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THE ROLE OF U.S. AGRICULTURE IN FEEDING THE HUNGRY WORLD

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When Jane Haynes invited me to participate in Forum VI she also sent me a copy of your January Newsletter. I found the article by Vice President Lukco very interesting. I quote from his article: "The Ohio Alliance for Environmental Education has maintained a serious commitment to communicate all sides of environmental issues to encourage citizens of Ohio to make meaningful quality of life decisions.....We are and will continue to be leaders in the field of environmental education. Those who believe that all citizens should be systematically informed participants in environmental and energy issues belong to our organization."

I subscribe to your commitment. It's a very important mission. In my judgement environmental education will be even more important in the future. As part of this presentation I want to build the case that leads me to that conclusion.

I. Where are we going?: I want to begin by sketching the world food situation looking ahead over the next two decades and then derive from that picture some implications for U.S. agriculture. Secondly, I will address some of the problems facing the U.S. on the road to fulfilling our role in helping to feed a hungry world: energy, U.S. economic growth and inflation, productivity and research, and managing the environment.

A. The World Food Situation

Let's start by looking at the world food situation. Today, the U.S. is more an interdependent part of the world economy than ever before. It is more dependent on other countries. It is more affected by the economic successes and failures of other countries and the economic policies promulgated by other countries. This is especially true for U.S. agriculture.

The world food situation is a delicate balance between demand for food and the production or supply of food. There are two major determinants of the demand for food, number of people and per capita income.

The population of this planet is growing in the neighborhood of 1.7-1.8 percent per year. In some developing countries population is growing at alarming rates. Death rates have fallen as modern medicine has been introduced. Birth rates remain high, hence, more people are surviving and we have the classic population explosion. In other developing and developed countries birth rates are falling and population is growing at more moderate rates. Simultaneously, a number of developed countries are approaching zero population growth (ZPG).

Income, real per capita income, is growing in the developed countries of N. America, W. Europe, Japan and in some developing countries -- Korea, Philippines, Thailand and many places in Latin America. In fact, a 1% increase in income in developing countries generates a larger increase in demand for food than a 1% income increase in developed countries. For the world as a whole a 1% increase in real per capita income translates

into an increase in demand for food of around .7% per year. Overall then, population growth plus increasing income means an increase in demand for food of around 2.5% per year. Or, 25% more food will be needed by 1990. Ten years; 25% more food needed as a result of population growth and income increases.

Production of food is also increasing. While we have had at least two world food crises in the last two decades when Mother Nature was unkind, food production has grown from 2.5 to 3.0% per year for the world as a whole. Viewed on a per capita basis food production in the past 20 years increased 10-12%. This is a world wide average. It hides some tremendous differences. In the U.S., USSR and Eastern Europe per capita increases were about 30% for the 1960-1980 period; in Western Europe and East Asia about 20%; in Latin America, 10%; in South Asia, no change; and in Africa, a 10-12% decrease.[1/]

As we enter the 1980's it appears that world food production is in a delicate balance with demand. Let me illustrate how delicate the balance is. World food reserves -- stocks at the end of the market year -- were at the 200 million metric ton level in 1979. By September 1981, it is estimated that stocks will be down to the 153 million metric ton level. This means that carry-over stocks could drop to a record low of 10.5% of consumption.

During the 80's, most projections indicate the demand for food will increase faster than supply. This means upward pressure on world food prices.

