

# *The Natural Resource Limits of U.S. Agriculture*



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**B**Y any measure, the U.S. has the world's most productive, most successful agricultural system. The specifics are spelled out ad nauseam in every experiment station annual report, in the introduction to every major address by the Secretary of Agriculture. Productivity increases have come through massive substitutions of physical, biological, and intellectual capital for land and people in the food production processes. Fewer people produce more food on less land than ever before. And there is little compelling evidence that we are running out of productive innovations.

Those macro trends obscure year to year or four-year to four-year output fluctuations associated with U. S. food policy, international competition, trade policies, etc. And while land goes out of agriculture, that which remains is farmed more intensively. National Inter Regional Agricultural Projection model anticipates reduction in pasture and less productive fragile lands in agricul-

ture with continued increases in irrigated cropland up from 19 million acres in 1945 to 47 million acres in 1987, capturing about 30 percent of profits in food production (6). Fewer farmers does not mean fewer people working in agriculture as the food system responds to lifestyle changes associated with a developed society. Today's consumers, who capture about three-fourths of the benefit of increased farm productivity, consume more packages and services than did an earlier generation. Real cost of food has dropped from 25 percent of per capita income to 15 percent in the past twenty years (11).

The whole U.S. food production and marketing system is wired together by a complex, even mysterious, superstructure of production and substitution incentives we call food policy, intended to maintain happy farmers, well-fed consumers, and a healthy trade balance. By and large the system works.

I will note my central conclusion up front—There is virtually no reliable evidence today of any "natural resource limits of U.S. agriculture." In fact, the evidence is quite the contrary. The most recent Re-



source Conservation Act appraisal concludes that "increasing supply (of food through 2030) will outstrip increasing demand resulting in increasing downward pressure on commodity prices and land values" (18). Conservation policy and the economics of production will idle the least productive, most erosive land. Erosion rates are declining; conservation policy has made a difference. We still farm too much fragile land, about 19 million acres in 1982 (18), but the trends are right.

Of course I can't leave it at that. The two most famous words in the lexicon of agricultural economics are "yes, but!" While there are no impending natural resource constraints on food production, the American people, and particularly the natural resource community, are professional worriers. We should not be complacent, should not confuse past success with permanent solutions, should not take progress for granted. There are important natural resource and related policy challenges to be addressed.

### Total productive capacity

Nearly 10 years ago, Sylvan Wittwer and

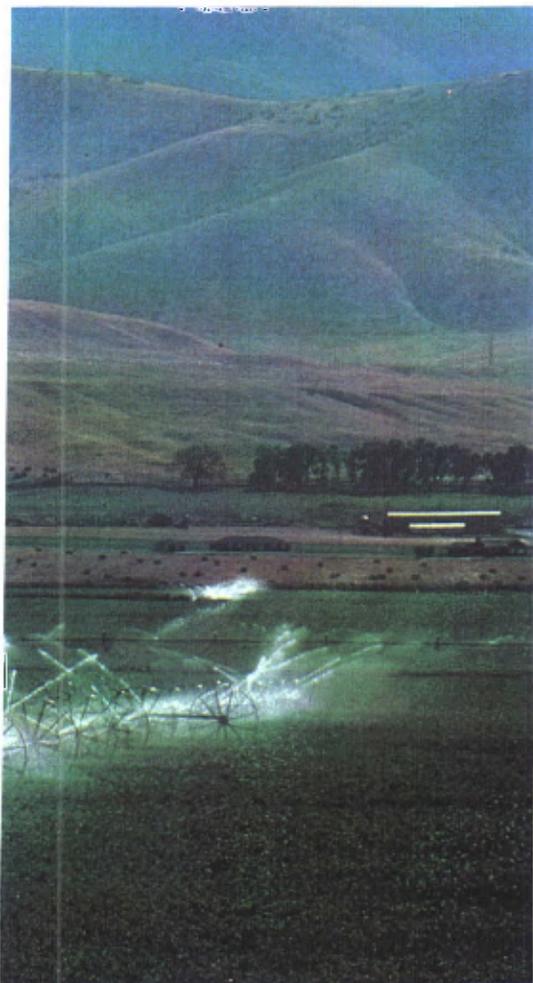
Glenn Johnson argued that improved diets worldwide, higher energy costs, and greater international competition in food production call for a U.S. food production capacity in 2030 double that which existed in 1980 (10). Actual production during those years will vary with world markets, marketing infrastructure, technology adoption behavior by farmers, and distribution of inputs. But increased capacity to produce requires that the technology, people, and natural resources be available when needed. Ruttan has argued that future gains in crop productivity will be more difficult than those of the past 25 years. We have peaked in fertilizer response and must increase maintenance research to avoid seeing yields decline (14). Conventional plant and animal breeding will carry us to about 2030, he says, but more fundamental bio-tech breakthroughs will be needed after that. Global food demand is expected to stabilize by 2050 (7). If we survive to 2050 with a world population of 11 billion or so, we've got it made!

