

LIMITS TO FOOD PRODUCTION

by

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I am an agricultural economist. Some of my environmentalist friends suspect me of being doubly negative. They think an economist can't see beyond dollar signs and they accuse agriculture of being one of the big polluters. We'll see how I come out on your scorecard when I am finished this evening.

I admit that agriculturalists have been shocked at the ease with which those who benefit from cheap food can turn on their benefactors with damning accusations. Economists have adjusted their sights to look beyond dollar signs more easily than agriculturalists have recovered from ungrateful accusations.

People in this room have said or implied that agriculture is performing a great disservice to mankind by using fertilizers, pesticides, hormone regulators, and tillage practices that disturb the balance of nature. They have condemned high speed farm machinery for destroying wild life, and equated the fecal by-products of livestock production with human sewage in its hazards to man and nature.

The agriculturalist's initial reaction is emotional: "The stupid ungrateful brats! They choose from a bountiful low-priced selection on the grocery shelf knowing nothing about how it got there, then in their ignorance condemn the methods by which it in fact got there."

Cooling a bit, they may admit their critics are intelligent -- though ignorant -- and agree that it has been a long tradition in this country to think agriculture is so simple no one needs to study it to know all about it. Some agriculturalists may even admit they themselves have given the impression that the new practices that pollute have been developed to help farmers make more money, thus lending credence to the popular notion that pollution control in agriculture would only reduce farm incomes not food supplies.

Actually this popular notion has combined with another one; the idea that most of our food is produced by large farm businesses and corporations who easily could recover from any handicaps pollution control would impose. And agriculturalists have contributed to this notion, too, because stories on big outfits are more news-worthy these days than a realistic picture of the family farmers who do most of the food producing.

The agriculturalist still, however, is likely to resent consumer ungratefulness and to protest actions by which agriculturally ignorant people gain power to modify practices in the food industry. If he has

worked in foreign countries he may begin to philosophize about the existence of an interesting cycle in agricultural development. This cycle might be considered to run from ignorance within agriculture, to rising know-how and efficiency within the industry, to the rapid displacement of people from farming, to a decline in political influence, and finally to a political takeover by the agriculturally ignorant majority outside the industry.

The people in agriculture in the United States -- professionals, farmers, agribusinessmen and their employees -- have been doing an outstanding job of pushing back the frontiers of food production and raising our expectations for what should be possible throughout the world. Yields per acre in this country increased some 20% in the decade of the 60's, following substantial though smaller increases in preceeding decades (1) (2) (3).

The Ehrlich's of Stanford University in their new book "Population, Resources, Environment," (4) state that "humanity now threatens to destroy most of the life on the planet." But those in a position to know best express strong belief in our ability to continue to increase food production in this country for a very long time. Agriculturalists in the U.S. Department of Agriculture predict a further rise of 20% in production per acre in the decade of the 70's (3) and many agricultural workers voice the belief that this increase in yields easily could be obtained only by applying more fully techniques already known.

But a look around us in the world, and back over history, can easily start us to wondering if the engine moving us forward to ever higher food production capabilities may be a rather fragil one.

Suppose that as farmer numbers decline, farmers come to realize more fully the latent potential they have for extracting a high return from the remainder of society by limiting production. The eleasticity of demand for food is low. A small crop sells for more than a large one. Farmers could exploit this fact for large gains.

Society has relied for many years on the assumption that farmers will remain highly competitive and thus assure a plentiful food supply at low cost. Today, however, most of the full-time commercial farmers in this state could be seated in the Cornell football stadium. Most of these men operate family farms in the traditional sense that they and their family supply most of the labor for their business (the average labor force per farm in the U.S. and in New York has remained essentially constant for over 50 years), but each turns out far more products than his father did. All also depend much more heavily than their fathers on the agribusinessmen who supply farm inputs, and on the machines, chemicals, drugs, complex feeds, and services now prerequisite for successfully competing as a farmer. With smaller numbers and a more business-like orientation, it is not impossible that they may think more about forming unions for their mutual benefit.

