Overview Section: Land and Water

Common Ground for Competing Uses

By Katherine Sherwood

The 2010 Colorado College State of the Rockies Report Card

Key Findings:

- In the Rockies, 90 percent of total water use is for agricultural purposes.
- Only 20 percent of agricultural land was used for cropland in 2007.
- The Rockies region falls in the middle of other regions in terms of land enrolled in conservation programs. Montana had the most conservation land (3 million acres) and Colorado saw the biggest increase (44 percent) in conservation between 2002 and 2007.
- From 1992 to 1997, more than 11 million acres of rural land were developed for non-agricultural use.

The Importance of Agricultural Land

The cowboy, "an independent, steadfast, resourceful" icon of the frontier who embodied Manifest Destiny by "taming nature and bringing order," is one of the greatest symbols of the American West.[1] Although the traditional idea of the cowboy has become a romanticized myth, the imagery of the American cowboy remains a symbol of our past. Like the cowboy, agricultural land also represents the founding of our country. The idea of owning property and making a living off the land is integral to the story of westward expansion and takes us back to our historical roots.[2] Conserving agricultural land is thus important for the preservation of American culture.

Agricultural land also plays a critical role in regional environments and economies. It preserves open space and wildlife habitat, and increases groundwater recharge and carbon sequestration. Soil that is adequate for plant growth takes thousands of years to develop; productive farmland is therefore a unique and non-renewable resource.[3]

Aside from providing non-market-value services, agriculture accounts for $100 billion of U.S. gross domestic product, around one percent of the total

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GDP, and similarly employs just under two percent of the labor force.[4] Agriculture supports the economies of rural communities and contributes significantly to the global economy and food supply.[5]

For all of these reasons, agriculture is the primary use of land in America. However, encroachment by urban areas is causing declines in farmland and ranchland acreage. Water transfers from agriculture to urban areas remove irrigation water from farms, ultimately leading to the loss of productive agricultural land. Pasture and rangeland are the primary uses of agricultural land in the Rockies, even though livestock production is highly water intensive and is threatened as the region struggles with water availability. Attempts to save agricultural land have included soil-bank type conservation programs which provide financial incentives for farmers to take land out of production or to practice farming techniques that are less intensive.

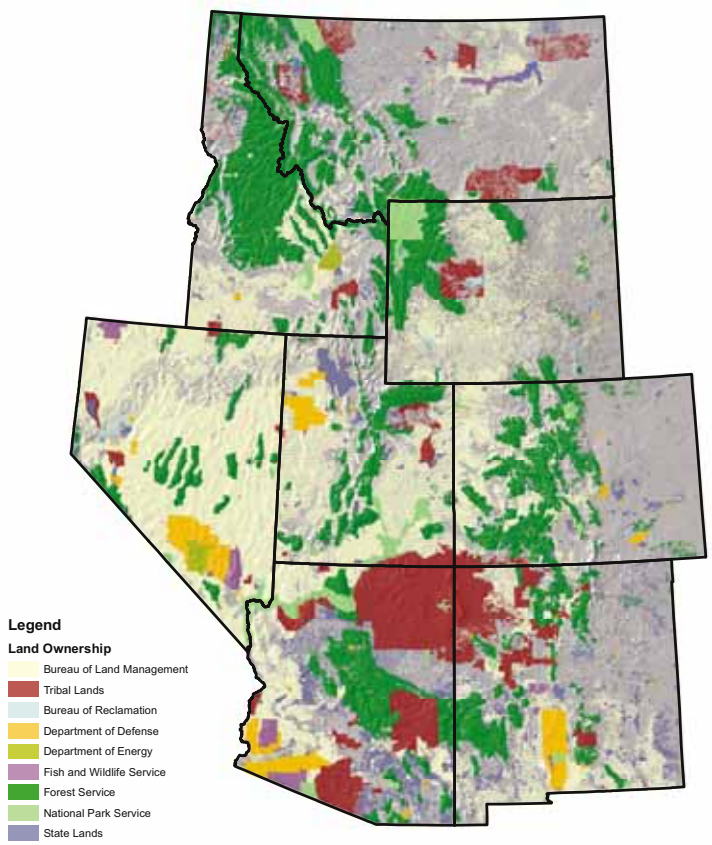
This section examines current trends in farm and ranch land in the Rockies region, looking at types of land use, developed agricultural land, irrigated land, and conservation practices based upon data from the 2007 Agriculture Census.

Table 1: Ownership and Use of Land in the Rockies, by Major Categories (in Millions of Acres, 2002)

Ownership	Cropland	Grassland, Pasture, and Range	Forest Land [1]	Special Uses, Urban Uses, and Miscellaneous Land [2]	Total Land Area [4]
Federal	-	152	246	237	635
State and Other Public	3	40	70	82	195
American Indian [3]	2	36	11	7	56
Private	436	358	422	162	1,378
Total	442	587	749	487	2,264

Source: USDA, Economic Research Service, 2002
Notes: -
- = Less than 500,000 acres.
[1] Includes reserved forest land in parks and other special uses.
[2] Excludes an estimated 98 million acres in special uses that have forest cover and, therefore, are included with forest land in this table.
[3] Managed in trust by the Bureau of Indian Affairs for American Indian and Alaskan Native tribes and individuals.
[4] Distributions may not add to totals due to rounding.

Figure 1: Federal, State, and Local Land Ownership in the Rockies



Source: Bureau of Land Management, 2009

Types of Agricultural Land Use

Agricultural Land Use

Of the 2.3 billion acres of land that make up the United States, 52 percent is used for agriculture, and the Rockies region[6] contains 23 percent of the total agricultural land in the U.S.[7] Agricultural land includes cropland, pastureland, and woodland. Cropland falls into several sub-categories: harvested, failed or abandoned, cultivated summer fallow, cover crops for soil improvement, and pasture or grazing. Woodland includes pastured and unpastured land. Pastured woodland is any woodland or timber tracts, either natural or planted, that is used for grazing, while unpastured woodland includes deforested land that has potential for future wood production[8].

Agricultural land in the U.S. has been declining. From the 1940's to 2002 there was a consistent upward trend in special-use land (including rural transportation uses, national and state parks, national defense, industrial developments, farmsteads, and farm roads) and urban areas, with decreases in land used for agricultural purposes.[9] From 1992 to 1997, more than 11 million acres of rural land were developed for non-agricultural use and more than half of those converted acres were agricultural land.[10]

Public Land

The Federal government owns 28 percent of the land in the U.S., with 41 percent of that land located in the Rockies region. Local and state governments own nine

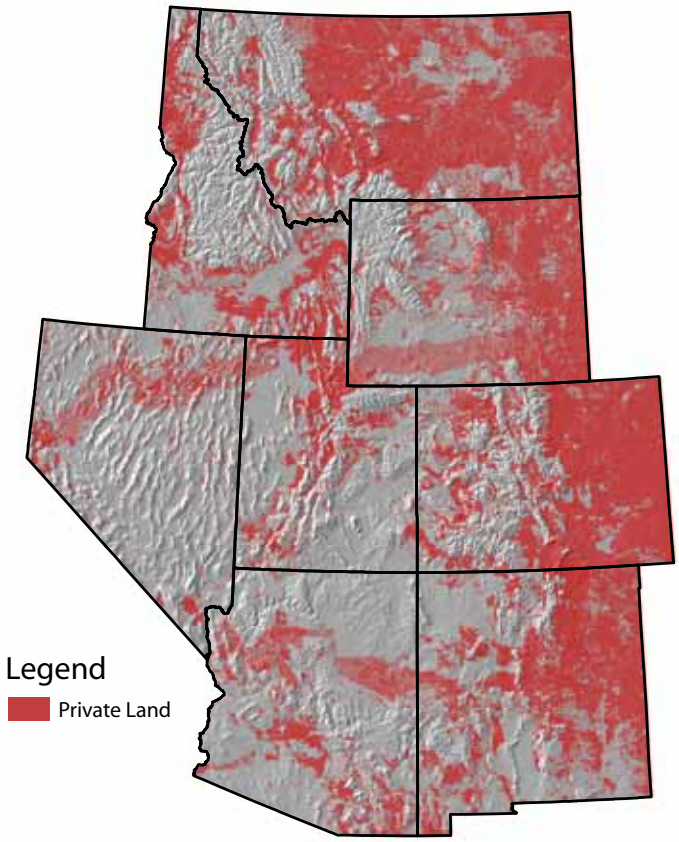
percent of the land, and Indian trust land makes up two percent of the total (See Table 1)[11] A land ownership/ management map of the Rockies (Figure 1) shows high concentrations of Bureau of Land Management (BLM) land located in Nevada and Utah, and tribal lands concentrated in Arizona, particularly in the northeast corner of the state

Most of the public land in the U.S. that has the potential to be used for pasture is leased for grazing: 90 percent of BLM land and 69 percent of United States Forest Service land is used for grazing. Most of these public grazing lands are in the Rockies and Pacific regions, where 95 percent of total public land is leased for grazing.[12]

Public land grazing is a controversial issue and has created an ongoing battle between ranchers and environmentalists. Some conservationists argue that ranching is destructive to public lands because cattle are not native to the ecosystem. They reduce habitat for native species, overgraze forage, and trample riparian areas. However, if ranchers and environmentalists work together to develop techniques that reduce the overall impact of the cattle, public grazing may become less destructive, and perhaps even beneficial to an ecosystem. For example, the Malpai Borderlands Group, based in southern Arizona, has shown that compromise between ranchers and environmentalists can promote healthy ecosystems while keeping cattle on public lands (see the case study on *Threatened Agricultural Land (p. 24)*.

The most prominent agricultural land use in the Rockies is livestock production on rangeland and pastureland. Large corporations and wealthy individual ranchers are the prevalent owners in the livestock industry. A 1992 General Office Accounting Report determined that the ten largest BLM permit holders are all corporations or billionaires, and the largest ten percent of ranches control 74 percent of the grazing on public lands.[13] According to Paul Robertson, director of the San Luis Valley Nature Conservancy Program, it is nearly impossible today for an individual to start up a ranch without being independently wealthy.[14]

Figure 2: Private Land Ownership in the Rockies



Source: Bureau of Land Management, 2009

Private Land

Private land in the U.S. accounts for over 60 percent of land ownership. Privately owned land includes 99 percent of cropland, 61 percent of grassland, pasture, and range, and 56 percent of woodland.[15] Figure 2 shows high concentrations of private land in the eastern Rockies, including Colorado, Wyoming, New Mexico, and most of Montana where cropland is most prominent. The western Rockies, where most of the BLM land is concentrated, have higher percentages of pastureland.

Changes in Agricultural Land

Agricultural land in the U.S. decreased between 1987 and 2007. In 1987, 442 million acres were devoted to cropland, but by 2007 cropland had decreased eight percent to 406 million acres. In the same time period, pastureland dropped nine percent from 516 to 473 million acres, while woodland dropped by six percent from 79 million acres to 75 million acres. Although these changes may not seem rapid on a regional basis, dramatic changes have occurred on local and regional levels.

