

Dissemination of Watershed Management Information through the World Wide Web

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Abstract.—Information and related literature on watershed management practices is sometimes not widely known nor readily accessible. New electronic technologies provide unique tools for disseminating research findings to scientists, educators, land management professionals, and the public. This paper illustrates how the usefulness and accessibility of research information from the Beaver Creek Experimental watershed in north central Arizona increases using the World Wide Web.

Introduction

Watershed management is formulating and implementing actions that manipulate natural and human resources for specific objectives. Watershed management in arid and semiarid regions is difficult because water supplies and resource productivity are limited. Watershed research, spearheaded by the USDA Forest Service and its cooperators, leads to increased understanding of the hydrology and ecology of our environment. This research effort also helps define management guidelines to meet the needs of a growing population in the Southwestern United States.

In the 20th century, our knowledge of all aspects of watershed management and our ability to manage our natural ecosystems has greatly improved. Simultaneously, dramatic changes in land management, partially as a result of the public's changing attitude about our environment, occurred. These changes will greatly effect management policies and actions in the 21st century. To help land managers make better management decisions, we must use computer technology to disseminate research information. Information obtained by the Forest Service and its cooperators from research on the Beaver Creek watershed study in north central Arizona illustrates technology transfer techniques.

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Web Site

The Internet's World Wide Web (Web) is a major technology transfer vehicle. The Web is a cost-effective way to transfer information between world regions that are challenged by similar environmental problems. In addition, using the Web, information is regularly and easily updated and revised. A Web site on the sustainable management of semiarid watersheds (<http://ag.arizona.edu/OALS/watershed/index.html>) features information from the Beaver Creek project. This site contains an annotated bibliography compiled by M. B. Baker, Jr. and P. F. Ffolliott (Baker and Ffolliott 1998). The bibliography contains references to approximately 700 articles produced during 40 years of investigations on Beaver Creek and is an important source of natural resource information about ponderosa pine and pinyon-juniper vegetation types in the Southwestern United States. These references, dating from 1956 through 1996, cover 24 subject areas including climate, erosion control, hydrology, water-yield improvement, and silviculture.

Introductory Topics

The home page of this Web site (Watershed Management in the Southwest with Information from the Beaver Creek Biosphere Reserve) includes links to introductory topics (water and watersheds, public land responsibilities, and environmental aspects) and in-depth information on the central Arizona Highlands in general and on the Beaver Creek Biosphere Reserve in particular. A biosphere reserve is a component of a worldwide network of ecosystems in Unesco's Man and the Biosphere (MAB) Program. These areas are set aside for study and investigation of various ecosystem components. Each Web page has a search engine and a list of related Web sites on watershed management.

The Introductory Topics link includes sublinks to frequently asked questions and answers about water, watershed management, and environmental issues. Questions such as:

- What is a watershed?
- What is a riparian area?
- What is erosion?

Topics such as:

- Water harvesting
- watershed safety
- stock tanks,
- climate and vegetation types of the central Arizona Highlands are addressed in 1 or 2 page fact sheet. The fact sheets were reviewed by subject matter experts from the Southwestern United States and can be printed and reproduced for use in various educational settings.

In-Depth Information

Topics on the In-depth Information page include:

- Training course in watershed management by Peter F. Ffolliott, University of Arizona, about the hydrologic cycle, water resource management, effects of management programs on water resources, and study questions.
- The Central Highlands Plateau of Arizona includes climate descriptions, vegetation types, and geographic regions where watershed research occurs.

1. General Information

- Climate and Vegetation Types of the Central Arizona Highlands contains a general description of the area's climate and specific information about mixed conifer, ponderosa pine, pinyon-juniper, chaparral, and riparian area vegetation.
- Prescott Active Management Area discusses the 1980 Arizona Groundwater Code related to this area.

2. Vegetation types contains specific information on vegetation distribution, soil type, climate preferred, and associated plant and animal species lists. Vegetation types in the Central Arizona Highlands include:

- mixed conifer forests
- ponderosa pine
- mountain grasslands

- pinyon-juniper woodlands
- chaparral shrublands
- riparian areas

3. Geographic Regions contains detailed information on the various research sites studied by the USDA Forest Service in the central Arizona Highlands including:

- Beaver Creek watersheds
- Whitespar watersheds
- Sierra Ancha watersheds
- Three-Bar watersheds
- Mingus Mountain watersheds
- Battle Flat watersheds
- Castle Creek watersheds
- Willow Creek watersheds
- Thomas Creek watersheds

Currently, of the above 9 geographic regions, the Beaver Creek watershed is linked to the greatest amount of additional information including:

- About the Beaver Creek Program
- Why Beaver Creek?
- Getting the Project Rolling
- Measuring Results
- Pinyon-Juniper Treatments and Results
- Tour of the Beaver Creek Watershed
- The Treatment Watersheds
 - Access by clickable map
 - Access by text index
- Plants and animals of the watershed
- Application for Designation of the Beaver Creek Watershed as a Biosphere Reserve
- Bibliography

The other 8 geographic regions are linked to currently available information.

4. History of the Arizona Watershed Program (Baker 1999) describes the history of all watershed research spearheaded by the USDA Forest Service and its cooperators across the central Arizona Highlands.

This Web site is currently linked to the USDA Forest Service, Rocky Mountain Research Station site (<http://www.rms.nau.edu/lab>), the International Arid Lands Consortium site (<http://www.ialc/>), the University of Arizona College of Agriculture site (<http://ag.arizona.edu/>), and AgNIC (<http://ag.arizona.edu/OALS/agric/home/html>), as well as others. This Web site provides a unique opportunity to combine the strengths of the USDA Forest Service as a major repository of watershed management information, the commitment of the University of Arizona Cooperative Extension to educational training and information dissemination to off-campus audiences, and the expertise of the University of Arizona Arid Land Information Center for the necessary Web site management.

Management Implications

The increased availability of the Beaver Creek data benefits professional practitioners, consultants, industrial personnel, students and faculty, citizens, federal, state, and local agencies, and policy makers. Disseminating practical and field-tested data on watershed management via the World Wide Web, provides a valuable service to the worldwide community of practitioners, educators, and policy makers. In addition, this project increases the usefulness of scientific information by helping the public make informed decisions about their natural resource use. Better access to land management information and technology contributes to the increased sustainability of semi-arid watersheds.

A tremendous amount of data on all aspects of watershed management have been collected by various public agencies during the 20th century. Often, much of these data are lost or forgotten after a study ends. Computer technology, allows us to document and archive these data to ensure continuous, readily available access through the 21st century.

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