National Report on Efforts to Mitigate Desertification in the Western United States

The First United States Report on Activities Relevant to the United Nations Convention to Combat Desertification

Table of contents

EXECUTIVE SUMMARY

Desertification has historically been a problem and remains a concern across a large portion of the western United States. Desertification has been a problem on rangelands and lower elevation forests and woodlands due to unsustainable practices such as overgrazing, particularly during drought conditions. Improved management and restoration has decreased the amount of degraded land in this region. However, the amount of land still requiring improvement is unknown since there is not a current assessment of land condition due to multiple ownership and management entities. Several national efforts (Sustainable Resources Roundtable and the Heinz Center Report) are underway to correct this deficiency.

The federal government manages 39% of the land susceptible to desertification in the western U.S. Federal lands are managed for sustainability, although agency missions may vary due to different policies and laws. These federal lands provide renewable energy sources, clean water, habitat and ecosystem protection, and economic and recreational opportunities for the public. The remaining 61% of the land in the western U.S. is owned or managed by private individuals or companies and state governments. Private lands provide the majority of the agricultural products in the western U.S. Federal and state governments seek to help private producers ranch and farm efficiently and to use technologies that reduce soil loss and that maximize the efficient use of water and other resources. Government agencies and non-government centers provide research capabilities to improve the sustainability of agricultural and rangeland and forest ecosystems.

Drought is a common phenomenon on western rangelands and can heighten the risk of land degradation and other hazards such as fire. The federal government has a national policy in place to coordinate responses to drought and to seek to minimize its impact. This policy stresses a proactive approach to resolving drought issues in a collaborative setting. Numerous resources are available on the web to assist managers and the public with dealing with drought planning and mitigation.

Even though the lands in the western U.S. are diverse and management entities are numerous, federal, state and other institutions continue to make a concerted effort to maintain the sustainability of all lands and to minimize desertification impacts, including the restoration of degraded lands.

INTRODUCTION

The United States (U.S.) ratified the United Nations Convention to Combat Desertification (UNCCD) in November 2000 and has been a major contributor of funds and technical expertise as a developed country to affected developing countries (see U.S. AID component of this report). The United States is also an affected country under the Convention given the large portion of the Western United States that meets the U.N.'s criteria for potential for desertification.

This report satisfies the U.N. request for developed countries to prepare a National Report on efforts to mitigate desertification. This is the first National Report prepared by the U.S. on this subject and focuses on the U.S. Government efforts to reverse desertification in the western U.S. The scope of the report will be increased in future updates to reflect more of the activities of State governments and private entities in this effort.

Historical Perspective on Desertification in the United States

A number of factors were historically responsible for the early land degradation and subsequent desertification of lands in the western U.S. Livestock grazing, largely unregulated from the mid-1880s until the 1930s, caused major damage to forests and rangelands. Natural vegetation was lost and the resulting increase in bare soil increased soil erosion (Figure 1).

Figure 1. Uncontrolled livestock grazing in Southern Idaho in the early 1900's resulted in loss of productivity and increased soil erosion.

The U.S. Government took action to reduce this degradation/desertification with the establishment of forest reserves (Forest Reserve Act of 1891) and the Department of Agriculture's U.S. Forest Service (http://www.fs.fed.us/) in 1905.

The vast majority of lands not in private ownership in the West were rangelands, first regulated by the U.S. Grazing Service, established with the passage of the Taylor Grazing Act of 1934, enacted in part to "stop injury to the public grazing lands by preventing overgrazing and soil deterioration,…" The U. S. Department of the Interior's (DOI) Bureau of Land Management (BLM) now manages the majority of the federal rangelands in the western U.S. (http://www.blm.gov).

Congress established Yellowstone National Park in 1872, which was the first reservation of wild lands for recreational purposes under the direct management of the Federal government. A system of wildlife reserves was also established starting in 1903 that are now managed by DOI's Fish and Wildlife Service. These early activities by Congress were taken to reverse the desertification of the American West by properly managing commodity uses (including timber harvesting, livestock use, and mining) of the land and preserving unique landscapes and wildlife habitat.

Desertification on agricultural lands east of the Rocky Mountains was first recognized as a national problem with the Great Drought of the 1930s (e.g., Dust Bowl) which stimulated early recognition of the results of land abuse and loss of soil and vegetation (Figure 2). This drought shaped American policy on dealing with desertification and society as a whole. The Dust Bowl caused a large, influential migration from the southern Great Plains to California and forever changed agricultural policy on the Great Plains. At its height in July 1934, nearly two-thirds of the nation was considered to be in a severe to extreme drought. Congress acted by establishing the Soil Erosion Service in 1933 to assist land owners in implementing proper soil and agricultural practices. In 1935, this agency was transferred to the Department of Agriculture from Interior and renamed the Soil Conservation Service. In 1994 it became the Natural Resources Conservation Service, with a similar mission of assisting private land owners in implementing sound agricultural practices.

In the 1930's, Congress also established the predecessor agency to USDA's Farm Service Agency. Its purpose was, among other things, to work with U.S. farmers and ranchers to preserve natural resources under the Agricultural Conservation Program in order to promote the conservation of private land.

Figure 2. Farm in the Great Plains abandoned during the Dust Bowl.

Improvements in range, forestry, and agricultural practices have resulted in a marked improvement in land health since the 1930's. Even with these improvements, there were still concerns about desertified lands in the Western U.S., as evidenced by two reports prepared in the 1980's. Sheridan (1981) expressed concern about the magnitude of desertified lands and the loss of biological and economic productivity. Sabadell et al. (1982) prepared an assessment of conditions in the western U.S. for the BLM as part of the U.N.'s initial meetings on desertification. This report concluded that a better understanding of the desertification processes and impacts in the western U.S. would lead to more desertification mitigation and better conditions of all resources.

Since the 1980's, management of rangelands and croplands has continued to improve and the overall area of degraded land has decreased (McClure 1998). However, desertification is still a problem in certain parts of the western U.S., especially when inappropriate management activities are combined with drought conditions. Unfortunately, no assessments of ecological condition or economic impacts of desertification have been consistently carried out so the degree of improvement is difficult to quantify.

What is Desertification and How Does it Apply to the United States?

The U.N. Convention to Combat Desertification defines desertification and related terms as:

Desertification: Land degradation in arid, semi-arid, and dry subhumid areas resulting from various factors, including climatic variations and human activities.

Land degradation: The reduction or loss, in arid, semi-arid, and dry subhumid areas, of the biological and economic productivity and complexity of rain-fed cropland, irrigated cropland, or range, pasture, forests and woodlands, resulting from land uses or from a

process or combination of processes, including processes arising from human activities and habitation patterns, such as:

1) Soil erosion caused by wind or water.
2) Deterioration of the physical, chemical, and biological or economic properties of soil.
3) Long-term loss of natural vegetation.

Arid, semi-arid, and dry subhumid areas: Areas other than polar and subpolar regions, in which the ratio of annual precipitation to potential evapotranspiration falls within the range from 0/05 to 0.65.

The area within the U.S. that meets the arid, semi-arid, and dry subhumid includes the 17 western states. The Great Plains are the lands east of the Rocky Mountains where agriculture is a predominant use of the land while the land between the major Western mountain ranges are more adapted to livestock grazing, recreational use and extractive industries

A more recent map produced by the USDA National Resources Conservation Service shows zones of desertification vulnerability based on soils and climate for the area covered in this report except for the inclusion of parts of the States of Louisiana, Mississippi, Arkansas, and Minnesota (Figure 3). This map helps managers to understand the vulnerability of areas to desertification and to plan management strategies accordingly.

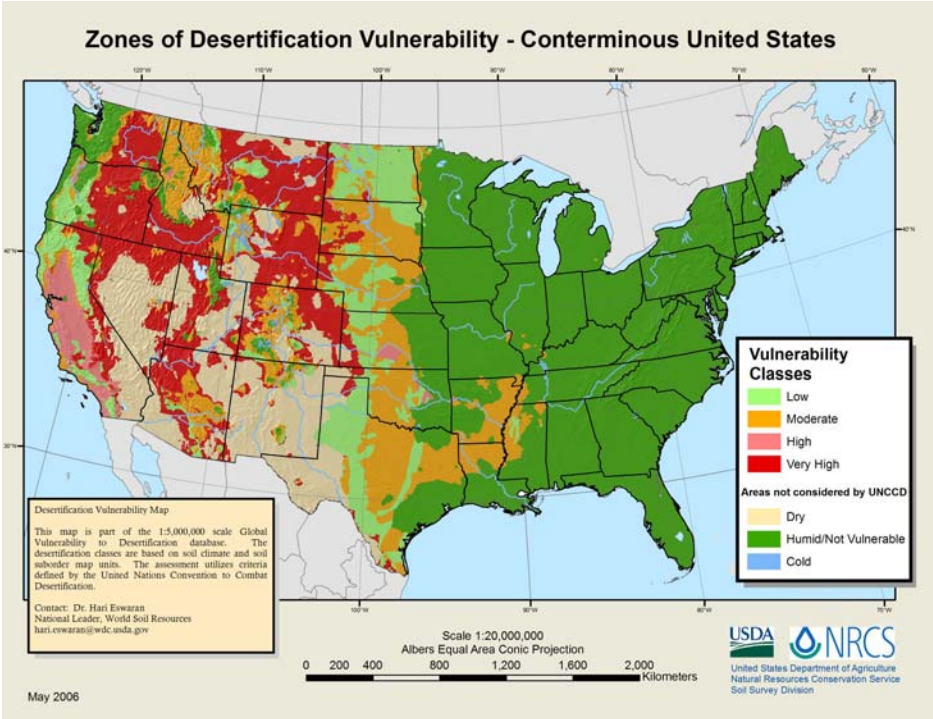

Figure 3. Zones of Desertification Vulnerability in the U.S..