In the Rockies region between 1987 and 2007, total farmland acreage decreased by 16 percent from 252 million acres to 220 million acres. Total cropland in the Rockies region was relatively unchanged between 1987 and 2007. Woodland, however, changed significantly from 12 million to eight million acres, a 48 percent decrease. In the same period, pastureland decreased from 198 to174 million acres, a 14 percent decrease.[16]

Pastureland and Livestock Production

Livestock production is resource intensive and can have negative impacts on the land if poor management techniques are used. Cattle consume large amounts of water; an estimated 3,430 gallons of water are needed to produce one steak,[17] and that does not include the water needed to irrigate feed crops. From the perspective of water demands, the Rockies region is a less than an ideal location for cattle production.

Despite the semi-arid/arid climate, the Rockies region had the most pasture and rangeland in the U.S. in 2007, with 163 million acres in pastureland and rangeland, representing 39 percent of the total pasture and rangeland in the U.S.[18] Of the total agricultural land in the Rockies, 74 percent was used for pasture and rangeland (See Figure 3).[19]

Cropland and Woodland

In the Rockies region, only about 20 percent of the land was used for cropland in 2007. Woodland made up a very small portion of the total land, with four percent designated as woodland and around three percent of that woodland used for pasture.[20] Woodland is concentrated in mountainous areas of the Rockies, whereas most agricultural land for crop and livestock production is located in lower and flatter areas.

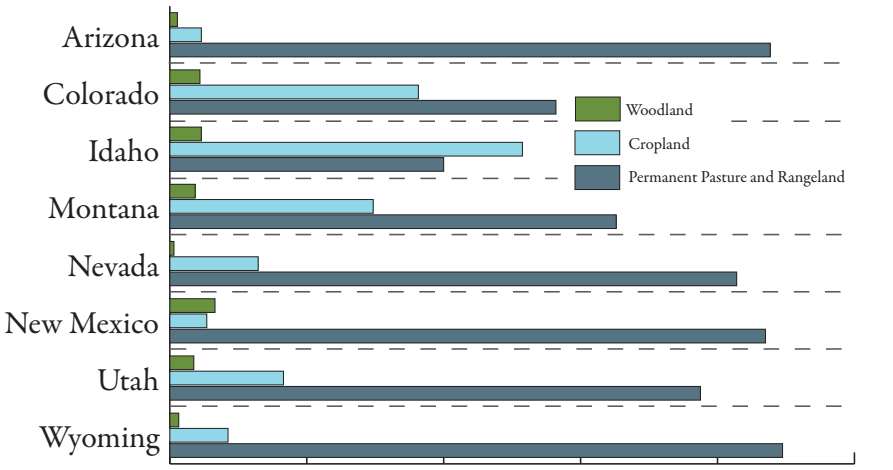
Rockies State Trends

The extent of cropland varies across the Rockies states, ranging from 50 percent of the total agricultural land in Idaho, to around five percent in Arizona. In the Rockies states, cropland used for pasture or grazing decreased between 2002 and 2007. Cropland used for pasture or grazing requires lower inputs, such as fertilizers and machines, and generally requires less maintenance. Typically, lands used for agricultural production shift between high and low labor and input use.[21] Thus, decreases in cropland used for pasture or grazing between 2002 and 2007 are a part of that cycle.

Arizona, New Mexico, and Wyoming had the highest percentages (around 85 percent) of land in permanent pasture and rangeland in 2007, while Idaho had 40 percent of agricultural land in permanent pasture, the lowest percentage of pastureland out of all the Rockies states (See Figure 3). In 2002 and 2007, New Mexico had the highest percentage of total land in woodland, with around six percent of land in woodland, most of which was pastured.

Figure 3:
Type of Land Use by Percent of Total Agricultural Land, by State, 2007

Source: USDA Census of Agriculture, 2007
Note: Permanent Pasture and Rangeland does not include Cropland and Woodland Pastured

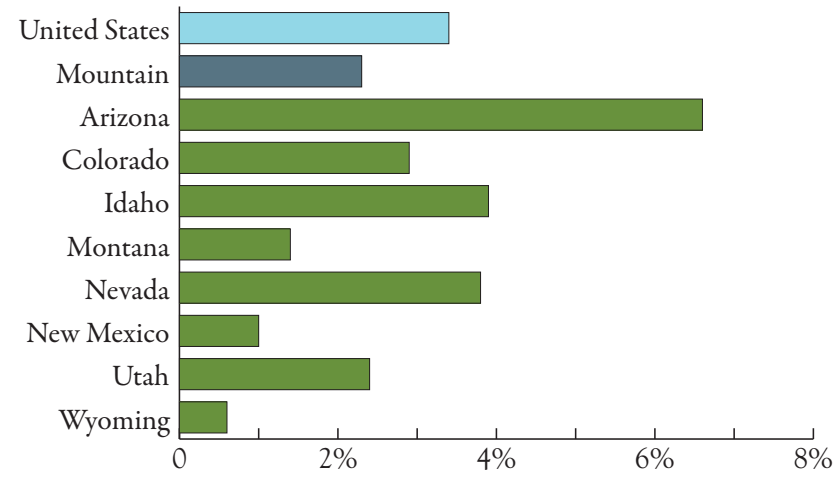


Developed Agricultural Land

Developed agricultural land includes farmsteads, buildings, livestock facilities, ponds, roads, and wasteland. The amount of developed land on a farm depends upon the size of the farm and the type of production. Farms that require more labor may have a greater number of buildings for housing. For example, John Post, the operator of a cotton farm in Marana, Arizona, provides housing on his land for most of his farm workers.[22] Shifts in outside involvement on the farm, such as community-supported agriculture, may also lead to increased roads in order to provide better access to the farm.

The Rockies region had a relatively low percentage of developed agricultural land in 2007. As shown in Figure 4, approximately two percent of the total Rockies land was developed, compared to three percent in the U.S. For perspective, four percent of land is developed in the Pacific Division.[23] At the national level some 50 percent of farms had some developed land.[24]

Figure 4:
Developed Agricultural Land as a Percent of Total Agricultural Land
(Farmsteads, Buildings, Livestock Facilities, Ponds, Roads, Wasteland, Etc.), 2007
Source: USDA Census of Agriculture, 2007



State Trends

In the Rockies states, Arizona had the largest percent of developed agricultural land (eight percent in 2002 and seven percent in 2007), whereas Wyoming had the lowest percent of developed land, with one percent in 2002 and less than one percent in 2007 (Figure 4).[25] The greater the number of farms,

the more total developed land. Wyoming had 2,274 large-scale farms (larger than 2,000 acres), while Arizona only had 515 large-scale farms. Meanwhile, Arizona had 9,873 small-scale farms (one to nine acres) compared to Wyoming which had 652 small-scale farms. Thus Arizona is divided into a greater number of small-scale farms, each of which requires different numbers and types of buildings, contributing to more overall development.

Irrigation

Agricultural irrigation accounts for more than 80 percent of the total water used in the U.S.[26] In the Rockies region, 90 percent of water use is for agricultural purposes.[27] The semi-arid/arid climate of the Rockies region provides a limited supply of water resources, and crop and livestock production largely depends on water availability. With increases in urban areas that also have high water demands, the availability of water for agriculture is constantly jeopardized.

Urban Water Transfers

According to the *2007 State of the Rockies Report Card*,[28] alternative water transfers from farms to cities are effective methods to balance competing urban and agricultural water needs. Several strategies currently exist. **Interruptible supply agreements** allow cities to gain access to agricultural water rights during droughts through annual payments or a "signing bonus." **Rotational crop management** involves an agreement between the farmer and buyer of the water rights. The farmer agrees to leave land fallow to make water available to the buyer. **Water banks** store surplus water that is not being used for irrigation. Those unused water rights are leased to other users who have access to the water bank. **Alternative crops or efficient irrigation systems** conserve water and allow the farmer to sell any water that is leftover to urban areas. **Purchase and lease back** is another water transfer practice. The city buys land from a farmer and gains some of the associated water rights. If the farmer needs the land back, he or she can lease it from the city.

photo: NRCS

Irrigation Systems

The type of irrigation system used has a large impact the success of water conservation goals. Irrigation techniques include flood irrigation systems, which convey water through open ditches and pipelines. Water is dispersed at the top of the field through siphon tubes, ditch gates, and pipe valves or orifices. Flood irrigation systems are inefficient because of surface water runoff, evaporation losses, and percolation below the crop root zone.

Pressurized irrigation systems include sprinklers and low-flow irrigation, and have been used as water and labor-conserving alternatives to gravity flow systems. However, a significant amount of water is still lost to evaporation.

Low-flow systems, which include drip, trickle, and micro-sprinklers, have 95 percent efficiency, compared with gravity systems which have 40–65 percent efficiency and pressurized systems which have around 75 percent efficiency. [29] In 2003, six percent of irrigated acres used low-flow systems. Although there are incentives to use low-flow systems, such as water conservation in dry years, possible increases in productivity, reduced energy costs, and reduction in labor, most farmers have not adopted these irrigation systems.[30] Often it comes down to initial cost; many farmers cannot afford low-flow systems. Increased international competition and increasing input costs, in combination with low water prices, provide little economic incentive to invest in low-flow systems.[31] Gravity flow systems are the predominant irrigation method in the Rockies, where uncontrolled flooding is used for hay and pasture production, a prominent land use in the region.[32]

In the U.S., large farms use the most irrigation water. The largest ten percent of irrigated farms in the western U.S. use half of the total irrigation water.[33] Farms with over 2,000 acres irrigated 150 million acres on average in 2002 and 2007, compared with farms with one to nine acres, which irrigated around 300,000 acres. Figure 5 depicts shares of total irrigated water used by farm size, with the largest farms (2,000 acres+) using 27 percent and small farms (1 to 9 acres) using only 1 percent.

Regional Trends

The Rockies region had the second-most land in irrigated farms out of all the U.S. divisions. However, the Pacific division had 20 percent of total farmland under irrigation, whereas the Rockies region irrigated only six percent of total farmland. This suggests that irrigated farmland is less concentrated in the Rockies region, and that there is greater abundance of non-irrigated grazing land.

