SUSTAINABILITY: AGRICULTURE AND SOCIETY

Papers from a symposium honoring
Dr. Harvey J. Schweitzer
March 8-9, 1990

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Sustainable ag conference honors UI's Schweitzer

A conference on sustainable agriculture will be held today and Friday at the UI.

"A Symposium on Sustainability: Agriculture and Society" is sponsored by the Illinois Agricultural Experiment Station of the UI College of Agriculture, and the UI Office of Continuing Education and Public Service.

The program will bring together educators, scientists, ecologists, farmers and agribusiness representatives. Registration begins at 11 a.m. today, with the first session scheduled for 1 p.m. All events are at the Chancellor Hotel and Convention Center.

The symposium, which will feature national speakers on agro-ecology, is in honor of Harvey J. Schweitzer, professor emeritus of agriculture at the UI who was the first coordinator of the College of Agriculture's sustainable agriculture program.

Among the speakers are Denis Hayes, an attorney and founder of Earth Day 1970; Vernon W. Ruttan, professor of economics and agricultural economics at the University of Minnesota; and Charles Hassebrook, leader of the Stewardship Technology and World Agriculture Program at the Center for Rural Affairs in Walthill, Neb.

Also, several UI faculty members are scheduled to speak, including Donald A. Holt, director of the Illinois Agricultural Experiment Station and associate dean for research in the College of Agriculture, and John C. van Es and Andrew Sofranko, rural sociologists.

"The issues affecting the quality of water, food, the environment and life concern us all," said John M. Gerber, assistant director of the Agricultural Experiment Station and coordinator of the College of Agriculture's program on sustainable agriculture. "Sustainable agriculture involves technological and management practices used on farms that strive to reduce costs, protect health and environmental quality and enhance beneficial biological interactions and natural processes.

"Interaction at this symposium will help people understand these issues."

Registration information is available from the UI Office of Conferences and Institutes, 244-7659. The registration fee is $95. Information about the conference is available from John Gerber at 244-4232.

EARTH DAY 1990: THRESHOLD OF THE GREEN DECADE*

Denis Hayes
The NRDC Marshall Lecture
Museum of Natural History
New York City
November 8, 1989

For many of my generation, involvement with serious issues -- adult issues -- began with some form of unconventional politics. Passive disobedience and freedom rides in support of civil rights. The endless town meetings of Vietnam Summer. Wearing gas masks down Fifth Avenue on Earth Day. Picketing a state legislature in support of the Equal Rights Amendment. Breaching the exclusion zone around Seabrook or Diablo Canyon. Blocking a train carrying fissionable material to the Rocky Flats bomb factory in Colorado.

We were impatient and idealistic. The first generation with Strontium-90 in its bones (from atmospheric nuclear testing), we trusted no one over 30. Outraged over the state of the world we were inheriting, we vowed that we would pass on to our children a world that was peaceful, just, and ecologically sustainable.

That was twenty years ago. Today, Holden Caufield is in his early 50's, has a beer belly, and commutes from the suburbs. The angry young women and men of Earth Day -- who poured sewage on corporate carpets, and pounded polluting automobiles apart with sledge hammers -- are now middle-aged. The first generation with Strontium-90 in its bones now has parented a post-Chernobyl generation with Iodine-131 in its thyroids.

Twenty years after Earth Day, those of us who set out to change the world are poised on the threshold of utter failure. Measured on virtually any scale, the world is in worse shape today than it was 20 years ago.

How could we have fought so hard, and won so many battles, only to find ourselves now on the verge of losing the war? The answers are complex. But if we can understand the mistakes that led to our current dilemma, we may yet be able to redeem our youthful promises to the next generation.

Roots of the Modern Environmental Movement

The American *conservation* movement has a long, distinguished tradition, tracing back to such giants as Thoreau, Audubon, Muir and Leopold. However, the *environmental* movement is of much more recent origin. Individuals, such as Rachel Carson and David Brower sounded the environmental alarm in the 1960's, and events such as the Santa Barbara oil spill of 1969 and the Storm King battle in New York gave rise to local waves of concerned activists. But a full-blown national movement emerged only in 1970.

Following the original Earth Day -- on April 22, 1970 -- the American conservation movement exploded in size and broadened its agenda to encompass modern urban and industrial issues. Old-line organizations saw their memberships double and triple, and the new members had broad environmental interests. This new membership -- much of it having tested its mettle in the anti-war and civil rights and women's movements -- caused many traditional conservation organizations to expand their agendas.

The modern environmental movement has enjoyed a string of spectacular successes on Capitol Hill, in the courts, and in the streets. Earth Day's 25 million participants could not be ignored. Within months, the federal Environmental Protection Agency was created. Congress then swiftly passed the Clean Air Act, the Clean Water Act, RCRA, FIFRA, CERCLA, and a host of other laws which fundamentally changed the rules under which American enterprise operates.

Whenever government agencies or corporations attempted to flaunt these new laws, NRDC and other groups swiftly hauled them into court. The movement's talented, idealistic lawyers have won hundreds of precedent-setting decisions.

Denis Hayes is the Chairman of Earth Day 1990. For the past several years, he has practiced law in San Francisco and taught engineering at Stanford University. During the Carter Administration, he was director of the federal Solar Energy Research Institute. Previously, he was a senior fellow at the Worldwatch Institute and a visiting scholar at the Smithsonian.

When litigation proved to be too slow or ineffective, the environmental movement's guerrillas put their bodies on the line -- in actions explicitly modeled upon the civil disobedience of the early civil rights movement. Such nonviolent direct action has at least temporarily halted some of the worst whaling abuses and most devastating destruction of old growth forests.

Yet, despite all these accomplishments, we are in serious trouble, and the problems are compounding with every passing year. There is no evidence that our leaders have the intelligence, the integrity, and the guts to lead us into a new era.

Environmental threats now vie with nuclear war as the preeminent peril to our species. If the world is to avoid calamity, the environmental movement must take both the tiller and the laboring oar. We must provide the direction and the energy for change. And we must achieve a far more ambitious and fundamental set of goals during the next twenty years than we have in the past.

Lessons From the Last Twenty Years: What Went Wrong?

1. Occasionally We Were Blindsided. Problems Snuck Up On Us Before Anyone Recognized The Threat They Posed.

We possess only a rudimentary understanding of the complex interactions of life in the biosphere, and of the myriad subtle effects of human action upon long-established processes. Comparatively few of the thousands of modern industrial chemicals have been subjected to thorough laboratory or epidemiological tests. We know even less about the cumulative, synergistic effects of long-term exposure to multiple chemicals on human health. We know still less about the effects of these chemicals upon other species, and upon the natural cycles -- the water cycle, the carbon cycle, the nitrogen cycle, etc. -- that shape the living planet. Indeed, on many important subjects, the range of opinion is greater among recognized experts than among the lay public. When you think about it, that is a shocking state of affairs.

Even where there is agreement among the experts, the consensus is often later found to have been wrong. If at the time of the first Earth Day a poll had been taken of industrial chemists, asking each to name ten triumphs of modern chemistry, most would probably have listed chlorofluorocarbons. These compounds served a diverse array of beneficial uses, and they appeared to have no undesirable side-effects. They are not toxic, carcinogenic, or mutagenic. They do not corrode materials; they are not flammable; and they don't explode.

If was not until 1974 -- four years after Earth Day -- that Professor Sherwood Rowland and his colleagues at the University of California at Irvine discovered that CFCs could pose a theoretical danger to the stratospheric ozone layer which protects the Earth from ultraviolet radiation. And it was not until 1985 -- just four years ago -- that a British team discovered a huge seasonal thinning of the Antarctic ozone.

A CFC molecule requires about 15 years to migrate up to the stratosphere. Therefore, virtually all the damage currently wrought on stratospheric ozone is being caused by CFCs that were released before Professor Rowland conducted his initial studies in 1974. Once in the stratosphere, the chlorine from a single CFC molecule will catalyze the destruction of ozone, on average, for about a century, during which time it will destroy 100,000 ozone molecules.