Suppose enthusiastic environmentalists succeed in getting laws that restrict chemicals, drugs, and tillage practices, or that those interested in alleviating poverty among agricultural laborers not only promote their unionization but also get laws preventing their replacement by machines. Or

suppose the nation, out of ignorance, just backs into an ignorance of agriculture, gradually cutting funds for education and research, failing to finance the updating of agricultural credit and marketing institutions, and generally downgrading the esteem in which agricultural occupations are held.

The ambiente (to borrow a word from my Latin American friends) necessary for progress in food production is subtle and complex. That the random probability for an appropriate conjunction of all the elements necessary for high food production is low is suggested by the scarcity of high rates of food production in the world generally, though we have no monopoly on good resources for food production, and by the wide and erratic shifts in rates of food production through history. The Latin Americans have an expressive word, ambiente, for a complex conjunction of surrounding elements, but they themselves certainly have not developed the appropriate ambiente for high levels of food production, as we shall see later.

Christensen, Hendrix, and Stevens wrote a little pamphlet that is well worth reading by all who are concerned with the limits to food production. It is called "How the United States Improved Its Agriculture" (5). They make the following statement:

"Numerous interrelated factors have contributed to the large output and high productivity of American agriculture. They include: (1) A large supply of land and water resources; (2) large investments for education that improve human skills and managerial abilities; (3) development and diffusion of new knowledge about agricultural technology; (4) complementary industrial development that supplies capital inputs for agriculture and nonfarm employment opportunities for people not needed in agriculture; (5) a structural organization of farm production and marketing that provides powerful economic incentives for farmers and marketing firms to increase output and productivity; and (6) public and private institutional services that (a) help conserve and improve natural resources, (b) increase the fund of knowledge about improved agricultural technology, (c) encourage capital formation and investments in agriculture, and (d) assure farm people that they will share in the economic benefits of increased production."

They could have added a few more points of a philosophical nature: a) a belief in the dignity of physical labor, b) a love of freedom of choice and of work with living things, and c) a genuine spirit of service among professionals in the field, most of whom came from a farm background.

The complexity of this ambiente and the delicateness of the balance among its elements has become clear to those who have struggled to create self-sustaining agricultural development in other areas of the world. A few countries have moved apace with us, of course; Denmark, Holland, and a few others. Japan moved firmly on tract in the past 20 years. But there is no clear evidence that even such large and well organized efforts as the Rice Research Institute or the institutes of tropical agriculture in Nigeria and Colombia have been able to capture and transmit the self-sustaining element. In fact I shall argue later that they have not and are not permitted to try.

Those who look back at the United States from the vantage point of efforts in an underdeveloped country often wonder how we ever were able to put the needed elements together. Perhaps it was just luck, in spite of the small probability mentioned above. Economists are struggling these days to discover the keys to development, and the results they are producing still leave one wondering if we were not simply lucky; their models for doing the job intentionally are not very convincing.

Beyond questions of how we got this way, some are beginning to wonder if we can continue to hold the key that was given us by chance. I have expressed some of these wonderings already. Let me bring the story closer to home.

Deep issues often surface first in the thinking on university campuses. (I hope universities can continue to hold a position of intellectual leadership, even though it conflicts with the old popular image of these institutions as havens of peace, quiet, and conservatism.) There is concern, confusion and frustration on the campuses of colleges of agriculture these days.

Colleges of agriculture have been very much a part of the engine that has moved us to higher levels of food production in this country. They have provided on-campus education of a highly relevant type -- relevant enough so many of the most successful farmers are agricultural college alumni and many of our other alumni are executives, managers, and operators of the agribusinesses that service farmers and process and market products from farms. They also have provided adult educational opportunities to farmers and agribusinessmen through a large and dispersed staff that students seldom see -- the Extension staff. And they have conducted hundreds of millions of dollars worth of research on a wide array of topics from conception rates in dairy cows to political strategies for farmers. Activities in research, extension and resident instruction have been intimately interwoven. Research has discovered more efficient ways to do things and extension and resident instruction have carried the results of research quickly to those who could use them. But extension has been a two-way channel of communication. While it was teaching, it was listening. In this way we found out how the new ideas worked when they were put to use by practical men and we discovered bottlenecks in the food production process that needed research. Resident instruction turned out men with whom we could communicate effectively from the start when they went into farming or agribusiness. It also, of course, trained men to serve in the educational and research activities; in fact graduate assistantships have provided an arrangement for accomplishing a very large part of our ongoing research at reasonable cost.