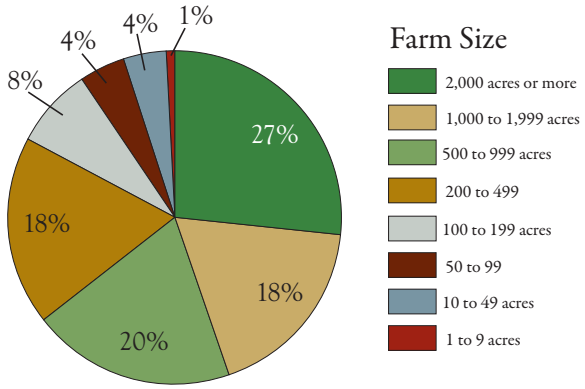
Figure 6 shows that the eastern Rockies had a lower percentage of irrigated land than the western Rockies. This is most likely a result of the Colorado River Compact which was established in 1922 and apportions certain Colorado River water rights to the western states.[34]

The Rockies region, when compared to other U.S. Census regions in Figure 7, had the highest percentage and number of irrigated acres dedicated to pastureland in 2007. While most regions put around 95 percent of their irrigation into cropland, the Rockies region put around 80 percent of irrigation toward cropland, and 20 percent toward pastureland. In total, the Rockies irrigated nearly 3 million acres of pasture in 2007. Although the percentage of irrigated acres in pastureland was lower than irrigated cropland, hay is one of the most water-intensive crops. Thus, livestock production, through the cultivation of forage, still requires a considerable amount of water.

State Trends

Among the Rockies states, Idaho had the most irrigated acres, over 3 million. As shown in Figure 8, Arizona had highest percentage of total irrigated acres as harvested cropland at 94 percent, and Colorado had the most irrigated pastureland, with over 500,000 acres. In 2002 and 2007, irrigated pastureland land represented between 30 and 40 percent of total pastureland in Wyoming. Arizona, which had a high percentage of land in pasture, only had five percent of land in irrigated pastureland, suggesting that much of the pastureland was non-irrigated grazing land.

Figure 5:
Percent of Total Irrigated Water Used, by Farm Size, Rockies Region, 2007
Source: USDA Census of Agriculture, 2007

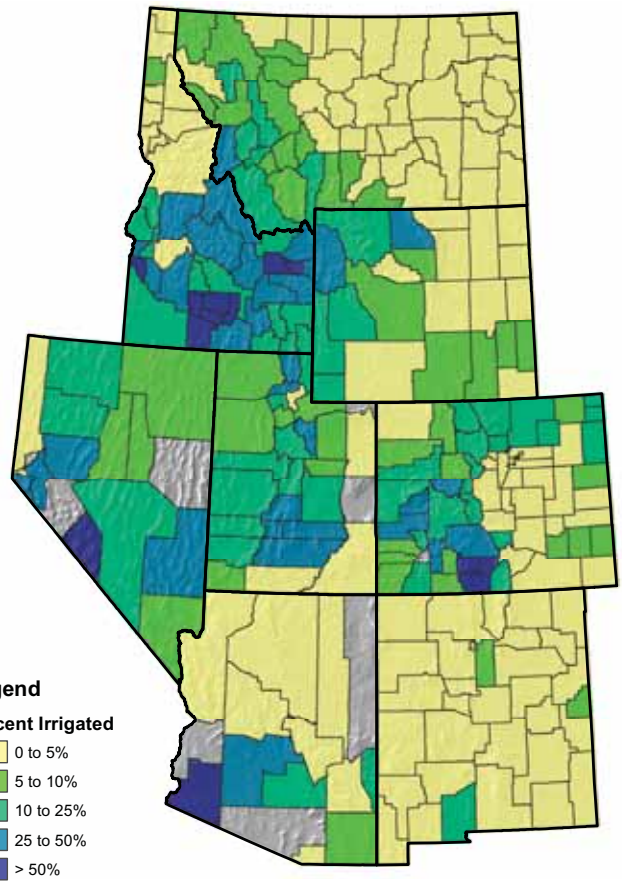


With increasing agriculture-to-urban water transfers, the irrigation-dependent cropland in the Rockies will struggle to survive, as hay is one of the most water-intensive crops in the West. In Colorado, 25 percent of all water is used to irrigate alfalfa.[35] Thus the livestock industry, the most predominant form of agriculture in the Rockies, is impacted by decreases in agricultural irrigation water.

Conservation of Agricultural Land

The federal government began addressing agricultural conservation in 1894 with the Division of Agricultural Soils. The department now focuses on air and water quality and wildlife preservation as well as soil erosion. [36] The Dust Bowl of the 1930's, a result of drought and poor soil management, slowed farm production and deepened the Great Depression. Because of this, many of the New Deal recovery programs were directed toward farmers. In particular, the Soil Conservation Service was developed, known today as the Natural Resources Conservation Service (NRCS).[37] Water is the most limiting resource in the arid/semi-arid Rockies region; conservation techniques directed at reducing water use and retaining soil moisture are vital to agricultural productivity.

Figure 6: 2007 Percent Irrigated Farm Land by County



Data were not available for selected counties due to disclosure restrictions in the Agricultural Census.

Source: 2007 Census of Agriculture, National Agriculture Statistics Service, U.S. Department of Agriculture.

Today, producers may be motivated to adopt conservation practices for numerous reasons, including cost reduction, continuation of subsidy payments, and cost-sharing to reduce the initial economic risk of adopting conservation practices. Some voluntary conservation programs provide farmers and ranchers with an economic incentive to retire land or integrate conservation practices into their farming methods. In short, a variety of voluntary programs exist to suit different farm types and managers.

Figure 7:
Irrigated Land Use, by Census Divisons, 2007
Source: USDA Census of Agriculture, 2007

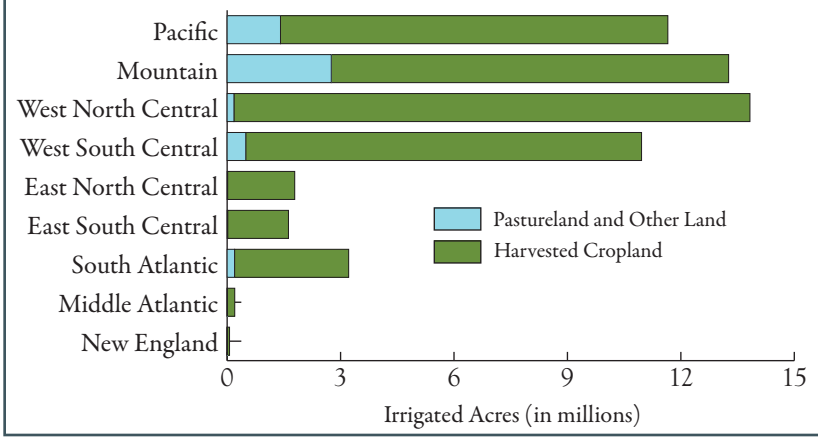


Figure 8:
Irrigated Land Use, by State, 2007
Source: USDA Census of Agriculture, 2007

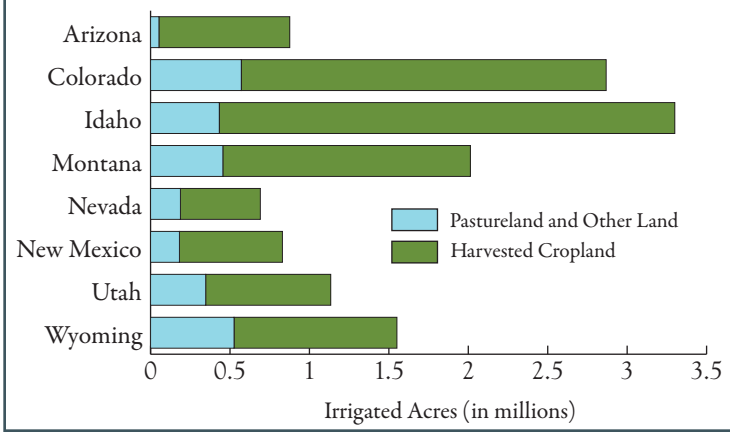
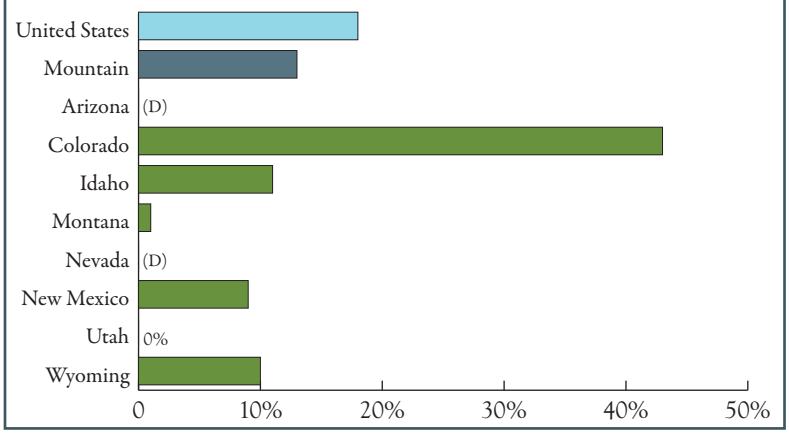


Figure 9:
Change in Acres Employing Conservation Practices, 2002 - 2007
Source: USDA Census of Agriculture, 2007
Note: Due to disclosure issues, data for Arizona and Nevada were not available.



Conservation Programs

The **Conservation Reserve Program** (CRP) was designed to retire environmentally degraded agricultural land (generally cropland) in exchange for an annual payment. Land is removed from production and replaced with cover crops, trees, and grasses.[38] Typically, CRP contracts require a 10–15 year period of time during which land must be taken out of production.[39] The **Environmental Quality Incentives Program** (EQIP) gives financial and technical support for farmers to adopt conservation strategies. The program pays for 75 percent of the cost for implementation, and 60 percent of the program's reimbursements go toward livestock production.[40] Finally, the **Conservation Security Program** (CSP) gives farmers and ranchers financial rewards for conservation efforts. It is similar to EQIP, but it gives producers financial assistance for conservation practices that have already been implemented and will be continued in the future.[41]

The area of cultivated cropland in the U.S. declined from 1982 to 1997, and part of this decline can be attributed to increased land enrollment in conservation programs. Thirty million acres of land were converted to CRP land between 1982 and 1997, contributing to the 1.8 percent decrease in cultivated cropland.[42] However, land that is taken out of production is still considered agricultural land, and thus is not included in the overall decrease of total agricultural land which is related to increases in urban development.

In the Rockies region, agricultural land enrolled in conservation programs increased 13 percent from 2002 until 2007, compared with the Middle Atlantic region which had a 13 percent decrease in conservation program acreage. The Rockies region ranked in the middle of regions nationwide in terms of percent of land in conservation programs. In 2007, the Rockies region had four percent of land enrolled in conservation programs, whereas the West North Central division had six percent of its land enrolled in conservation, the highest percent out of all the regions.

Among the Rockies states, Montana had the most land enrolled in conservation programs, with three million acres in 2007, compared to 700,000 acres in Nevada. However, Montana had very few changes in land that was enrolled in conservation programs between 2002 and 2007 (around a one percent increase), whereas Colorado showed a 44 percent increase in land enrolled in conservation programs during the same time period (see Figure 9).