Where will the food be produced? The first point is that most food will have to be produced in-country, i.e., in each and every country around the world. Secondly, many industrialized countries will add to their food supplies by importing. They will trade cars, clothes, shoes, TV sets, and oil for food. An increasing number of developing countries will also trade to add to their food supplies. I find it very interesting that Korea, clearly a developing country, has passed the billion dollar level in food imports from the U.S. Who will do the exporting? There are five major suppliers -- Canada, Australia, Brazil, Argentina and the U.S. But the U.S. is the single most important country with the capability to produce and export grain and food products. Currently the U.S. accounts for 53% of all world grain trade. Wally Barr, one of my colleagues at Ohio State, expects that share to increase to 65% by 1990.2/

B. Implications

(1) This picture presents a very positive situation for U.S. agriculture and generates important implications for farmers, the agribusiness sector, scientists and educators. It suggests a strong underlying trend that should generate favorable prices and incomes for U.S. farmers and for the U.S. agribusiness sector. This does not mean prosperity year-in and year-out. It does project an expanding market opportunity and the definite possibility that the U.S. agricultural sector will grow faster than the rest of the economy.

(2) Growth of the export market -- especially for soybeans, food and feed grains may bring about significant changes in production patterns in the U.S. For example, corn sells for 20-30¢ more per bushel in Ohio than in the Upper Mississippi Valley. Our location provides cheaper transportation to foreign markets out the St. Lawrence, down the Ohio River and by rail to East Coast ports. This could mean more corn and soybean production in Ohio and less production of fed beef, market hogs and even milk. I believe such shifts in production patterns have direct environmental implications here in Ohio. I'll come back to this point.

If careful analysis confirms this line of reasoning then there are very important implications for farmers and agribusinesses and the investment strategies they should pursue over the next decade.

(3) Increased dependence of U.S. agriculture on the export market will further subject U.S. farmers and the agribusiness sector to the ups and downs of the demand for food around the world. Year to year changes will certainly occur because of the weather, resulting in large crops in some years and small crops in others. Almost as certain are changes brought about by policy decisions of individual governments. Farmers will be faced with greater price and income instability. One of the challenges is to help farmers develop ways and means to cope with instability.

(4) Increased demand for U.S. agricultural exports will place added pressure on our natural resources. As marginal lands are brought into production we will need to give more attention to tillage systems and conservation practices that control erosion and other forms of non-point source pollution.

(5) If agriculture is prosperous then research in the public and private sector and educational efforts extending knowledge will be more valuable. The return to dollars invested in research, development and extension education programs will be greater.

(6) Let's turn now to a different set of implications. These implications derive from the needs of the developing world for highly trained people. John Mellor, Director of the International Food Policy Research Institute, refers to a requisite for growth in the agricultural sector. He says: "It has to be technological change, and research is the core of that. And the bulk of the research has to be done in the country where it is going to be applied. That takes a lot of highly trained people."3/

Training people is a central purpose of our universities and colleges of agriculture. We have the ability and the capacity to help train the future scientists, teachers and public officials of the developing world. We've also got substantial experience in helping to develop agricultural universities, research systems and extension systems. It is in these areas, absolutely

basic to the discovery and diffusion of new knowledge, that we have a comparative advantage. Mellor points out that in the 1950's and 1960's we helped a lot of countries with training and institution building. But, he says: "We got discouraged with it because we said it was only trickling down. Those processes took 20 years or more to pay off. Is that so long in human history? It is because of that effort that a country like India can now talk in terms of being self-sufficient in food...."[3/] Recently, international programs at U.S. universities have been in the doldrums. Funding has been down. Also, some of the emphasis in our technical assistance has shifted away from research and the generation of new technology. Fewer U.S. professionals have been involved and very few young professionals have international experience. Our capacity in terms of experienced people is clearly much less today than 10 years ago. Now it's not at all clear that we're going to have a major increase in funding for U.S. international programs. It does appear that there is a rebirth or at least a re-examination of the importance of training and institution building and the role of new technology as the engine that drives the development process. I see the role of U.S. agriculture in feeding a hungry world as two fold. First, is the production of part of the food supply to feed an increasing world population and one that is moving to a higher standard

of living. Second, is the very important task of helping developing countries learn how to produce more food from their own resources.

II. Let's turn now to address some of the problems on the road to fulfilling our role...our potential in feeding the hungry world.