Through these three branches of activity, colleges of agriculture have stayed so close to food production processes that they felt as responsible for them as if they were the overall industry managers.

Again, work in foreign countries can illuminate work at home. Many of us appreciate more fully the role of colleges of agriculture here, having struggled with the problem of convincing colleges elsewhere that they should become relevant, then helping them start in that direction.

As approximations to overall industry managers, colleges of agriculture here have been very proud of increases in U.S. agriculture's capacity to

produce. Why then are we unhappy? Food production capacity is increasing as never before.

We are concerned, confused, and frustrated because it is beginning to look as though we could get a greater degree of popular acceptance, and more funds, if we could get rid of the word "agriculture" in our name. We have been damned for a long time for creating surpluses that necessitated costly government programs. Now we are damned for disturbing the bees, birds, and bunnies. We are accused of working on unimportant problems in a world where "space", "urbanization", "industrialization", "ghettos", "establishment", "confrontations", "civil strife", and "polarization" are words that designate the issues of the day. We read beautifully illustrated and expensive planning reports in which we see some of our best farm land labeled "open and vacant", or "outdoor recreation". The agricultural establishment finally has reached a level of organization and know-how so it really can push back the limits to food production, but now its very name is spoken in derision.

Where do colleges of agriculture go from here? As we look over the alternatives, we see that we have gotten ourselves in a curious box. We have said over the decades that we were helping farmers. We have felt very close to farmers; we have considered ourselves as servicing them. And we have helped them so well that we have put well over three quarters of them out of business! Now the small group that remains has too little political power to sustain our requests for continued support from legislatures. Now we would like to appeal to the group we really have been helping -- the consumers of food -- but to do this would make it clear that we have been less than fully truthful in claiming we were helping farmers.

We could admit our past untruthfulness and try to win support from consumers. It would be a tough job. We would need a new rhetoric and new communication media. We not only would have to continue to make progress on the production end, but we would need also to convince people who think food comes from grocery stores that we really are a vital part of the food supply chain. We would need to add a department we might call the "Madison Avenue Department".

If we took this alternative, farmers might get a little bitter at the realization of how coldblooded we have been in using them as instruments for satisfying the wants of other people. They could burn our bridges behind us, and if the Madison Avenue Department did not succeed in its mission we would have no supporters of any kind.

Another possibility would be to pursue further the pathway we seem actually to be backing into. This is a pathway in which we drift off gradually into all sorts of nonagricultural areas, from wildlife, which is close, to water resources planning, which is further away, to general planning, to urban planning, to ghetto problems. We can fully justify each step. They embrace important problems, and we are the colleges with the greatest skill and aptitude for being relevant. But in the longrun they will dilute our efforts in agriculture. At the least they do not help to build clientele that will support our requests for money for work on food problems, and this work needs a new or expanded clientele to continue strong.

Or we can drift away from our posture of immediate relevance into academic biology, or academic sociology, or academic economics. "Pure" research in biology can have all sorts of extremely valuable spin-off. It can lay the ground work for controlling cancer, it can find out the nature of life itself, it can provide the foundation for pushing back the biological limits to food production. Other kinds of academics can be valuable too, but the contribution of any "pure" science effort to food production will be accidental and a long step will remain between its findings and the possibility of putting them to use in the fields and factories of agriculture. As we move into academics, we move away from a capability for continuing to be the managers of an industry.

As a third alternative, we might try to really become helpful to farmers -- to all farmers, and in a clear and present sense. We might encourage any thoughts they are beginning to have about turning to their advantage the fact that a small crop sells for more than a big one -- the fact that the demand for food is inelastic.