Conclusion

Steady decreases in agricultural land in the Rockies since the 1980's suggest that rising urban land uses and high water demands are threatening pasture and rangeland. Conservation programs have been successful, but generally do not address the issues of growing demand from the urban sector, which threatens agricultural water use and places urban development pressures on farmland.

To further illustrate agricultural land issues in the Rockies, two case studies are presented: *Threats to Agricultural Land* and *The Northern Colorado Water Crisis*.

photo: © Monica Mueller '13. Jackson, Wyoming

[1] Wuerthner, George and Mollie Matteson, eds. 2002. *Welfare Ranching, The Subsidized Destruction of the American West*. Washington: Island Press.
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[3] *Ibid.*
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[5] Farmland Information Center, 2003.
[6] The eight-state Rockies region coincides with the Mountain Division as defined by the U.S. Census Bureau.
[7] United States Department of Agriculture. *2007 Census of Agriculture*. Geographic Area Series, Table 8. 2009.
[8] *Ibid.*
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[10] Farmland Information Center, 2003.
[11] Lubowski, Vesterby, et al., 2006.
[12] Wuerthner and Matteson, 2002. p. 3.
[13] *Ibid.,* p. 30
[14] Robertson, Paul. Interview by author. Zapata Ranch, Colorado, July 22, 2009.
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[18] United States Department of Agriculture. *2007 Census of Agriculture*. Table 8. 2009.
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[20] *Ibid.*
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[32] Aillery and Gollehon, 2006.
[33] Schaible, 2004.
[34] Western Water Assessment. Colorado River- Law and Policy. University of Colorado at Boulder. http://wwa.colorado.edu/colorado_river/law.html. (Accessed October 29, 2009).
[35] Wuerthner and Matteson, p. 195.
[36] Lambert, Dayton, Patrick Sullivan, et al. 2006. Conservation-Compatible Practices and Programs: Who Participates? *United States Department of Agriculture, Economic Research Service Report Number 14* (February).
[37] Wessels Living History Farm. Farming in the 1930s, Conservation. http://www.livinghistoryfarm.org/farminginthe30s/crops_09.html. (Accessed August 12, 2009).
[38] Lambert, Dayton, et al., 2006.
[39] Lubowski, Bucholtz, et al., 2006.
[40] *Ibid.*
[41] *Ibid.*
[42] *Ibid.*

Case Study: The New Food Economy

By Katherine Sherwood

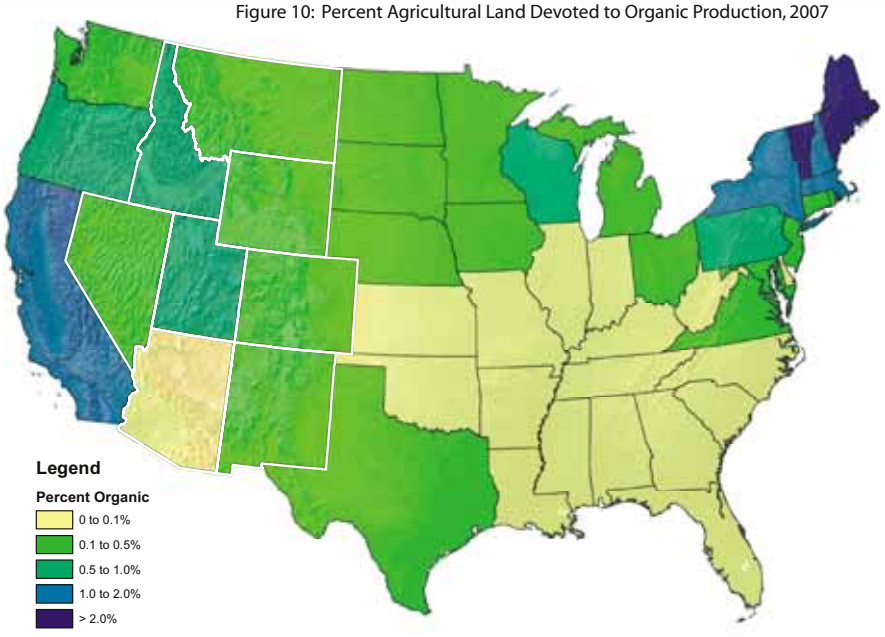
Introduction

Traditionally, the food economy has represented the entire food chain from research in labs to the process of growing crops, and the resulting intermediate and end crops and food products that are sold to consumers.[1] The "new economy" represents the revolution in production and distribution resulting from breakthroughs in transportation, communication, and manufacturing processes. A synthesis of these phenomena results in the "new food economy," which presents both a challenge and opportunity to revolutionize agriculture through new processes, products, and techniques as well as dramatic shifts in consumer preferences for the way food is grown, transported, packaged, and sold. A healthy, local "food chain" is rapidly evolving within which consumers are willing to pay more for the food attributes they value, resulting in higher prices and profit opportunities for the agricultural sector. In the new food economy, food characteristics such as natural, organic, value-added, and local food, as well as distribution and communication have become important means for differentiating products.

The new food economy has also been shaped by marketing dynamics. Retailers that were not traditionally involved in the sale of foods, such as drugstores, convenience stores, and supercenters, grew from approximately 14 percent of food sales for at-home use in 1988 to around 33 percent in 2006.[2] Upscale food supermarkets, such as Whole Foods, offer a wider variety of perishable, ethnic, natural, and organic products. Even fast food chains such as McDonalds and KFC now offer some healthy choices in response to rapid changes in consumer preferences. Another indication of a new food "dynamic" to consumer purchases is shown by mainstream food chains such as Safeway and Walmart[3] offering increasing proportions of products popular in the new food economy**.** For example, supermarkets, which traditionally stock store brands at lower prices, have increased their store-brand organic products, which are sold at premium prices. The new food economy is catering to a wealthier and more socially and environmentally conscious consumer through "niche products" to give consumers the ability to express individuality, social status, and social and environmental awareness. Corporate social responsibility (CSR), including the use of Fair Trade Coffee and American Humane Certified labels, has become a way for businesses to advertise these niche products. Competition between these new sectors of the food economy has created more "customized" products.[4]

A focus on higher end, specialized, and socially and environmentally responsible products has given farmers significant incentives to produce using methods that are less harmful to the environment. For example, defining production as organic and natural, using permaculture methods, and implementing "holistic resource management" are important marketing tools. Environmentally and socially conscious consumers purchase local foods through community-supported agriculture and farmers' markets, and increasingly through grocery stores that stock local products. (See Appendix A for more details on different aspects of the new food economy).

Figure 10: Percent Agricultural Land Devoted to Organic Production, 2007



Source: 2007 Census of Agriculture, National Agriculture Statistics Service, U. S. Department of Agriculture

The 2007 Census of Agriculture was the first to collect data on one dimension of the new food economy, organic production. This case study will therefore focus on trends of organic agriculture in the Rockies, as an aspect of the new food economy. In future agriculture census years, it is likely that other aspects of the new food economy will be included as important aspects of American agriculture.

Introduction to Organic Agriculture

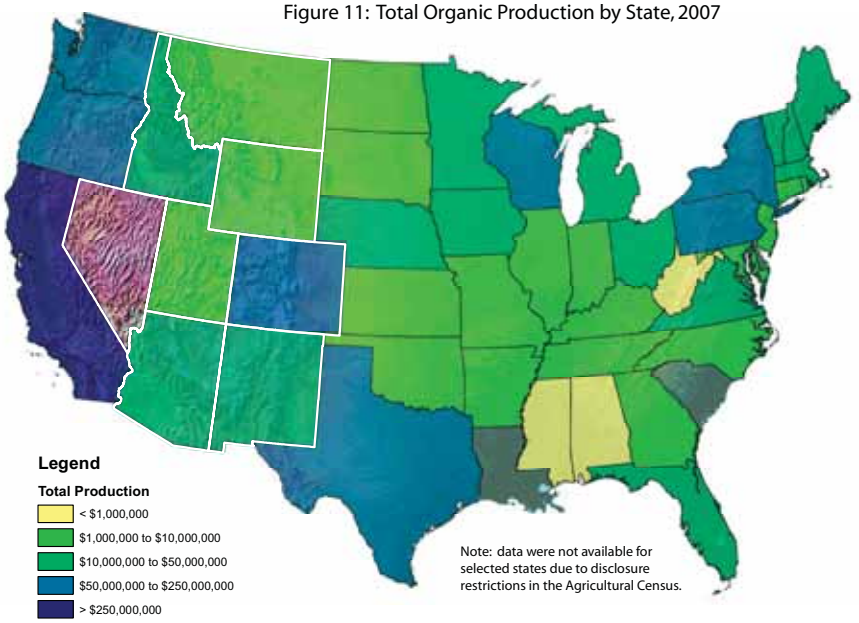
Organic farming was born in the 1920's with Rudolf Steiner's creation of biodynamic agriculture. Food was grown using methods that intertwined philosophy, spirituality, and the earth. In the 1960's, Rachel Carson's *Silent Spring* was a catalyst for the modern organic food movement. Her book shed light on the detrimental effects of pesticides

on human and environmental health.[5] In the 1990's, Congress passed the Organic Foods Production Act to create a national standard for organic production. The act requires that all farmers who claim to be organic must be certified by a state or private agency that is accredited by the USDA.[6] Today, organic production appeals to many farmers because it can lower input costs, mitigate use of nonrenewable resources, and take advantage of premium market prices.[7]

Since the 1990's, consumer demand for organic products has dramatically increased. A study conducted by the Hartman Group in 2007 found that 66 percent of consumers bought organic products for health reasons. Other reasons for organic purchases were taste, environmental concerns, and availability. Organic food has become less of a niche product and more available and affordable in mainstream markets.[8] The "mass market channel," which includes supermarkets, grocery stores, and mass merchandisers, was involved in 46 percent of organic sales in 2007.[9] In the early 1990's, mass markets made only seven percent of organic sales.[10] More than two thirds of consumers buy organic products and 28 percent of consumers buy organic products on a weekly basis.[11]

In 2008, Congress reacted to decreases in supplies of organic commodities by increasing funding for organic research and gave financial incentives to farmers who used conservation practices related to organic production.[12] Greater incentives for farmers to adopt organic practices will increase the quantity of organic commodities to meet the growing consumer demand. An analysis of organic farming in the Rockies indicates that organic production is increasing in the region, as described below.

