Water Supply in a Changing Climate

The Perspective of Family Farmers and Ranchers in the Irrigated West

a report prepared by the family farm alliance • august 2007

Family Farm ALLIANCE SM

Protecting and enhancing
Western irrigated agriculture

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Channel restoration project completed by Ladder Ranch along Battle Creek, Wyoming.

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EXECUTIVE SUMMARY

The Family Farm Alliance is a grassroots organization of family farmers, ranchers, irrigation districts and allied industries in 16 Western states. The Alliance is focused on one mission: To ensure the availability of reliable, affordable irrigation water supplies to Western farmers and ranchers. We are also committed to the fundamental proposition that Western irrigated agriculture must be preserved and protected for a host of economic, sociological, environmental and national security reasons – many of which are often overlooked in the context of other policy decisions.

Climate change in the Western United States is not only tremendously important to the Alliance, it also is immediately relevant to farmers, ranchers and small communities all over the West. We are increasingly hearing reports that predict dire long-term hydrologic forecasts for the West. Despite the highly variable and uncertain nature inherent with climate change predictions, it can safely be concluded that, in the West, there will be less water stored in our biggest reservoir... the snow pack. More water in the form of rainfall and runoff will come at farmers and ranchers sooner in the season, when it may not be useful and may even present a threat.

Irrigators and agricultural consultants have identified several impacts to crops and livestock– both good and bad - that climate change may generate in the coming decades. Overall, hydrologic impacts in the form of the "triple threat": 1) increased evaporation of snowpack and surface water; 2) increased crop evapotranspiration and consumptive use; and 3) decreased groundwater recharge and surface runoff – will mean less water to work with and higher water needs.

Western water supplies are already inadequate to meet the demands of agriculture, future energy needs, urban growth and environmental enhancement. Global climate change, we're told, will further reduce those supplies. Working with farmers has made us incredibly sensitive to the big picture ramifications facing the future of Western agriculture, and the critical role reliable water supplies play in that big picture. We must immediately begin to address the critical challenges we face. A practical, prioritized approach to addressing these challenges is possible:

The fruits of the harvest, Umatilla Basin Project, Oregon, 1914. Source USBR

1. **The federal government must work in partnership with the states and local water managers to *prioritize research needs and quantify projected West-wide hydrologic impacts*;**
2. **State and local water management agencies should take the lead to *implement a balanced suite of conservation and supply enhancement actions*;**
3. **The federal government must *streamline the regulatory process to facilitate development of new infrastructure* by state and local water agencies;**
4. **Congress and the Administration should *make self-sufficiency in food production a national priority*; and**
5. **At all levels of government and in our communities, we must *find ways to protect farmland*.**

Millions of acres of barren Western lands have been transformed into the most efficient and productive agricultural system in the world. Now is not the time to retreat from our investment. Now is the time to enact sound policies that encourage continued investment in irrigated agriculture. Allowing water-short cities to absorb farmers' water supplies will significantly diminish domestic food production at exactly the

same time global warming is predicted to severely adverse impact food production worldwide.

The U.S. recently became a net importer of food, and the safety of that food is becoming increasingly suspect. President Bush has given a new Cabinet-level committee just 60 days to develop plans to guarantee the safety of food and products imported into the U.S.[1] As food production moves off shore, a large part of our security is moving with it.

Climate change could further strain fresh water supplies in the American West. We must begin to plan for that now, and not wait until we are forced to make decisions during a crisis. Relying on agriculture to be a "shock absorber" to soften or eliminate the impending water shortage is not planning. It is a choice to put our heads in the sand and hope for the best. It is a decision that could worsen the overall impact of climate change on our nation's economy and security.

[1]The Interagency Working Group on Import Safety was established and met for the first time in July 2007.

BACKGROUND ON THE FAMILY FARM ALLIANCE

The Family Farm Alliance is a grassroots organization of family farmers, ranchers, irrigation districts and allied industries in 16 Western states. The Alliance is focused on one mission: To ensure the availability of reliable, affordable irrigation water supplies to Western farmers and ranchers. We are also committed to the fundamental proposition that Western irrigated agriculture must be preserved and protected for a host of economic, sociological, environmental and national security reasons – many of which are often overlooked in the context of other policy decisions.

Alliance Involvement with Climate Change Issues

The Family Farm Alliance Board of Directors at its 19th Annual Meeting in Las Vegas in February 2007 established a subcommittee to develop a white paper that addresses the important issue of climate change, its possible impact on Western water supplies and irrigated agriculture, recommendations on how to plan and provide stewardship for this change. The board of directors felt that this issue could once again demonstrate the Alliance's realistic approach to problem solving.