CFCs were in use for fifty years before they were found to have *any* negative side effects. Now it has been determined that the side effects could include the destruction of vital links in the food chain, increases in skin cancer, and harm to human immunological systems.

Ozone threats are not a unique example of our ignorance. Until recently, we employed asbestos routinely throughout our built environment, never dreaming the havoc it could cause to human health. Today a thriving industry exists for the sole purpose of removing asbestos from locations where it poses a health hazard. Asbestos litigation is carving out new domains of tort law.

Another example of scientific uncertainty, which has catapulted to widespread public attention only in the last year, is the debate over the health effects of non-ionizing electromagnetic radiation. Some evidence indicates that electromagnetic fields (EMFs) can promote childhood leukemia, fetal deformities, learning disabilities, depression, miscarriages, and cancer. Until recently, there was a consensus among mainstream scientists that EMFs had no biological effects. Today, virtually all scientists concede that such radiation does interact with tissue at the cellular level, but they disagree as to whether these effects are harmful. The debate is hindered because the EPA's major study of the field -- like so many of

EPA's important health studies -- was eliminated under President Reagan. If, like asbestos, EMFs are found to foster health risks, the consequences will be far-reaching. In addition to high voltage transmission and distribution lines, potentially dangerous EMFs are created by computers, photocopiers, cellular phones, and even household appliances. *Consumer Reports* this month recommended that pregnant women and infants avoid electric blankets.

Asbestos, EMFs, and CFCs have given us a degree of humility. When yesterday's "triumph of modern chemistry" turns out instead to be today's deadly threat to the global environment, it is legitimate to ask what else we don't know.

2. It is Always Easier to Tackle Urgent Problems Than Distant Threats -- Even When the Distant Threats Are More Important.

In 1978, four years after the oil embargo, the *Washington Post* carried a column heaping thick ridicule upon those energy experts "purporting to describe an unparalleled misfortune that exists, if its exists at all, at an imaginary point where six or seven lines intersect on a graph." Soon thereafter, war erupted between Iran and Iraq; oil production from the two countries fell from 8 million barrels per day to two million; and the world price for oil doubled.

This tendency to dismiss "lines intersecting on a graph" remains a staple of American political thought. Among countries, we are what boxers call a counter-puncher. What we do best is respond. Bomb Pearl Harbor, and American will pull out all the stops. Launch sputnik, and America will have NASA functioning overnight.

What America does *not* do well is anticipate and avoid problems. Unfortunately, many environmental phenomena involve thresholds that, when passed, cause damage that is essentially irreversible. If we wait until the damage occurs and then respond, it will be too late.

History provides many examples where such thresholds have been breached and ecological collapse has ensued. Civilization first took root in Mesopotamia, a region between the Tigris and Euphrates rivers known as the fertile crescent. Here the wheel was invented and the earliest known writing was produced. Unsustainable irrigation practices destroyed the region's fertility and turned it into the desert wasteland that is now Iraq.

Similarly, North Africa was the breadbasket of the Roman Empire. It produced the huge agricultural surpluses that fed the Roman legions around the known world. Again, the very agricultural practices that produced the region's surpluses ultimately undermined its fertility. Today, the North African desert is on the march. Some areas are suffering mass starvation, and the region imports more than half of its grain. I

We face numerous such thresholds in the years ahead. Some, such as rainforest destruction, are already causing irreversible harm. Every area cleared is lost forever. Others, such as global warming, could eventually result in rising oceans covering huge tracts of land, including the rice-producing river deltas of East Asia. These are not problems we can experience and then respond to. They are problems we must avoid.

The root of this failing lies in discount rates. We tend, for fundamental economic reasons, to assign a higher value to a dollar of income we receive today than to a dollar promised for delivery a year from now. We "discount" the future dollar-to a lower present value.

In the same way, we discount future costs. The farther into the future a cost is postponed, the lower its present value. Even future death is discounted. Radon from uranium mining will cause a certain predictable number of deaths for hundreds of years into the future. In calculating the cost benefit ratio for trapping radon where it will do no harm, a death 50 years from now is given a lower value than a death tomorrow. To anyone other than an economist, of course, this is appalling.

Take an extreme example. Assume we could invest in a Faustian device that would give the world immediate access to an unlimited supply of affordable, environmentally-benign energy. We could use this source as we wished for 200 years. On the last day of the 200th year, the Earth would be blown to smithereens. Under the methodology and values of the financial systems used in both market economies and in planned economies, every bank and brokerage house would be scrambling for a piece of the action. The contemporary rewards are great. The costs will be delayed so far into the future that their present value is zero.

It is this same methodology that leads lumber companies to harvest 1,000 year-old redwoods, and also leads them never to plant a redwood sapling.

The contemporary essayist, "Adam Smith," has written that "killing whales is very profitable until the day when there are no more whales, because we have only been amortizing the ships and the radar and the depth charges and the harpoons. We haven't amortized the whales, and anyway, how do you replace whales?"

You don't.

The role of governments is to rise above this methodology. Government has the power to remove redwoods and whales from the financial marketplace before they disappear. Redwoods are protected inside national parks. Rapacious lumber companies cannot harvest a redwood tree that is inside a national park, regardless of what price they are willing to pay. The protected trees are, quite literally, priceless. Whales, likewise, are protected by various laws, treaties and conventions.

But government has its own limitations. The problem is that politicians also have discount rates -- governed roughly by the next election, and loosely by the politician's expected political lifetime. Problems that will be felt only after a politician has retired from office are perceived to be "on someone else's beat."

Environmentalists must force the political system to assign high priority to distant but dire threats. We must draw a line in the political sand on *this* side of each irreversible threshold. The public intuitively understands this. Environmental victories are always carried on the shoulders of a mobilized public.

3.The "Solutions" We Pursue For Today's Problems Can Create Tomorrow's Catastrophes.

Despite all the environmental literature, both scholarly and poetic, describing how everything is connected to everything else, we have repeatedly ignored this elementary truth. We organized our departments and agencies to solve problems on a piecemeal basis. As a result, we frequently cleaned the air by polluting the water, and cleaned the water by fouling the ground.

We face a serious possibility of making the same error again. For example, some are advocating biodegradable plastics as the answer to the plastic litter problem. Discarded plastic six-pack holders can strangle birds and other species; plastic "baggies" can wreak untold havoc in marine environments; plastic diapers are clogging our landfills. But the problems posed by biodegradable plastics are themselves serious. For example, when biodegradable plastic is mixed with other plastic, it renders the latter virtually impossible to recycle. Biodegradable (and photodegradable) plastic may have some important uses, such as in medicine and possibly in composing, but it holds no promise as "the" solution to plastic waste.

Similarly, many are advocating the construction of hundreds of large incinerators as the answer to the declining availability of landfills for garbage. However, such incinerators produce major air pollution problems, and their hazardous ash constitutes a difficult disposal problem. Perhaps most important, incinerators create a strong vested interest in a continual flow of combustible trash which can effectively destroy efforts at source reduction, recycling, and composing -- all preferable solutions to incineration. This is an instance where a bad solution can preclude better solutions.

Nuclear power is another example of a solution being worse than the problem. The nuclear industry is mounting a massive international campaign heralding a new generation of "inherently safe" reactors as the answer to the problem of global warming. But the problems inherent in nuclear fission pose a threat that is at least as intractable as global warming.

As a thinking exercise, assume that the world's population will level off after one more doubling at 10 billion. Further posit a goal of meeting a per capita energy demand that is 1/3 of the current level in the United States -- more than enough for a productive economy and comfortable lives.

Meeting this level of demand with coal would have dire consequences for global warming. Atmospheric carbon dioxide would double in about twenty-five years.

To meet this same level of demand with nuclear energy would require the world to use 20 million kilograms of pluto-

nium per year. *Every year.* This is enough plutonium to manufacture 4 million Hiroshima-size bombs. Every year. It is impossible to imagine this flood of fissile material continuing for many years without it leading to wide-spread weapons proliferation among nations, terrorist groups, and even criminal gangs.