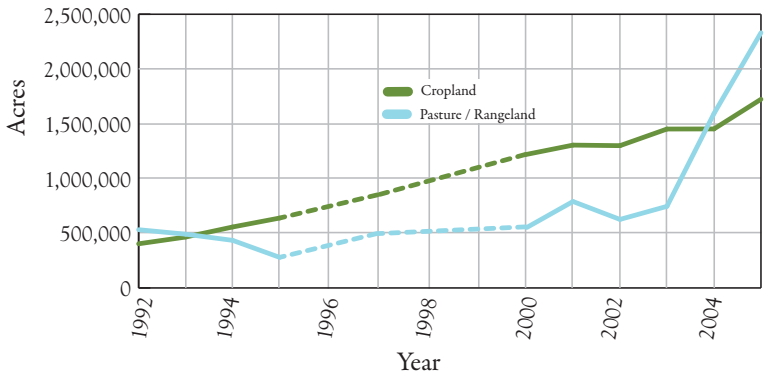
Figure 11: Total Organic Production by State, 2007



Source: 2007 Census of Agriculture, National Agriculture Statistics Service, U.S. Department of Agriculture

Figure 12:
Change in Organic Acreage, United States, 1992 - 2005

Source: USDA, Economic Research Service, 2009
Note: No data were available for 1996, 1998, and 1999



Organic Land

Organic Land in the U.S.

The U.S. has seen tremendous growth in organic agriculture, with production of organic crops quadrupling between 1992 and 2001.[13] Although organic agriculture has expanded over the last two decades, in 2005 only 0.5% of all U.S. cropland and pastureland was certified organic.[14] Organic cropland and pasture/rangeland both steadily increased from 1992 until 2005, with a rapid increase in the growth of pasture/rangeland from 1.5 million to 2.3 million acres from 2004 to 2005 (See Figure 10 and Figure 11) Looking at organic acreage for crops vs. pasture/rangeland, Figure 12 shows that before 2004, acres of organic cropland exceeded acres of organic pastureland and rangeland. Factors that inhibit the growth of organic agriculture include high initial costs, risks of changing farming methods, lack of knowledge, lack of infrastructure and technology, and lack of processors and distributors.

Conversion to Organic Land in the Rockies Region

By 2007 the Rockies region had 677,993 total acres certified organic and 147,962 total acres in the process of being converted to organic land, the highest total organic acreage and total acreage being converted in the U.S. (see Figure 13). However, regions with less land devoted to agriculture had a greater percentage of land being converted to organic relative to the existing total organic land, an indication of the widespread growth of organic agriculture.

Conversion to Organic Land in the Rockies States

In the Rockies states, by 2007 Montana had 195,204 acres certified organic, the largest total acreage used for organic production in the Rockies region, with only 37,000 acres in the process of being converted to organic land (see Figure 14). Comparatively, Nevada had

6,237 acres of total organic land, and 1,603 acres in the process of being converted (Figure 14). Nevada's total organic acreage and acreage being converted to organic production were very low compared with the other states, but land being converted to organic agriculture, relative to preexisting organic land, was higher. This is an indication that organic agriculture is catching on, even in places where traditionally organic agriculture was not as prevalent as other industries.

Figure 13:
Total Acres For Organic Production and Acres Undergoing Conversion to Organic Production, by Census Division, 2007

Source: USDA Census of Agriculture, 2007

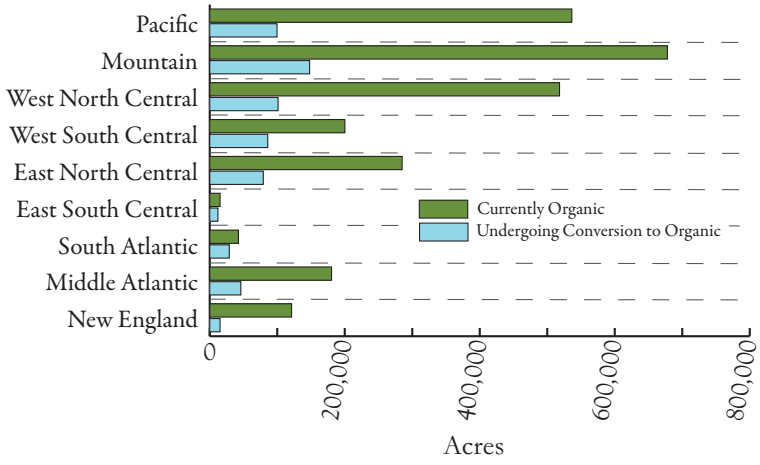
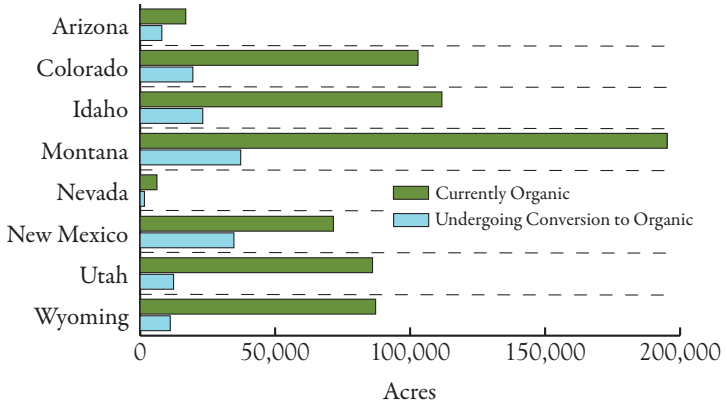


Figure 14:
Total Acres For Organic Production and Acres Undergoing Conversion to Organic Production, by State, 2007

Source: USDA Census of Agriculture, 2007



Who Is the Organic Farmer?

Farm Income and Place of Residence

If the externalities[15] of conventional agriculture were reflected in the market price of conventional food, it is likely that organic foods would be equal in price or cheaper than that their conventional counterparts.[16] Unfortunately, the environmental and health costs of farming techniques and chemical use in conventional agriculture are often not included in the "nominal" market price. The substitute for the lack of harmful chemicals in organic farming is an increase in labor. Crops must be constantly tended to mitigate weeds and pests that cannot be eliminated by pesticides and herbicides. In the Rockies region, organic farmers were more likely to live on their farm than conventional farmers, a widespread trend seen in other regions as well.[17] This could be a reflection of higher labor demands on organic farms. However, both conventional and organic farmers spent six percent of days on average working off the farm.[18] This suggests that supplemental income from off-farm work was not more of a necessity for organic farmers than for conventional farmers, because their earnings are supplemented by the premium prices for organics.

Gender

Findings from the International Federation of Organic Agriculture Movements show that conventional farming "is strongly identified with the expression of rural masculinities."[19] Increasingly, however, primary operators are female (see *Demographics Overview Section*, p. 56), and across the nation a higher percentage of female operators are organic farmers.[20] (See Figure 15) This trend is also true in the Rockies region, where 18 percent of conventional operators were female, and 22 percent of organic operators were female. Three states in the Rockies had a higher percentage of females in conventional operations: Arizona (by a 14 percent margin), Nevada, and Wyoming. In New Mexico 28 percent of total organic principal operators were female, the highest percentage of female operators for organic agriculture in the Rockies states.

Age

Organic farmers in the Rockies were, on average, the same age as conventional farmers (in their 50's).[21] In states outside the Rockies region, there was a greater age discrepancy between methods of farming. This indicates that in the Rockies region, organic farms are operated by the mainstream age demographic, instead of being preferred by an older generation of retired farmers or a younger generation who are motivated to try new farming methods.

Organic Commodities in the Rockies States

The Rockies produce only a small percentage of the nation's food crops in 2007. Vegetable production in the Rockies made up three percent of the U.S. total, and fruit production in the Rockies made up 10 percent. In 2005, Arizona led organic fruit production in the Rockies region and accounted for 92 percent of the state's organic acres. Low elevation deserts provide a climate suitable for winter crops, enabling Arizona to fill a supply niche during a time when other states cannot meet the market demand.[22]

The remainder of the Rockies states specialized in different commodities. Table 2 shows the share of each Rockies states' certified organic acreage by product. Arizona was the top organic producer of fruits and vegetables; Colorado was the top producer for livestock and herbs, nursery, and greenhouse products; Idaho produced the most organic hay and silage; and Utah was the top organic oilseed producer.

Farm Size and Specialization

As organic agriculture increases in scale, it begins to resemble conventional farming. Often large organic farms are owned by conventional mega-farms and the organic food is grown within the boundaries of the conventional farm. Large-scale organic farms often produce monocrops, confine their cows (but feed them organic grain), and ultra-pasteurize milk to keep it fresh longer. [23] Michael Pollan describes large-scale organic farms as contradicting the roots of organic farming:

> When I think about organic farming, I think family farm, I think small scale, I think hedgerows and compost piles and battered pickup trucks. I don't think migrant laborers, combines, thousands of acres of broccoli reaching clear to the horizon.[24]

These industries sometimes wipe out mid- and small-sized farms that cannot compete with lower prices.

Organic Farm Size in the Rockies

By 2007 the Rockies region had the greatest abundance of large-scale organic farms in the U.S., whereas the Pacific division had the greatest number of small-scale organic farms. In the Rockies region, 253 organic farms were large scale (greater than 500 acres), and 687 farms were small scale (one to nine acres). In comparison, the Pacific division had 149 large-scale farms and 3,492 small-scale farms. Small-scale farms outnumber large-scale farms in both regions. However, the Pacific division had more than four times the number of small-scale farms in the Rockies region, while the Rockies region had almost twice the number of large-scale farms.[25] Furthermore, the Rockies had 32 percent of the large-scale farms in the U.S. but only seven percent of the total small-scale farms in the U.S.

Large-Scale Organic Farms in the Rockies States

Farms in Montana, Idaho, and Colorado account for more than half of the large-scale organic farms and ranches in the Rockies region. Montana had 51, Idaho had 72, and Colorado had 77 large-scale organic farms and ranches (see Figure 16). Idaho has the most large-scale farms focused on livestock and poultry products, while Montana has the largest number of large-scale organic livestock operations. Colorado, which has the highest total number of organic farms in the region, also boasts the most large-scale organic crop farms.

Small-Scale Organic Farms in the Rockies States

Colorado and New Mexico had the most small-scale organic farms. Colorado had 163 small-scale organic farms, and New Mexico had 211, again making up nearly half of all the small-scale organic farms in the Rockies region, as shown in Figure 16. Most of the small-scale organic farms in New Mexico were used for crop production, whereas most of the small-scale farms in Colorado were used for livestock, poultry, and their related products.

Figure 15:
Organic and Conventional Female Operators, by Percent, 2007
Source: USDA, Economic Research Service, 2009.