The members of the subcommittee assigned to this task were pulled from the Alliance's Advisory Committee, and include Gary Esslinger (Elephant Butte Irrigation District, New Mexico), Jamie Mills (Newlands Water Protective Association, Nevada), Dick Moss (Provost & Pritchard, California), Bob Stackhouse (Central Valley Project Water Association, California), Jeff Sutton (Tehama-Colusa Canal Authority, California). Alliance President Patrick O'Toole (Ladder Ranch, Wyoming), Executive Director Dan Keppen (Oregon), Counsel Gary Sawyers (California) and Joe Raeder (Washington, D.C.) contributed to this effort. We also appreciate the input provided by Colorado Water Resources Research Institute at Colorado State University, the Wyoming Water Association, and the Wyoming Water Development Commission.

CLIMATE CHANGE IMPACTS TO AGRICULTURE: OUR CONCERNS

Potential Climate Change Scenarios

In the past six months, the public has been inundated with a flood of new studies that focus on projected climate change impacts to Western water resources. Predictions and conclusions reached about the impacts climate change will have on future water resources availability are as varied as the Western landscape. However, we are increasingly hearing reports that predict dire long-term hydrologic forecasts for the West. One such analysis by Richard Seager at Columbia University in New York suggests the region is in the early stages of a profound shift in climate that may last for decades. The models used in that study predict prolonged drought conditions in the western U.S., with rainfall reducing by about 1.4 inches each year until 2150. Seager's work suggests that drying of arid lands in the southwestern United States and northern Mexico will have

important consequences for water resources, regional development and cross border relations and migration. According to the models, the drying should already be underway and, over the length of time it takes to plan significant changes in water resource engineering and allocation (years to a few decades), will become well established.

Several other studies further focus on specific regions or watersheds and are briefly discussed below.

Yuma Water Users Assocation installed extensive improvements including automated water tracking systems, measurement stations, and key canal structures. Source: U.S. Dept. of Interior website

Arizona

Experts in Arizona say that climate change is occurring and will likely have more impacts in the future to water resources. A climatic water budget runoff model has been developed for the Salt and Verde River basins of central Arizona (Balling, 2007), which used the outputs of six global climate models to estimate runoff in the future under assorted "scenarios" developed by the Intergovernmental Panel on Climate Change (IPCC). Due to projected warmer temperatures by the year 2050, projected changes in runoff for the two basins suggest that the runoff from the Salt and Verde will have approximately an 85% chance of being less in the future due largely to warming in the study area. This could have significant impacts for these two basins, which have six dams, a variable hydrology, and a total storage capacity of 2.3 million acre-feet (as compared to the 50.2 million acre-feet "live" capacity of Lakes Powell and Mead on the Colorado River).

California

A report released by the State of California (California Climate Change Center, 2006) predicts that climate change will result in a drastic drop in the state's drinking and farm water supplies, as well as more frequent winter flooding. The report suggests that warmer temperatures will raise the snow level in California mountains, producing a smaller snowpack and more winter runoff. This means more floodwaters to manage in winter, followed by less snowmelt to store behind dams for cities, agriculture, and fish. By the year 2050, the statewide snowpack would shrink by 5 million acre-feet, more than the total capacity of Lake Shasta, the state's largest reservoir.

In an "average" winter, the slowly melting snow from the Sierra Mountains gets captured downstream by Central Valley reservoirs. By 2050, however, the State study predicts that average snowpack is likely to diminish by more than a third, and more precipitation will fall as rain rather than as snow, making it harder for the reservoirs to capture for the long summer the same amount of water. The dwindling snowpack could reduce deliveries of Sierra supplies to Central Valley farmers and cities by 10%.

According to another recent study developed by the University of California (Tanaka et al, 2007), agricultural water users in the Central Valley are the most vulnerable to climate warming. For the driest climate warming scenario assessed, the predicted hydrology would reduce agricultural water deliveries in the Central Valley by about a third. For that dry scenario, financial losses to the agricultural community would "likely result in an uncompensated structural change in the agricultural sector".

Colorado River Basin

A February 2007 report by a National Research Council (NRC) committee says agriculture is the likeliest target for shifting use to urban needs in the fast growing West. But it cautions that "the availability of agricultural water is finite." It adds that rising population and water demands "will inevitably result in increasingly costly, controversial and unavoidable trade-off choices" in managing a shrinking resource.

In the NRC study, tree-ring based reconstructions of the Colorado River's flow over hundreds of years show that average annual flows vary more than previously assumed and that extended droughts are not uncommon. Future droughts may be longer and more severe because of a regional warming trend that shows no signs of dissipating, the report adds. It also states that a preponderance of evidence suggests that rising temperatures will reduce the river's flow and water supplies.