Naturally, the Department of Energy has enthusiastically endorsed this path. The enduring affection of the Department of Energy for nuclear fission brings to mind Disraeli's classic dismissal of Gladstone: "He had only one idea, and that was wrong."

More troubling is the born-again nuclear enthusiasm of leading environmentally-sensitive politicians, and the ambiguous stances of some environmental spokesmen.

Coal versus nuclear is not a Hobson's choice. It's a false choice. We must not solve global warming by creating nuclear garrison state. We must not approach problems with such singleminded tunnel vision that our "solutions" ultimately make things worse.

4.Time and Again, the Environmental Movement Has Relied Too Heavily Upon the Government.

The irony in our over-reliance on government is not subtle. The punch line of many jokes is "We are from the government, and we are here to help you."

The government has aggressively promoted unsustainable agricultural practices, an unbalanced transportation system, the nuclear power quagmire, dams with no purpose but pork, and logging policies reminiscent of Paul Bunyan. Government is the nation's largest polluter, and it frequently exempts itself from rules it applies to industry. The toxic brews around nuclear weapons facilities may be the most contaminated sites in the world, and the estimated price tag to clean them up is more than $150 billion.

It would be difficult to find a more compelling example of governmental failure than the responses to the energy crises of the 1970's. The first response was to cook up a pot of Potomac alphabet soup. The AEC and the OCR were folded into ERDA and the FEO (which became the FEA). These were merged with the FPC and redeployed as the DOE, the FERC, and the NRC. The result was congealed chaos.

The second element of Washington's response was to study the issue. Thousands of federal studies were undertaken; their data fill large libraries. But to no effect. The government's approach to energy is like the man in the *New Yorker* cartoon who knows all about art but doesn't know what he likes.

Federal studies were supplemented by a raft of private studies, each of which "proved" what its sponsor wanted to hear. The coal industry actually produced studies showing that acid rain is good for the environment. The nuclear industry's reports showed that operating a reactor is safer than operating a health food store. Considered as a whole, they provide great support for an old piece of folk wisdom: Don't ask the barber whether you need a haircut.

The final element of Washington's response was to throw money around. The record here was especially embarrassing.

Our excursions into what I call lemon socialism -- having the government fund projects that the private sector is too shrewd to finance -- produced a notable collection of gold-plated turkeys. The Synfuels Corporation was America's biggest bust before Star Wars. Despite an initial budget of $88 billion --more than the Space Race, the Marshall Plan, and the Interstate Highway program combined -- the synfuels program yielded no net energy at all.

On the nuclear side of the house, the Clinch River Breeder Reactor was a classic example of Cheop's Law: Nothing ever gets built on schedule or within budget.

In both cases, failure was fortuitous. A successful synfuels program could have increased America's contribution to global warming three-fold, and a successful breeder program would have confronted us with the need to manage thousands of tons of bomb-grade plutonium.

Most of the energy strategies that the government pursued were non-starters, and the situation has deteriorated. U.S. production of oil has been declining since 1971; in July, 1988, for the first time, we imported more than half of all the oil

we consumed. Our vulnerability is far greater today than it was in 1973, at the time of the Arab embargo.

If we follow the current course, we can safely predict the international price of oil to begin rising in 1992-93. OPEC presumably has learned its lesson. These next rises will be no more than 20 to 25 percent per year, though sufficient to cause a fiscal hemorrhage.

The obvious solution is to increase the price of oil ourselves -- with a carbon dioxide tax, and a gasoline tax - - so that the revenues will stay at home to be redistributed and invested. Americans pay between one-half and one-third as much for gasoline as do our industrial allies -- all of whom enjoy robust economies and comfortable lifestyles. (The 1990 fuel efficiency standard for France is 39 mpg, versus 27.5 for the United States.) A dollar-per-gallon gasoline tax would is an important step toward sound energy policy and fiscal integrity. Instead, our leadership resolutely chants its unthinking mantra of "no new taxes," thus guaranteeing that when crude prices soar, the proceeds all will flow to the Middle East.

Not to put too fine a point on it, our national energy program has been a bust. Our leaders have wasted the nation's time, money, and intelligence pursuing a collection of hopeless dead ends. Past programs have enriched certain vested interests and enhanced certain political interests, but they have utterly ignored the national interest. Government has been part of the problem, not part of the solution.

This, obviously, is *not* to suggest that the environmental movement should ignore the government. On the contrary, governments (local, state, federal, and international) must be a major focus of our efforts. Governments will set the rules and establish the framework if we are ever to build a sustainable society.

However, 99 cents of every environmental dollar raised today - - other than funds earmarked for land acquisition - is spent trying to influence government. Such singlemindedness has caused us to ignore other vitally important opportunities. Continuing to pin all environmental hope upon the government is, as Samuel Johnson described a man taking his second wife, a triumph of hope over experience.

5. We Have Not Asked Enough Of Our Supporters.

Most environmentalists are willing -- even eager -- to do more than send money and write letters. We need to appeal to them as consumers, as workers, as investors, and as parents. One of the greatest potential strengths of our movement is the ability to integrate environmental goals into all aspects of a person's life.

All the most successful movements, and all the world's major religions, have succeeded in part because they ask people to improve their behavior. The civil rights movement and the women's movement, for example, ask their supporters for heroic changes in their personal lives.

Environmentalists, on the other hand, have often tried to convince the public that we could all have our cake and eat it too. People were encouraged to believe that, if only we could effect the necessary changes in government and industry, people would not have to change their habits at all.

The answer to air pollution was claimed to be catalytic converters on tailpipes and scrubbers on smokestacks. We have pursued this strategy, at enormous cost, for 20 years. Yet the sky today in Los Angeles resembles split pea soup. We have been spectacularly successful at cleaning up automobile exhaust. Meanwhile, our cities grew larger. People moved farther away from their jobs, and drove more miles; and their cars idled more at stop lights, drivethrough windows and traffic jams.

It was necessary, but not sufficient, to scrub pollutants out of exhaust. We must also begin using cleaner fuels and more efficient engines. We also should encourage widespread use of (and improvements in) public transportation. We should also promote bicycle riding wherever possible (and bicycle lanes and veloways). We should create incentives for people to live closer to their workplaces to reduce urban commuting and the resulting congestion.

Similarly, we should encourage environmental supporters to be mindful of their values when they go shopping. In Europe, the "green consumer" has become a force to be reckoned with. Environmental labels are commonplace; consumer magazines are devoted to the environmental impacts of products. In the United States, such consciousness is only beginning.

Several of us are exploring criteria for an American environmental label, to be awarded to the best products from the best companies. Such an easy guide would convert environmental consumerism from an esoteric research enterprise into an easy habit. It should have been a mainstay of our efforts for the past two decades.

If everyone used the most efficient light bulbs, the most efficient appliances, the most efficient furnaces and optimum insulation, average household energy consumption could be cut by more than two-thirds. If everyone ate more organic produce and more local produce, and moved lower on the food chain, energy use in the food system could be cut by two-thirds. If everyone bought the most efficient vehicle having the same internal dimensions as his current car, gasoline use would fall by more than half.

Perhaps no American behavior is more ripe for change than recycling. Sending our natural resources on a one-way trip from the mine to the dump is spherically senseless: it makes no sense no matter how you look at it. We throw away valuable resources, eliminate jobs, waste embedded energy, and destroy the environment — all because people don't put glass in one container and aluminum in another.

Some of our landfills are now richer in resources than some of our mines. But regulatory and tax systems designed to promote exploration and exploitation in a pioneer society have acquired their own inertia and their own vested interests. So we mine virgin ore instead of reducing use, and repairing, re-using and recycling substances than have already entered the stream of commerce. To take perhaps the most obscene example, the federal government is currently selling 300-year old trees in the Tongas for less than the price of a Big Mac.