The use of the term desertification was commonly used in the U.S. from the 1950's-1970's. It is not commonly used in either land management or scientific literature now as

other terminology with similar connotations have replaced it. Recently, the term "land health" has been used to describe rangelands and forests where ecological processes are functioning properly in concert with climate and soils to support appropriate native plant communities and associated fauna. As deviation from a standard of land health increases, the more likely it is that the land is undergoing desertification as defined by the UNCCD. For example, the BLM has developed Standards for Rangeland Health and requires by regulation that livestock be managed to meet these standards (http://www.blm.gov/nhp/info/stratplan/strat0105.pdf).

Regardless of the term used, the increase in soil erosion, decline in soil quality, and loss of native vegetation e.g. desertification is a management issue across the western United States and a wide array of agencies and organizations have implemented policies and strategies to address it.

Land Management Responsibilities and Ownership

The Western U.S. contains a myriad of state, federal, tribal and private landowners, which complicates a unified approach to address desertification (Figure 4). This large land area contains nearly 1.5 billion acres (486,000 ha). The Federal government is responsible for the management of 39% of this area (Table 1) with the remaining 61% under state or private ownership. The majority of this report deals with the efforts of the federal government to assess and mitigate the effects of desertification in the western U.S..

The majority of the federal land in the Western U.S. (29%) is managed by the Department of Agriculture's Forest Service and the Department of the Interior's (DOI), Bureau of Land Management (Table 1). DOI's National Park Service, U.S. Fish and Wildlife Service, and Native American Tribes (Bureau of Indian Affairs) are responsible for management of nearly seven per cent of the land. Each of these agencies has its own mission, mandates and policies as established by Congress and the President, further complicating a unified effort to reverse or prevent desertification.

State governments and private landowners account for 61% of the total acreage in the western U.S., mostly in the eastern part of the affected area. State laws and private land owner management objectives also complicate a unified approach for dealing with desertification. The USDA's National Resources Conservation Service does provide state and private landowners with technical assistance and financial incentives to maintain land productivity and diversity on a "willing partner" basis. USDA's Farm Service Agency provides funding to farmers and ranchers and also partners with State governments to address conservation problems, including water quality and quantity.

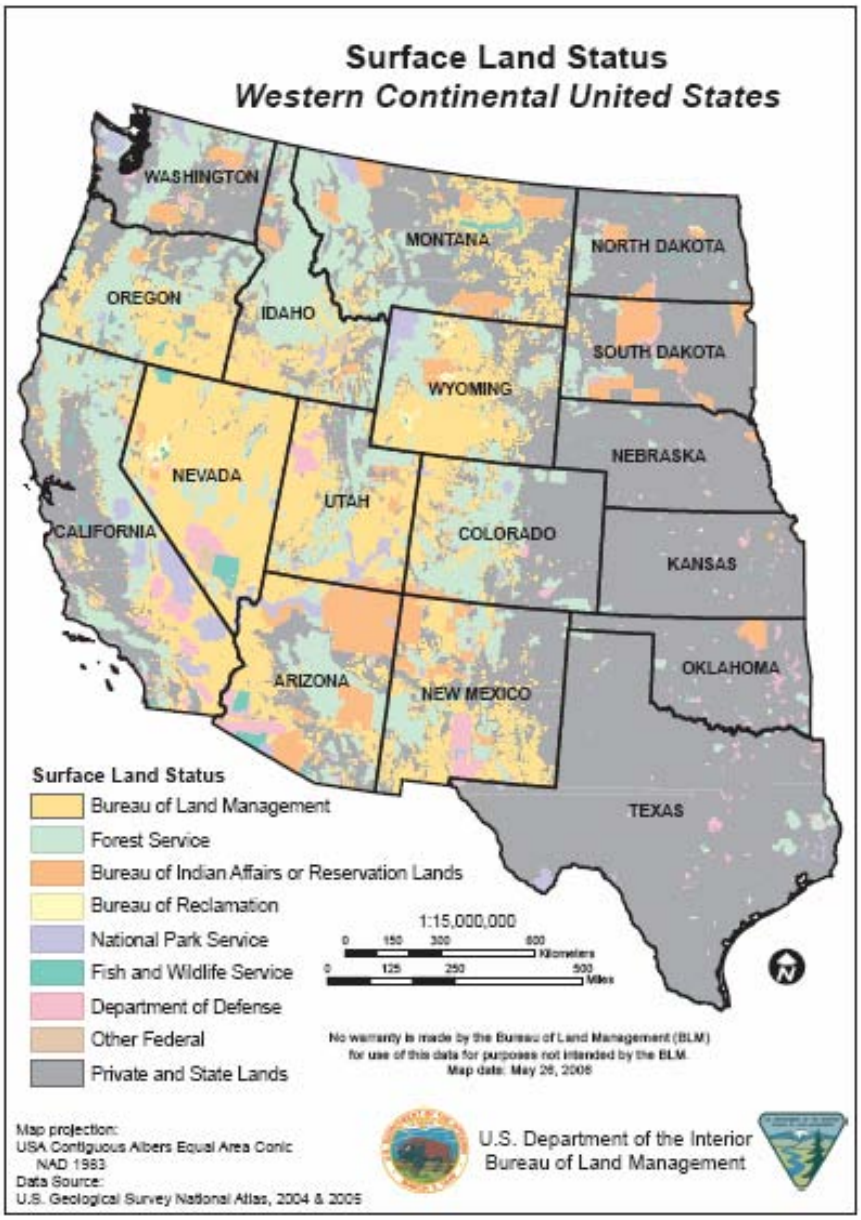

Figure 4. Land ownership in the Western United States.

Table 1. Surface land status and acreage of the Western United States.

Federal Agency	Bureau of Land Management	Defense Department	Fish and Wildlife Service	Other Federal	National Park Service	Bureau of Indian Affairs	Forest Service	Private or State Lands
Acres (Ha)	175,090,000 (70,820,000)	19,400,000 (7,689,000)	8,630,000 (3,237,000)	4,930,000 (1,619,000)	22,010,000 (8,903,000)	60,380,000 (24,281,00)	166,940,000 (67,178,00)	713,450,000 (288,542,000)
% of Total	15%	2%	< 1%	< 1%	2%	5%	14%	61%

This report is divided into sections that cover the U.N. thematic topics as specified in the supplement to Decision 11 of the Conference of the Parties.1 and Decision 4 of the Conference of the Parties.6.

SUSTAINABLE LAND USE (INCLUDING RANGELANDS) AND MANAGEMENT, INCLUDING WATER, SOIL AND VEGETATION IN AFFECTED AREAS

Nearly 80% of the land in the areas affected or potentially affected by desertification in the western United States is classified as rangelands (Figure 5). Rangelands are a type of land (not just lands grazed by livestock) on which the natural vegetation is dominated by grasses and shrubs and the land is managed as a natural ecosystem. Forests in the higher elevations of the western mountains do not generally fall under lands susceptible for desertification due to their mild climate and higher precipitation compared to rangelands. Agricultural lands in the west include croplands and pastureland (intensively managed lands used for livestock grazing).

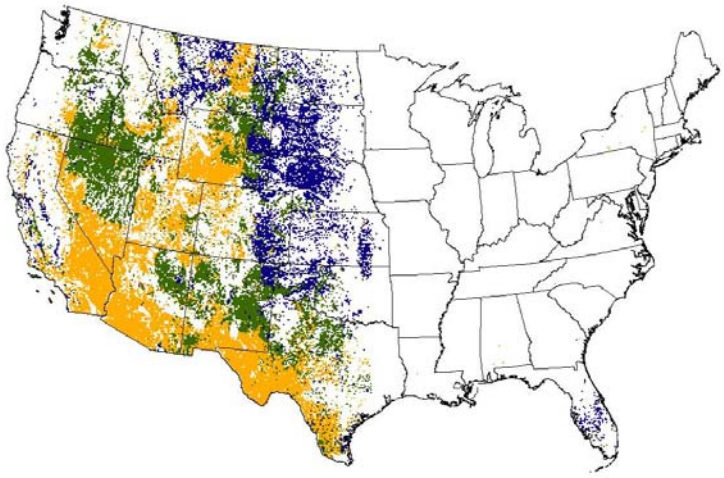

Figure 5. Colored areas on map are lands classified as rangelands (USFS map).

Federal Lands

Sustainable use of lands is the underpinning of many of the laws and directives governing the management of federally owned lands. The Department of Agriculture's Forest Service is mandated to manage its lands for sustainable use pursuant to the Multiple-Use Sustained-Yield Act of 1960 (P.L. 86-517) and the Forest and Renewable Resources Planning Act of 1974, as amended (PL 93-378). The Forest Service issued a report entitled, "National Report on Sustainable Forests—2003" which is the most comprehensive national report ever prepared on the status of sustainable forest management in the United States. (http://www.fs.fed.us/research/sustain/documents/SustainableForests.pdf).
This report addresses the indicators and criterion for sustainable forests as described in the Montreal Process (http://www.mpci.org/home_e.html) in conjunction with the U.N.'s Conference on Environment and Development (UNCED).

The Department of the Interior's Bureau of Land Management (http://www.blm.gov/nhp/index.htm) requires lands to be managed for sustainable multiple use and for areas degraded by desertification to be restored (Public Rangelands Improvement Act of 1978 (PL 95-514)) and the Federal Land Policy and Management Act of 1976 (PL 94-579). DOI's National Park Service directs that lands disturbed by human activity will be restored to reestablish natural functions and processes unless otherwise directed by Congress (http://www.nps.gov/policy/mp/chapter4.htm). Other DOI agencies responsible for land management in the western U.S. have similar laws and policies.

Livestock grazing is the most pervasive use of federal lands in the western U.S. According to the USDA's National Agricultural Statistics Service (http://www.nass.usda.gov/) there were 57,350,000 cattle and 2,987,000 sheep produced on all lands in the western United States in 2005. This includes livestock grazed on rangelands, in managed pastures and in feedlots.

Federal land management agencies administer livestock grazing through a permit system, controlling numbers, kind, and season of use for livestock on federal lands. When warranted due to range conditions, livestock owners can be required to remove all or part of their livestock until conditions improve. Part of the fees paid for livestock use to the Bureau of Land Management and the Forest Service are returned for range improvements (such as management fences and livestock water developments) on rangelands managed by those agencies. The goal of these management actions is to maintain the sustainability of the rangeland resources for future generations.