Coping with water shortages is becoming more difficult because of rapid population growth. Technology and conservation will not solve the limited water supply problem in the long run, the report warns. For many years, understanding of the river's flow was based primarily on records from stream gages. But the tree-ring data demonstrates that the river occasionally shifts into decades-long periods in which average flows are lower, or higher, than the 15 million acre-feet average of the gauged record. In particular, tree-ring reconstructions show that the years 1905-1920 were exceptionally wet, which is significant because the Colorado River Compact governing allocation of water between upper and lower basin states was signed in 1922 when it was assumed that annual average river flow was closer to 16.4 million acre-feet. Tree-ring data also indicate that extended droughts are a recurrent feature of the basin's climate.

The committee also looked at how a steadily rising population and related increases in water demand will affect Colorado River water management. The population across the western United States has grown rapidly. Despite some successful water conservation efforts, urban water use in the region has increased significantly along with the expanding population. Increasing urban water demands are often met through sales, leases, or transfers of water rights from farm users. Although a significant portion of available water in the West is devoted to agriculture, this allocation is finite, the committee warned. Water transfer agreements will be limited in their ability to satisfy growing, long-term demand. Such agreements may also cause problems for third parties, such as downstream farmers or ecosystems. Technology and conservation measures are useful and necessary for stretching existing water supplies, the committee acknowledged, but any gains in water supply will be eventually absorbed by the growing population.

Hoover Dam, on the Colorado River. Source: USBR.

The NRC Colorado River report recommended that another study be undertaken of water use patterns and demands, population projections and possible effects of transferring water from agriculture to urban areas. The latter recommendation is one the Family Farm Alliance asked a U.S. Department of Agriculture advisory committee to implement (Family Farm Alliance, 2006).

Pacific Northwest

The IPCC recently released a report (Intergovernmental Panel on Climate Change, World Meteorological Organization, 2007) that predicts climate-change related impacts to water resources in the Pacific Northwest. Similar to predictions made in other parts of the West, dwindling moun-

tain snowpack is expected to make summer water scarce especially east of the Cascades, where agriculture is a strong component of rural communities.

Snowpack in the Cascade Range holds two-thirds of the region's stored water. As it melts during the dry summer months, it fills rivers, generates hydropower, and helps meet the water needs of irrigation, fish, recreation and growing urban areas. But, as noted earlier, Cascade snowpack has diminished in the past fifty years and is expected to further shrink. Projected warmer winter temperatures will cause snowpack to melt earlier in the spring, which could exacerbate both spring-time flooding and late-summer drought conditions. This prediction does not bode well for irrigation-dependent eastern portions of Oregon and Washington.

Ladder Ranch, Wyoming

"We expect more contention over water resources much like what we have seen in the Klamath Basin," Mark Abbott, co-chair of Governor Kulongoski's Climate Change Integration Group, recently told the Oregonian newspaper (Hill, 2007).

Utah

A 2003 study directed by Congress and led by Utah State University professor Frederick Wagner lays out a variety of possibilities if temperatures increase from nearly 4 to 6 degrees Fahrenheit by 2100. The potential scenarios range from increased precipitation (with decreased snowpack and greater downstream flood risks) to decreased precipitation (desertification and a decline in water resources). In all scenarios, water management changes would be required, and the worst-case scenario would likely trigger water transfers from agriculture to urban areas, which would contribute to a sharp decline of farming and ranching. A particularly vulnerable area is the heavily populated Wasatch Front, where the nearby Great Salt Lake could rise, causing extensive flooding.

The impacts in all of these scenarios are exacerbated by a backdrop of a dramatic explosion in growth and development in recent decades. Across the Colorado River Basin, which includes parts of Utah, 85 percent of the water consumed by households, industry and farms comes from snowmelt. As in other parts of the Mountain West, the biggest factor in terms of warming temperatures will be the timing of the snowmelt and the amount of variability between rain and snow.

Water resources experts in Utah also realize that new surface water storage projects may be necessary to capture more snowmelt or more water from other sources (Schmidt, 2006). The Southern Nevada Water Authority – which has essentially used up its share of Colorado River water - is already planning to take groundwater out of aquifers near and under the Utah-Nevada state line and pipe it to Las Vegas. Ranchers in this area are fighting this proposal.

Summary of Anticipated Impacts

Summary of Potential Hydrologic Impacts

The Western Governors' Association (WGA) recently testified in support of a bill that would reorient and fully fund the U.S. Global Change Research Program to make it more user-driven. The WGA testimony (Bittleman, 2007) mirrors many of the common themes and findings developed in the reports identified above. WGA found that we can expect to see the following general effects and impacts caused by warming future temperatures in the Western U.S.:

- *Smaller snow packs and earlier snowmelt* will affect reservoir storage and demand for water and impact productivity and value of hydroelectric generation;
- *More rain than snow* is likely, with uncertain projected impacts to overall precipitation amounts in specific areas;
- *Extreme flood events* could be more common and larger; and
- *Droughts and higher temperatures* would be more intense, frequent and last longer, which would increase stream and reservoir evaporation, diminish surface water supplies, and stress groundwater supplies and water quality.