A. Energy: Availability and Costs

The two most important dimensions of the U.S. energy problem in the 1980's are availability of liquid fuels and the cost of energy in any form.

Availability -- Wally Tyner, an Ag Economist at Purdue University, characterizes the next 20 years as an energy transition from petroleum fuels to alternate energy sources.[4/] The list of alternate sources usually includes coal, oil shale, nuclear, solar and biomass. The biomass category covers such sources as wood, forage crops, grains and municipal solid wastes. Production of energy from any of these biomass sources will certainly have implications for U.S. agriculture.

There is general agreement that the energy availability problem during the rest of this century is a liquid fuels problem. Total energy reserves in the U.S. are enormous. Most of it is coal, probably enough to last far into the future. Even with all this coal, today only about 19% of our energy consumption is from coal, 47% is from oil and natural gas liquids, 26% from natural gas and 4% nuclear. Almost 50% is consumed in liquid form, of which we import almost one-half.

This dependence on imports for a full quarter of our total energy supply, with much of it coming from a turbulent Middle East, is at the heart of the national security question, i.e., availability.

What can be done to reduce dependence on foreign oil? In the 1980's conservation is probably the most important possibility with new energy sources next in line. A recent OTA report concludes that in the next five years the most important new source is likely to be alcohol produced from grain with greater use of wood, forage crops and municipal solid waste later in the 1980's. Syn-fuels from coal and oil shale are not likely to be important until late in the decade.[4/]

Cost of Energy -- Low cost energy aided and abetted the technological revolution on farms and in farm homes between 1940 and 1970. Cheap energy hastened the adoption of labor saving devices for the housewife, enhanced labor productivity in farm production, made the home a more comfortable place to live, and increased the mobility of people generally. Real energy prices actually decreased in the 1940's and 1950's. Since 1970 rapid increases in energy costs have squeezed family budgets and have caused dramatic increases in the price of many farm inputs as well as increases in the costs of processing and transporting food products. By 1990 energy costs are expected to be at least double what they are today, in real terms.

Implications --

(1) The implications are many. One of the most important has to do with our life style, the cars we drive, the homes we live in, the leisure activities we pursue and where we live relative to where we work and seek recreation. Energy as a big budget item is so new that we've barely begun to see the adjustments people will make. It takes about 8 years to roll over the nation's stock of cars and 50 years to roll over the stock of houses. What if prices in the next 10-20 years double or triple in real terms, i.e., relative to other prices. I think we need to study alternative life styles that require much less energy per day or per year. We need to identify and analyze alternatives including the positive and negative side effects.

(2) A second implication -- also of broad scope -- deals with the effect of high energy costs on agricultural production systems. For example, back in 1975 Norm Rask looked at the systems we use for growing corn. He then asked what would happen if energy prices doubled or tripled. Would we go back to corn/legume rotations or stay with continuous corn. Given the parameters of the study, he concluded that no major change would take place. Does this conclusion still hold if prices increase four times, five times, or six times. These are magnitudes far beyond our imagination just a few years ago. Now I suggest we need to give serious consideration to change of such magnitudes and the vast array of implications for agriculture and food production as we know it today.

(3) A straightforward implication is the need to conduct research to identify energy conserving practices and to develop energy conserving technology -- for farms, homes and businesses. These efforts should feed directly into a regular dissemination program of information on energy conservation.

(4) We need research on new energy sources. Production of energy on farms or the growing of feed stocks to produce energy represent new enterprises. Are they feasible? If so, then farmers will face the full range of production, management and marketing problems that confront the producer of any new product.

(5) The use of agricultural resources to produce energy will affect food prices and the production of other agriculture products. At the heart of this implication is the food-fuel trade off. We need to study what those impacts are likely to be and to estimate their magnitudes at different levels of world energy prices and under different assumptions with respect to U.S. national security policy.