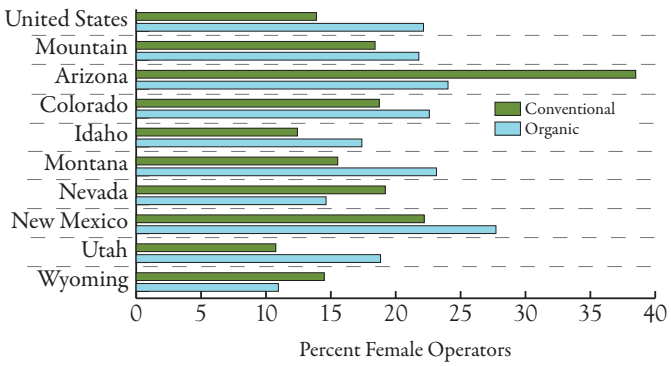


Table 2:
Distribution of Organic Acreage in the Rockies, by Product, 2007

	Livestock	Grain Crops	Beans	Oilseeds	Hay and Silage	Vegetables	Fruits	Herbs, Nursery, and Greenhouse
Arizona	0%	2%	6%	7%	1%	54%	92%	2%
Colorado	76%	25%	23%	1%	10%	29%	4%	71%
Idaho	6%	13%	6%	2%	61%	2%	0%	6%
Montana	14%	37%	59%	42%	17%	3%	1%	4%
Nevada	0%	0%	0%	0%	3%	0%	1%	0%
New Mexico	4%	2%	4%	0%	1%	9%	2%	3%
Utah	0%	11%	0%	48%	2%	3%	0%	14%
Wyoming	0%	10%	1%	0%	5%	0%	0%	0%

Source: USDA, Economic Research Service, 2009

Small-Scale Organic Perspective

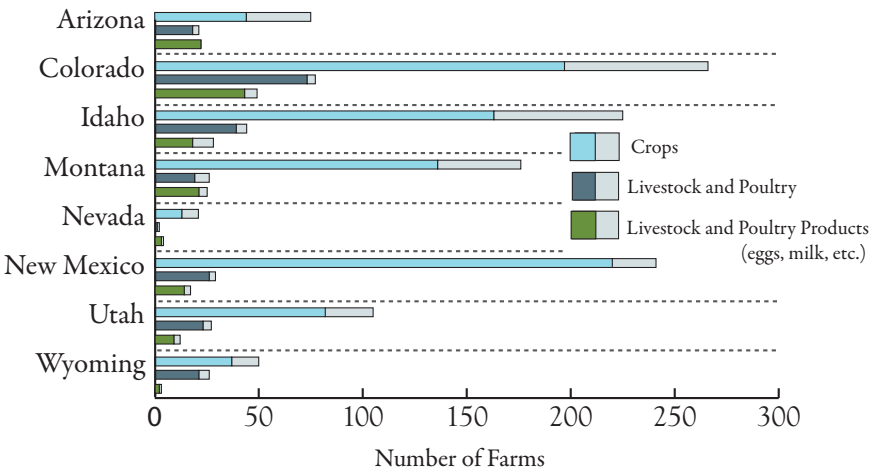
Javernick Family Farms

On a morning at Javernick Family Farms in Canon City, Colorado, fields of squash, garlic, melons, and beans lie against the backdrop of the Sangre de Cristo Mountains and a clear blue Colorado sky. A small white house on the side of the dirt road running through the fields is the home of Beki Javernick and her husband.

Beki's grandparents bought the land in 1947 and grew cabbage and cauliflower. In 1992, Beki's parents switched to hay and cattle production. Today, 10 acres are devoted to produce and the remaining 60 to hayfields, where they raise cattle. All of their cattle are grass-fed and free of growth hormones and antibiotics. They also produce sheep for wool and meat. They grow plant starts in their greenhouse, which they sell to local farms such as Larga Vista Ranch and Venetucci Farms.

When Beki and Carl began operating the farm, they moved to organic production without going through the USDA certification process which was too expensive for their small operation. This does not mean that they are not committed to growing plants free of pesticides and synthetic fertilizers. Beki believes that not being USDA certified is only detrimental if they were selling to a large corporation such as Whole Foods. Most of the produce from Javernick Family Farms is sold at farmers markets and to 88 community-supported agriculture (CSA) members, with the rest sold to local restaurants. Beki estimates that only about one percent of customers are bothered by the fact that her produce is not USDA certified.

Figure 16:
Number of Organic Farms, by Type of Product and Value of Sales, 2007
Source: USDA Organic Production Survey, 2007
Note: Colors indicate sales of less than $50,000; gray indicates sales greater than $50,000.



Javernick Family Farms is fortunate in terms of their water rights. They have 69 water shares for their 70 acres and thus are able to use flood irrigation on their crops. However, the farm faces problems with weeds and pests. The Mexican Bean Beetle, which looks like an orange lady bug, eats the entire leaf of the bean plant. They have tried organic sprays but have not had much success in getting rid of the bug. The farm has one full-time employee and four full time "WWOOFers" (World Wide Opportunities on Organic Farms Participants). Beki describes them as a "blessing" on an organic farm with high labor demands.

Beki expresses worry that they will never be able to afford to pay the inheritance tax when the time comes for her to inherit the farm. However, she optimistically adds, we'll "worry about that when it happens." Although data indicate that small organic farms are threatened by large-scale organic farms, Beki does not feel threatened. She believes that educating people on the difference between local organic production and industrial organic production will strengthen the small-scale organic industry.

Large-Scale Organic Perspective

Aurora Organic Dairy

Green pastures scattered with black and white Holstein cows span the 400 acre Aurora Organic Dairy in Platteville, Colorado. The farm was bought as a feedlot and then converted to a part conventional, part organic dairy. The company owns five farms located in Colorado and Texas and has 11,000 cows and 325 employees. Sonja Tuitele, the Public Relations and Communications Vice President, noted that the neighbors also appreciated the change in scenery and reduction in smell when the feedlots were replaced with grass pasture for the dairy cows.

In 2003, the opportunity arose for the dairy to produce USDA certified organic milk for the private label market, including 14 grocery store brands. Since the dairy owns the whole supply chain, the private labels can be 10 to 15 percent less expensive than other organic labels. Aurora's products are distributed to all 50 states.

At the Platteville farm, 70 employees work on the farm and in the milk processing plant. Ninety percent of the employees live on the farm, benefiting from subsidized rent, which also helps keep employees on the farm longer. Some of the employees have worked there for 25 years, providing the dairy with experienced, skilled labor.

The farm additionally includes a $40-million-dollar, state-of-the-art milk and cream processing plant. Ninety percent of the milk produced is ultra-pasteurized, a process that involves rapidly heating the milk to just below boiling point, which gives it a shelf life of 60 days. The plant has the ability to produce 5,000 gallons of milk per hour.

The conversion to organic from conventional on a dairy farm is a much shorter process than for crop conversion. A dairy cow can be transitioned to organic in 12 months by switching to organic feed and eliminating antibiotic and hormone use. After the cow has been converted to organic, it cannot be switched back to conventional, which would allow producers to take advantage of the changing market for organic and conventional milk. Management of the organic dairy cows becomes an issue of prevention and sanitation once they have been converted. Employees examine every cow three times a day when the cows are milked, in order to

detect any health abnormalities.

Sonja Tuitele discussed the benefits and difficulties of USDA organic certification. "How do you trust an organic farmer who says they don't want to pay [for USDA certification]?" She explained that there is a lot of record keeping involved, which is the hardest part. Earning the trust of the consumer by following the comprehensive USDA regulations makes the process worthwhile. She does not believe that the cost of certification is so high that small organic farmers should use it as an excuse to not seek USDA certified status.

Conclusion

Although both Javernick Family Farms and Aurora Organic Dairy follow the guidelines for organic production, they each represent opposite ends of the spectrum in terms of organic agriculture. Javernick Family Farms produces for the local consumer and has gained consumer trust through creating relationships with buyers through community-supported agriculture. On the other hand, Aurora Organic dairy has created that trust by going through the USDA organic certification process in order to provide for a much larger and widespread market. Javernick Family Farms has more flexibility in terms of experimenting with different organic techniques because they have the support of a local community who purchases their food. However, Aurora Organic Dairy distributes to a much larger population and its sales are dictated by the market. Large-scale and small-scale organic production could be two separate categories in the new food economy, each filling a different niche. It is likely that small-scale organic farms are not accurately represented in the 2007 Agriculture Census because many are not USDA certified. Perhaps in the future, like other aspects of the new food economy, small, non-certified organic operations will be incorporated in the census data.

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APPENDIX A:
The New Food Economy Matrix

Organic Agriculture

In order for a farm to become certified organic, it must be approved by a certifier that is accredited by the National Organic Program (NOP). Certification standards include using farmland that has been chemical free for three or more years, separating organic products from conventional ones, avoiding fertilizers, pesticides, antibiotics, food additives, genetic modification, irradiation, and sewage sludge, and feeding only organic feed to organic livestock. Certified farms must keep a record of sales and production, and are subject to on-site inspections. [26]

Organic products may be labeled "100% organic" or "organic" if they contain 95–99 percent organic ingredients. If the product is 70% organic, it can be labeled "made with organic ingredients" but will not bear the organic seal. Products with less than 70% organic cannot advertise that the product is organic, except in the ingredient facts.[27]

Permaculture

Permaculture systems are small-scale designs for the use of land that mimic nature while integrating humans, plants, animals, and the earth. Every component of the system has multiple functions. Permaculture systems may be implemented in rural or urban settings, and every design is specific to the location. These systems are not only focused on food production, but also include energy-efficient buildings, waste water treatment, recycling, and land stewardship. [28]

The Permaculture Institute is located near Santa Fe, New Mexico, and is the leading permaculture educational institution in the U.S. To learn more, visit www.permaculture.org.

Local/Farmers Markets

Locavores are consumers who eat food that is primarily grown within a 100-mile radius. Local food has gained popularity among consumers because it supports local economies, may have a higher nutritional value due to its freshness, tastes better because it has longer to ripen, reduces use of fossil fuels in food transport, ensures food security, and supports small farms, which protects open space. [29]

Farmers' markets are a means for consumers to purchase

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local food. They provide urban communities with fresh food that is often hard to find and give community members the opportunity to interact with local small-scale farmers. The number of farmers' markets increased 6.8 percent from 2006 to 2008. [30]

Farmers' markets across the country have begun to accept food stamps which has brought local food to a wider variety of consumers. State and local governments have set up electronic systems to accommodate the new debit cards used in place of paper food stamps. In 2008, 753 farmers' markets nationwide were accepting food stamps.[31]

To find a local farmers' market, visit www.localharvest.org/.

Community Supported Agriculture (CSA)

Community- supported agriculture establishes social and economic connections between community members and farmers. Before the growing season, members sign an agreement that commits them to pay a fixed amount of money for the season, in return for a share of whatever is grown. This fixed membership cost is beneficial because it allows the farmer to focus on sustainable production, without worrying about prices and market fluctuations. It is beneficial for members because they have a direct connection with the food that they are consuming. [32]

To find local CSA in your community, visit www.localharvest.org/csa/.

Slow Food

Slow Food International was founded in 1989. The "eco-gastronomic" organization is non-profit and member supported with 100,000 members in 132 countries. It was founded in 1989 in an attempt to raise awareness of fast life and fast food, through focusing on local, fresh, seasonal, and organic food and protecting local food cultures. [33]

Slow Food International founded the Slow Food movement. Visit their website at www.slowfood.com/.