Despite the highly variable and uncertain nature inherent with climate change predictions, it can safely be concluded that, in the West, there will be less water stored in our biggest reservoir. . . the snow pack. More water in the form of rainfall and runoff will come at farmers and ranchers sooner in the season, when it may not be useful and may even present a threat.

Potential Impacts to Crops and Livestock

Irrigators and agricultural consultants have identified several impacts to crops and livestock– both good and bad - that climate change may generate in the coming decades.

Overall, hydrologic impacts in the form of the "triple threat": 1) increased evaporation of snowpack and surface water; 2) increased crop evapotranspiration and consumptive use; and 3) decreased groundwater recharge and surface runoff – will mean less water to work with and higher water needs. However, other more specific impacts include:

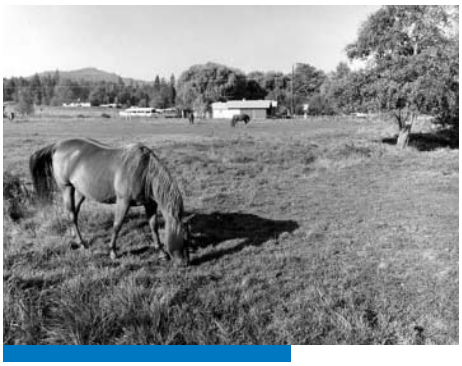
Negative Impacts to Crops

- The potential for increased heat stress to crops during pollination and maturation – which will impact both crop yield and quality;
- Increased weed competition and spread of invasive species;
- Increased insect and disease over-wintering;
- Increased soil salinity and related water quality impacts;
- Increased night temperatures, which can increase respiration and reduce yields;
- Concern about loss of pollinators (honeybees); and
- Potential loss of soil carbon.

Irrigated crops turn carbon dioxide into oxygen

Negative Impacts to Livestock

- Increased range and pasture competition from weedy and invasive species;
- Potential for increased summer heat stress due to prolonged number of days where temperatures exceed 90°F;
- Change in native range forage quantity and quality; and
- Loss of irrigated lower value crops (hay and grain). Water shortage or continued conversion of these crop lands towards support of ethanol or biodiesel will further reduce feeding industry competitiveness.



There are also possible benefits to crops and livestock resulting from predicted climate changes. For example, increased CO_2 levels have been shown to increase crop growth in laboratory and greenhouse settings. At this time, however, the impact in actual field situations is unclear. Also, in northern parts of the country, the increased number of frost-free days and increased "heat units" would benefit growers. Similarly, milder winters may improve the wintertime rate of weight gain and survival rates for calving and lambing operations.

WHAT WESTERN IRRIGATORS HAVE DONE

While a great deal of scientific inquiry and public discourse has been focused on climate change and its possible consequences for the planet's future, Western irrigators and irrigation districts are concerned about the problems threatening their water supplies today – drought and urban population growth. Even without climate change, these factors present an immediate crisis for agricultural water users in the West. If the effects of climate change are anything like those outlined in the research summarized previously, Western irrigated agriculture could be largely eliminated. This is of extreme concern to farmers and ranchers and their communities. It ought to be of great concern to our nation as a whole because climate change may result in a disruption of food production worldwide. If that is what is in store for us, then clearly this country cannot afford to lose the food production capacity of Western irrigated agriculture.

The ongoing, initial response of irrigators and water agencies to current water supply challenges can provide some insight into the possible measures that might be taken to cope with long-term water supply reductions resulting from climate change.

Water Conservation Improvements

Farmers and ranchers are remarkably resourceful business people, who employ creative strategies to survive prolonged drought periods. Throughout the West, creative measures have been taken to develop and efficiently manage water resources for irrigation:

- In the San Joaquin Valley of California, state-of-the-art drip irrigation systems water some of the most productive farmland in the world. Drip irrigation has also been recently installed on thousands of acres of California's Imperial Valley
- Further north, in the Sacramento Valley, producers and local governments are working to develop a regional water management program that will help address not only water quantity challenges, but also water quality and environmental issues. Those same growers 15 years ago were key players in a state-managed drought water bank that temporarily transferred local water to southern California to meet other statewide needs.
- In Idaho, water users are working with state and federal agencies and the Nez Perce Tribe to settle longstanding disputes and create more certain water supplies.
- Along the Columbia River, irrigators are developing water exchange programs to increase supply reliability while improving salmon habitat.
- In the Klamath Basin of Oregon and California, the federal government is spending millions of dollars to temporarily compensate producers for re-allocating

water for environmental demands. Stored water is being shifted from its initial intent - crop production - to a perceived need; to create artificial lake levels and artificial river flows in a naturally occurring cycle.

