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Bringing Agriculture Back to Water – A Sustainable Solution for the 21st Century

Richard T. McNider*
John R. Christy
University of Alabama in Huntsville
Huntsville, Alabama

James E. Hairston
Auburn University
Auburn, Alabama

1. Background –The Past

At the turn of the 20th Century most of the food and fiber production in the U.S. was carried out under a rain-fed agricultural system in the east and mid-west. Commodity prices were set in a market system that included weather losses as part of the price. Individual farmers incurred weather losses in specific places and years but since all farmers eventually incurred losses the mean market price adjusted to a price that allowed farmers on average to stay in business. Economically, drought losses on a macro scale were factored in as part of the cost of production. Additionally, transportation and distribution systems were such that local vegetable and regional commodity markets were a necessity.

By 1950 this agricultural system that had endured for generations went through a dramatic change. Water projects for irrigation in the West built in the 1920s –1940s were coming fully on line. (Riesner, 1986). Additionally, electricity availability in the dry High Plains allowed farmers to pump from underground aquifers such as the seemingly inexhaustible Ogallala. Thus, by 1950 a substantial part of the food and fiber of the country was being produced in the arid west under irrigation. In this new system where weather losses due to drought for western farmers were no longer an issue, rain-fed farmers in the east were faced with an intrusion into the market that in some sense removed drought losses as a cost of farming. Thus, a commodity price evolved such that drought was no longer a fully recovered cost of production.

*Corresponding Author Address: Richard McNider, Department of Atmospheric Sciences, University of Alabama in Huntsville, Huntsville, AL 35899 Email- mcnider@atmos.uah.edu

If the western and eastern markets had been isolated then two sets of commodity prices might have evolved. However, with world cotton markets, the advent of refrigerated transport, faster rail networks and the interstate highway system, the eastern and western markets were generally amalgamated. Eastern farmers then began to see downward pressures on commodity prices that made profitability difficult.

This downward pressure on commodity prices was further exacerbated by a tremendous increase in agricultural productivity through improved genetic strains, advances in fertilizer blends and farming techniques. While eastern farmers had the same access to genetics and technical improvements as western farmers the western farmers were in a much better position to take advantage and tune the refinements. This is because in rain-fed agricultural systems the variability and timing of rain is the single most important factor in production. Thus, it is nearly impossible to extract the impact of fine scale adjustments in genetic types, fertilizer application or other actions when the signal is dominated by rainfall variability. Thus, farmers and agricultural scientists in the eastern U.S. were unable to carry out controlled production experiments to define enhancement strategies.

For western irrigating farmers the opposite was true. Since they could always control water, they could fine tune fertilizer and chemical strategies, see the difference between seed types and even fine tune water application (Arax and Wartzman, 2003). The end result of the sustained and improved productivity of western irrigated agriculture was that from 1950-1990 agricultural output in the east decreased substantially. Only the grain belt in the mid-west utilizing the water holding capacity of its deep soils to mitigate

droughts was able to maintain its acreage in production of corn and wheat.

The south was particularly hard hit. Agriculture, primarily cotton and corn, was the economic underpinning of the rural south. While average rainfall was plentiful, extreme variability in time and space of rain in the growing season coupled with the poor water holding capability of soils meant large losses in productivity due to weather. Farmers in a slow agonizing death went out of business. Alabama as an example has lost over 10 million acres in row crops since 1950 (see Figure 1). The first to go were capital poor sharecroppers on marginal land. Cotton acreage dropped dramatically in Alabama, yet, California increased its cotton acreage in the same period (see figure 2).

The reduction in agriculture was devastating to rural areas. While giving up row-crops, landowners retained some income from government set-aside programs and timber farming yielding of order $25-75 per acre per year. However, the value of this income to the local economy paled compared to the $300-600 a farmer spent while actually farming. Small towns and their retail activities dried up as agriculture declined. The end result today is that many parts of the rural south are near third world in terms of literacy, poverty, health care and infant mortality. It is ironic that rural federal welfare programs under the Great Society initiative in the 1960's were aimed at poverty in part kindled by federally supported water projects in the west thirty years earlier.