Holistic Resource Management

Holistic resource management is a method of land management that reduces the negative effects of cattle grazing and restores damaged land. Advocates claim it is beneficial environmentally, socially, and economically. The methods used attempt to mimic nature as closely as possible and focus on frequent rotating of livestock to different pastures in order to reduce overgrazing and over-resting. HRM challenges the traditional management techniques to reduce the impacts of grazing. For example, overstocking cattle, which is normally considered harmful, is a technique that is used to graze the land more evenly.[34]

Rockies Example: The Medano-Zepata Ranch, located in the San Luis Valley, is the largest Nature Conservancy ranch in Colorado. They raise cattle using holistic resource management techniques.
www.zranch.org/

Information on Holistic Management

International, founded by Allan Savory, can be found at www.holisticmanagement.org/.

Hydroponics

Hydroponics is a method for growing plants in fertilized water, with or without the use of an "artificial medium," such as sand, gravel, or sawdust to support the plant roots. Hydroponic systems are an example of controlled environment agriculture (CEA) because they are often enclosed in a greenhouse, in order to regulate temperature, air, light, and water. Although hydroponic systems are often highly productive, they are capital intensive. [35] Hydroponics reduces reliance on agricultural land and also may be more energy efficient than importing produce from other countries, although the creation of an artificial growing area is energy intensive. [36] Water use is also reduced due to recirculation, and herbicides are not needed. [37]

Rockies Example: Hydro-Pure Growers is a hydroponic producer located east of Pueblo, Colorado. www.hydro-puregrowers.com/.

Value-Added Products

Any raw product that is altered in some way by the farmer and sold as a product with a higher value than the original product due to the labor and creativity that were put into creating the product. For more on value-added products, see p. 122.

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Case Study: The Northern Colorado Water Crisis: The Big Thompson Project

By Katherine Sherwood

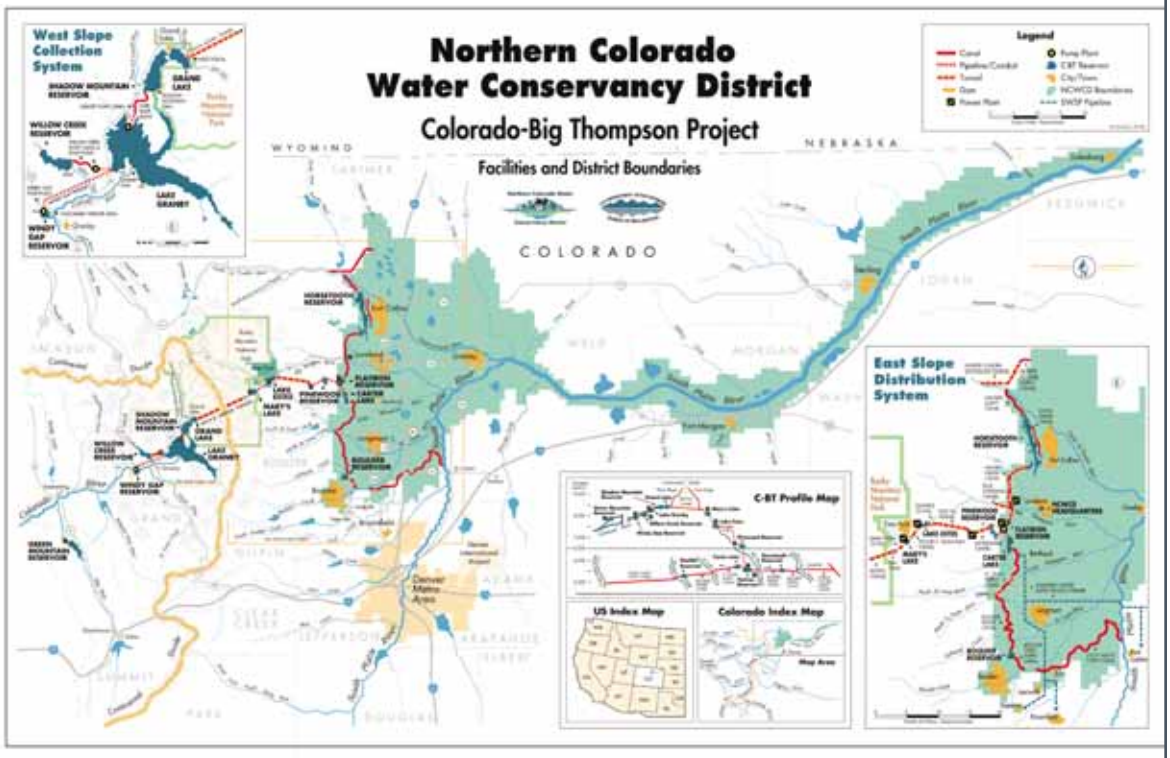
The Colorado Big Thompson Project

In the semi-arid/arid region of the Rockies, agriculture is only economically viable with irrigation. Agricultural land makes up 40 percent of the total land in the Rockies region,[1] and agricultural irrigation accounts for about 90 percent of freshwater use in the Western United States.[2] Water diversion projects, once relatively unchallenged as beneficial "reclamation" of the land and rivers, created a breakthrough in agricultural productivity in the Rockies region. Today, however, diversion activities are increasingly scrutinized as environmental concerns question the trade-offs that occur as water is moved in location and use.

With its hot sunny days, cool nights and long growing season, the Eastern Slope of Colorado's Front Range is a prime regional agricultural location. However, lack of precipitation makes farming a challenge. The average annual precipitation in Greeley, Colorado is 12-14 inches, compared with 30 inches at elevations over 10,000 feet on the Western Slope.[3] Irrigation is necessary in regions where annual precipitation is less than 20 inches.[4] Although 80 percent of Colorado's water is located on the Western Slope, 80 percent of the population and farmland are located on the Eastern Slope.[5] Water Projects that transport water from West to East were developed to meet Eastern Colorado's demands. The Colorado Big Thompson Project (C-BT) was designed in the 1930s for the enhancement of the Northern Front Range agriculture and municipal use.

The Colorado Big Thompson Project spans 250 miles east to west from Brush in Eastern Colorado to Kremmling in the mountains of Western Colorado.[6] Colorado's pipeline for the Big Thompson Project diverts 220,000 acre-feet of water each year from the Colorado River Basin west of the continental divide to Eastern Colorado.[7] Water is collected from the Colorado River headwaters at Lake Granby and Willow Creek Reservoir, where the water is lifted up to 186 feet to the Granby Pump Canal. The water from the canal is transported 1.8 miles to Shadow Mountain Reservoir, which is connected to Grand Lake where it flows to the Alva B. Adams tunnel, where it travels under the continental divide to the Big Thompson River on the Eastern Slope[8] (See Figure 17). Today, the diverted water irrigates 650,000 acres, supplies water to more than 800,000 people in the South Platte River Basin, and provides power to numerous Front Range cities, including Boulder, Greeley, Fort Morgan, Sterling, Longmont, Loveland and Fort Collins.[9] The project consists of 12 reservoirs, 35 miles of tunnels, 95 miles of canals, and 700 miles of transmission lines.[10]

Figure 17:



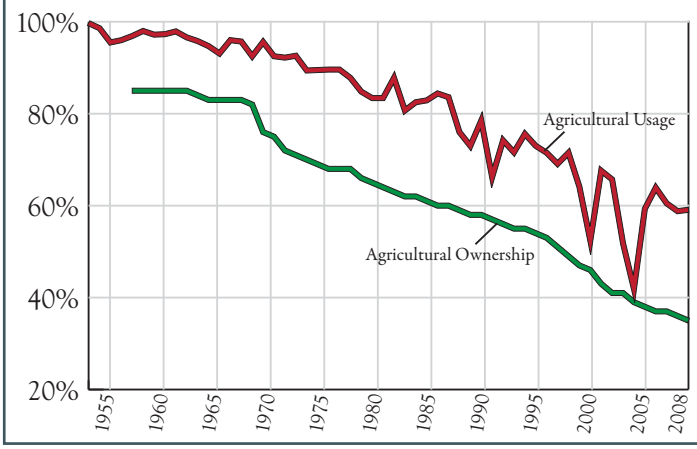
Source: City of Longmont Public Works & Natural Resources, 2009

In 1938, the Northern Colorado Water Conservancy District (NCWCD) had 6,400 irrigated farms, but by the 1990s, that number had decreased to 2,700 farms.[11] Population in the South Platte Basin has also increased. The population is expected to increase by 1.9 million by 2030. The total water use is predicted to reach twice the amount of current water use by 2030, which will leave a shortage of 92,000 to 184,000 acre feet of total irrigation water.[12] The increase

in population has caused a shift in water ownership from agricultural to municipal use, in order to provide more water for urban uses. C-BT water ownership went from 95 percent agricultural in 1956 to 74 percent in 1991.[13] By 1997, 50 percent of ownership was designated to agriculture and 50 percent to municipal and industrial use. Today, ownership is 35 percent agricultural and 65 percent municipal.[14] Figure 18 shows the decreasing trend in agricultural ownership from 1953 to 2008 and the associated change in water usage, which is directly related to ownership.

The high urban and suburban demand for water, coupled with the lower financial return to water used for agriculture, faced with stagnant markets and prices, has steadily motivated farmers to sell their water rights to urban areas. Figures 19 and 20 show the change in ownership of agriculture "project units" between 1957 and 2002.[15] One unit is equal to a full share which is 1/310,000 of the annual project yield (around 0.72 acre feet). The share size varies over the years depending on the quota that is set. The maps reveal that ownership of agricultural project units decreased from 1957 to 2002. Additionally, agricultural units are much more dispersed, and fewer in number, as indicated by the shift from a high concentration of dark blue and green, to yellow and light green. Front Range cities in the South Platte valley that benefit from the Big Thompson project have seen increased growth in food processing, telecommunications, biotechnology and energy sectors,[16] all of which require more water to be allocated from agriculture. These supplement growing urban requirements for municipal water.

Figure 18:
NCWCD Agricultural Water Usage and Ownership, 1953 - 2008
Source: Data provided by Brian Werner
Note: Data for Agricultural Ownership begins in 1957



NCWCD Water Market

The NCWCD's water market is a unique and successful system that defies traditional water rights and Colorado's Prior Appropriation Doctrine. Every share of the project controls the same amount of water annually without priority and water transfers do not have to be approved by the water court (they only have to be authorized by the NCWCD.)[17] This system lowers the cost of water transfer transactions. However, water in this district cannot be transferred to outside the NCWCD boundaries.[18]

The NCWCD's C-BT water market uses the April Quota, developed in April of 1957. The quota, which is set annually, is the maximum amount of water that an owner can use each year. The quota has never gone below 50 percent of the water owner's total allocation. In wet years the quota is usually set lower, whereas in dry years it usually is higher to compensate for drought, lower snowfall and less runoff. This means that the "district acts as the collective conscience for the system… If the quota is set high, everyone shares the wealth at the same percent, if it is set low, everyone conserves in a like manner." [19] Figure 18 shows annual and seasonal variation in water usage due to the April Quota. Agricultural usage has high variation due to seasonal climate patterns and the associated need for irrigation water. Municipal/ industrial usage is indirectly dependent on year-to-year climate variability, as the April Quota determines allowed withdrawals.