Livestock grazing occurs on some parks managed by the DOI's National Park Service and wildlife reserves operated by the Fish and Wildlife. National Parks are directed to use management practices that are environmentally and culturally sound without damage to natural and cultural resources. NPS in collaboration with Colorado State University and the U.S. Geologic Survey has developed and uses a model, called ParkGraze, (http://www.nrel.colostate.edu/projects/parkgraze) to better understand and manage the effects of native ungulate numbers on native vegetation and soil condition.

Wildfires are getting larger in the West due to droughts, invasive species that facilitate rapid fire spread, and fuel accumulations. From 2001-2005, nearly 131,000 wildfires burned 13,815,000 acres of rangeland and forests in the western U.S. The loss of vegetation cover after wildfires promotes soil erosion, invasion of weeds, and loss of sustainability of the land. Treatments to mitigate the adverse impacts of wildfires include installation of erosion control structures, reseeding, and construction of fences to allow recovery and/or establishment of seeded species.

Guidance on emergency stabilization and rehabilitation practices and policies for the Department of the Interior are at http://fire.r9.fws.gov/ifcc/Esr/home.htm and at http://www.fs.fed.us/biology/watershed/burnareas/index.html for the Department of Agriculture.

Invasive species are a major concern to public land management agencies. An invasive species is a non-native species (plant, animal, or organism) whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health. A Presidential Executive Order (No. 13112) was signed in 1999 to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause. http://www.invasivespeciesinfo.gov/laws/execorder.shtml.

Each State in the U.S. has a list of invasive species that are of special concern, e.g., noxious weeds that require landowner action to control (http://www.weedcenter.org/inv_plant_info/2004_weedlist.html). The National Invasive Species Information Center (http://www.invasivespeciesinfo.gov/) and the Center for Invasive Plant Management (www.weedcenter.org) provide information to inform landowners about invasive species and how to control them. The Federal Government also works closely with partnerships of State, and local government agencies; Native American tribes; individuals; and various interest groups to control and manage noxious weeds in specified areas called Cooperative Weed Management Areas http://www.weedcenter.org/management/guidelines/tableofcontents.html).

All federal agencies that manage land in the western U.S. fund programs to survey, control, and monitor invasive species:

DOI National Park Service	http://www.nature.nps.gov/biology/invasivespecies/
DOI Bureau of Land Management	http://www.blm.gov/weeds/
DOI Bureau of Reclamation	http://www.usbr.gov/pmts/tech_services/analyses/invasive.html
DOI Geological Survey	http://biology.usgs.gov/invasive/
DOI Fish and Wildlife Service	http://www.fws.gov/contaminants/Issues/InvasiveSpecies.cfm
USDA Forest Service	http://www.fs.fed.us/publications/policy-analysis/invasive-species-position-paper.pdf

Sustaining adequate water supplies for human consumption, agricultural, recreational, wildlife and other uses in the arid West is causing conflicts the area continues to see population increases.

The Department of the Interior launched Water 2025 as a problem-solving initiative to help manage scarce water resources and develop partnerships to nourish a healthy environment and sustain a vibrant economy. Water 2025 encourages voluntary water banks and other market-based measures, improve technology for water conservation and efficiency, and removing institutional barriers to increase cooperation and collaboration among federal, state, tribal, and private organizations (http://www.doi.gov/initiatives/water2025.html).
The magnitude of this water problem is described in the 2005 report entitled, "Water 2025 - Preventing Crisis and Conflict in the West" (http://www.doi.gov/water2025/) and shown in Figure 6.

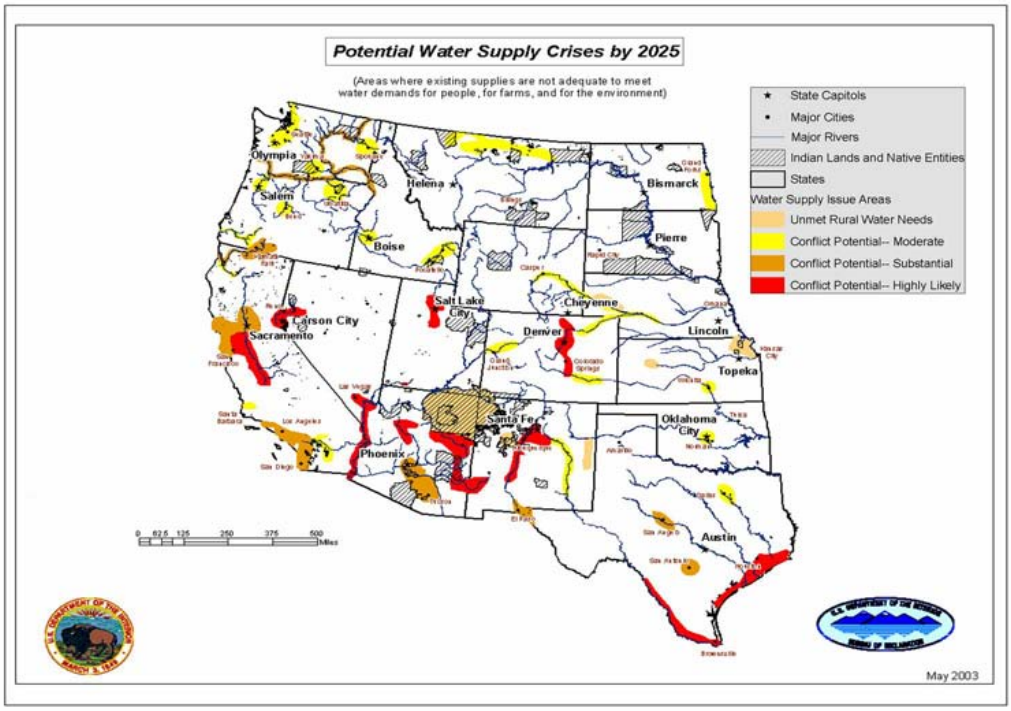

Figure 6. Areas in the Western U.S. susceptible to water shortages by 2025.

Water rights are often held by the federal agencies managing the land to provide consumptive as well as habitat (springs, streams, etc.). A close partnership with individual, tribal, and State entities is required given the limited water available in the arid west. The National Park Service often obtains water rights for visitor and administrative use to protect natural and cultural resources and forestall desertification (http://www.nature.nps.gov/water/Water_Rights/adjudications.cfm).

Riparian areas include rivers, streams, and springs and require special management due to their sensitivity to disturbance and importance in providing water for domestic uses, livestock and habitat for many wildlife species. A stream corridor, or stream valley, is a complex and valuable ecosystem which includes the land, plants, animals, and network of streams within it. The U.S. has 3.5 million miles of rivers, some of which must be carefully managed as they do not have the capacity to fully support multiple uses, including drinking water supply, fish and wildlife habitat, recreation, and agriculture, as well as flood prevention and erosion control.
Restoration of streams is described in Stream Corridor Restoration**:** Principles, Processes, and Practices (http://www.nrcs.usda.gov/technical/stream_restoration/) produced by the Federal Interagency Stream Corridor Restoration Working Group.

Both the DOI and USDA have research organizations to assist land managers in the applying the appropriate practices to manage water, vegetation, and soils in a sustainable manner.

The DOI's U.S. Geological Survey (USGS) provides sister agencies in DOI and other entities with access to water-resources data (occurrence, quantity, quality, distribution,

and movement of surface and underground waters) collected at approximately 1.5 million sites in the U.S. (http://waterdata.usgs.gov/nwis). Rangeland research on invasive species, monitoring technology, wildfire impacts, biological soil crusts, and livestock impacts are also conducted by USGS scientists at several regional centers: http://fresc.usgs.gov/, http://sbsc.wr.usgs.gov/ and http://www.werc.usgs.gov/

Forest Service Research and Development (R&D) conducts both basic and applied research to study biological, physical, and social sciences related to very diverse forests and rangelands. The four major areas of research are:

- Resource Valuation and Use Research
- Science Policy, Planning, Inventory and Information
- Vegetation Management and Protection Research
- Wildlife, Fish, Water, and Air Research

Private and State Lands

The U.S. government also assists private land owners with technical and financial assistance to promote the sustainable use of agricultural, pasture and rangelands. This assistance includes technical and financial support to sustain water, vegetation and soil conservation. Water conservation is important as irrigation accounted for 65 percent of U.S. consumptive fresh water use in 2000. The U.S. Department of Agriculture provides assistance for actions that can lead to drought mitigation and combat desertification, although none are specifically funded for this purpose. Such programs can help farmers to plant drought-resistant crops, improve water management practices and restore wetlands and wildlife habitat.

Examples of programs or laws that improve sustainability of water, vegetation, and soil resources on private lands include:

1954 Small Watershed Act. Provides rural communities funds to address natural resource concerns in small watersheds (less than 250,000 acres in size) including flood control, watershed management, water conservation, water supply, recreation, and fish and wildlife protection.

1964 Resources Conservation and Development Act. Assists local units of government in addressing erosion problems, water management problems, and economic development needs by funding technical assistance for the approximately 2,500 local Resource Conservation and Development Councils in the country.

1985 Food Security Act. The goal is to replace 39.2 million acres of highly erodible and other environmentally sensitive lands with a non-crop plant community. Farmers receive technical and financial assistance as well as an annual rental payment for retiring the land from agricultural production and maintaining an approved conservation cover in the Conservation Reserve Program.

1996 Environmental Quality Incentives Program. The Environmental Quality Incentives Program (EQIP) provides a voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality as compatible national goals. EQIP offers financial and technical help to assist eligible participants install or implement structural and management practices on eligible agricultural land. For example, implementation of water conservation measures on irrigated acres have resulted in reduced water use on 18.5 million acres, improved crop yield on 18.7 million acres and decreased energy cost on 15.3 million acres (1998-2003). http://www.nrcs.usda.gov/programs/eqip/

Ground and Surface Water Conservation (GSWC). The Ground and Surface Water Conservation portion of EQIP is a voluntary program that provides assistance to farmers to conserve ground and surface water in their agricultural operations. USDA's Natural Resources Conservation Service provides assistance to producers to carry out eligible water conservation activities in order to improve groundwater and surface water conservation.