B. U.S. Economic Growth and Inflation

Real GNP, which is a broad measure of economic growth, increased 3.8% per year in the 1950's, 4.6% per year in the 1960's and 3.4% in the 1970's. In 1980, a recession year, real GNP was decreased .7%. For 1981 the projection is for an increase of 1.4%. Overall for the next 10 years we expect real GNP to increase, probably in the range of 1-3% per year. This is a smaller rate of growth than we've experienced in the past several decades.

Price increases in the 1950's as measured by the Consumer Price Index (CPI) averaged 2.3% per year, in the 1960's 3.1% per year and in the 1970's almost 10% per year. Projections for the 1980's fall in the range of 8-12% per year. At no time in the past 60 years have we experienced inflation rates this high for such a long period of time.

Bringing down the rate of inflation is a very painful process. It will take concerted action over a period of several years. There are no quick fixes. Perserverance, self-discipline, courage and sacrifice are descriptors of the national will needed to deal with our inflation problem. It would be easy to conclude that we no longer know what those words mean and that we have no stomach to set in place and live with the national, state and local policies to which those terms accurately apply.

There's a phenomena accompanying inflation that makes it tough to deal with. It's called expectations. If prices go up unexpectedly and then level off or come back down people don't expect inflation to continue and therefore they don't take action to try to protect themselves. However, when prices rise 8-10% per year and continue to rise for several years, people expect inflation to continue and the actions they take to try to protect themselves complicate the inflation problem. Examples include: cost of living escalators in wage contracts, product prices tied to a fixed level of parity, higher interest rates and a buy now/pay later attitude.

Implications --

(1) One of the most important implications is the impact of slow growth on budgets for higher education, research in the public and private sector and extension of knowledge. On the private side R & D is one of the first departments to get cut back. On the public side a slower rate of economic growth in the 1980's means a smaller rate of increase in public revenues. Tax increases in the 1980's are possible, we've seen it in Ohio on a temporary basis, but the public mood is for lower public expenditures or, at least, a slower rate of growth of public expenditures. Competition for public revenues will be keen including minimal assistance to the unemployed and a military budget that seems likely to grow in real terms. In addition, past experience indicates that during periods of rapid inflation there is a low probability of maintaining the purchasing power of our budgets from appropriated sources. Therefore the most likely outcome for the early 1980's is a reduction in our budgets in real terms and the necessity to face the tough trade offs between salary levels, number of people, number of programs, and level of support resources. In short, we face a decapitalization of our research programs in both the public and private sector. This leads directly to the next problem, namely, productivity.

C. Productivity and Research

The slower rate of real growth of the U.S. economy projected for the 1980's is directly related to a sharp slow-

down in productivity growth. Barry Bosworth, Senior Fellow at the Brookings Institution writes: "Labor productivity within the private non-farm economy expanded at an average annual rate of 2.8 percent in the 1948-65 period, 2% between 1965 and 1973 and only 1% in the last five years. During 1979 it actually declined by 2 percent."[5/] In 1980 productivity growth declined by almost 1%.

In the agricultural sector over the past 30 years productivity has been growing and at a rate which has generally been faster than in the non-farm economy. In recent years many agricultural economists and others have expressed concern about a slow down in agricultural productivity growth rates. The pipeline of new technology flowing into the agriculture sector simply isn't as full as it used to be.

It seems that the case for investment in research needs to be pushed hard for the economy in general and for agriculture in particular. Incentives for the private sector to invest in research and development are probably best handled through our taxing policies. For several years now we've had investment credits to the private sector for the purchase of new plant and equipment. If we're concerned that more investment in research is needed, then why not provide investment credit for new dollars or additional dollars devoted to research and development.

The case for research in agriculture is compelling. Research is probably the most important factor contributing to productivity increases over time. And productivity increases are absolutely necessary if U.S. consumers are to spend only

17% of their disposable income on food -- the lowest in the world. Productivity improvement is necessary to capitalize on the opportunity to increase our foreign exchange earnings from food exports as well as to contribute to the world food situation.