Comprehensive recycling is essential. At even a 50 percent recycling rate, after just five cycles, only 3 percent of the original material is left in the economy. We need to do *much* better than that.

Comprehensive recycling and composing will require significant government involvement — to end its bias in favor of raw materials, end its bias in favor of landfills and incinerators, provide curbside pick-ups, set standards, and provide near-term markets for recycled goods. But the necessary first step is to ask people to do their part. Environmentalists must comprehensively recycle all their used items, and we must purchase recycled goods whenever possible.

This past fall, I co-chaired a coalition of environmental leaders and socially responsible investors who developed a new code of ethics for business: the Valdez Principles. These cover the elimination of pollutants, the use of sustainable resources, product safety, damage compensation, disclosure of potential hazards, and environmental representation on corporate boards of directors. Signatory corporations are required to conduct an annual environmental audit by an independent auditor and make the results public. By the time they were announced, the Valdez Principles already claimed support from managers of $160 billion of investments — mostly pension funds and socially responsible mutual funds. The next stage is to seek support for the principles by the trustees of college endowments, and by the general public.

The point of the Valdez effort is to make clear that ethical business practices will benefit owners (shareholders) as well as consumers, employees, neighbors, and the environment. Shareholder interests need to be defined in terms far broader than just the next quarter's dividend, and the Valdez Principles are an important milestone in that direction.

6. The Environmental Movement Has Not Diversified

The most dangerous environments are in communities that are the least powerful. Poor people and people of color are downwind from most toxic incinerators. They are down-gradient from most hazardous waste dumps. They are in the fields when the pesticides are sprayed from planes. They work in factory jobs having the highest exposure to dangerous substances. Yet poor people are not well-represented in the ranks of the environmental movement. In communities racked by the devastation of drugs, plagued with violent crime, suffering school drop-out rates of over 50 percent, experiencing rising problems of homelessness and malnutrition, environmental issues are not considered a "priority." But they should be. The problems are indivisible.

In an important speech in the 1960's at the Riverside Church here in New York, the Reverend Martin Luther King came out against the war in Vietnam. The wave of criticism he suffered was intense. To those who challenged him for getting involved in an issue other than civil rights, he replied that African Americans were being drafted in disproportionate

numbers, and returned home in body bags in disproportionate numbers. There is no more fundamental civil right, he said, that the right to live to be an adult.

Similarly, the right to lead healthy, productive lives means that environmental values should be of great importance to those communities most deeply scarred by environmental degradation.

We environmentalists have to ally ourselves with other who have good reason to be environmentalists, but who have not traditionally been part of this movement. We need to reach out to farmers, laborers, the religious community, health care professionals, educators, and every other identifiable group of prospective supporters.

Why? Because otherwise we will get rolled. There are not currently enough "card-carrying" environmentalists to win the tough political battles that must be won if the 1990's are to be the Green Decade.

There are probably no more than 10 million dues-paying environmentalists in the country. They are powerful beyond their numbers because they tend to be highly educated, well-paid, and politically active. That is enough to pass some good, narrowly tailored legislation. However, it was not enough to successfully withstand the full frontal assault of the Reagan Administration.

Ronald Reagan was the most anti-environmental head of state since Ivan the Terrible. His Department of Interior was controlled by people who regarded wilderness in much the same way that Rome regarded Carthage. The Council on Environmental Quality was pillaged. The Department of Energy was placed in a state of intellectual receivership.

When Wilfred Sheed began reviewing movies for Esquire, he confessed that he reviewed movies "in much the same sense that pigeons review statues." That is how I review the last eight years in the White House. The environmental movement had the strength to drive James Watt and Anne Gorsuch out of government in shame, but we did not have the clout to reverse the wholesale attach on environmental values that characterized the Administration.

Let me cite a particularly painful example. In 1980, the United States led the world in every renewable energy technology. Today, we lead in none. Most of our photovoltaic industry has been sold to foreign companies or abandoned. Renewable energy sales have declined by more than 95 percent. This was not an "accident."

Falling oil prices played a role in the demise of solar, but only a supporting role. The destruction of the U.S. renewable energy industry, and the abandonment of solar research by many of our most prestigious scientists, was the result of explicit governmental policies that served powerful economic interests — the conventional energy industry — which were colorfully characterized during this period by Budget Director David Stockman as "pigs in the trough."

For solar advocates, the Reagan years were like Dunkirk without the boats. The environmental movement — despite all our rhetoric about the absolute necessity for a renewable energy future — was helpless to reverse the Reagan assault. We simply didn't have enough troops, or enough clout.

The environmental movement will face the same hard battles again and again in the years ahead. Global warming, for example, requires that we move swiftly off of fossil fuels and on to renewable fuels. It demands an explosive growth of photovoltaics, a swift transition from oil and gas to solarhydrogen, universal use of passive solar architecture, and perhaps a trillion dollar investment in energy efficiency. Such a transition will necessarily entail winners and losers. Conventional energy producers will be among the losers. These energy producers are some of the richest and most powerful institutions in the country, and they will fight like hell to avoid being phased out of existence.

Our most powerful ally necessarily will be the people. We have no powerful economic institutions on our side. A solar transition will only be achieved if it enjoys enthusiastic backing from a broad cross-section of the entire society. Environmentalists must proselytize much more actively, and much more successfully, than we ever have in the past.

7.We Have Avoided Some Hard Issues.

It will not be possible to build a sustainable society without confronting some controversial, emotional issues. Many environmental organizations have avoided issues that should be of central concern. Two such issues are of paramount concern.

The proposed U.S. military budget for next year is $305 billion — all ostensibly to defend our national security, Yet many of the most vital threats to our security — global warming, ozone destruction, the ecological undermining of agricultural productivity, mounting dependence upon foreign oil, the crack epidemic, the creation of a permanent urban underclass, and the erosion of much of the national infrastructure — all cry out for more money. These threats cannot be averted as long as 75 percent of *all* federal R&D is devoted to military research.

This is not merely an American problem. The world cannot build a sustainable future so long as it spends one trillion dollars annually — virtually all the discretionary capital — on military ends. To take just one poignant example, if Ethiopia had diverted one-third of its military budget to agriculture and tree- planting, the recent tragic Ethiopian famine could have been averted.

Even as Martin Luther King was told to stay out of the war issue, we have well-intentioned friends and allies cautioning us to stay out of the defense debate. They warn us that we will dilute our impact if we spread ourselves too thin. They caution that defense is not an environmental issue. They note that we will alienate many potential supporters with conservative military views if we attack the defense budget as unnecessarily bloated and misdirected.

We must quietly but firmly reject that advice. We can never save the planet if mankind spends $1 trillion a year on instruments designed to destroy it. There was a time when “more” made sense as a military strategy. “More” ships and planes and tanks is what won World War II. But in a nuclear age, “more” can undermine all our aspirations while riot providing any additional measure of security. “More” cannot win a nuclear war, using any sane definition of winning. It is time for a major paradigm shift in how we view national security, and the environmental movement should be leading the way.

Similarly, we frequently are urged to sidestep the population issue. Environmental advocacy of family planning will alienate major religions, certain racial and ethnic leaders, and some heads of state, from the environmental. cause. Some feel we should sidestep the issue and instead focus all our attention upon matters over which we can build a consensus.

Again, we must ignore the advice. The human population, which has doubled since my birth, may quadruple before my death. There is no reason to believe that the Earth can sustain these higher numbers indefinitely, even with radical changes in diet and lifestyle. Failing to come to terms with population growth will guarantee unprecedented disaster, of which the recent North African famine was merely a preview.

Current population levels are undermining the biological basis for our future. Water tables are plummeting far faster than they are recharged. Topsoil is eroding 5 times faster than it is replaced; in some parts of Ohio, farms lose 2 bushels of topsoil for every bushel of corn harvested. Pests display an increasing resistance to pesticides. Deserts are on the march in Africa, Asia, Australia and America. There is not a single important problem facing the planet that could not be more easily solved with a population of under 5 billion.