Wetlands Reserve Program (WRP). WRP is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. USDA's Natural Resources Conservation Service provides technical and financial support to help landowners with their wetland restoration efforts. The agency's goal is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program. This program offers landowners an opportunity to establish long-term conservation and wildlife practices and protection (www.nrcs.usda.gov/programs/wrp/).

Grassland Reserve Program (GRP). Initiated in 2002 (Farm Security and Rural Investment Act of 2002) and administered by USDA's Natural Resource Conservation Service and Farm Service Agency, GRP offers landowners the opportunity to protect, restore, and enhance grasslands on their properties. This voluntary program protects vulnerable grasslands from conversion to cropland or other uses and conserves valuable grasslands by helping to maintain viable ranching operations (www.nrcs.usda.gov/programs/grp).

Healthy Forests Reserve Program (HFRP). HFRP was created by Congress with the enactment of the Healthy Forests Restoration Act of 2003 and has the potential to become an integral part of conservation efforts on private forest lands. It is a voluntary program established to restore and enhance forest ecosystems in order to (1) promote the recovery of threatened and endangered species, (2) improve biodiversity, and (3) enhance carbon sequestration. The program is authorized through 2008.

Grazing Lands Conservation Initiative (GLCI). GLCI is a nationwide collaborative process of individuals and organizations working to maintain and improve the management, productivity, and health of the Nation's privately owned grazing land. The coalitions actively seek sources to increase technical assistance and public awareness activities that maintain or enhance grazing land resources. http://www.nrcs.usda.gov/programs/glci/

The USDA Forest Service manages more than 120 million acres of publicly owned rangelands in the United States, and USDA programs influence the use and management of other Federal and 414 million acres of nonfederal rangeland supplying livestock forage, water, recreation, wildlife and fish habitat and cover, as well as minerals and archeological, historical, and cultural amenities. USDA emphasizes cooperation and coordination among Federal, State, and local agencies; private organizations and institutions; and individuals in planning and executing sustainable rangeland programs.

The USDA Natural Resource Conservation Service has a website (www.glti.nrcs.usda.gov/technical/) that includes web-based models, technical publications, technical and other useful tools to encourage the adoption and use of conservation practices that sustain rangeland and pasture productivity and longevity.

The USDA/NRCS also administers Grassland Reserve Program (GRP) that Congress initiated in 2002 (Farm Security and Rural Investment Act of 2002) offering landowners the opportunity to protect, restore, and enhance grasslands on their property. This voluntary program protects vulnerable grasslands from conversion to cropland or other uses and conserves valuable grasslands by helping to maintain viable ranching operations.

Within USDA, the Agricultural Research Service has a program focusing on the sustained and productive use of rangeland, pasture, and forages. The mission of the program is to develop and transfer economically sustainable technologies and integrated management strategies that conserve and enhance U.S. rangeland, pasture, and forages. The research components of this program are:

- Ecosystems and their Sustainable Management
- Plant Resources
- Forage Management
- Grazing Management: Livestock Production and the Environment
- Integrated Management of Weeds and Other Pests

DEVELOPMENT OF SUSTAINABLE AGRICULTURAL & RANCHING PRODUCTION SYSTEMS

The western U.S. is an important contributor to the Nation's food supply. Therefore maintaining the sustainability of agricultural lands in the 17 western states and reducing the potential for or areas of desertification is a high priority. Most agricultural lands and ranches are in private ownership although livestock production may take place on private, state, tribal and federal land. The U.S. Government functions in an advisory role to private land owners involved in agricultural and livestock production (ranches) systems.

Agricultural Systems

The U.S. Department of Agriculture is responsible for providing technical assistance to private land farmers and ranchers. A big concern on agricultural lands is the loss of topsoil to wind or water erosion. If erosion were to continue at the 1982 rate for the next 50 years, it would cause an estimated decrease in yield of 5.1 percent and 3.4 percent of

corn and soybeans, respectively (Crosson 1998). Given that crop yields are projected to increase more slowly in percentage terms than food demand over the next several decades, even small degradation-induced losses of productivity raise concerns (Wiebe, 2003).

Crop residue management practices, including conservation tillage systems, are among the most effective conservation efforts recommended to directly reduce water and wind erosion on cropland. In areas where crop residues are grazed, residue management must be integrated with grazing management. Producers can change crop rotations; add cover crops, contouring, strip cropping and terraces; or any combination of these practices, to create an integrated crop system (Figure 7). The effectiveness of these conservation practices is demonstrated by the reduction of total soil erosion on cultivated and non-cultivated cropland in the U.S by 43 percent between 1982 and 2003.

NRCS conservation practice standards provide guidance and set the minimum level for acceptable application of the technology. NRCS describes conservation practice standards for many types of land treatments in its National Handbook of Conservation Practices (NHCP) for applying conservation technology on the land (http://www.nrcs.usda.gov/technical/Standards/nhcp.html). Additional resources to sustain agricultural and ranching systems and mitigate desertification impacts are described at http://www.nrcs.usda.gov/technical.

Figure 7. Windbreaks reduce soil eroison on cropland in North Dakota

Soil salinity caused by improper irrigation methods can reduce productivity and sustainability of agricultural soils. Subsurface, or "tile" drainage as it is often called, provides water table management and the ability to apply excess water for the leaching of salts from the soil. However, utilization of subsurface drainage has been limited by environmental restrictions on the discharge and storage of drain water. Growers in affected areas must now manage the drain water on-farm.

Crop-integrated approaches for treating drain-water use increasingly saline water to irrigate successively more salt-tolerant crops and other non-crop species.
As the salt concentration increases, the volume of drainage water requiring ultimate treatment or disposal is decreased. The resulting highly concentrated drain water is

captured facilitating final evaporation in a solar evaporator. This is a more environmentally acceptable method than storage of drainage in evaporation ponds which often attract and injure waterfowl.

Excessive salinity in streams and rivers occurs in areas with high evaporative losses of water, and can be exacerbated by repeated use of water for irrigation, or by water withdrawals (by slowing transit time of flowing waters). According to the U.S. Environmental Protection Agency, approximately 6% of stream length west-wide had salinity levels considered to be in the most disturbed range, while nearly 85% were considered to be in least-disturbed condition http://www.epa.gov/nheerl/arm/documents/EMAP.W.Assessment.final.pdf. Streams and rivers in the major agricultural areas had the highest proportion of stream length in poor condition with respect to salinity followed by the desert lands.

Ranching Systems

The USDA Natural Resources Conservation Service is the primary federal agency that provides technical and financial assistance to private ranches (see "Sustainable Land Use (including rangelands) and Management, Including Water, Soil and Vegetation in Affected Areas" section for additional information).

The USDA Agricultural Research Service also provides ranchers with technical information on improving livestock production in pastures and on rangelands. There Food Animal Production Program is designed to protect, evaluate, identify, and develop biotechnological methods to use animal germplasm and associated genetic and genomic repositories and databases to ensure an abundant and safe supply of animal products at a price that is competitive in the United States and foreign markets. The research components of this program include:

- Reproductive Efficiency
- Conserve, Characterize, and Use of Genetic Resources
- Product Quality (pre-harvest)
- Genetic Improvement
- Genomic Tools
- Growth and Development
- Nutrient Intake and Utilization
- Integrated Systems

The USDA ARS's Office of International Research Programs facilitates international cooperation and exchange to benefit U.S. agriculture and consumers. Office of International Research Programs is the principal ARS contact for international issues (OIRP Services). Other international research projects include:

- ARS - Former Soviet Union Scientific Cooperation Program
- Asia
- Europe
- Middle East and North Africa
- Sub Saharan Africa

- North America
- Central and South America
- Overseas Biological Control Laboratories
- International Research Seminar Series

Other non-governmental organizations that provide private farmers and ranchers technical and financial support to manage their agricultural or ranches in a sustainable manner are:

- **The Grazing Lands Conservation Initiative** is a broad coalition that provides high quality technical assistance on privately owned grazing lands on a voluntary basis and increases the awareness of the importance of grazing land resources (http://www.glci.org/).

- **Western Sustainable Agricultural Research and Education** encourages research and education projects that provide positive outcomes and impacts on agriculture by promoting good stewardship and economic viability of ranch and farmlands (http://wsare.usu.edu/).

- **Rangelands West** is the website for the *Western Rangelands Partnership* delivering quality information, resources, and tools to improve management and ensure sustainability of western rangelands (http://rangelandswest.org/).

- **The Institute for Agriculture and Trade Policy** promotes resilient family farms, rural communities and ecosystems around the world through research and education, science and technology, and advocacy (http://www.iatp.org/).

DEVELOPMENT OF NEW AND RENEWABLE ENERGY SOURCES

The western United States is an important area in meeting the goals of the President's energy plan (http://www.whitehouse.gov/infocus/energy/) especially for the development of new and renewable energy sources. Renewable energy sources include, but are not limited to, biomass, hydropower, wind and solar. Lands managed by agencies in the U.S. government provide many opportunities to increase renewable energy sources to the benefit of the public. Other sources of information on renewable energy development and potential in the western U.S. can be found at:

Assessing the Potential For Renewable Energy On Public Lands. The BLM, in cooperation with the Department of Energy, has evaluated the potential for renewable energy on federal lands it manages in this report. It identifies high potential areas for wind, solar, biomass utilization, and geothermal energy sources. (http://www.nrel.gov/docs/fy03osti/33530.pdf).