A puzzling question is why we have continued to underfund research in agriculture. Evenson, Waggoner and Ruttan in a Science article last September summarized studies estimating the annual rate of return on investment in agricultural research.7/ Annual rates of return on research for hybrid corn, poultry, wheat, cotton and tomato mechanization ranged from 20-90% per year. They also looked at rates of return to all agricultural research for different time periods. From 1868 to 1926 the analysis shows a 65% annual rate of return to all expenditures on agricultural research. For the period 1927 to 1950 they identified two kinds of agricultural research: technology oriented and science oriented. Technology oriented research yielded a 95% annual rate of return; science oriented research, a 110% rate of return. From 1948 to 1971 their results showed an annual rate of return to technology oriented research by region of the U.S., ranging from 93-130% and a return to science oriented research for the total U.S. of 45%. In addition, for the 1948-1971 period they estimated a 110% annual rate of return on investment in farm management and agriculture extension.

These are excellent results using criteria for investment in either the public or private sector. Why then do we continue to under invest? Evenson, et.al., suggests two causes.[7] First, the benefits to farmers spill over across state lines to those who do not pay for the research. This says that farmers in Ohio benefit from research done in Indiana, Michigan and Pennsylvania but they don't actually have to pay for it. Similarly research results obtained in Ohio benefit farmers in other states. Part of the return goes elsewhere and farmers in Ohio don't see the total return and hence don't place as high a value on the dollars they invest or encourage to be invested in research.

Secondly, Evenson suggests that the benefits to consumers are partitioned into such small amounts that the individual consumer cannot make the connection. In other words the results of research represent savings of a few pennies each week on the grocery bill for year after year and for millions of consumers. But, at any point in time the savings are small enough, the connection between the lab bench and the meat counter is fuzzy enough, and the time lag is great enough that the consumer simply doesn't feel or realize the value of the investment in research.

Implications --

(1) The case for research is strong. The case for agricultural research is well documented. We've got to sell the case and that's going to take some hard work, imagination and a helping hand by researchers and by recipients of research results. We must be willing to

experiment with new approaches. We can't afford to put all our eggs in one basket.

Let me pause to inject a separate but related comment. Some of you are involved with the OARDC Support Council or the Ohio Cooperative Extension Support Committees. Others I know are involved on Advisory Committees at the county and state levels. I strongly encourage your active participation. We need the best thinking of the users of our research and the recipients of the extension education programs. We need informed citizens who can speak to the importance of these programs on the basis of their own knowledge and independent assessment.

(2) A second implication which I draw from the general funding picture is that we should explore new sources of funds or perhaps put more emphasis on sources we've only begun to tap. Let me suggest just one idea. Suppose that an investment credit for research and development were instituted in our federal tax law and that farm businesses as well as non-farm businesses were eligible to participate. The larger corporations including some agribusinesses could be expected to expand their research and development departments. But most farm businesses and many agri-business firms are too small to set up research operations. This could be a powerful incentive for these firms to channel additional support to agricultural research, and experiment stations across the country would be a natural recipient of many of these funds.

D. Managing the Environment

The problem as I see it has several components.

1. The world food situation will generate increased demand for U.S. farm products and this increased demand will put additional pressure on our land and water resources. The pressure will result in more intensive use of land already being cultivated and will bring additional land under cultivation.

Intensity of land use is already a problem. The Ohio Resources Inventory indicates that the number of acres of Ohio agricultural and forest land on which adequate conservation was being practiced dropped from 6.3 million acres in 1967 to 5 million acres in 1977. This is one measure of the problem. Part of this drop is directly attributable to continuous cropping and less use of rotations with legumes and small grains.

In addition we've converted pasture land and woodland to cropland. In the past 10 years in Ohio cropland harvested is up 25%, cropland not harvested is down 10%, pasture and grazing land is down 27% and woodland is down 9%.