The USDA has been trying to help farmers this way for some 35 years, but they have gone about it wrong. They have paid farmers for holding land out of use, but this has only heightened the farmer's interest in the yield increasing technology generated by the colleges, and by some other branches of the USDA. The price of land not held out of production has risen, so only the first generation of farmers has benefitted from the payments, and food supplies have continued to outrun demand. The USDA never convinced farmers they themselves should get together and manage their own program for extracting a greater share out of the national income. Farmers can defeat any program anyone else invents to improve their economic position. But colleges of agriculture would have a good chance for convincing them of the possibilities for action on their own part.

In fact, right now would be a most opportune time to undertake such an effort. Farm incomes would be much higher if farmers could get rid of fertilizers, pesticides, and hormone regulators. (6) We now have a wave of environmental evangelism condemning these things. Why shouldn't colleges of agriculture organize massive educational programs to make farmers aware of the monetary gains they could realize from federal action to outlaw these pollutants? Specialists from the colleges of agriculture might even let it be known that they could be convinced they should stretch the definition of education to the point where they would help in writing a proposed law.

The law would need to be a little complicated. It should provide an embargo on all imports from any areas where polluting fertilizers, pesticides, and hormones are used. It should provide also for some equalization of benefits among farmers since otherwise farmers in some types of production would be benefitted more than others. But since none of the present programs for trying to increase farm incomes would be needed, a well organized bureaucracy would become available for any benefit-equalizing activities that are needed.

We should supplement our work with farmers and farm organizations with an educational program designed to keep environmental evangelism alive and growing. We have been smart enough to hoodwink farmers into producing more food cheaper for decades. I think we could now hoodwink consumers into so strongly hating fertilizers, pesticides, and hormones, and maybe even manure

and advanced tillage practices, that they would support proposed legislation for getting rid of these things. We would need to be a bit clever and we would need to teach farm organizations how to be a bit subtle, but we have learned from experience how to be effective educators.

Actually, I expect we would have more trouble with farmers than city people. Farmers consider it sinful to not use a practice that could increase food production, and farmers hold to their ideas of sin very strongly. City people are sheep. They love fads: long skirts, short skirts; short hair, long hair; hoola hoops, drugs, environmental evangelism. If we could just get access to enough TV coverage I am sure we could handle the city people. And the number of farmers is small today. We would need to talk to them face-to-face, but it could be arranged. As soon as the scheme began to work, rising farm incomes would come to our support in further efforts with farmers.

Lest my non-social science colleagues in the college of agriculture fear I may be forgetting them in my outline of this alternative, let me hasten to point out that great production challenges would exist in a world without fertilizers, pesticides and hormones, and with strong controls on manure handling and the like. It would be like going back to the good old pioneering days. We could look forward to developing a whole new set of technology. And hungry people would provide support for the effort, so long as the social scientists and communications experts could keep their value patterns in line.

What, then, are the limits to food production in this country? A subtle and complex conjunction of elements has produced in this country some of the greatest increases in food production potential the world has ever seen, and promises the possibility of more to come. But consumers have proven to be ungrateful. Some of the important leaders in agriculture resent getting kicked in the teeth and fear for their continued security. They are looking for alternatives. They are thinking of abdicating their role as public spirited managers of the agricultural industry. Maybe we overestimate our importance in colleges of agriculture, but since many leaders everywhere in the industry have passed through our doors, I think not.

There is still another alternative for colleges of agriculture. We are backing into this one too, but so far it is teaching us some very interesting things about U.S. agriculture -- some of the things, in fact, that I have talked about this evening. This alternative is work on agriculture overseas.

People in many areas are hungry and governments are scared. We seem to be appreciated there. But in most instances we have found it phemonenally difficult to initiate anything that looks like self-sustaining development, as I have already indicated.

Let me talk a bit about Latin America. I have worked there.