The claim sometimes is made that the United States is overpopulated, but India is not. The purported explanation is that the average American consumes 20 times more resources than the average Indian. The core assumption underpinning such an argument is that India will never develop, and that the average Indian’s impact on the Earth will remain negligible. While the environmental destruction caused by contemporary Americans is unconscionable and should not be continued or replicated, it is similarly unconscionable to consign the majority of the world’s population to perpetual poverty.

Global population growth is an urgent priority, and it must be addressed with substantial family planning assistance and provisions for social mechanisms (e.g. old age insurance) to undercut the motivations for large families while advancing social justice. For $4 billion per year, family planning could be provided to all who want it. It might be the single most cost-effective investment available to the world. But right-wing religious zealots have intimidated much of our political leadership, and virtually all national Republican leadership.

Unless human population growth is halted, we will suffer the same ecological collapse that has governed other species that have bred themselves into oblivion. The record of the last two American administrations on population issues — their overt hostility to family planning — has been irresponsible and immoral.

We Have The Power To Choose Our Future

During the last eight years, the U.S. national debt has nearly tripled. The United States has shifted from being the world's greatest creditor nation to being the world's largest debtor. Hostile takeovers, leveraged buy-outs, and greenmail have left our businesses mortgaged to the hilt in unstable junk bonds. The Federal Savings and Loan Insurance Corporation has collapsed under $300 billion of prospective liability. It is not a promising time to look to the federal government for salvation.

Instead, we must look to ourselves.

A common feature of all the problems we have been discussing is that none is the result of forces beyond human control. None is caused by sun spots, or the gravity pull of the moon, or volcanic activity. All are the result of conscious human choices. All can be cured by making other choices.

First, we need to make our own lives congruent with our values. For most of us, there is room for improvement in virtually all spheres. We should conserve energy with easy things, such as replacing incandescent light bulbs with folded fluorescents which are five times as efficient, insulating our water heater, and doing laundry in cold water. Then we should do the more expensive and difficult things, such as superinsulating our dwellings and buying a more efficient furnace and more efficient appliances.

We should pledge not to purchase another new car until we can buy one that meets our needs while getting at least 50 miles per gallon. We should install flow restricters in our faucets and showers, and dams in our toilets. We should plant indigenous vegetation. We should search out environmentally sensible soaps and cosmetics, and look for recycled paper and other products.

We should eat lower on the food chain, and develop a preference for fresh organic products grown nearby. We should carry our own, reusable string bags to the supermarket, and search out ways to eliminate other unnecessary packaging. We should recycle our metals, glass, paper, and plastics, and compost all organic waste.

There are many reasons why such lifestyle changes make sense. In the aggregate, they make a huge difference. If everyone used the most efficient refrigerators available, we could save the equivalent of 12 large nuclear power plants. Using the most efficient cars having the same internal dimensions as our current vehicles would cut gasoline consumption in half. Every year, we send more iron and steel to our dumps than we use in the entire automobile industry. The aluminum we throw away every three months could replace the nation's entire fleet of airplanes.

Leading lives that are congruent with your values is a necessary and important first step, but it does not discharge your responsibility. Next you need to explore what you can do as an employee, an investor, a parent, and a member of your church and civic clubs. You should be alert to ways you can lessen the environmental impact of your job, from avoiding styrofoam coffee cups to suggesting modifications in industrial processes. You should ask your pension fund trustees to adhere to the Valdez Principles in choosing investments. You should set a good example for your children.

Integrating your values into your job and your other activities is another important step, but it still does not discharge your responsibilities. Next, join local and national organizations that share your goals and your philosophy, and proselytize on their behalf. Give gift memberships for Christmas; display their publications on your coffee table; support their campaigns financially and with your volunteer efforts.

Working on behalf of environmental groups that represent your views is vitally important, but this still does not fully discharge your responsibilities. The next step is to become actively involved in politics. Support candidates who share your vision; vigorously oppose those who do not. Invest the time, energy, and financial support needed to win elections. Play the sort of role that causes political friends and foes alike to view you as a person of substance, a person to be reckoned with. Communicate your environmental goals and values to your candidate, and make clear that there are narrow limits on how much compromise is acceptable.

Finally, my most urgent plea to each of you is to play an active role in organizing Earth Day 1990.

Earth Day — April 22, 1990 — will officially usher in the 1990's as the green decade. Earth Day organizations have sprung up in thousands of American communities and hundreds of colleges and universities. We have almost a thousand

affiliated organizations in 103 countries on all continents. We are raising a citizens' army to fight for the future of the planet.

Earth Day campaigns have been designed for elementary and secondary schools, as well as for colleges and universities. There is a "green pledge" campaign, a minority outreach campaign, religious campaigns, and labor campaigns. Earth Day will recognize corporate environmental leadership, and it will criticize those who are fouling the planet.

On Earth Day, more than 100 million people around the world will make a personal affirmation of their environmental commitments. At the same time, we will send a message to our leaders that talk is no longer sufficient. Time is running out. We have, at most, ten years, to embark on some undertakings if we are to avoid crossing some dire environmental thresholds.

Individually, each of us can do only a little.

Together, we can save the world.

SUSTAINABILITY IS NOT ENOUGH*

Vernon W. Ruttan**

ABSTRACT. Traditional agricultural systems that have met the test of sustainability have not been able to respond adequately to modem rates of growth in demand for agricultural commodities. A meaningful definition of sustainability must include the enhancement of agricultural productivity. At present, the concept of sustainability is more adequate as a guide to research than to farming practice.

Any definition of sustainability suitable as a guide to agricultural practice must recognize the need for enhancement of productivity to meet the increased demands created by growing populations and rising incomes. The sustainable agricultural movement must define its goals sufficiently broadly to meet the challenge of enhancing both productivity and sustainability in both the developed and developing world. I will illustrate the problems of achieving these goals with some historical examples.

Ambiguity About Technology

The productivity of modern agriculture is the result of a remarkable fusion of science, technology and practice. This fusion did not come easily. The advances in tillage equipment and crop and animal husbandry which occurred during the Middle Ages and until well into the 19th century evolved almost entirely from husbandry practice and mechanical insight. The power that the fusion of theoretical and empirical inquiry has given to the advancement of knowledge and technology since the middle of the 19th century has made possible advances in material well-being that could not have been imagined in an earlier age.

These advances have also been interpreted as contributing to the subversion of traditional rural values and institutions and to the degradation of natural environments.

They led, in the 1960s and 1970s, to the emergence of a new skepticism about the benefits of advances in science and technology. A view emerged that the potential power created by the fusion of science and technology is dangerous to the modern world and the failure of the human race.

This ambiguity about the impact of science and technology on institutions and environments has led to a series of efforts to increase the sensitivity of scientists and science administrators and to reform the decision processes for the allocation of research resources. These efforts have typically attempted to find rhetorical capsules which would serve as a banner under which efforts to achieve reforms might march. Among the more prominent have been "appropriate technology," "integrated pest management," "low-input technology" and, more recently, "sustainability."

Reforming Agricultural Research

It is not untypical for such rhetorical capsules to achieve the status of an ideology or a social movement while still in search of a methodology, a technology, or even a definition. If the reform movement is successful in directing scientific and technical effort in a productive direction, it becomes incorporated into normal scientific or technological practice. If it leads to a dead-end, it slips into the underworld of science often to be resurrected when the conditions which generated the concern again emerge toward the top of the social agenda.

Research on new uses for agricultural products is an example. It was promoted in the 1930s under the rubric of chemurgy and in the 1950s under the rubric of utilization research as a solution to the problem of agricultural surpluses. It lost

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both scientific and political credibility because it promised more than it could deliver. It has emerged again, in the late 1970s and early 1980s, in the guise of enhancing value added.

The "sustainability" movement, like other efforts to reform agricultural research, has experienced some difficulty in arriving at a definition that can command consistency among the diverse and sometimes incompatible reform movements that are marching under its banner. Those of you who may recall the more populist conservation literature of the 1950s, such as *Topsoil and Civilization* (1955) by Tom Dale and Vernon Carter, or *Malabar Farm* (1947) by Louis Bromfield, will recognize the poetry that has emerged in some of the new sustainability literature. Fortunately we can draw on several historical examples of sustainable agricultural systems.