Farm Practice Improvements

Western farmers and ranchers are already taking actions to reduce greenhouse gases and other possible contributors to climate change. Some of these actions are undertaken consciously with this objective in mind; others have been implemented as part of the broad portfolio of actions that successful farmers have to take to stay profitable in today's fierce economic and regulatory climate. In virtually every Western state, there are examples of activities that agricultural producers are taking that have the overall effect of reducing carbon dioxide emissions, which many policy makers and media spokespersons believe are a primary contributor to global warming. These actions include:

- Use of cleaner and more efficient diesel engines;
- Reduction of energy needs on farms;
- Use of biodiesel;
- Low-till practices;
- Creation of methane plants to maximize dairy production and reduce waste and methane emissions to the atmosphere;
- Involvement in conservation programs (Conservation Reserve Program and other programs provided by the Farm Bill conservation title), which provide incentives to set aside thousands of acres of farmland for wildlife habitat; and
- Selling carbon credits to industries for approved management actions.

Probably most obvious - and most importantly - crops turn carbon dioxide into oxygen. Further, new research suggests that irrigation has kept croplands cool, essentially countering rising temperatures caused by greenhouse gas emissions over the last half century (Kueppers et al, 2007). That impact may be compounded by the predicted decreases in water available for agriculture in the future due to climate change. This, in turn, would cause more reductions in water supply, which would further restrict irrigation.

Drip irrigation system on wine grapes in Westlands Water District (California)

Success of Conservation Projects in Meeting Previous Challenges

Conservation efforts have been effective, but it overstrains credibility to believe that conservation alone will supply enough water for the tens of millions of new residents expected to arrive in Western cities during the coming decades. Also, conservation does not work in many cases, especially where the desire is to increase in-stream flow. Water that is conserved tends to be used by the next junior downstream appropriator and the flow remains the same.

The above examples demonstrate the creative measures that have been taken to develop and efficiently manage water resources for irrigation. These examples represent just a handful of the creative water management programs that Western irrigators are working on. Efforts to conserve water in urban areas have also been impressive, particularly in the Southwest.

Consider the commendable and dramatic conservation measures imposed by the Southern Nevada Water Authority (Authority)

in the urban areas around Las Vegas:

- In 2005, community residents and businesses converted more than 15 million square feet of turf, resulting in savings of more than 846 million gallons of water. The progress in 2005 brought the Water Smart Landscapes program total since 1999 to 67.8 million square feet, with a savings of more than 3.7 billion gallons of water. This helped the community achieve water savings of about 29.5 percent—surpassing the 25 percent goal five years ahead of the planned 2010 deadline.

Wyoming wetlands created via partnership with private landowners and U.S. Dept. of Agriculture. Western irrigators are involved in conservation programs, which provide incentives to set aside thousands of acres of land for wildlife habitat.

- New restrictions were imposed on landscaping;
- Use of recycled water was stepped up dramatically;
- Casino-hotels along the Las Vegas Strip have made significant investments in water features, capturing and treating grey water and using recycled water; and
- A stiff four-tier rate structure was imposed, as were high connection charges.

With conservation measures in place, southern Nevada reduced water use by 65,000 acre-feet in two years. However, despite these aggressive conservation actions, the Authority is moving with equal determination to develop new water supplies in other parts of the region, since probabilities of shortages on the Colorado River are likely going to increase over time. As noted earlier, the Authority is already planning to take groundwater out of aquifers under the Utah-Nevada state line and pipe it to Las Vegas.

So, this particular example – which describes some of the most innovative and aggressive conservation measures undertaken in the West – suggests that even the highest level of conservation is insufficient to keep up with new demands caused by new residents moving to Las Vegas. We envision similar situations to arise in other parts of the West as a result of climate change and ever-increasing population growth.

Impacts of Previous Challenges to Meet Diminished Water Supplies

The West is the most rapidly growing part of the United States. Yet, water supplies there are essentially static. In some areas, urban demand for water – and land – is straining agriculture and rural communities to the breaking point. New environmental water demands imposed by regulatory agencies or courts also first look to agriculture (Family Farm Alliance 2006). This is happening in every state, but farmers and ranchers point to some striking examples:

- A report released in April by Environment Colorado found that, from 1987-2002, Colorado lost an average of 460 acres per day of agricultural land. The report predicts 3.1 million more acres will be lost to development by 2022.
- Arizona's Salt River Project (SRP) is the "poster child" for transfers of agricultural water to urban areas. In a few years, the SRP will cease to provide water to agriculture in order to meet new demands exerted by development.
- In Las Vegas, Nevada, over 70,000 new residents are moving in every year, and Southern Nevada Water Authority is looking to rural areas to satisfy its growing thirst.