2. The Present

The water projects in the west built by the Bureau of Reclamation (BoR), the Corp of Engineers and federal/state partnerships were by economic standards a magnificent success. The original intent of many of these projects was to attract farmers to the west (or to save farmers previously attracted to the west by federal land programs) (Reisner, 1986). This was accomplished by increasing agricultural production value rather than number of small farmers. California and Arizona became agricultural powerhouses, dominating national production in fresh vegetables and cotton. Additionally, power generation and water for municipalities spurred tremendous population growth in the southwest and Great Basin. In the Ogallala region, ground water pumping turned the pain of dust-bowl farms into the relief of farming with fair returns and little risk.

However, continued population growth in the west has introduced a competitive use for the farmer's water. In California municipalities currently face paying $300 or more per acre-foot for water while farmers continue to pay the (BoR) rate of $15. Urbanites supported in economies isolated from agriculture question whether the agricultural reward is worth the price they must pay. Environmentalists deplore the environmental destruction of rivers and fisheries for the sake of agriculture.

In the Ogallala region decades of pumping has reduced ground water levels significantly and farmers have been forced to reduce irrigated acreages. Irrigated land has dropped 30% since 1978 (de Villiers, 2000). Growing cities to the south such as San Antonio and El Paso look to the Ogallala for future needs as local sources of water are being depleted.

The recent drought in the west has accelerated water fights and concerns in the region. It has underscored the problem first posed by George Wesley Powell – the west in total has too little water no matter how it is distributed or managed (Reisner, 1986). The original allocation of the Colorado River amongst the states was made during an extraordinary wet period so that even average conditions represent a shortfall over obligations and needs.

It is ironic that with all the surface water Alabama and the southeast had available that they did not participate more in irrigated agriculture (Hairston et al., 1990). As an example New Mexico supports a thriving agricultural system from the Rio Grande near Las Cruces with an average annual flow of near 1 million acre-ft. The Alabama River alone in the southern part of the State has 10 million acre-ft in the driest year on record with average flows near 25 million acre-ft. Part of the reason for not irrigating is that southern farmers can almost make it without irrigation - but almost is not enough. In a capital poor and high interest rate environment, southern farmers were evidently unwilling to make the investment based on what was seen as a marginal return. They did not recognize that only increased productivity could overcome what many saw as unsustainable low commodity prices.

There is a tremendous disparity in the amount of water used between western and eastern states. Alabama and Georgia use only a few per cent of the water that run off their states while California and Arizona use well more than they receive through ground water pumping and river imports (see figure 3). Since natural rainfall in the growing season in the south is almost sufficient, irrigation can be practiced using only a fraction of the water available.

3. The Future

Population growth in the west is expected to continue at an aggressive pace. For example, California's population is currently increasing at a rate of 600,000 people per year – equivalent to the population of Birmingham (Alabama's largest city). In many areas of the west, such as Tucson, ground water supplies for urban use will be depleted at an accelerated pace forcing cities to look to surface water supplies now used by farmers (de Villiers, 2000).

Calls for river restoration by western urban environmentalists will add new demands for limited water supplies. While Alabama and Georgia might have minor environmental skirmishes over removing a small fraction of available water for urban and agricultural use, this pales in comparison to totally consuming rivers such as the San Joaquin.

While population and environmental initiatives will consume additional western water, the major issue in the west will likely not be increased consumption but decreased supply. The observed precipitation climate history in the west is quite short – approximately 100 years. However, recent tree ring and paleoclimate data indicate that the recent climate (especially the last 70 years) has been extraordinarily wet (Piechota et al., 2004). The recent five year drought in the west which has taken major reservoirs to record low levels and raised the consciousness of the vulnerability of water supplies may actually be closer to the norm of expected future climates. Tree ring data indicate that numerous droughts have occurred in the past 500 years with the current drought only the seventh worst in 500 years (Piechota et al 2004).. Thus, even without considering anthropogenic climate change, the west is vulnerable to climate shifts from that of recent times to those in the past climate history.