Sustainable Agricultural Systems

One example of sustainable agriculture was the system of integrated crop-animal husbandry that emerged in Western Europe in the late middle ages to replace the medieval two- and three-field systems (Boserup, 1965). The "new husbandry" system emerged with the introduction and intensive use of new forage and green manure crops. These in turn permitted an increase in the availability and use of animal manures. This permitted the emergence of intensive crop-livestock systems of production through the recycling of plant nutrients in the form of animal manures to maintain and improve soil fertility.

A second example can be drawn from the agricultural history of East Asian wet rice cultivation (Hayami and Ruttan, 1985). Traditional wet rice cultivation resembled farming in an aquarium. The rice grew tall and rank; it had a low grain-to-straw ratio. Most of what was produced, straw and grain, was recycled into the flooded fields in the form of human and animal manures. Mineral nutrients and organic matter were carried into and deposited in the fields with the irrigation water. Rice yields rose continuously, though slowly, even under the monoculture system.

A third example is the forest and bush fallow (or shifting cultivation) systems practiced in most areas of the world in pre-modern times and today in many areas of tropical Africa (Pingali, Bigot and Binswanger, 1987). At low levels of population density, these systems were sustainable over long periods of time. As population density increased, short fallow systems emerged. Where the shift to short fallow systems occurred slowly, as in Western Europe and East Asia, systems of farming that permitted sustained growth in agricultural production emerged. Where the transition to short fallow has been forced by rapid population growth, the consequence has often been soil degradation and declining productivity.

Sustaining and Enhancing Productivity

This brings me to the title of this paper. The three systems that I have described, along with other similar systems based on indigenous technology, have provided an inspiration for the emerging field of agroecology. But none of the traditional systems, while sustainable under conditions of slow growth in demand, has the capacity to respond to modem rates of growth in demand generated by some combination of rapid increase in population and in growth of income. Some traditional systems were able to sustain rates of growth in the 0.5-1.0 percent per year range. But modem rates of growth in demand are in the range of 1.0-2.0 percent per year in the developed countries. They often are in the range of 3.0-5.0 percent per year in the less developed and newly industrializing countries; rates of growth in demand in this range lie outside of the historical experience of the presently developed countries!

In searching the literature on sustainability, I do not find sufficient recognition of the challenge that modem rates of growth in demand impose on agriculture. If the concept of sustainability is to serve as a guide to practice, it must include the use of technology and practices that both sustain and enhance productivity.

In the United States, the capacity to sustain the necessary increases in agricultural production will depend largely on our capacity for institutional innovation. If we lose our capacity to sustain growth in agricultural production, it will be a result of political and economic failure. Failure to reform agricultural commodity programs in a manner that will contribute to both sustaining and enhancing productivity will mean the loss of one of the few industries in the United States that has managed to retain world-class status--that is capable of competing in world markets (Ruttan and von Witzke, 1988).

It is quite clear, however, that the scientific and technical knowledge is not yet available that will enable farmers in most tropical countries to meet the current demand their societies are placing upon them nor to sustain the increases that are currently being achieved. Further, the research capacity has not yet been established that will be necessary to provide the knowledge and the technology. In these countries, achievement of sustainable agricultural surpluses is dependent on advances in scientific knowledge and on technical and institutional innovation.

Implications for Research

I am deeply concerned that the commitment to support the development of the research capacity in both developed and developing countries that will be necessary to achieve productive and sustainable agricultural systems has been weakening. And I am also concerned that the sustainability movement is pressing for adoption of agricultural practices under the banner of sustainability before either the science has been done or the technology is available.

It has been surprisingly difficult to find careful definitions of the term sustainability. This is at least in part because "sustainability," if it is to provide a useful rhetoric for reform, must be able to accommodate the several traditions that must march under its banner. These include the organic agriculture tradition, the land stewardship movement, the agroecology perspective, and others. In my judgment, any attempt to specify the technology and practices that meet the criteria of sustaining and enhancing productivity would be premature. *At present it is useful to define sustainability in a manner that will be useful as a guide to research rather than as an immediate guide to practice*. As a guide to research, it seems useful to adhere to a definition that would include (a) the development of technology and practices that maintain and/or enhance the quality of land and water resources, and (b) the improvement in plants and animals and the advances in production practices that will facilitate the substitution of biological technology for chemical technology.

Furthermore, it is desirable to generate the knowledge that will enable us to determine what it is possible to achieve in the direction of the above objectives primarily from a biological perspective. Maximum yield experiments represent a useful analogy. The objective of a maximum yield experiment or trial is not to provide a guide to farm practice. Rather it is to find out how a plant population performs under high level input stress. *The research agenda on sustainable agriculture needs to define what is biologically feasible without being excessively limited by present economic constraints*.

References

Boserup, E. 1965. Conditions of Agricultural Growth. Aldine Publishing Company, Chicago, Illinois.

Bromfield, L 1947. Malabar Farm. Harper, New York, New York.

Dale, T., and V. G. Carter. 1955. Topsoil and Civilization. Oklahoma University Press, Norman, Oklahoma.

Hayami, Y., and V. W. Ruttan. 1985. Agricultural Development: An International Perspective. The Johns Hopkins University Press, Baltimore, Maryland, pp. 280-298.

Pingali, P., Y. Bigot, and H. P. Binswanger. 1987. Agricultural Mechanization and the Evolution of Farming Systems in Sub-Saharan Africa. The Johns Hopkins University Press, Baltimore, Maryland.

Ruttan, V. W., and H. von Witzke. 1988. Toward a Global Agricultural System. Interdisciplinary Science Reviews (in press).

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REFORM AND INNOVATION OF SCIENCE AND EDUCATION: PLANNING FOR THE 1990 FARM BILL

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AGRICULTURAL RESEARCH AS SOCIAL PLANNING: SETTING AGRICULTURAL RESEARCH PRIORITIES TO ADVANCE SOCIAL GOALS

(By Chuck Hassebrook, Center for Rural Affairs)

Agriculture research is a form of social planning. Choices made by Congress, research institutions and researchers about what research is undertaken in part determine what farming systems, varieties and technologies are developed, become cost effective, and are put to use. These technologies, in turn, profoundly shape our economic and social structures, the natural environment and human health. If we are to achieve the kind of society we want, these decisions must be made with consideration of broad social and environmental goals. If we are to be a truly democratic society, the public must gain control of these decisions.

Unfortunately, many land-grant research programs are not guided by any broad set of public purposes, leaving a void to be filled by private companies with product development interests. For example, land-grant institutions have been scrambling to develop research programs in biotechnology, but few have defined agronomic or social goals for such research (Buttel, 1986). In the absence of clear public purposes, private parties often leverage public research funds and the time of public sector agriculture researchers to advance their private interests through grants and consulting arrangements with, equity interest in, and employment by biotechnology companies (Buttel, 1986). Many land grants now view royalties from patents and fees as a source of income to support research (Burkhardt, et al., 1987), creating pressure to direct agricultural research toward development of products to sell to farmers. What may be lost in the shuffle is research which helps farmers cut input costs and consequently offers little profit potential to agribusiness corporations (Buttel, 1986). As for consideration of the structure of agriculture in setting research priorities, the University of California and National Association of State Universities and Land-Grant Colleges recently argued in court that land-grant experiment stations have no obligation under Federal law to consider impacts on small family farms in setting their research agenda and a California appellate court agreed (Court of Appeal of the State of California, 1989).