- A restoration agreement developed for the Platte River could potentially dry up hundreds of thousands of acres of farmland in Nebraska and Wyoming, in order to reallocate water to meet the perceived needs of ESA-listed fish and wildlife.
- According to the American Farmland Trust, the California Department of Conservation documented more than 1 million acres of farmland in the state that were converted between 1988 & 1998. Last year, California's population officially topped 37 million, and the California Department of Finance predicts that the state's population will reach 59.5 million by the year 2050 (State of California, 2007).

Farmers, ranchers and rural communities cannot solve the water supply problem created by the Western population boom. Nor can they be expected to sacrifice their livelihoods for the "greater good" of golf courses, strip malls and housing developments.

Farmland is disappearing at a time when the U.S. needs a stable domestic food supply (just as it needs a stable energy supply). We are concerned that this critical issue – which becomes even more serious when viewed in the context of projected climate-change impacts to water supplies - is being overlooked by our national leaders.

A reliable, safe and sustainable domestic food supply is just as important as a strong military to the protection of our national interests. The post 9/11 world of terrorist threats makes the stability of domestic food supply even more pressing.

Other Potential Future Demands on Western Water Supplies

Throughout the West, we are seeing proposals to build plants to make ethanol, another "answer" that may (or may not) lower greenhouse gas emissions. An April 2007 *Sacramento Bee* editorial provides a reality check on how much water it would take to grow all the corn required to meet California's goal of producing a billion gallons of ethanol a year. According to the *Bee*'s calculations, that's about 2.5 trillion gallons of water for 1 billion gallons of ethanol, which is more than all the water from the Sacramento-San Joaquin Delta that now goes to Southern California and valley farms. Because there is only so much water for agriculture in California and other Western states, this means that some other existing crops will not be grown, thus furthering our dependence on imported food sources.

With the high priority currently placed on ethanol and other biofuels, corn is currently a hot commodity. Because there is only so much water for agriculture in Western states, this means that some other existing crops will not be grown, thus furthering our dependence on imported food sources.

Another growing demand that will be placed on Western water resources is driven by power requirements. The total water consumed by electric utilities accounts for 20 percent of all the nonfarm water consumed in the United States. By 2030, utilities could account for up to 60 percent of the nonfarm water, to meet the water needs required for cooling and pollutant scrubbing. This new demand will likely have the most serious impacts in fast-growing regions of the U.S., such as the Southwest. Even without warming climate conditions, continued growth in these regions will put the squeeze on both water and power use. When you throw in climate change considerations, the projections look worse (Spotts, 2007).

THE IMPORTANCE OF WESTERN IRRIGATED AGRICULTURE

Western Irrigated Agriculture is Vital to the National Economy

Western water policy, over the past one hundred years, is one of the great success stories of the modern era. Millions of acres of arid Western desert have been transformed into the most efficient and productive agricultural system in the world.

Sprinkler irrigation keeps croplands cool, essentially countering rising temperatures caused by green-house gas emissions over the last century.

The Bureau of Reclamation operates about 180 projects in the 17 Western States. Reclamation projects provide agricultural, household, and industrial water to about one-third of the population of the American West. About 5 percent of the land area of the West is irrigated, and Reclamation provides water to about one-fifth of that acreage (in 1992, some 9,120,000 acres). Reclamation is a major American generator of electricity. In 1993, Reclamation had 56 power plants on-line and generated 34.7 billion kilowatt hours of electricity. All of this has been done for a total federal investment of $11 billion (U.S. Bureau of Reclamation).

A 1998 study by Dr. Darryl Olsen and Dr. Houshmand Ziari, estimates the impact of irrigated agriculture in the Western states to be $60 billion annually (direct and indirect income). Using Reclamation's estimate that 20% of irrigated agriculture receives water from Reclamation projects, then the annual return to the economy from the $11 billion investment in the federal system is $12 billion annually. In other words, the economy of the United States receives a greater than 100% return each year on this investment.

Western Agriculture Provides a Safe, Domestic Food Supply

Americans are justifiably concerned about the recent contamination of wheat gluten imported from China and used in pet food that killed thousands of animals in the United States. Earlier this year, federal agencies revealed that domestic chickens and pigs had been given feed similarly tainted by imported ingredients, and that many of the affected chickens had entered the nation's food chain. Those two events graphically demonstrate just how vulnerable the American public is to lax food safety standards in other countries, or potentially, to acts of food-based terrorism.