The NCWCD's model for transferring water challenges the traditional system of allocation. Prior Appropriation, which dates back to the 1860s in Colorado, gives priority to those who were first to use the water and put it to beneficial use from a particular stream. After going through the court to verify their "priority status", the user becomes the senior water right holder. The senior holder gets their full allocation before any other junior appropriators receive theirs. One of the main issues with this system is over-appropriation, which means that the junior holder does not receive their entire allocation in very dry years.[20] The success of the NCWCD system, which does not use the traditional system of prior appropriation, is demonstrated by the greater amounts of trading due to the equality of water shares, a decrease in cost due to the bypassing of the water court for review, and the ability to trade often, which means that buyers do not have to "buy ahead", a trend seen with traditional transfers.[21] The system of water allocation within the NCWCD is based on a free market, allowing water rich areas to transfer water to drier areas in any given year.

Despite the size of the Colorado Big Thompson project, population growth and development continue to increase the demand for water. New water projects are underway to meet these demands, including the Northern Integrated Supply Project and the Windy Gap Firming Project.

The Northern Integrated Supply Project

The Northern Integrated Supply Project is part of the Northern Colorado Water Conservancy District's (NCWCD) attempt to divert more water to the Front Range. The project would extract water from the Cache La Poudre River. The Galeton and Glad reservoirs would supply water for suburbs and farms in Weld, Laramer, Boulder and Moran Counties.[22]

The project is controversial. On one side, supporters of Save the Poudre, a group that is dedicated to preserving the Cache La Poudre River, argue that draining the river will be destructive to the surrounding ecosystems. Furthermore

it will impact drinking water and waste water treatment operations. If there is not enough water to dilute the wastewater, it will harm aquatic life and create undesired odors. The NCWCD argues that the project will save agricultural lands, because water that would be transferred from agriculture to urban areas would be replaced by water from the Cache La Poudre River. However, Save the Poudre argues that the Environmental Impact Statement for the project never mentions preserving agricultural land as its purpose. If the focus was on water conservation, rather than increasing development, more water would not be needed.[23]

On the other side of the controversy, many farmers argue that the project would preserve agricultural land. Bob Sakata, a farmer in Weld and Adams counties, visited farms in Denmark and Spain and observed their noticeable respect for American farmers: "They told me that we in the United States have never gone hungry…It is not possible to survive in an impoverished land and that can happen to us if we continue to stop these kinds of projects." [24] Farmers look at the precedent set by the Big Thompson Project and argue that without it, Weld County would not be the fourth richest agricultural producing county in the U.S.[25] In order for the agriculture sector to continue to prosper, more water is needed to maintain productivity.

Both perspectives present valid opinions that reflect the tensions between environmentalists, farmers and growing Front Range cities. Both sides of the issue must be examined in order to come to a satisfactory result for all stakeholders.

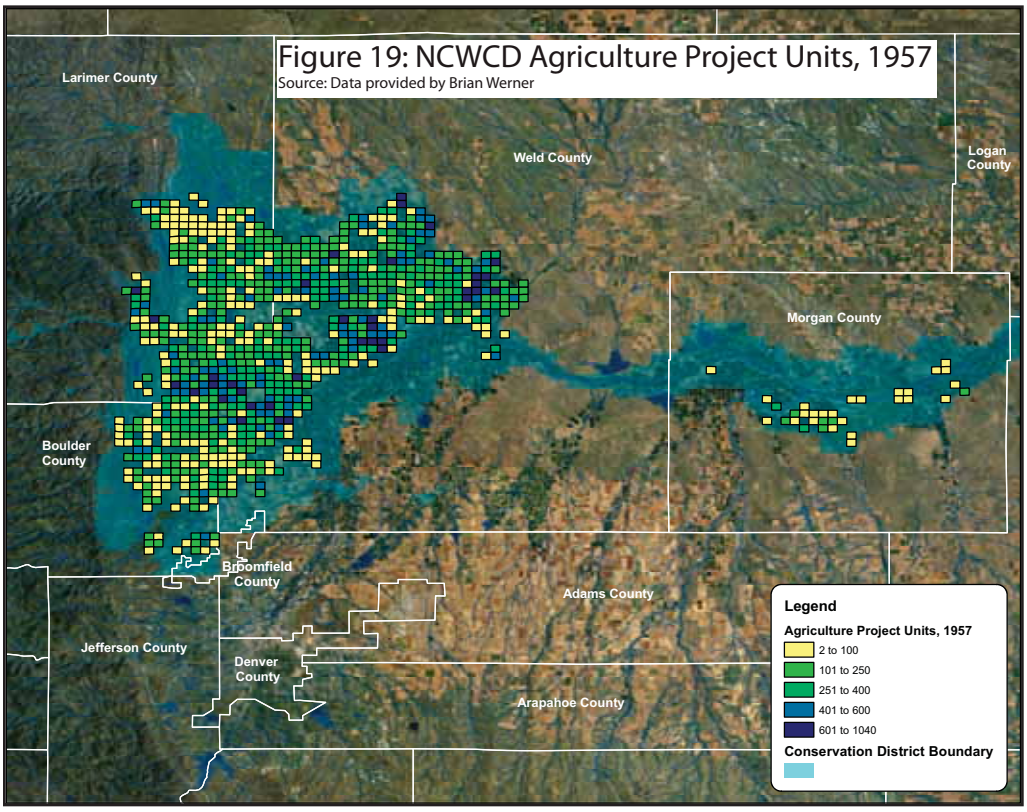


Figure 19: NCWCD Agriculture Project Units, 1957
Source: Data provided by Brian Werner

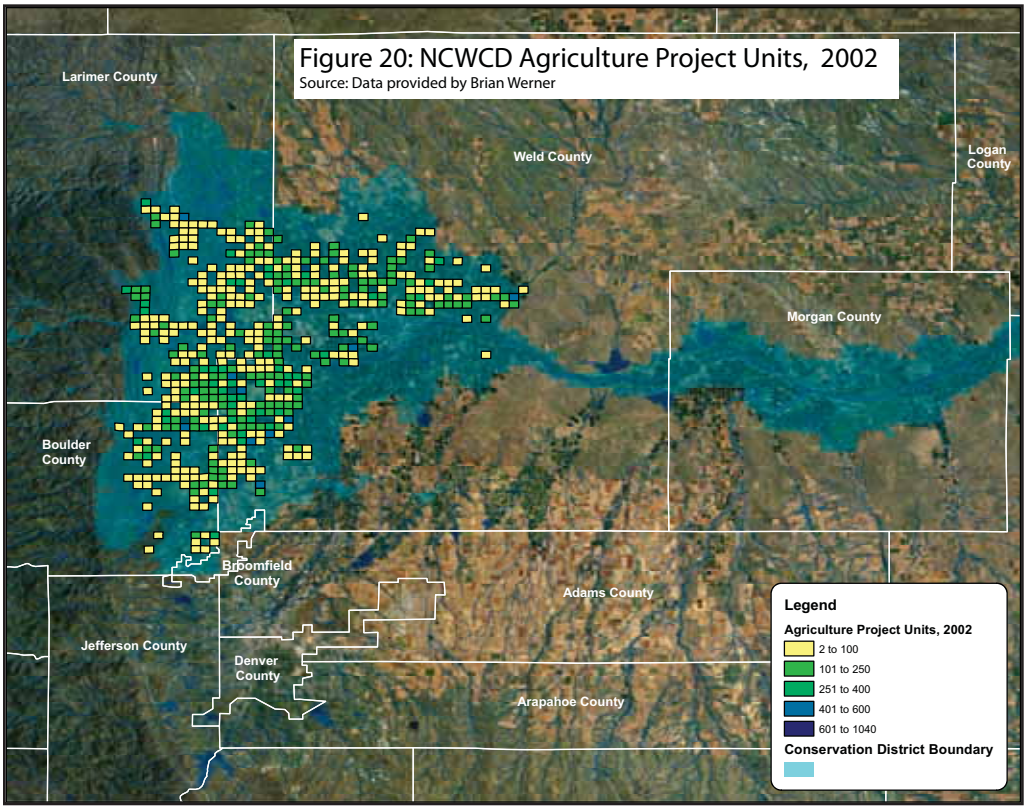


Figure 20: NCWCD Agriculture Project Units, 2002
Source: Data provided by Brian Werner

The Windy Gap Firming Project (WGFP)

Windy Gap is part of the Big Thompson Project water diversion from the Colorado River. Built in 1985, the Windy Gap project transports water to the Granby Reservoir, depending on available storage capacity. The WGFP would also build an additional reservoir to store water that cannot be contained in the Granby Reservoir during wet years. The goal of the project would be to deliver 30,000 acre feet of water by 2010 from the Windy Gap project. [26] The Windy Gap project would help meet the water demands of rising urban populations that are pulling resources away from the agriculture sector.

Although the project would supply additional water to the region, there are many drawbacks that arise from the potential environmental degradation. One of the main problems is that 50 percent of the Colorado River water is already being withdrawn by other projects, and the proposed Windy Gap Project, along with other new projects, would remove another 20 percent in certain years. The Environmental Impact Statement for the WGFP

does not address the cumulative impact of all previous and current projects. Another issue is that the project would only divert water during wet periods of the year. However, that could reduce flow, creating overall dryer conditions for downstream aquatic life and remove the "refuge" time between dry periods. The project could also have a negative impact on the part of the Colorado River with potential for designation as Wild and Scenic. Furthermore, if more water is withdrawn from the Colorado River, it is expected to reach temperatures that exceed the state's limit set by the Water Quality Control Commission. [27] Despite the growing need for more water in Front Range cities, new projects, after getting permitted, must also be adequately assessed for environmental impacts.

Conclusion

Water is the limiting resource in the Rockies. Without it, urban development and agriculture would not exist. This case study from the Front Range presents an example of issues faced by other Rockies states. With growing population, water is removed from agriculture and transferred for urban development, and new projects are developed to supply that water. The environmental impacts of decreasing agricultural land and drying up of rivers are very apparent, and must be assessed in conjunction with the demands of a growing population. Although water is generally shifting from agricultural to municipal/industrial use, the NCWCD's innovative water market has been very successful because it is not based upon the Prior Appropriations Doctrine. It is also beneficial for agriculture because it allows farmers to use and sell with flexible trading.

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Photo: Headwaters of the Big Thompson River. Wikipedia Commons