National Renewable Energy Laboratory (NREL) is the nation's primary laboratory for renewable energy and energy efficiency research and development and supports the U.S. Department of Energy's effort to secure an energy future for the nation that is environmentally and economically sustainable. (http://www.nrel.gov/about.html)

Renewable Energy Atlas of the West. The Atlas is an 80-page, full-color presentation of the renewable energy resources in the West, including newly-released high-resolution wind maps of the Pacific Northwest. The Atlas profiles wind, solar, geothermal and biomass power. (http://www.energyatlas.org/)

Efforts to increase use of specific renewable energy sources include:

Biomass

Biomass is living material that can be converted to fuel of some type to produce electricity or heat.

Biomass Initiative (http://www.biomass.govtools.us/about.asp) is a multi-agency effort to coordinate and accelerate all Federal biobased products and bioenergy research and development. The Initiative is guided by two principal documents:

- The The Biomass Research and Development Act of 2000, passed in June of 2000 (Title III of the Agricultural Risk Protection Act of 2000, P.L. 106-224), as revised by section 937 of the Energy Policy Act of 2005
- Executive Order 13134: DEVELOPING AND PROMOTING BIOBASED PRODUCTS AND BIOENERGY, issued in August of 1999 with the accompanying Executive Memorandum.

Under this initiative is the Biomass Research and Development Board (http://www.biomass.govtools.us/about/biomassBoard.asp), co-chaired by the DOE and the USDA, which is responsible for coordinating Federal activities that promote the use of biobased industrial products (fuels, chemicals, building materials, or electric power or heat produced from biomass).

Farm Bill Farm Security and Rural Investment Act of 2002 established the Renewable Energy Systems and Energy Efficiency Improvements Program under Title IX, Section 9006. Since 2001, USDA Rural Development has awarded nearly $290 million in renewable energy funding to support renewable energy projects such as **ethanol plants**, wind and solar power units (www.usda.gov/energy). The Forest Service and other USDA agencies will intensify their support of renewable energy research, development and use (http://www.usda.gov/wps/portal/usdahome).

Healthy Forests Initiative and Healthy Forests Restoration Act provides Federal grants aimed at reducing the risk of wildfire and providing economic incentives to rural communities to provide energy from woody biomass (http://www.fireplan.gov/healthyforest/index.html).

Hydropower

Efforts to combat desertification require collaborative, holistic watershed approaches to decision-making processes, and often require development of projects for multiple purposes. Hydropower is one of the products of developing rivers for multiple purposes.

Over the years, Congress has directed the U.S. Army's Corps of Engineers and the USDI Bureau of Reclamation to construct dams and reservoirs to meet flood control, water supply, and navigation needs. Hydropower is a very efficient means to generate electricity (Figure 8).

ADVANTAGES OF HYDROPOWER

- ***Renewable.*** *The earth's hydrologic cycle provides a continual supply of water from rainfall and snowmelt.*
- ***Efficient.*** *Hydropower plants convert about 90 percent of the energy in falling water into electricity.*
- ***Clean.*** *Hydropower plants do not emit waste heat and gases.*
- ***Reliable.*** *Hydropower machinery is relatively simple, which makes it reliable and durable.*
- ***Flexible.*** *Units can start quickly and adjust rapidly to changes in electricity demand.*

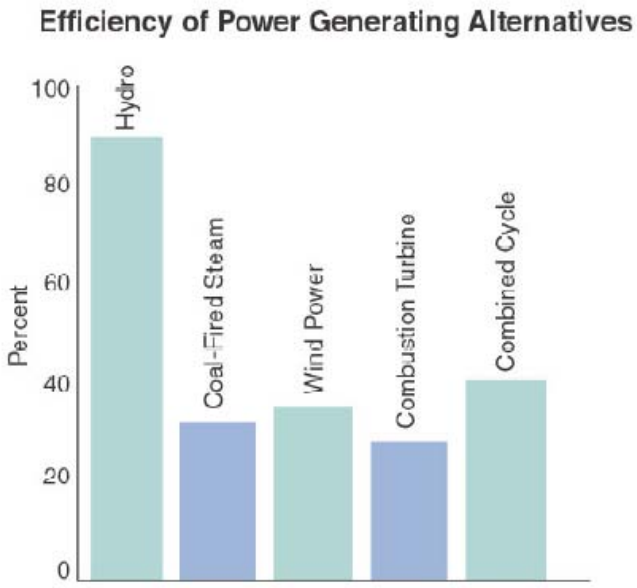

Figure 8. Advantages of hydropower over other power generating alternatives.

The Corps of Engineers operates 41 power plants in the area of the U.S. affected by, or potentially at risk of, desertification. These plants have a total installed capacity of 16,431 megawatts and are spread out over nine states:

STATE	No. of Plants	Total Capacity (MW)
Idaho	2	530
Missouri	3	407
Montana	2	1,110
North Dakota	1	400
Oklahoma	8	584
Oregon	13	6,697
South Dakota	4	1,483
Texas	3	82
Washington	5	5,138
Total	**41**	**16,431**

The Corps also coordinates power operation with the projects' other purposes. Flood damage reduction, navigation, recreation, fish and wildlife, water quality, and water supply are some of the needs that must be considered in a holistic manner in order to ensure sustainability of the project (http://www.corpsresults.us/pdfs/hydropower.pdf).

The DOI Bureau of Reclamation is best known for the dams, powerplants, and canals it constructed in the 17 western states. Bureau of Reclamation has constructed more than 600 dams and reservoirs and is the largest wholesaler of water in the country. This agency delivers water to more than 31 million people, and provides one out of five Western farmers (140,000) with irrigation water for 10 million acres of farmland that produce 60% of the nation's vegetables and 25% of its fruits and nuts.

The Bureau of Reclamation is also the second largest producer of hydroelectric power in the western United States. It owns and operates 58 powerplants in the areas of the U.S. affected by, or potentially at risk of, desertification. These plants have a total installed capacity of 14,808.86 megawatts distributed over 11 states:

STATE	No. of Plants	Total Capacity (MW)
Arizona/Nevada	3	3,637.80
California	13	2,117.82
Colorado	14	733.81
Idaho	5	257.91
Montana	3	728.0
New Mexico	1	27.94
Oregon	1	17.29
Utah	2	156.90
Washington	3	6,833.94
Wyoming	13	297.45
Total	58	14,808.86

Wind Energy

About six percent of the continental United States has been identified as highly suitable for construction of wind turbines. This area alone has the potential to supply up to 20 percent of our Nation's electricity. The President's goal is to expand the use and lower the cost of wind turbine technology so that our country can get more electricity from clean, renewable wind power (http://www.whitehouse.gov/infocus/energy/).

Wind turbines capture the kinetic energy in the wind, converting it into electrical energy. Currently wind turbines produce 4,200 megawatts of electricity with approximately 500 megawatts of this installed capacity located on Federal lands in the western U.S. managed by BLM (http://www.blm.gov/nhp/what/lands/realty/wind_energy.htm). Continued growth in energy obtained from wind power is expected due to improved technology and increased demand. For example, the USDA Farm Service Agency supports the President's goal to expand the use of wind turbine technology by permitting the placement of wind turbines on land enrolled in the Conservation Reserve Program.

The National Wind Technology Center (NWTC) is a research facility managed by the National Renewable Energy Laboratory for the U.S. Department of Energy. NWTC researchers work with members of the wind energy industry to advance wind power

technologies that lower the cost of wind energy through research and development of state-of-the-art wind turbine designs. (http://www.nrel.gov/wind/)

The American Wind Energy Association (http://www.awea.org/default.htm) also provides information on current and potential wind energy development in the U.S.

Solar Power

Photovoltaic technologies can convert roughly 10% to 20% of energy from the sun directly into electricity (http://www.crest.org/index.html) and provide another source of renewable energy in the western U.S.. The U.S. Department of Energy provides links to many websites with solar energy resources at (http://www.eere.energy.gov/RE/solar.html). The western U.S. with its abundant sunshine is expected to meet a growing share of the solar energy production in the U.S.

LAUNCHING OF REFORESTATION/AFFORESTRATION PROGRAMS AND INTENSIFICATION OF SOIL CONSERVATION PROGRAMS

Lower elevation forests and woodlands in the western U.S. are subject to desertification processes. Inappropriate harvest techniques may result in accelerated erosion and loss of biodiversity. Forest management practices are in place on federally managed forests to reduce impacts of harvest techniques and to improve the health of the forest.
The following series of websites provides USDA (FS and NRCS) information on solutions for land degradation and soil conservation in forested ecosystems:

- Agroforestry for Farms and Ranches
  NRCS Technical Note describing tree and shrub practices in sustained agroforestry systems (growing trees and shrubs in combination with crops or forage) (http://www.nrcs.usda.gov/technical/forestry.html).
- Ecosystem Services
  Website describing economic and social values of forest ecosystems including new opportunities in market-based conservation and stewardship.
- Forest Incentive Program (FIP)
  A cost share program to assist qualifying landowners with establishing and improving their forests.
- Forestry Economic Models
- Forestry Links
- National Agroforestry Center
  The latest in agroforestry practices and technologies. Information and publications are available on the six major agroforestry practices: silvopastures, alley cropping, windbreaks and shelterbelts, forest farming, forest riparian buffers, and specialty practices. The National Agroforestry Center is a joint USDA-Forest Service and NRCS effort.

- National Forestry Handbook
  The National Forestry Handbook (NFH) provides informational material to assist NRCS personnel in the planning and application of forestry and agroforestry practices on nonfederal forestland throughout the United States.

- National Forestry Manual
  The National Forestry Manual (NFM) describes forest policy within the Natural Resources Conservation Service and complements the General Manual.
- State of the Land: Forest Land
  Maps and analysis
- Windbreaks
  A series of publications designed to aid the private landowner in the use of windbreaks for conservation and improved agricultural production.

Other initiatives and acts that have components that restore forest and woodland health and address sustainability and therefore desertification include:

National Fire Plan addresses stabilizing soils and reestablishing desired vegetation after wildfires to reduce erosion, maintain diversity and slow the spread of invasive plants. The Emergency Stabilization and Rehabilitation Program under the National Fire Plan also provides funds to complete fish and wildlife habitat restoration, invasive plant treatments, and replanting and reseeding with native or other desirable vegetation. Another component of the plan provides funds to reduce hazardous fuels in forests and woodlands while restoring historical structure, function, diversity, and dynamics. Treatments are accomplished using prescribed fire, mechanical thinning, herbicides, grazing, or combinations of these and other methods (http://www.fireplan.gov/overview/whatis.html).