Projections developed as part of the RCA process, on the other hand, conclude that in fact that capacity will be there in 2030. After reviewing trends in population, income, food demand, production technology, water availability, and resource policy, the study team concluded that even under the highest domestic and export demand scenario, needs can be met on cropland projected to be available in 2030. Under intermediate demand projections, we'll need considerably less cropland than was used in 1982. Greatest reductions in cropland will be in the Northern Plains and Mountain states (18). Key to that result are sustained investment in basic science and production technology, informed people to put it to work, and institutions that provide adequate access to resources.

### Farm land losses

Land will continue to leave agriculture due to continued substitution of capital as noted previously. But there is the possibility, even danger, of over-shooting. Land-use choices converting farmland to non-farm use are not irreversible but are expensive to reverse. National or state policies designed to encourage retention of our most productive lands in agriculture, a key part of that "capacity" that Johnson and Wittwer discuss, have largely failed. We still have a strong agriculture, but not through any organized foresight by policymakers. We just had plenty of land to start with and are still living off the surplus.

Since returns per unit of land are so much higher outside of agriculture, land becomes an enormous store of private wealth. Pres-



sure for conversion is literally irresistible; farmers fight to retain the opportunity to sell. Most of the land converted to non-farm use is prime farmland, since historic human settlement patterns favored productive farm areas. All 50 states have programs to encourage farmers to keep the best land in farming and to divert development pressure elsewhere, but with a few exceptions those programs have been ineffective.

### Water sources

Fresh, clean water may be the most limiting natural resource in the immediate future of our food production system. Only about one-fourth of the 1.4 trillion gallons per day of the U.S. renewable supply is actually withdrawn for use—there is plenty of water in the aggregate. But available supply at the right place and right time is another matter (8). RCA analysts project, however, that only under the “high stress” demand scenario will irrigated acres increase, from 50 million in 1990 to 68 million acres in 2030, and a net reduction is more likely as cropland needs decline. Local shortages will still be a problem. Salinity problems and competition have forced some irrigated land out of production in the West. Adequate national supply is small comfort to the Florida fern producer needing a sudden boost in supply for freeze protection, or the citrus grower in southwest Florida whose consumptive use permit may be in jeopardy in competition with golf courses and condo developers. There are similar situations in all states. It is unlikely that past subsidies or inattention to water quality impacts of large irrigation projects will continue (8).

Agriculture is still a messy business, more so in these times of high tech and specialization. Damage to the quality of land, water, air, and even “rural solitude” are inevitable by-products of intensive agriculture.

There will be increasing political pressure for controlling residuals. These natural resource challenges are far more compelling than those of productivity or resource availability. The RCA process and the SCS have made an interesting and altogether appropriate transition to these quality issues as results of their own analysis. Plans for the third resource appraisal required under the Soil and Water Resources Conservation Act of 1977 “... will emphasize the bond between economic and environmental progress” (18). Special attention will be paid to environmental enhancement through wise use of pesticides, improved management of both organic and inorganic fertilizer, reduced sediment run-off, wildlife habitat improvement, and other issues previously considered. USDA has joined with EPA in a cooperative effort to reduce agricultural pollution (20). Special emphasis is on

nonpoint sources, acknowledged by EPA as their most perplexing water quality challenge. Their recent final report to Congress documented significant progress with state-level nonpoint programs (20).

The pressure on farmers to be good citizens in their use of natural resources is high and increasing. Large animal confinements, consistent with trends toward intensive and concentrated agriculture, create particular problems. There is a general mood of impatience out in the countryside, farmers are feeling the pressure, non-farm neighbors are becoming more demanding. Government agencies in Washington are collaborating on these problems. It has not always been that way. Bureaucrats and agency scientists have learned to be civil to each other. Things are much less civil in the countryside.

Perhaps the greatest natural resource limit on the future of agriculture is the human resource. Constraints come in the total number of people needing land, demanding space, and various other forms of land-based utilities that may compete with food production and in their distribution over the landscape. Policy experience with distribution of people is far richer and better documented than total numbers of people. Policies to affect population size are poorly defined, uneven, and emotion-charged. The compelling facts are that developed nations of the world, including the U.S., have rates of natural increase less than one-fourth of those of the developing countries (12). Food needs in the developing world are dramatic. Many U.S. consumers eat too much and waste more, while hunger is a way of life in many nations. As the world's largest food exporter, the U.S. has the special capacity to reduce, even eliminate world hunger. The real limitation is the collective will to do so.