Goals And Purposes Of Public Agricultural Research

The establishment of priorities for public sector research plays too large a role in shaping society to be left to individual scientists and product development interests. If agricultural research is to advance broad public purposes, Congress must take the lead by articulating the appropriate goals and purposes. Those goals and purposes should include the following:

-Maximize the number of opportunities for self-employment in agriculture and rural communities and enhance -an economic and social structure free of great inequality. A substantial body of sociological research indicates that a dispersed farm structure with many owner operated farms creates healthier communities than a large farm structure. A University of California researcher summarizes these findings as follows:

As farm size and absentee ownership increase, social conditions in the local community deteriorate. We have found depressed median family incomes, high levels of poverty, low education levels, social and economic inequality between ethnic groups, etc., associated with land and capital concentration in agriculture. . . . Communities that are surrounded by farms that are larger than can be operated by a family unit have a bi-modal income distribution with a few wealthy elites, a majority of poor laborers, and virtually no middle class. The absence of a middle class at the community level has a serious negative effect on both the quality and quantity of social and commercial services, public education, local governments, etc. (MacCannell, 1983)

—*Prevent environmental contamination and resource depletion*. Over 170 million acres of U.S. farmland are eroding faster than new soil is formed, threatening long term food production potential and contaminating surface waters (USDA, 1987). (This data predates implementation of the Conservation Reserve Program and consequently may be overstated by 25 to 30 million acres.) A 1985 .U.S. Geological Survey study revealed that 20 percent of the Nation's wells are contaminated by nitrogen fertilizers (Madison and Brunett, 1985). More than 25 percent of Iowa's population is using drinking water that contains pesticide residues (Hallberg, 1986). To date, the Environmental Protection Agency has found 74 different pesticides in the ground water of 38 States including Nebraska (EPA, 1988).

—*Enhance human health*. While much attention has been focused recently on issues of food safety, growing evidence of the impact of modern farming practices on the health of farmers has received relatively little attention. Numerous

epidemiological studies have shown a strong correlation between various types of cancer, especially leukemias, and farming or living in agricultural areas (Strange, Krupicka and Looker, 1984). Studies by the National Cancer Institute and the University of Kansas indicate that farmers who are exposed to herbicides for more than 20 days each year are six times more likely than nonfarmers to develop cancerous tumors known as non-Hodgkins lymphomas (The Furrow, 1988).

—*Enhance the resiliency of our food and fiber system.* "U.S. oil production is poised on the edge of a sharp dropoff" and with that dropoff, the United States "may be unable to export food much beyond the year 2000" (Gever, et al., 1986). Likewise, U.S. agriculture is vulnerable to potential rainfall reductions associated with global warming. Although the impact of global warming on rainfall patterns is most uncertain, some climatologists predict that the " greenhouse effect" will shift rainfall north and east away from the Nation's best soils, moving unirrigated corn production out of most of Illinois, Iowa, Kansas, Missouri, Nebraska, and the Dakotas in 50 years (Decker, 1985). -Enhance efficiency and maintain our competitiveness, as we address social and environmental concerns.

Can the Nation's public agricultural research system advance each of these goals simultaneously? I believe that it can do so, but it will not, unless we fundamentally change both current directions in agricultural research and the ways in which research priorities are established.

Industrial Versus Sustainable Systems

Much of the current public research program pursues an industrial approach to agriculture, which is inimical to rural social well being and environmental quality. These systems seek efficiency through reducing the role of people in agriculture, both quantitatively and quality, to make it possible for fewer people to farm the Nation's land and produce its food and fiber. They seek to reduce the amount and sophistication of labor involved in farming to make it possible to more completely separate labor from management and the exercise of judgment to facilitate provision of farm labor by unskilled and low paid employees. These systems use technology, such as chemical and biological products, to override the pest and nutrient constraints on monocrop systems, such as continuous corn. While research may yield new and safer products to over come these constraints, industrial systems will remain vulnerable to the development of resistance by pests and the resistance of natural systems to monocropping and biological uniformity. Likewise, these systems will remain on a treadmill on which new products are needed on a continuing basis to respond to such developments. And for the foreseeable future, these products will continue to present health and/or environmental risks.

By contrast, if we want agriculture research to advance each of the goals set forth above, I believe it can do so, but only if we take a fundamentally different approach to agriculture and technology. That approach is sustainable family farm agriculture, in many respects a more sophisticated and more knowledge and management intensive system than industrial systems.

Sustainable systems seek efficiency by enhancing the role of people in agriculture and making it possible to reduce capital expenditures and input use through more intensive application of skilled labor and hands on management. Whereas industrial systems seek to reduce costs by replacing $2 worth of time with $1 worth of inputs, sustainable family farm systems seek to improve efficiency by replacing $2 worth of inputs with $1 worth of time. Because these systems rely on sophisticated and highly motivated labor able to exercise judgment in the field and barn, they are well suited to an owner-operator structure. These systems require a better understanding of natural systems to enable farmers to adjust their management practices to work in concert with nature, to avoid problems and reduce the need for inputs. They typically involve practices such as crop rotation and cover crops to meet nutrient needs, reduce pest problems, conserve soil and reduce vulnerability to drought.

Several examples illustrate the alternative research approaches appropriate to these two systems. In the area of weed control, no focus of research has recently received more attention and more research dollars than the development of herbicide resistant crop varieties. Such varieties would allow farmers to use a greater number of herbicides to provide more complete weed control chemically, and thereby eliminate the need for mechanical cultivation, allowing one person to farm more acres. This is exemplar of the industrial approach. By contrast, a sustainable agriculture research focus would be the development of more cold tolerant crop varieties, which germinate and emerge faster in cool spring temperatures to get ahead of weeds and allow for more effective weed control without chemicals through light tillage, such as rotary hoeing and row cultivation. The former seeks to reduce costs by reducing the role of the farmer. The latter seeks efficiency by enhancing the role of the farmer to reduce purchased input use.

In the area of insect and disease control, industrial systems are supported by research to create new products for farmers to buy to control the pests that plague monocrop systems, such as corn rootworm, grey leaf spot and head smut in continuous corn (corn produced on the same land year after year). By contrast, sustainable agriculture would be supported by research in the field of agroecology, aimed at developing an understanding of the interactions between living organisms, environmental conditions and farming practices in agricultural ecosystems. Such research would provide the knowledge base for farmers to use their skills and management to alter practices and farm in concert with nature, to avoid pest epidemics. Plant breeding efforts supportive of sustainable agriculture would focus on developing resistance to those pests which are not adequately controlled by economically acceptable changes in farming practices. Researchers would develop new uses for the crops added to rotations in sustainable systems, such as oats and alfalfa, to make these rotations more profitable.

In livestock production, millions of dollars of public funds have been spent to refine industrialized total confinement production systems for hogs and other livestock, and to address diseases and other problems which occur in these systems. By their very nature, total confinement systems move meat and milk production off of moderate sized owner operated farms. The high investment costs preclude small scale application and the routinization of labor and management tasks in these systems is conducive to employee operation. For example, it costs twice as much per cow to build confinement facilities for a 52 cow dairy as for a 600 cow dairy (Buxton, 1985). Lower investment facilities are a better alternative to moderate scale producers. A University of Tennessee study found that hogs could be produced more cheaply in a moderate investment farrow-to-finish system than in a high investment total confinement system (Johnston, 1984).

A sustainable family farm research agenda in livestock production would focus on development of lower investment livestock production systems which reduce capital barriers to small and beginning farmers and allow them to earn a return on their skilled labor and the intensive hands on management that such systems require. Disease and breeding research would focus on overcoming the stresses in such systems, including parasites and temperature variation. Researchers would seek to improve the nutritional con tent of the crops grown on diversified farms to reduce the need for feed supplement purchases. This would reduce the significance of the economic disadvantage smaller farms face in buying feed inputs. Small hog producers pay much more for their feed supplements than larger producers (Van Arsdall and Nelson, 1985).