Healthy Forests Initiative and Healthy Forest Restoration Act provides land managers with additional tools to achieve long-term objectives in reducing hazardous fuels and restoring fire-adapted ecosystems (http://www.fireplan.gov/healthyforest/index.html).

DEVELOPMENT OF EARLY WARNING SYSTEMS FOR FOOD SECURITY AND DROUGHT FORECASTING (INCLUDING DROUGHT MONITORING AND ASSESSMENT)

National Drought Policy

The U.S. has a national drought policy instituted by Congress in 1998. The National Drought Policy Act of 1998 (Public Law 105-199), recognizes the need to prepare for and lessen the severe impacts of drought on the American people and the environment. This act created the National Drought Policy Commission (http://www.fsa.usda.gov/drought/) to advise Congress on formulation of national drought policy based on preparedness, mitigation, and risk management rather than on crisis management, which is the cornerstone of current federal responses to drought. The Act also directed the Commission to present a strategy that shifts from *ad hoc* federal action toward a "systematic process similar to those for other natural disasters" and to integrate federal programs with "ongoing state, local, and tribal programs."

The National Drought Policy Commission included representatives from city, county, state, tribal and federal government, NGO's and private industry. From a series of public

forums between 1999 and 2000, farmers, politicians, local citizens and concerned organizations met to improve awareness of the national issues at the local level on drought mitigation, drought monitoring, federal and state conservation programs, risk management and planning. These meetings, facilitated by the USDA's Farm Service Agency, served as the basis for the preparation of the report on "Preparing for Drought in the 21st Century" (http://www.fsa.usda.gov/drought/finalreport/fullreport/reportdload.htm) in May 2000.

In this report, the U.S. National Drought Policy Commission strongly recommended that resources of the federal government be used to support but not supplant nor interfere with state, tribal, regional, local, and individual efforts to reduce drought impacts. The guiding principles of the national drought policy are:

1. Preparedness favored over insurance, insurance over relief, and incentives over regulation.
2. Research priorities are based on the potential of research results to reduce drought impacts.
3. Federal services are best delivered through cooperation and collaboration with nonfederal entities.

This policy recommends a shift from the current emphasis on drought relief. Preparedness—especially drought planning, plan implementation, and proactive mitigation—is emphasized as the cornerstone of national drought policy.

Regional drought issues are addressed via earlier guidance provided by the Water Resources Planning Act in 1965. This act emphasized a basin perspective, multi-objective assessments, public involvement, and risk assessment.
A number of federal/state river basin organizations take a variety of forms designed by their member states to address specific issues, often including drought.

Activities by Federal Agencies to Mitigate Drought in Affected Areas

Appropriate and timely changes in management of rangelands and lower elevation forests are required to mitigate drought and lessen the potential for initiation of desertification processes (increased soil erosion, loss of native vegetation and increase in invasive species, and loss of productive capability of lands. On federal lands managed by the BLM and Forest Service, the agency may require grazing permit holders to reduce or remove livestock until drought conditions abate. Development of new water sources or movement of livestock to less affected areas are other management options to mitigate drought impacts on vegetation. Management changes need to be made at the beginning of the drought to proactively minimize livestock impacts to native vegetation.

Within National Parks, the NPS applies a mix of tools to measure and mitigate the effects of drought, specifically the increased fire potential following extended droughts. Tools include drought indices, the development of fire potential and burn severity predictive models, and an aggressive fuel treatment program using fire, mechanical and chemical techniques to reduce fire hazards.

See http://www.nifc.gov/, http://burnseverity.cr.usgs.gov/fire_main.asp
http://www.wfas.us/component/option,com_frontpage/Itemid,1/ ,
http://www.nps.gov/fire/public/pub_und_hazardousfuel.html

Drought Monitoring and Assessment

About 22 U.S. federal programs have some responsibility for drought monitoring/prediction and research. In relation to monitoring and prediction, these include programs that focus on weather patterns, climate, soil conditions, and streamflow measurements. Examples are three networks—the Department of Agriculture's Soil Climate Analysis Network (SCAN)/Snow Telemetry Network (SNOTEL) (http://www.wcc.nrcs.usda.gov/snow/), the National Oceanic and Atmospheric Administration/National Weather Service's Cooperative Observer Network (COOP) (http://www.noaa.gov/) , and the U.S. Geological Survey's stream gauging and groundwater monitoring network. The U.S. Army Corps of Engineers uses and supports non-Corps federal monitoring systems and has developed its own remote data sensing network to manage its reservoirs.

The **Mapped Atmosphere-Plant-Soil System** (MAPSS) Team, a collaborative effort of the USDA Forest Service and other federal, state, industry and private partners, has developed forecasting technology for both long-term (100 years) and near-term (seasonal) ecosystem responses to drought, climate variability and climate change (http://www.fs.fed.us/pnw/corvallis/mdr/mapss/).

Drought Monitor is a synthesis of multiple indices, outlooks and news accounts that represents a consensus of federal and academic scientists on drought severity (Figure 9). For more information about the science or impacts of drought, please visit the National Drought Mitigation Center's web site.

Main federal partners:

- Joint Agricultural Weather Facility (U.S. Department of Agriculture and Department of Commerce/National Oceanic and Atmospheric Administration)
- Climate Prediction Center (U.S. Department of Commerce/NOAA/National Weather Service)
- National Climatic Data Center (DOC/NOAA)

Academic partner:

- National Drought Mitigation Center (University of Nebraska-Lincoln)

Other participants:

- U.S. Geological Survey (U.S. Department of Interior)
- National Water and Climate Center (USDA/Natural Resource Conservation Service)

- Climate Diagnostics Center (DOC/NOAA)
- Regional Climate Centers
- National Weather Service Hydrology (DOC/NOAA)
- State Climatologists

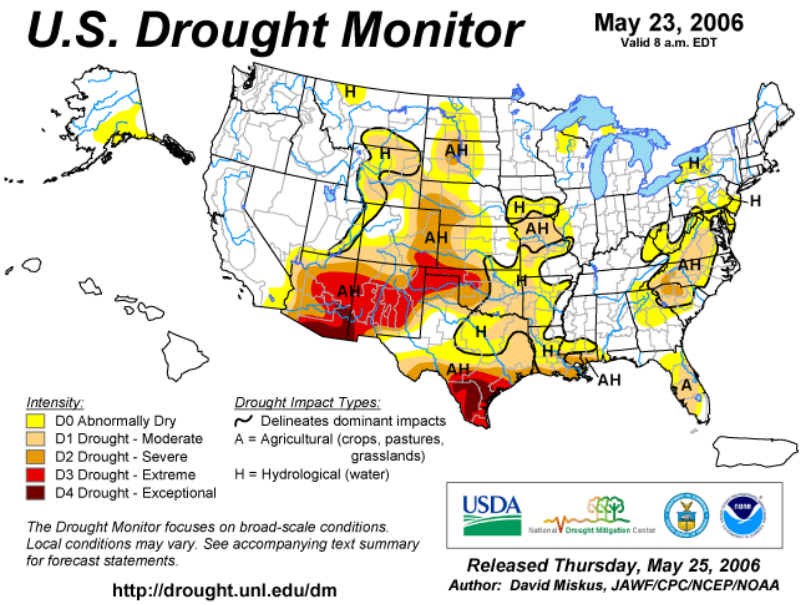

Figure 9. U.S. Drought Monitor depiction of drought intensity and impact type.

National Drought Mitigation Center (NDMC) helps people and institutions develop and implement measures to reduce societal vulnerability to drought, stressing preparedness and risk management rather than crisis management.

Most of the NDMC's services are directed to state, federal, regional, and tribal governments that are involved in drought and water supply planning.

The NDMC's activities include maintaining an information clearinghouse and drought portal; drought monitoring, including participation in the preparation of the U.S. Drought Monitor and maintenance of the web site (drought.unl.edu/dm); drought planning and mitigation; drought policy; advising policy makers; collaborative research; K–12 outreach; workshops for federal, state, and foreign governments and international organizations; organizing and conducting seminars, workshops, and conferences; and providing data to and answering questions for the media and the general public. The NDMC is also participating in numerous international projects, including the establishment of regional drought preparedness networks in collaboration with the United Nations' Secretariat for the International Strategy for Disaster Reduction.

Drought, climate and weather resources linked to NDMC's website include:

- NOAA's Drought Information Center
- MesoWest is a great source for current weather conditions around the Intermountain West.

- The Pacific Northwest Cooperative Agricultural Weather Network is part of the Bureau of Reclamation's AgriMet weather station network.
- NOAA's Extreme Weather and Climate Events page links to all sites within NOAA that are related to climatic extremes and weather events.
- NOAA/NWS Government Weather Information Services is another useful link to various weather services.
- The National Center for Atmospheric Research's (NCAR) Weather section has satellite images and links to many weather and climate resources on the WWW.
- NOAA's Climate Prediction Center (CPC), formerly the Climate Analysis Center, monitors regional and global climate anomalies, which can be indicators of potential target areas for drought.
- NOAA's Climate Diagnostic Center (CDC) is an excellent archive of historical studies on climatic variability.
- NOAA's National Climatic Data Center (NCDC) CLIMVIS program graphs historic drought data for any U.S. climate division, 1895–present, using the Palmer Drought Severity Index (PDSI).
- The National Weather Service's (NWS) Interactive Weather Information Network (IWIN) has raw data from a variety of sources. "National Products" has national and international crop summaries.
- Regional Climate Centers (RCCs) An index to the six regional climate centers in the United States, some of which give you regional climate and drought products by climatic division. The Western Regional Climate Center (WRCC) has a great mapping tool for the Standardized Precipitation Index (SPI) and other climatic parameters for the United States over the last 6 years.
- U.S. Climate at a Glance, prepared by the National Climatic Data Center, provides national, regional, state, and/or local temperature and precipitation maps and data.
- The North American Drought Monitor (NA-DM) is a cooperative effort between drought experts in Canada, Mexico and the United States to monitor drought across the continent on an ongoing basis.
- The Interim National Drought Council was formed in September 2000 to establish a more comprehensive, integrated, and coordinated approach to drought.
- The Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service, is home to the National Water and Climate Center, where they monitor water supplies in the West.
- The Farm Service Agency's (FSA) services/programs area has information about conservation, commodity programs, crop insurance, and farm loans, along with state and county contacts.
- United States Geological Survey (USGS). Go to USGS News Releases to see the latest advisories, warnings, and events. Water Resources of the United States contains more links. The USGS Drought Watch site provides real-time streamflow information for locations in the United States.