When we travel in Latin America we see large numbers of intelligent but ignorant people struggling with primitive methods to grub a meager living from the land. Many of the people are in the mountains where most of the land is steep and some is stony but the soil often good. It is impossible to



farm in the mountains without a lot of hard work, but a few experiment stations, and once in a while a farmer, have demonstrated that yields could be doubled and more. It is in the alluvial lowland areas, however, where some of the greatest opportunities exist for increased food production -- areas like the forested llanos of Venezuela and Colombia, the Maracaibo Basin, the Plata River Valley, the Santa Cruz area of Bolivia and similarly situated lands to the north, parts of the deltas and terraces of the Orinoco and Amazon, and many others. DDT made these lands liveable starting about 25 years ago. I love DDT. I like to see the DDT letters they paint on the houses. I don't like to see hungry people and I don't like malaria and yellow fever. I trust Latin America will continue to produce it. The use of DDT has increased food production potentials in the tropics more than all the experiment stations put together.

Most people have less to eat in Latin America than in the U.S. and not by choice. Food production is increasing only slightly faster than population (7) (8) and most of the increase is coming from the opening of new lands.

Looking at Latin America through U.S. eyes, many conclude the Latin Americans are unable to borrow our technology. Others look a bit deeper and conclude they can't make the adaptations in our technology that would fit it to their conditions. The Ford Foundation has taken the latter point of view and is creating a big experiment station near Cali, Colombia to create new and adapted technology. They are providing for capable North American control of the station.

I am uneasy about either of these points of view -- that Latin Americans can't borrow or can't adapt. They imply laziness or a lack of intelligence on the part of Latin Americans. They say in effect that Latin Americans will take new technology if it is handed to them on a silver platter, but they are not smart enough to borrow or generate it. Personally I rate my Latin American friends quite as intelligent as I and highly capable of borrowing or generating if they have any incentive to do so.

It is the incentive that is lacking in Latin America. Their's is a highly stratified and polarized society. It is a system of inherited privilege in which a few easily could borrow or create new technology but have no need for it, and those with need don't know, have no chance to learn, and control too few resources to do anything about it. (9) (10) (11)

One is not rewarded for productivity in Latin America. One gets ahead by learning how to extract efficiently from his fellow men. Even the universities reflect this. They excell in law but not in the professions that produce. The dedicated scientist or educator in agriculture would starve. The hacendado who tries to improve his farming has to depend on ignorant workers and most of the workers who improve are just suckers. There are no family farms or family farmers in our sense of the term (with very rare exceptions) and if they were created they could not survive.

The Ford Foundation at Cali can learn very well how North Americans would use Latin America if they controlled it. If we continue our policies of pusing people around, this might be very useful someday. But the Ford

Foundation cannot learn the real reason for Latin America's backwardness and they can't learn what to do about it.

I strongly suspect, however, that the Ford Foundation has no alternatives. Deep social change is needed in Latin America before it can move forward, change as deep as that over which we fought our Civil War. This depth of social change is very expensive in peaceful form. Possibly we are pouring enough money into Venezuela, in return for oil of course, so it has a chance for peaceful change. We could not do the same for all of Latin America. A cheaper path is to foment change. The communists are willing to do this, but the American people simply can't believe that inhibiting social systems exist, other than the communistic system. It is interesting to see North Americans in Latin America go through "culture shock" as they finally grasp the vastness of the gulf between our two social systems. One has to be more than a tourist to get the shock, and most North Americans have not even been tourists in Latin America.

So the American people limit Ford to activities that would be useful if it were working within U.S. territory. And the powerful few in Latin America reinforce, of course, this circumscription.

This has been a disjointed foray into a very large and important area -- the limits to food production. The moral to my story is this: The limits to food production are far more social than they are biological. Social arrangement (including political and economic) determine the extent and nature of the work that is done on biological problems and determine the use made of the biologist's findings. At any point in time there are biological parameters to food production, of course. In the United States in the past the social limits have been close to the biological limits; in fact pushing on them at many points. This could change here. In most of the world the social limits do not even approximate the biological limits.

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