We all know that this country imports huge amounts of food. We've also now learned that the federal Food and Drug Administration (FDA) inspects only about one percent of that imported food. The call has now gone out to radically increase the FDA's inspection capabilities. Recently, former Secretary of Health and Human Services Tommy Thompson advocated for a doubling of the FDA's resources.

Mr. Thompson knows what he's talking about. This is the same man who, as he was leaving the Bush Administration, bluntly said, "I cannot understand why the terrorists have not attacked our food supply, because it is so easy to do."

However, while Mr. Thompson's proposal to bolster FDA's resources would represent an improvement, in reality, it means the agency would be able to inspect a whopping 2% of the imported food supply, thus leaving 98% un-inspected. Nobody should be very com-

fortable with an expanded inspection process that gives a foreign terrorist a 98% chance of succeeding in poisoning a commodity that finds its way into our food supply.

Yes, the U.S. has recently exp-erienced failures in its own food safety systems. But domestic food safety issues are within our power to address. Contamination of food stuffs produced by factories and farms beyond our borders is not.

RECOMMENDATIONS

So how will we meet the ever-increasing demand for water in the West in an era when there will be an ever-decreasing supply? Improved conservation and efficiency by urban and agricultural water users is certainly part of the solution, but only part. Climate change could further strain fresh water supplies in the American West. We must begin to plan for that now, and not wait until we are forced to make decisions during a crisis.

What We Must Avoid

Relying on agriculture to be a "shock absorber" to soften or eliminate the impending water shortage is not planning. It is a choice to put our heads in the sand and hope for the best. It is a decision that could worsen the overall impact of climate change on our nation's economy and security. Allowing water-short cities to absorb farmers' water supplies will significantly diminish domestic food production at exactly the same time climate change is predicted to severely adverse impact food production worldwide.

What Needs to be Done

Western water supplies are already inadequate to the demands of agriculture, urban growth and environmental enhancement. Global climate change, we're told, will further reduce those supplies. Working with farmers has made us incredibly sensitive to the big picture ramifications facing the future of Western agriculture, and the critical role reliable water supplies play in that big picture.

We must immediately begin to address the critical challenges we face. A practical, prioritized approach to addressing these challenges is possible, and essential. Our recommendations follow.

Grand Coulee Dam, Washington. The federal investment in the Columbia River Basin Project and other Western water projects generates a greater than 100% return each year. Source: USBR.

1. ***Prioritize Research Needs and Quantify Projected West-Wide Hydrologic Impacts***

Our country has tremendous, but limited, resources available to fix our problems, so accordingly we must prioritize and sequence our actions. An initial priority research item should be a comprehensive validation of West-wide changes in climate change-driven streamflow. This should be followed by quantification of the amount of additional above- and below-ground reservoir storage, conservation targets, etc. required to re-regulate the anticipated hydrologic regime changes. To optimize water management for beneficial use, researchers should look at scenarios where storage is spaced through the drainage. Potential storage sites should be located at high and low elevations to regulate and subsequently re-regulate the water supply to maximize beneficial use. A study of this type would quickly illustrate to policy makers the need to start modernizing our water infrastructure.

Congress should also authorize the U.S. Department of Agriculture (USDA) to work with national agricultural associations to assess the collective impacts to agricultural land and water use changes in western states over the last 10 years, as well as predicted trends. A study of this sort may provide the type of hard findings that may help wake up policy makers to the "big picture" ramifications of what is occurring across the Western landscape.

Both of these proposed studies lend themselves well to a private-public partnership that would add non-governmental farming

organizations, state agencies and academic institutions to a team of federal agencies including the expertise found within the Natural Resources Conservation Service, Bureau of Reclamation, and U.S. Geological Survey. For example, the Family Farm Alliance has partnered with Colorado State University and recently developed a proposal to the USDA for a project that would assess public attitudes and perceptions regarding agricultural water use in the West. That proposal has been funded by USDA. A similar type of proposal – one that involves producers, state and federal agencies, and academia - could be developed to create a partnership of the above agencies and other entities to collaboratively lead a climate change / hydrology research effort.

2. *Implement a Balanced Suite of Conservation and Supply Enhancement Actions*

We believe that it is possible to meet the needs of cities and the environment without sacrificing Western irrigated agriculture. To achieve that goal, we must expand the water supply in the West. There must be more water stored and available to farms and cities. Maintaining the status quo simply isn't sustainable in the face of unstoppable population growth, diminishing snow pack, increased water consumption to support domestic energy, and increased environmental demands.