Beyond numbers and distribution of people as consumers of the various services of farmland are concerns about the quality of the human component of the U.S. food production system. Reference here is to leadership, knowledge, communication, tolerance, patience, concern for others, and both the willingness and wisdom to make sound decisions. I honestly feel these are the greatest natural resource challenges in U.S. agriculture. To be more specific:

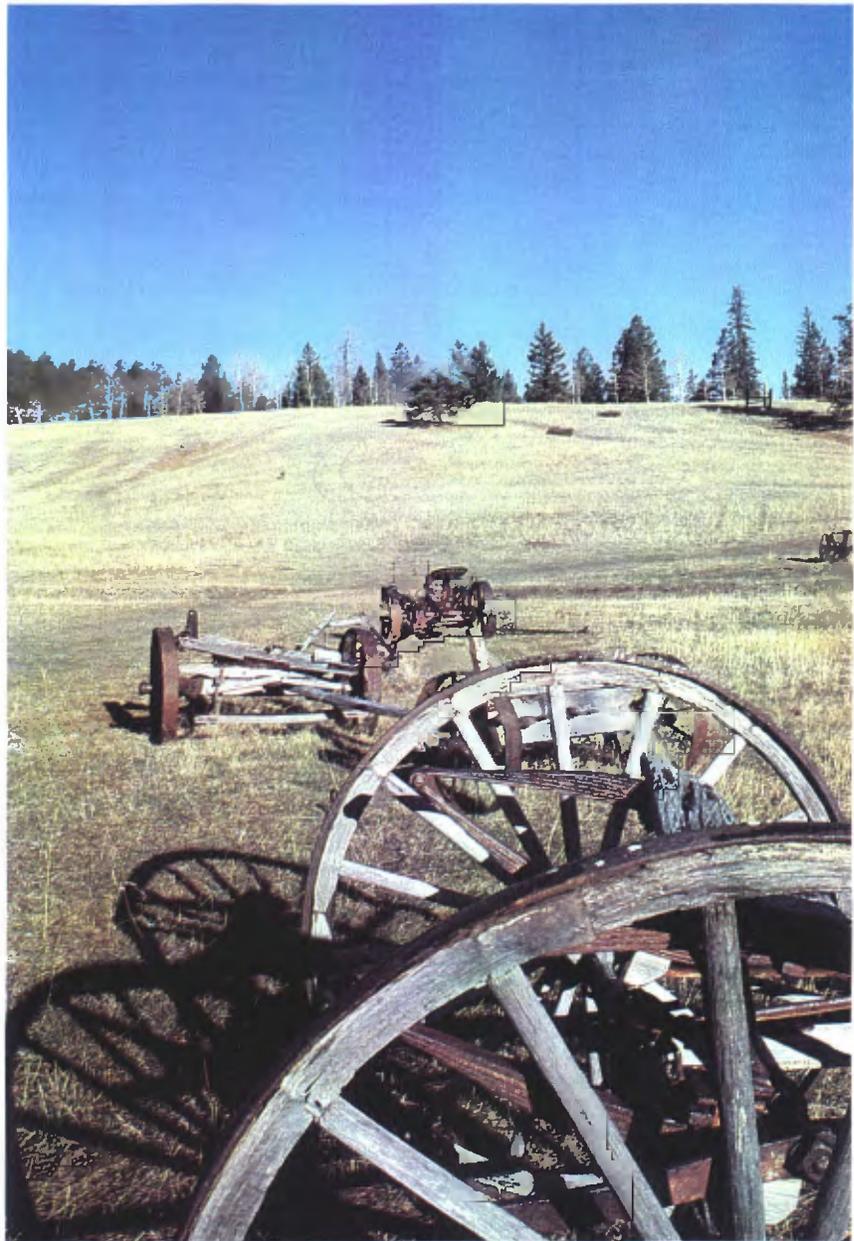
1. Coping with global food needs of the future requires continued, even increased, investment in knowledge. Not only must we know more about biological and genetic processes that affect human health and well being, we must also invest in knowledge about human values and behavior. We need to better understand why people do what they do, why they adopt or resist technology or spend their scarce time, energy, or capita in certain ways. To quote Pierre Crosson “Achieving the necessary increases in produc-

tivity will require a substantial increase in the social capital represented by knowledge of agricultural production embedded in people, technology, and institutions (7).