Because of water supply concerns, many observers and agricultural scientists (Postel 1992, Reisner, 1986) point out that desert irrigated agriculture is unsustainable. Salt build up due to evaporation in an arid climate eventually makes soils useless. Only enhanced flushing of the soils requiring ever-increasing amounts of water can stave off the inevitable poisoning (Postel 1992, Arax and Wartzman 2003)

Given the above considerations it seems certain that there will be a contraction of agriculture in the west. Urbanites and their water needs (and votes) will eventually trump farmers. This loss of agriculture in the U.S. will have to be made up elsewhere. It could go offshore. However, we believe that this is not in the best interest of the food/fiber security for the U.S. or in the best interest of the global environment. Agriculture is not benign in its environmental impact. Foreign countries (especially third world countries) will not take the same precautions relative to pesticides, herbicides, erosion and water pollution as will the U.S. Additionally, worldwide demand for irrigation water in arid areas is outstripping supply (Rosegrant et al., 2002).

4. A Sustainable Solution

Based on the past, present and gloomy outlook to the future, we believe that the more natural and sustainable agricultural system for the U.S. is irrigated assisted rain-fed agriculture in the east and not desert irrigated agriculture in the west. Because of natural rainfall in the south only 6-9" of irrigated water are needed for crops rather than the four feet needed in Arizona and California. This irrigated water, however, is critical by being available at the right time for maximum production. Non-irrigated corn in Alabama produces 60-80 bushels per acre in good years while 200- 250 bushels per acre can be had with irrigation. With irrigation, crops can be fertilized more heavily and planted more densely without concern for burning up the crops if rains don't come. Thus, production is increased even during wet years when the irrigation systems are rarely used.

This does not mean that the west would have to give up its agricultural economy. Studies on the sustainability of California agriculture (Glieck et al., 1995) have indicated that crops such as "alfalfa, cotton, rice, and irrigated pasture now consume 54 percent of all agricultural water used, yet produce only 17 percent of the state's agricultural revenue.

By shifting acreage from these crops to higher-value crops which use less water, "agricultural net water demand could decline by 3.5 million acre-feet while farm income rises by $1.5 billion (in 1988 dollars).""

A holistic program for U.S. agriculture would be for the states, the U.S. Department of Agriculture and the Bureau of Reclamation to establish incentives for farmers in the west to give up low value but water intensive crops like those mentioned above by buying their water rights. Or as in a recent settlement for Imperial Valley farmers require they sell their water to urban areas. (We note that western farmers seem to come out pretty well when they go out of business and sell the federal water - southern farmers driven out of business by this same federal water got nothing). For those western farmers (or their son's or daughters) who want to continue to farm cotton or corn after giving up their water, an incentive and relocation program could be designed to encourage farmers to move their farming operations to the south by providing water and low interest land. This might be considered analogous to the water and land incentives given to encourage immigration to the west in the 19th century.

In the long-term such a program would be the most efficient for the Nation as a whole - it is sustainable and cost effective. California alone will have to spend billions of dollars in the next ten to twenty years just to keep pace with increased water use (this is not even considering the scenario that dry is the norm). The federal government will be asked to pick up much of this cost. California could solve its water problems for the next 30 years by giving up cotton. If this cotton production were moved to the south, it would invigorate the economies of the poorest parts of the U.S. and relieve southern states and the federal government of millions of dollars in welfare and other payments for these depressed areas.

In summary - the paradigm for the 20th century was to take water to agriculture. This led to colossal water projects in the west that moved water hundreds of miles to be put onto deserts and the ultimate dislocation of agriculture from the east. These projects were fostered by the belief that any water making it to the sea was wasted water and resulted in great harm to natural river systems, fisheries and estuaries. We believe that the paradigm for the 21st century should be to return agriculture to the east where irrigated assisted rain-fed agriculture is sustainable.

