site has grown into a western regional initiative involving 12 other states, and is the umbrella site for many related sub-projects that have developed specific information modules and tools. One is the database of Ecological Site Guides for Arizona [<http://rangelandswest.org/az/siteguides/guides.html>] that are used by the Natural Resources Conservation Service (NRCS) and other agencies for making land management decisions; another is a series of remote sensing tools for range management developed by the Arizona Remote Sensing Center through a NASA/Raytheon funded program [<http://rangeview.arizona.edu/>].

AN ARID LANDS INFORMATION SYSTEM

This project model involving multiple partners from a variety of backgrounds also has provided the framework for discussions about the viability for developing a web-based global information system for drylands. In its original configuration, the Arid Lands Information System (ALIS) was largely print-based encompassing a print newsletter, abstracting journal, thesaurus, and a print-based reference service. Computer technology was limited to the compilation of the abstracts for the irregularly published journal. However, the ultimate vision was much grander than this almost from the very start. Even in the 1970s, the vision was for a global information exchange system that would tie together major arid lands studies centers, but in this case through satellite links. The problem with this scenario was the significant cost involved and presumably this is why it never came to be.

However, with the advent of the Internet and the World Wide Web, it was not long before the ALIC staff realized they now had the technologies necessary to bring the vision to reality. Formal internal discussions began to take place by the mid-1990s. This resulted in a draft document outlining a possible structure for an information system which was then called OASIS (Online Arid Lands Information Service). Over time, the concept became more refined, growing and developing in conjunction with staff skills in web site design, navigation, web-based databases, and portal technology. Although other web site developers laid claim to the original ALIS and OASIS names, the vision has stayed alive through the ensuing years and has gained momentum as new more dynamic web technologies have become available.

A number of recent publications also speak to the merit of the concept for an international arid lands information system. They each address the need for improving access to information and tools related to the problems, opportunities, and issues of the world's arid environments. For instance, the World Bank's 2003 *World Development Report* targets challenges for improving livelihoods on fragile lands and for developing sustainable solutions for managing renewable natural resources. It even specifies the need to "invest in initiatives that...ensure systematic learning" (World Bank, 2002).

Similarly, the U.S. National Research Council recently prepared the report, *Grand Challenges in Environmental Sciences* (NRC 2001). Eight environmental targets were identified including biological diversity and ecosystem functioning, land-use dynamics, and climate variability – themes with particular relevance to those living in the marginal drylands of the world. The NRC recommended the establishment of research centers to support interdisciplinary research for the purpose of making science useful to decision-makers, managers, and the public. It also speaks to the need for international data harmonization. Another pertinent document is the GEO3 report published by UNEP but which involved many agencies in its compilation. One of the underlying needs identified as fundamental to action is a "greater provision of and access to information in all its forms as the fundamental basis of successful planning and decision-making" (UNEP, 2002). Challenges include similar themes to the NRC and World Bank reports such as biodiversity threats, land degradation, human pressures on the land, and human vulnerability to environmental change.

Given this history, and the information and research needs documented in these reports, the ALIC staff is reinitiating the idea for creating a comprehensive, value-added web resource focused on the world's arid regions. The purpose is not only to identify what already exists, but to fill knowledge gaps and to turn available resources into user-friendly tools. Also building on the successful model used for developing other web resources, an integrated approach would tie resources together under a single contextual umbrella. Such an initiative would draw on web

portal technology and recognized standards to facilitate personalization of resources and to fully harmonize collaborative efforts.

To visualize the entry point for such an information system, the ALIC staff designed a mock-up of a potential home page for a newly christened “Deserts of the World” web resource. [http://alic.arid.arizona.edu/drylands/] (See Figure 1). This prototype includes a map interface which would link to extensive location-specific resources. A categorical search interface provides a dropdown list of topics covering many of the targeted issues outlined in the World Bank, NRC, and GEO3 documents, including human vulnerability, land degradation, and biological diversity and ecosystem functioning. These topics relate to the science and research aspects, whereas the applications listed on the right-hand column cover the more practical aspects. They are also repeated in the categorical search interface. Search options also include data type such as statistics, bibliographies, databases, and other tools.



Figure 1. Deserts of the World Prototype Home Page

To demonstrate the extent of information and data to be included in the specific “desert” modules, a prototype section on the Sonoran Desert was developed [http://alic.arid.arizona.edu/sonoran/index.html] (See Figure 2). Major sub-topics include both human and physical aspects covering a variety of subjects such as urban and rural environments, recreation, agriculture, demographics as well as land degradation and pollution. The content for this module was developed by Professor Tina Kennedy from Northern Arizona University and while it is not complete, it already includes extensive synthesized information on the Sonoran Desert that was not previously available on the web. Drawing on 2000 census data, a complete overview of the demographics of the region has been completed. In addition, much of the site is extensively documented with current photographs. The Sonoran Desert module is a work in progress, but it provides a model for developing additional desert modules.



Figure 2. Sonoran Desert Module Home Page

It is obvious that there are significant operational challenges if such an information system is to be fully developed. There are technical issues including interoperability and standards that need to be adhered to for data integration. There are accessibility issues in terms of design, navigation, and usability. There is the need to identify existing resources and information gaps and to fill those gaps with newly analyzed and synthesized information. Intellectual property and other legal issues also need to be considered, and it is necessary to consider how such a system could be managed and sustained over time. Finally, it seems clear that no one organization or institution can hope to accomplish all of these ends individually. To this end, it is the hope of the ALIC staff that the “Deserts of the World” prototype web site and the issues presented above will provide an appropriate framework to facilitate discussions and collaborations with other arid lands related entities, heading, ultimately, to the realization of a collaborative, international arid lands information system.

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