DESERTIFICATION MONITORING AND ASSESSMENT INCLUDING MEASURES FOR THE REHABILITATION OF DEGRADED LAND

There is no single monitoring or assessment program or protocol to measure desertification or degradation in the western United States. However, a number of monitoring systems provide useful information related to this issue.

There are several comprehensive efforts to describe the status and trend of resources and social well-being on lands in the western United States. In addition, a number of federal agencies have protocols and strategies to report on regional or local ecosystem conditions.

National and Regional Programs

Sustainable Rangelands Roundtable

The Sustainable Rangelands Roundtable is a collaborative partnership with over 50 federal, academic, environmental, commodity, and public entities working to develop and promote the use of common criteria and indicators for rangeland assessments (http://sustainablerangelands.warnercnr.colostate.edu/). The five categories of criteria, which meet the U.N. definition of land degradation, include:

1) Conservation and maintenance of soil and water resources
2) Conservation and maintenance of plant and animal resources
3) Maintenance of productive capacity of rangelands
4) Maintenance of current and future social and economic benefits
5) Legal, institutional, and economic framework for rangeland conservation and sustainable management

The roundtable has also selected 64 indicators for these criteria. To date, however, these indicators have not been used to prepare a national report.

State of the Nation's Ecosystems

The Heinz Center, a nonprofit organization (http://www.heinzctr.org/ecosystems/) is publishing a periodic update of the condition and use of U.S. ecosystems. An initial report entitled, "The State of the Nation's Ecosystems: Measuring the Lands, Waters, and Living Resources of the United States" was produced in 2002 with input from nearly 150 experts (http://www.heinzctr.org/ecosystems/report.html). One of the ecosystems addressed in this report is grasslands and shrublands in the western U.S. Partial or complete data are available for six of the 17 indicators used to address the condition of grasslands and shrublands. The next full report on the state of the Nation's ecosystems is scheduled for 2007.

Department of Agriculture

In 1977, Congress passed Public Law 95-192, the Soil and Water Resources Conservation Act, which addressed the importance of conserving soil and water resources on private and other non-federal lands.

The Act directed the U.S. Department of Agriculture (USDA) to develop a national soil and water conservation program and to periodically assess the condition of the nation's soil, water and other natural resources. Since then, USDA has issued several reports that assess the condition of and trends in soil, water and related resources (http://www.nrcs.usda.gov/technical/land/). The results guide the Department's soil and water conservation priorities and have been the basis for improvements in the nation's overall conservation efforts.

"A Conservation Act Report: Interim Appraisal and Analysis of Conservation Alternatives," September 2001 (http://www.nrcs.usda.gov/technical/land/pubs/rca/NRCSfinal.pdf) describes conditions and trends in soil, water and other environmental resources. It discusses conservation needs identified by USDA, conservation partners and numerous land users through discussions at public hearings and other forums and during deliberations over proposed legislation and policy.

The report identifies technical assistance and financial incentives to accomplish different resource conservation objectives. Initiatives to meet these goals include reducing erosion on all cropland; establishing two million miles of buffers for the nation's waterways; enrolling 250,000 additional acres per year in the Wetlands Reserve Program; investing $65 million per year in the Farmland Protection Program; and expanding the Conservation Reserve Program to 45 million acres. Overall results have been positive and indicate that there are significant future opportunities to improve soil, water and other environmental conditions.

National Resource Inventory

The Department of Agriculture's Natural Resources Conservation Service has conducted a National Resource Inventory (NRI) (http://www.nrcs.usda.gov/technical/NRI/) on U.S. private land use and natural resource trends every 5 years during the period 1977 to 2005. NRI data are collected at scientifically selected sample sites across the nation. The latest national report on NRI findings as they relate to land use was published in 2002 (http://www.nrcs.usda.gov/technical/land/nri02/landuse.pdf). Between 1982 and 2002, nonfederal acreage devoted to grazing uses, rangeland, pastureland, and grazed forest land, declined from 611 million acres (247 million ha) in 1982 to 578 million acres (234 million ha) in 2002, a decrease of over 5 percent. Between 1992 and 2002, the net decline in grazing land acreage was less than 3 percent (Figure 10).

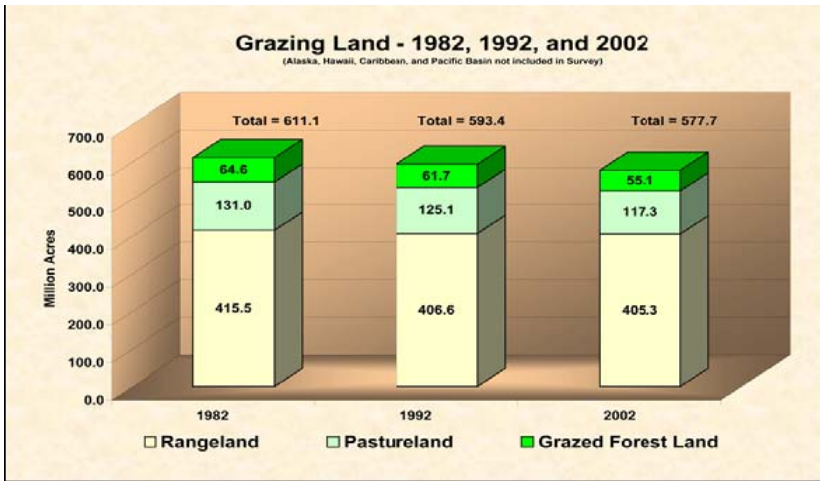

Figure 10. Changes in grazing land acreages from 1982 to 2002.

Forest Inventory and Analysis (FIA)

The FIA is conducted by the U.S. Department of Agriculture's Forest Service and reports annually on status and trends in forest area and location; in the species, size, and health of trees; in total tree growth, mortality, and removals by harvest; in wood production and utilization rates by various products; and in forest land ownership (http://www.fia.fs.fed.us/). The FIA uses a set of core methods collected on a standard plot that are analyzed and reported in a similar manner nationwide. FIA is managed by the Research and Development organization within the USDA Forest Service in cooperation with State and Private Forestry and National Forest Systems and has been in operation for 70 years.

Details on rangeland resource trends in the U.S. can be found in "Rangeland resource trends in the United States: A technical document supporting the 2000 USDA Forest Service RPA Assessment**"** at http://www.fs.fed.us/rm/pubs/rmrs_gtr68.html. This report indicates that rangeland values and uses have gradually shifted from concentrating upon forage production and meeting increasing demand for red meat to a more broad-based framework of sustainable resource management. The total extent of rangeland will likely continue a trend of slow decline, but any changes will be small in relation to the total U.S. grazing land base of about 800 million acres. Data from various sources indicate that range condition has been fairly static over the past decade, although non-indigenous weed invasions are a concern.

Bureau of Land Management

The BLM's inventory of ecological status of rangelands is used to report on the condition of rangelands as mandated in the Public Rangelands Improvement Act of 1978. The report is expressed in degree of similarity of present vegetation to the potential natural, or climax, plant community: Potential Natural Community = 76-100 percent similarity; Late Seral = 51-75 percent similarity; Mid Seral = 26-50 percent similarity; Early Seral = 0-25 percent similarity.

As of 2004, 52% of the public lands managed by BLM were inventoried for range condition with the following condition classifications:

Potential Natural Community	8%
Late Seral	34%
Mid Seral	41%
Early Seral	16%

This information and other related reports are found in an annual report "Public Land Statistics" at http://www.blm.gov/natacq/pls04/. An effort is underway to consider changing the report from a range condition based format to one that reports status of land health. Land health assessments are being done on all livestock grazing allotments which will eventually allow a full report on all of these BLM-managed lands.

Water Resources

The Department of the Interior's United States Geological Survey (USGS) monitors and delivers information on Ground Water, Surface Water, Water Quality, and Water Use across the U.S. (http://water.usgs.gov/). The programs and links to websites where the information on U.S. Water Resources can be found are:

- Cooperative Water Program
- National Streamflow Information Program (NSIP)
- National Water Quality Assessment Program (NAWQA) -- Since 1991, USGS scientists with the NAWQA program have been collecting and analyzing data and information in more than 50 major river basins and aquifers across the Nation. The goal is to develop long-term consistent and comparable information on streams, ground water, and aquatic ecosystems to support sound management and policy decisions. The NAWQA program is designed to answer these questions:
    - What is the condition of our Nation's streams and ground water?
    - How are these conditions changing over time?
    - How do natural features and human activities affect these conditions?
    - NAWCA Programs include:
        - Toxic Substances Hydrology (Toxics) Program
        - Ground Water Resources Program
        - Hydrologic Research and Development
        - State Water Resources Research Institute Program

USGS also has several international programs related to water and desertification:

International Programs:

- **EXACT** -- The Executive Action Team Multilateral Working Group on Water Resources, Water Data Banks Project consists of a series of specific actions to be

taken by the Israelis, Jordanians, and Palestinians that are designed to foster the adoption of common, standardized data collection and storage techniques among the Parties, improve the quality of the water resources data collected in the region, and to improve communication among the scientific community in the region. The project is managed by an Executive Action Team, EXACT, comprised of water experts from Israeli, Jordanian, and Palestinian water-management agencies. Technical and financial support to EXACT is contributed by Australia, Canada, the European Union, France, the Netherlands, and the United States.