There is potential for conversion of additional land now in pasture, woods and other uses to cropland; probably in the neighborhood of 2 million acres in Ohio. Much of this land will be highly susceptable to erosion.

The bottom line, however, is that over the next two decades the incentives will be in place to encourage further conversion and thus the likelihood of an increased erosion problem.

2. Education is a continuous process. I suggest this as a second component of the problem we face in managing our environment. We aren't born with an understanding of best management practices. Furthermore, what represents best management changes over time as we discover improved methods and new technology. There is a continuing flow of new operators and managers onto Ohio farms. For some their fathers and uncles and grandfathers have set a good example and have sensitized them to the use of good practices. For many the previous example is not the one to follow.

In addition it seems to me that best practices seldom represent the easiest way to do it, frequently they cost more money, at least in the short run, and usually require more management skills and more management discipline.

Hence the need for education on the basics at all levels in our educational institutions, the need for demonstrations and testing of improved practices and continued reinforcement by a broad range of organizations and peer groups.

3. A third component of this problem is that adoption of good practices frequently costs the adopter and benefits somebody else. It may be the adopters children or grandchildren, or his neighbor down stream or down wind, or a friend who fishes in Lake Erie who is benefitted. It does seem that very often someone else is the beneficiary. Further with respect to many practices the benefits are realized some time in the future. These factors complicate the problem.

What Can Be Done?

I'm encouraged by the accumulating evidence on what can be accomplished with no tillage and reduced tillage systems. To be sure reduced tillage is not a panacea. However, given the importance of erosion as an environmental pollution problem, the close relationship of sediment pollution with phosphorus pollution and the effect of erosion on decreasing topsoil, it seems to me that the new evidence on these tillage systems represents a breakthrough.

Three years ago Lynn Forster did a study on the economics of reduced tillage systems using test plot data generated by Sam Bone and others in our Agronomy Department. The results were startling -- to me at least. They indicated that the net income to farmers using reduced tillage would be the same or in some cases even higher than if they used conventional tillage. Furthermore Forster suggested that these results might hold for up to two-thirds of Ohio's cropland. The exciting thing about these results was that reduced tillage would generate about the same net income as conventional tillage and you got a bonus -- the improved impact on the environment.

These results were on test plot data. More recently Forster and Logan have been working with the U.S. Army Corp of Engineers on a Lake Erie Wastewater Management Study. The first phase of that study established that about half of the pollutant load to Lake Erie comes from land runoff. Phase II concentrated on analyzing the impacts of alternative land management practices on water quality and on net farm income.

Earlier this week I saw some of the preliminary results of Phase II where Forster is looking at actual farm operations in 15 counties in the Lake Erie Basin. For the three soil management groupings studied the results showed that no tillage increased net returns over conventional tillage and use of minimum tillage or chisel plow tillage resulted in net income that was not significantly different from that received via conventional tillage. This is further evidence that improved water quality and improved net farm income are not necessarily conflicting goals.

I might add that Phase III of the project now underway is to establish a demonstration watershed management program using "best management practices."

III. Summary

1. The world will look to the U.S. for additional food production over the next two decades. Our role is twofold. First to produce and export part of the food needed to feed an increasing world population. Second to export the scientific and technical know how to help developing countries learn how to produce more food themselves.

2. U.S. agriculture will be a bright spot in the performance of the U.S. economy. Agriculture will be a major contributor to foreign exchange earnings.

3. The increased demand for food will lead to more intensive use of cropland and will encourage continued conversion of pastureland and woods to cropland. If conventional tillage systems are used the result will be increased erosion and adverse impacts on water quality.

4. Increased research and development in both the public and private sector together with demonstrations and educational programs are badly needed to increase productivity. The case for increasing research in agriculture is especially strong to help us contribute to the challenge posed by a hungry world and to help us improve the management of our environment.