2. Farmers need a better understanding of their rights and responsibilities as producers of food and stewards of the productive engine that makes it possible. They need a better sense of where they fit in the social, political, and economic fabric of the nation. They need a better understanding of and respect for the policy process. We need an agricultural leadership in business, government, and universities that is positive not defensive, that can help farmers improve their posture and their image in the broader society. A recent column by Alston Chase in the *Washington Times* (3) asserted that "as a political issue, property rights is a dinosaur." Certainly farmers are often over-regulated—there are numerous horror stories of unreasonable restriction on normal farm practice. But his point is that circling the tractors around property rights is a losing strategy. Instead, he says, farmers should claim the moral high ground as stewards of the resource, protectors of habitat, replenishers of the supply of fresh groundwater. One of the most striking slide presentations I've ever seen was by a Florida cattle rancher, focused entirely on deer, hawks, eagles, even the endangered Florida panther on his ranch. We agriculturists must become better informed, more active participants in processes of economic and human value changes, not try to fight them off with conspiracy theories and other indicators of collective paranoia. We do not control the agenda. To paraphrase Don Paarlberg, far worse than not being in control of our agenda is not knowing that we lack control.

3. Active commercial farming needs to be better understood by the public. This is an old issue, but still accurate—the old cliché about how food is created by the manager of the local supermarket. People need to know that farms are not just land or the absence of buildings and people. Many land use plans are still written as if that were the case. A recent study in Florida bemoans the urban water subsidy to farmers based on per capita use not the role of water in production systems that serve many people. Overall, we need more enlightened and consistent communication among those producing, marketing, and consuming the U.S. food supply. Recent cooperative success in the New York City watershed is a case in point (1).

4. We need greater clarity and understanding on the major themes of agricultural debate. For example, the debate on size in agriculture is largely empty. There is no inherent virtue or evil in large or small enterprises. Many small farms seek to get bigger; they face constant struggles for survival. Other small



farms make more sense, consistent with the land, capital and attention span of the operator.

Sustainable agriculture is another key theme in the current debates. It is an important concept, an attitude as much as a set of technologies. Much energy has been wasted on semantics. The term "environmentally sound agriculture" is fairly descriptive of the policy challenge before us. It is a set of familiar practices—crop rotations, use of cover crops, tillage systems, integrated pest management, conservation plans, erosion reduction—that may fit in some combination depending on the resource and political environment of an area (17). It is not the blueprint for our agricultural future, it should not be oversold, but I would argue it is the attitude about agriculture that must prevail in the future.

Finally, there is the more esoteric but fun-

damental notion of a social discount rate, or our collective values about future generations relative to present needs. We must engage such matters, not leave them as a residual by-product of day-to-day actions. The idea of intergenerational fairness is key to debates on environmentally sound agriculture (16). To worry about sustainability or adequacy of future productive capacity is to argue for a low rate of discount on future options. Such discussions are essential (2).

### Concluding thoughts

My basic point is the only real natural resource limit on the future of U.S. agriculture is on the natural resource between our ears. The physical and biological potential of agriculture is without bounds if we have the wisdom to harness that productive capacity consistent with patterns of human preference and values. We cannot afford to be sanguine about future productivity. If we do, we may allow too much of our land to be paved, too expensive to plow; most importantly, we may disinvest in the science and management skills essential for that productivity. In the rush to reduce our national budget deficit we must not dismantle the human capital structure that has created and sustained our productive agriculture. We cannot and should not resist broad human value trends that demand food production systems that are environmentally sound and farmers who accept responsibility for the quality of the land and water they use.

I conclude with a brief thought on policy direction. Vern Ruttan has coined the term "incentive compatible institutions" in his study of international development programs (14). The idea is that rules designed to alter resource-using behavior through social bribery are more effective and less costly than those relying on threat, edict, prohibition and enforcement. Traditional commodity programs have sought resource change by manipulating economic signals to the user. Why not the same for soil and water policies? Conservation compliance, wetland reserve, and CRP provisions of recent farm legislation are in that spirit. Input taxes (13), emission taxes, water marketing, emission credits with air quality "bubble" concepts employed by EPA are further examples that have merit. Recent denial of consumptive use water permits in southwest Florida has led to a lively if unofficial market in water rights. The Florida sugar industry has proposed marketable phosphorus credits to encourage growers to work together in meeting acceptable pollutant loadings in Lake Okeechobee and the Everglades. Those able to do so could sell phosphorus loading rights to neighbors or to municipalities (9). There are practical difficulties, but the possi-

bility of substituting enlightened self interest for regulation is an attractive one (21). By the same token, I am not ready to turn everything over to quasi-market techniques. There are limits. We must not let an eagerness for "economic correctness" (4) dominate all public policy. There is still room in my value system for aggressive, concerted, but informed public action on behalf of natural resource needs of today and tomorrow. All the expert predictions of future food sufficiency assume those public actions.

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