- Global Drainage Basins Program (database) -- Currently at the EROS Data Center, UNEP, NASA, and the USGS are developing continental drainage basins from the 30 arc second (~1-km) digital elevation models (DEM). The goals of the project are two-fold. The first goal is to produce the most realistic, verified drainage basins from the DEM. The second goal is to compare the drainage areas from the 30 arc second (~1-km) source to existing basin sources. A comparative analysis of what drainage source produces the best physical boundary will benefit researchers, scientists, and individuals that use hydrological feature data for modeling, calculating, and assessing environmental problems.

- Watercare -- Water problems in the Middle East are common because most of the area has semi-arid to arid climatic conditions. A multilateral track was established to focus on issues of common interest and importance throughout the region that can best be addressed on a regional basis. The multilateral track consists of five working groups: (1) Working Group on Water Resources, (2) Working Group on the Environment, (3) Working Group on Regional Economic Development, (4) Working Group on Refugees, and (5) Working Group on Arms Control and Regional Security.

LANDFIRE

LANDFIRE is a five-year project that is a joint effort between the USDA Forest Service and Department of the Interior to provide the spatial data and predictive models required to characterize fuel conditions and help evaluate wildland fire hazard (http://www.landfire.gov/). This project will generate consistent, comprehensive maps and data describing vegetation, fire, and fuel characteristics across the United States. These maps can assist in prioritizing and planning hazardous fuel reduction and ecosystem restoration efforts.

The consistent and comprehensive nature of LANDFIRE methods ensures that data will be nationally relevant, while the 30-meter grid resolution (Landsat imagery) assures that data can be locally applicable.

The development of detailed vegetation maps is a significant component of LANDFIRE. These maps will provide a benchmark for future assessments to monitor change in vegetation communities, specifically long-term loss of natural vegetation, which is a component of the land degradation definition for desertification.

Mapped Atmosphere-Plant-Soil System (MAPSS)

MAPSS is a landscape to global vegetation distribution model that was developed by the U.S. Forest Service to simulate the potential biosphere impacts and biosphere-atmosphere feedbacks from climatic change (http://www.fs.fed.us/pnw/corvallis/mdr/mapss/). Model output from MAPSS has been used extensively in the Intergovernmental Panel on Climate Change's (IPCC) regional and global assessments of climate change impacts on vegetation and in several other projects.

The role of climate variability and change in historical desertification at regional to global scales has been a focus of the MAPSS Team since the early 1990s. Dynamic general vegetation model (DGVM) simulations of vegetation and fire response to climate variability and change has allowed the investigation of the interactive roles of climate and fire suppression or exclusion on vegetation dieback and general vegetation health. With The Nature Conservancy (TNC), the MAPPS Team is extending the DGVM simulation to all global upland terrestrial ecosystems for both historical climate and future scenarios. Analyses of the interaction between climate variability over the past 100 years and regional desertification allows the differentiation of human and natural causes of desertification and highlights the potential for rehabilitation. Simulations of both historical and future climate-induced desertification trends, along with human interventions, allow determination of regions most likely to positively respond to rehabilitation efforts.

Environmental Monitoring and Assessment Program

The U.S. Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP) is a long-term research program designed to develop the scientific basis for monitoring programs that measure the current and changing conditions of the nation's ecological resources(http://www.epa.gov/emap/index.html). EMAP's goal is to develop the scientific understanding for translating environmental monitoring data into assessments of current ecological condition and forecasts of future risks to our natural resources. EMAP aims to advance the science of ecological monitoring and ecological risk assessment, guide national monitoring with improved scientific understanding of ecosystem integrity and dynamics, and demonstrate multi-agency monitoring through large regional projects.

EMAP achieves this goal by using statistical survey methods (probability survey designs with a random site selection component) that allow scientists to assess the condition of large areas based on data collected from a representative sample of locations.

A regional application of EMAP to environmental problems across a large and diverse geographical region (EMAP-West) was completed in 2005.

The **Ecological Assessment of Western Streams and Rivers** report (http://www.epa.gov/nheerl/arm/documents/EMAP.W.Assessment.final.pdf) presents an ecological assessment of non-tidal streams and rivers across twelve states of the western U.S. It focuses on direct measures of biological assemblages and identifies and ranks the relative importance of potential chemical, physical and biological stressors affecting stream and river condition.

Wildfire Rehabilitation

Wildfires have a large impact on western U.S. lands and increase the potential for desertification. To mitigate these adverse impacts, agencies in the Department's of Agriculture and Interior implement land treatments to reduce erosion and encourage the recovery or establishment of desirable vegetation as part of the Emergency Stabilization and Rehabilitation program, and to monitor the results. The various monitoring protocols used are reviewed in the USGS publication, "Monitoring Post-fire Vegetation Rehabilitation Projects: Current Approaches, Techniques, and Recommendations for a Common Monitoring Strategy in Non-forested Ecosystems" available at: (http://fresc.usgs.gov/products/)

Vital Signs Monitoring

The U.S. Department of the Interior's National Park Service is charged with managing the natural resources 102 National Parks and Monuments in the western U.S. Knowing the condition of natural resources in units of the National Park System is fundamental to the agency's ability to manage park resources. Vital signs monitoring is a key component in the Service's strategy to provide scientific data and information needed for management decision-making and education (http://science.nature.nps.gov/im/monitor/index.cfm, http://science.nature.nps.gov/im/monitor/docs/Monitoring_Brochure.pdf), and http://science.nature.nps.gov/im/monitor/ProgramGoals.cfm#LawsPolicy).

Park vital signs are selected physical, chemical, and biological elements and processes of park ecosystems that represent the overall health or condition of the park, known or hypothesized effects of stressors, or elements that have important human values. The goals of the vital signs monitoring project, which should improve inter-agency coordination and mitigation efforts, are:

- Determine the status and trends in selected indicators of the condition of park ecosystems.
- Provide early warning of abnormal conditions of selected resources.
- Provide data to better understand the dynamic nature and condition of park ecosystems and to provide reference points for comparisons with other, altered environments.
- Provide data to meet certain legal and Congressional mandates related to natural resource protection and visitor enjoyment.
- Provide a means of measuring progress towards performance goals.

Several vital signs networks have identified indicators applicable to desertification and are developing and implementing integrated soil, climatic, and vegetation monitoring protocols that will help NPS to determine the status and trends in ecosystem condition. The NPS has also implemented a Watershed Condition Assessment Program to assess watershed resource conditions within national park units (http://www.nature.nps.gov/water/watershedconds.cfm.)

Local Assessment and Monitoring Programs

At the local or project level, there is a wide array of both qualitative and quantitative protocols available to monitor or assess land degradation and treatments to restore land health. These assessment and monitoring protocols provide good information at the local scale on the indicators of land degradation, specifically soil erosion, soil quality, and natural vegetation. A few suggested quantitative monitoring references are:

Measuring And Monitoring Plant Populations. Elzinga, C.L., Salzer, D.W., and Willoughby, J.W. 1998. USDI Bureau of Land Management Technical Reference 1730-1. 492p. (http://www.blm.gov/nstc/library/pdf/MeasAndMon.pdf)

Sampling Vegetation Attributes. 1999. BLM Technical Reference 1734-4. 158 p. (http://www.blm.gov/nstc/library/pdf/samplveg.pdf)

Monitoring Manual for Grasslands, Shrublands, and Savanna Ecosystems (Vol. 1 and 2). Herrick, J.E., Van Zee, J.W., Havstad, K.M., Burkett, L.M., Whitford, W.G. 2005. (http://usda-ars.nmsu.edu/Monit_Assess/PDF_files/)

Land Condition Trend Analysis Department of Defense. 1999. Land Condition Trend Analysis II Technical Reference Manual. (http://www.cemml.colostate.edu/itamtrm.htm)

An interagency team has also developed a qualitative assessment protocol that addresses these same indicators of land degradation:

Interpreting Indicators of Rangeland Health, Version 4. Pellant, M., P. Shaver, D.A. Pyke, and J.E. Herrick. 2005. Technical Reference 1734-6. U.S. Department of the Interior, Bureau of Land Management, National Science and Technology Center, Denver, CO. BLM/WO/ST-00/001+1734/REV05. 122 pp. http://usda-ars.nmsu.edu/JER/Monit_Assess/monitoring.php

These are a few examples of information sources on conducting monitoring and assessment studies at the project or local level. Unfortunately, the information collected at this scale is difficult to aggregate to a regional or national level to report on the status of desertification in the western U.S. due to myriad of techniques and sampling strategies used to collect the data.

REFERENCES

(Crosson, P.R. 1998. The on-farm economic costs of erosion. In: Methods for Assessment of Land Degradation, eds. R. Lal, W.E.H. Blum, C. Valentin and B.A. Stewart. Boca Raton: CRC.

McClure, B.C. 1998. Policies related to combating desertification in the United States of America. Land Degradation and Development 9:383-392.

Sheridan, D. 1981. Desertification of the United States. Council on Environmental Quality. U.S. Government Printing Office. 142 p.

Sabadell, J.E.; Risley, E.M.; Jorgenson, H.T.; Thornton, B.S. 1982. Desertification in the United States: Status and Issues. Department of the Interior, Bureau of Land Management. 277 p.

Stoddard, J. L., D. V. Peck, S. G. Paulsen, J. Van Sickle, C. P. Hawkins, A. T. Herlihy, R. M. Hughes, P. R. Kaufmann, D. P. Larsen, G. Lomnicky, A. R. Olsen, S. A. Peterson, P. L. Ringold, and T. R. Whittier. 2005. An Ecological Assessment of Western Streams and Rivers. EPA 620/R-05/005, U.S. Environmental Protection Agency, Washington, DC.

Wiebe, K. 2003. Linking Land Quality, Agricultural Productivity, and Food Security. Agricultural Economic Report No. 823. USDA Economic Research Service. Washington, DC. 64 p.