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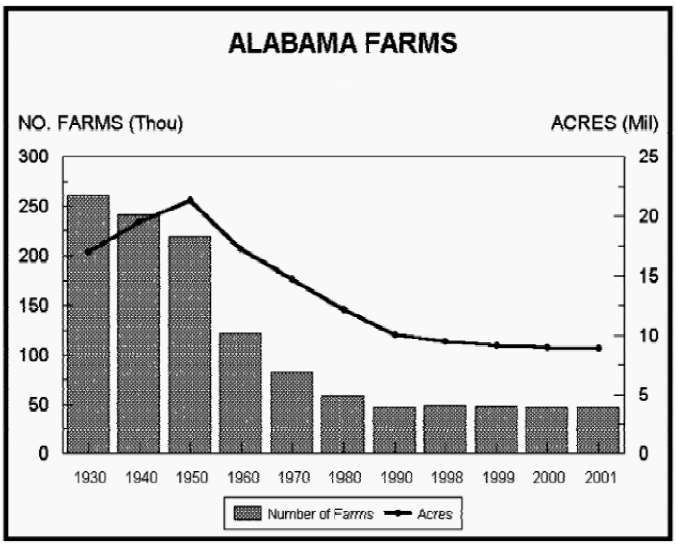

Figure 1. Number of farms and farm acreage in Alabama. Acreage peaked in 1950. Plot courtesy Alabama Agricultural Statistics Service.

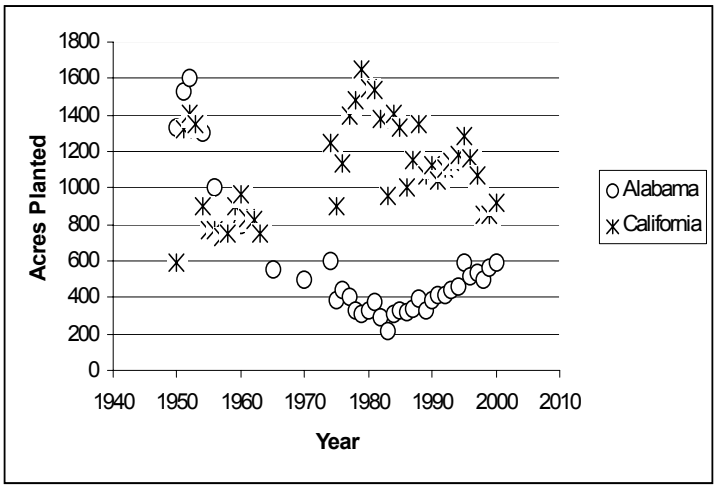

Figure 2. Acres of cotton planted between 1950 and 2000 for California and Alabama. Data obtained from USDA NASS.

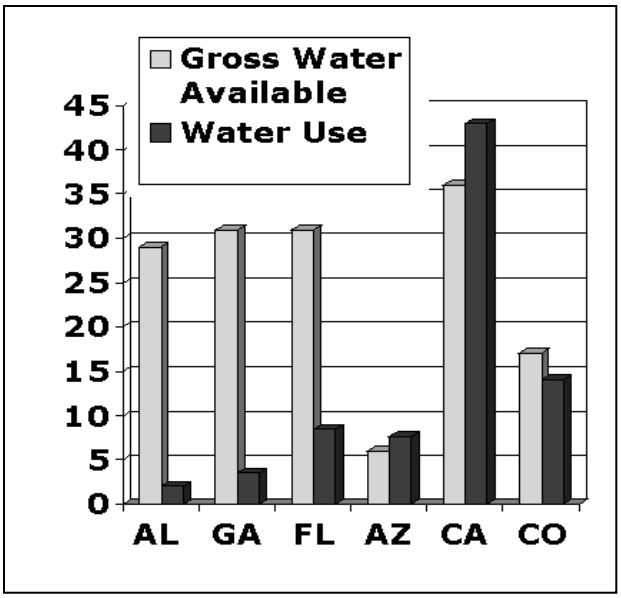

Figure 3. Gross water availability (precipitation minus evaporation) and water use. Water use from USGS. Units –million acre feet.