It is simply ludicrous to believe that conservation alone will supply enough water for the tens of millions of new residents expected to arrive in Western cities during the coming decades. Farmers and ranchers understand that conserved water cannot realistically be applied to instream uses, as it will more likely be put to beneficial use by the next downstream appropriator or held in carryover storage for the following irrigation season.

Whether water shortages are attributable to drought or to climate change, reason dictates that measures should be implemented to provide more certainty for impacted water users. These measures should include rehabilitation of existing facilities and construction of new infrastructure. Many of the West's Reclamation projects are nearly a century old and many are badly in need of repair and/or modernizing. Rehabilitation measures should focus on maximizing the conservation effort through increased delivery efficiencies, construction of re-regulation reservoirs to minimize operational waste, and construction of new dams and reservoirs in watersheds with inadequate storage capacity to increase beneficial use and provide operational flexibility. Additional groundwater supplies should also be developed, but in a manner where groundwater use falls within the safe yield or recharge parameters of the aquifer. Conjunctive management of surface and groundwater supplies should be encouraged. As an example, groundwater might be utilized more during drought and allowed to recover during wet cycles. Installation of additional stream gauges, water meters, groundwater monitoring wells and better estimates of consumptive use are of paramount importance for the equitable management of available water supplies.

Temporary water transfers, conservation, recycling, and desalination efforts must

continue. However, these demand management actions must be balanced with supply enhancement measures that provide the proper mix of solutions for the varying specific circumstances in the West.

Many water projects are ready to be developed in the West (see Family Farm Alliance, 2005; also U.S. Bureau of Reclamation, 2005). While conservation and recycling programs have done a tremendous job of meeting new growth, only a small amount of new water storage capacity has been developed in the past 30 years. We cannot continue to "conserve just a little more" forever. It's time to start implementing the water infrastructure needed to cope with a changing climate, meet the needs of a burgeoning population, and support a healthy agricultural base in the West.

3. *Streamline the Regulatory Process to Facilitate Development of New Infrastructure*

Modern, integrated water storage and distribution systems can provide tremendous physical and economic flexibility to address climate transformation and population growth. However, this flexibility is limited by legal, regulatory, or other institutional constraints, which can take longer to address than actually constructing the physical infrastructure (Tanaka et al, 2007).

The often slow and cumbersome federal regulatory process is a major obstacle to realization of projects and actions that could enhance Western water supplies. In addition, there exists with agencies a defeatist attitude that no dams or water supply projects will be built. So, there is no commitment to earnestly begin and engage in the difficult problems described above.

4. *Make Self-Sufficiency in Food Production a National Priority*

Remarkably absent from the newly-ignited dialogue about food safety is a recognition of the importance of a secure and sustainable domestic food supply. Politicians from both parties now routinely urge us to end our reliance on foreign energy sources, but nobody is talking about food independence. A national response to climate change should include as one of its goals self- sufficiency in food production. It is time for our national leaders to stand up and focus on improving the security, stability, and economic aspects of domestic food production so that our food remains readily available, ample, affordable, and safe.

5. *Find Ways to Protect Farmland*

As previously noted, new research suggests that irrigation has kept croplands cool, essentially countering rising temperatures caused by greenhouse gas emissions over the last half century. Crops also turn carbon dioxide into oxygen. In addition to a multitude of other benefits (economic, security, habitat and open spaces, to name a few), our diminishing farmland needs to be protected. Federal funds and other money should also be authorized to help local governments protect farmland, analyze ways to keep farmland in production, set up grant programs for local governments and provide technical assistance to farmers. Congress should consider the option to encourage states to lease development rights from farmers to buffer their farmland.

Friant Dam, on the San Joaquin River, California. Temperance Flat Dam would be a new structure constructed on the San Joaquin River, above Friant Dam, which would provide much needed water supplies and hydroelectric power. Source: USBR

Opportunities exist to improve water conservation in Western agriculture, such as finding ways to minimize channel seepage losses. However, conservation alone cannot supply enough water for the tens of millions of new residents moving to the West. Source: USBR.

Conclusion

Europeans aggressively protect their farms and food production capability because they still remember the hungry years during and after World War II when they relied on other nations, America in particular, to feed them. The time has come – indeed, it's long overdue – for the United States to similarly adopt an overriding national goal of remaining self-sufficient in food production. Policy decisions on a wide range of issues ranging from taxation to the management of natural resources should then be evaluated to be sure they are consistent with that goal.

"Management of natural resources" equates to implementation. We must immediately begin on-the-ground work to maximize the ongoing conservation effort through increased delivery efficiencies, construction of re-regulation reservoirs, and construction of new dams and reservoirs in watersheds with inadequate storage capacity to increase beneficial use and provide operational flexibility.

It's hard to imagine a simpler or more important step to safeguard the American public.

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