Policy Recommendations

The highest priority for the research title of the 1990 farm bill should be articulation of the goals and purposes of the Federal investment in agricultural research, including formula funds, competitive grants and other Federal agricultural research funds. Those goals and purposes should include those presented earlier in this paper for the structure of agriculture, human health, farm resiliency and environment. Procedures should be defined by Congress to ensure that these goals and purposes are reflected in the research priority setting process. That should include requiring an annual report of the Agriculture Research Service and each land-grant experiment station describing its efforts to incorporate these goals in its research priority setting process. In addition, the USDA Joint Council and Extension Users Advisory Board should report annually on how they have incorporated these goals in their plans and recommendations.

With respect, to competitive grants for agricultural research, Congress should direct the administering bodies, including USDA and the National Science Foundation, to incorporate these goals both in their calls for proposals and criteria for evaluating proposals. That may require giving them the authority to spend a portion of their funds on research to assess likely impacts of alternative research directions. The result might be calls for proposals that list areas of research deemed to be especially appropriate, and criteria that reward research in such areas. For example, a call for proposals might give priority to basic research in agroecology or research aimed at gaining a basic understanding of specific pests for which no economically viable low input solution exists.

New Spending

Any new funds for agricultural research should be likewise targeted, including the Board on Agriculture proposal to increase appropriations for competitive grants for agricultural research by $500 million per year. Any increased authorization should include the following:

—*Increased funds to the Low Input Sustainable Agriculture Research Program (LISA).* Any new funding should substantially be directed to this program which has a strong track record. The LISA proposal review process, which includes scientists, farmers and nonprofit sustainable agriculture organizations, provides for decisions reflecting sound science, farmer needs and social and environmental considerations. The program is grossly underfunded relative to the cost of quality proposals submitted. Current fundings levels are adequate to support fewer than 10 percent of the proposals submitted.

—*Funds for a strong agroecology research program*. As stated by Texas A&M University plant pathologist J.A. Browning, "There is a great dearth of research from an 'agroecosystern approach' which would enable farmers to choose, from among the many interacting cropping systems and farming practices, those that work together to produce the desired result" (Browning, 1985).

—*Funds for genetics research on development of crop varieties and livestock* of potential value in addressing pests and other constraints which cannot be controlled at an acceptable economic cost, by changes in farming practices.

—*Funds for research on farming in an uncertain climate*. While predictions of reduced rainfall from climate change are uncertain, it would be wise to step up research efforts to prepare us for the possibility, including breeding more drought tolerant plants; development of management systems to maximize populations of beneficial mycorrhizae fungi, which help plants better utilize soil moisture; and development of management practices to reduce evaporation and increase water absorption including rotations, tillage systems, field windbreaks, organic matter management and cover crops.

—*A directive that "calls for proposals" and evaluation criteria which reflect congressional goals* and purposes for agricultural research, as discussed above.

—*Allocation of a portion of the new research funds to assessment of the social and environmental impacts of alternative research directions.*

—*Allocation of a portion of new funds to competitive grants for innovative extension programs* to reach small and moderate sized farmers, including potential beginning farmers, and minority farmers who might otherwise be left behind by rapidly changing technology. We are entering the era of information intensive agriculture, as we make greater use of biotechnology and low-input sustainable systems. Whereas in recent years those who lacked capital were left behind, in coming years those who lack information will be left behind (Harshbarger, 1987). If society wants to protect a base of small farm operators, it may be necessary to undertake a major extension effort to develop their management capabilities (Kliebenstein and Shin, 1987). The content of the program should include a major focus on low-input and low investment systems appropriate to farmers with limited capital. The program would include procedures for identifying research needs of participating farmers and feeding those into the land-grant research priority setting process.

—*Allocation of a portion of the funds to competitive grants for innovative programs to engage the public in the debate* over the future of the food and agricultural system and involve them in setting agricultural research priorities.

New Uses And New Crops Research

Authorization of new funds for research to find new uses for existing crops and to develop new farm crops with market potential should give priority to the following:

—*Research which develops new crops and new uses* for existing crops which, when added to rotations, reduce soil erosion and use of petrochemicals and other purchased inputs.

—*Development of production systems suitable to small and moderate sized family farms* for new crops and development of new uses for existing crops grown principally on such farms. For example, USDA's efforts to develop aquaculture should focus on low investment systems which work on family sized farms.

—*Development of modest scale processing techniques* appropriate to location on farms and in small rural communities and development of new crops suitable to small scale processing, to support rural development.

Finally, such authorization should provide for representation of sustainable agriculture groups on any appointed body controlling or advising the use of such funds.

Water Quality Research And Extension Efforts

The farm bill should direct that USDA and EPA research and extension efforts on water quality include a strong sustainable agriculture component. That might include research to evaluate the effectiveness of low-input sustainable agriculture approaches in addressing water contamination and special demonstration and educational programs on low-input sustainable agriculture in areas with water contamination problems. It might also include the development of best management practices for manure and legume sources of crop nutrients.

Conclusion

If the public agricultural research system is to yield a desirable structure of agriculture, vital rural communities, a resilient food system, and environmental and human health, Congress must clearly articulate these as the public purposes the system is to serve. Those who serve in the system must accept the responsibility of directing their research toward the advancement of public purposes democratically defined.

To fail these challenges risks continued erosion of public support for the land-grant system and science. People forced to choose between a research system and technologies which produce results that are neither desirable nor necessary, will reject the system and technology itself. We must instead gain public control of research and technology to direct them toward advancement of social well being and service of broad public purposes.

References

Browning, J.A., 1985, "Plant Disease and Nematode Control, Background Paper for *Technology, Public Policy, and the Changing Structure of American Agriculture,* OTA.

Burkhardt, Jeffrey, et al., 1987, "Biotechnology and Food: A Social Appraisal," in *Food Biotechnology,* Dietrick Knorr, Ed., Marcel Dekker, Inc., New York.

Buttel, Fred; 1986, "Biotechnology and Public Agricultural Research Policy," in *Agricultural Science Policy in Transition,* James H. Rhodes, Editor, Bethesda, MD.

Buxton, Boyd M., 1985, "Economic, Policy, and Technology Factors Affecting Herd Size and Regional Location of U.S. Milk Production," Background Paper for *Technology, Public Policy, and the Changing Structure of American Agriculture,* OTA.

Court of Appeal of the State of California, May 25, 1989, *California Agrarian Action Project, Inc., et al. v. Regents of the University of California et al.;* First Appellate District, Division Five.

Decker, Wayne L., 1985, "The Implications of Climate Change for 21st Century Agriculture," The Farm and Food System in Transition: Emerging Policy Issues, USDA-Extension, Washington, DC.

EPA, May 1988, Pesticides in Ground Water Data Base.

Gever, John, et al., 1986, *Beyond Oil,* Ballinger Publishing Co., Cambridge, MA.

Hallberg, George, Nov./Dec. 1986, "From Hoes to Herbicides: Agriculture and Ground Water Quality," *Journal of Soil and Water Conservation,* 41:6.

Harshbarger, C. Edward, Feb. 1987, "Financial Survival in an Era of Technological Change," *Journal of Agribusiness.*

Johnston, Gene, Nov. 1984, "Mid-Cost Hog System Shows Most Profit," *Successful Farming.*

Kliebenstein, James and Seung Y. Shin, 1987, "Impact of bST on Dairy Producers," Dept. of Economics, Iowa State University.

MacCannell, Dean, 1983, "Agribusiness and the Small Community," Background paper to *Technology, Public Policy and the Changing Structure of American Agriculture,* Office of Technology Assessment, U.S. Congress, Washington, DC.

Madison, R.J., and Jilann Brunett, 1985, Overview of the Occurrence of Nitrate in Ground Water of the United States, U.S. Geological Survey Water Summary 1984, USGS Water Quality Paper 2275.

Strange, Marty, Lis Krupicka and Dan Looker; 1984, "The Hidden Health Effects of Pesticides," in *It's Not all Sunshine and Fresh Air,* Center for Rural Affairs, Walthill, NE.

USDA, 1987; The Second RCA Appraisal.

Van Arsdall, Roy N. and Kenneth E. Nelson, Dec. 1985, "Economies of Size in Hog Production," Economic Research Service, Technical Bulletin No. 1712, USDA.