PROCEEDINGS OF THE SYMPOSIUM ON WATER POLICIES ON U.S. IRRIGATED AGRICULTURE: ARE INCREASED ACREAGES NEEDED TO MEET DOMESTIC OR WORLD NEEDS?

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DEMAND AND SUPPLY PROSPECTS FOR U.S. AGRICULTURE

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This paper summarizes a series of projections related to possible future economic parameters of U.S. and world supply, demand and trade in agricultural commodities made in 1973 in the Economic Research Service of the U.S. Department of Agriculture. The time horizon of our projections is 1985. The methodology employed relies heavily upon extension of basic trends and estimates of functional economic relationships prevailing in the recent past constrained by sets of assumptions which I shall make explicit as I proceed. Some policy issues growing out of these projections are presented in the final section of the paper.

1. Projected Production Capacity of U.S. Agriculture, 1985

For the better part of the last 50 years agricultural economists have portrayed U.S. agriculture as an industry with substantial excess capacity in which returns to resources were lower than in most other sectors of the economy. For the better part of the last 40 years, there have been Federal Government programs to restrain production and thereby increase farm prices and incomes.

The current position of U.S. agriculture stands in sharp contrast to that scenario. Realized net farm income attained a record high $26.1 billion in 1973; realized net income per farm of $9,193 in 1973 was nearly 35 percent above levels of three years ago and a little more than double 1960 in constant dollars. The passage of new Federal legislation featuring target prices and deficiency payments when market prices fall below target levels, reduced world output of food in 1972 and subsequent sharp increases in commodity prices to well above target price levels will result in virtual suspension of Government supply-restraining programs in 1974. Some 25 million acres of land were brought back into production in 1973; as much as 19 million additional acres idled under Government programs may be put in production this year.

Suddenly with virtually no land held in reserve by Government, low stocks of grains, a persistent, debilitating drought in sub-Sahara Africa, and rapidly rising input costs, the capacity of U.S. agriculture to meet growing demands for food at home and abroad has come under scrutiny. We completed in early fall of 1973 a study examining production capacity of U.S. agriculture in 1985 which I shall summarize briefly. 2/

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2/ For a more complete statement see "American Agriculture: Its Capacity to Produce," The Farm Index, U.S. Dept. of Agr., Washington, D.C., December 1973, pp. 8-16.

Five major sets of assumptions undergird the projections:

1. No Government restrictions on use of land.

2. No quantitative or physical limitations in availability of other farm production inputs needed to generate and sustain increased production.

3. Continuing research and education programs at a level to provide for maintaining historical rates of yield increases but no major scientific breakthroughs in crop yields or livestock productivity.

4. "Normal" weather conditions, i.e., weather conditions would conform to the normal or average patterns of the past two decades.

5. Favorable farm product prices relative to prices of farm production inputs such that there would be incentive for long-run investments and a high rate of utilization of plant capacity.

This is a crucial but opaque assumption. In essence it implies, without specifying exact price-cost relationships, a 12-year period of favorable returns to resources in agriculture. As prices (costs) of farm production inputs rise, the assumption requires that farm product prices will rise accordingly to maintain economic incentive for investment and production taking into account gains in resource productivity and economic efficiency.

Here I remind you of the purpose of the analysis--not to predict what will happen and details of the path of adjustment to 1985 but to project what agriculture might look like in 1985 under a set of specified assumptions. Obviously, we have adopted a favorable set of assumptions for farmers. They might be described as "economically optimistic." However, they stop well short of maximum physical potential if all factors were used at physical rather than economic maxima.

Some projected parameters are:

1. Land Use: With favorable price-cost relationships, cropland harvested could increase by 32 million acres between 1973 and 1985, reaching 350 million acres by 1985.

The bulk of the increase in harvested acreage would come from land formerly diverted from Federal supply management programs and from cropland pasture. A smaller portion would be shifted from permanent pastures and some would be developed through irrigation, drainage and clearing. These last two sources are a part of the 264 million acres (1967 inventory) not now being cropped but which are physically suitable for cultivation.

With favorable prices, cropland area in the Southeast and in the Delta could go up by 5 million acres as a result of stepped-up clearing and drainage projects. Attractive prices would also encourage reclaiming Corn Belt land that is in small, scattered fields or has erosion or wetness problems.

Acreage in the Western half of the U.S. would come from public and private irrigation and some increase in dryland cultivation, primarily in the Plains States. It is difficult to estimate how much cropland would be added in the latter area, but in the 1940's high farm prices stimulated a 20-million acre expansion in dryland cropping.

A large amount of land in the Northern Cutover and Appalachian-New England regions is technically arable. However, little would be converted to cropland, even under the favorable prices assumed in this study. Most of the land there is in small, scattered fields with cultivation problems.

Acreage under irrigation could rise from 35½ million in 1973 to 38½ million in 1985. This estimate is based on potential private development and projects now authorized and funded by the Bureau of Reclamation.

One factor limiting near-term expansion in output from this source is the relatively long time needed for irrigation development. Other restraints are the limited availability of water for private development, environmental concerns which may put brakes on drainage and clearing, particularly in coastal areas, and the probable loss by 1985 of 840,000 acres of irrigated land in the High Plains of Texas because of a declining water table.

Over the next 10 or 15 years, irrigation development is projected in Florida for fruit and vegetable production, and in the Delta States primarily for rice and cotton. There also could be further development in Nebraska, Kansas and North Dakota. Increases are projected for Oklahoma and Texas through 1980, followed by a dropoff in irrigation due to depletion of water in the Texas High Plains.

Added irrigated acreage in the Mountain States would come primarily from limited public development. Development in the Pacific States would be mainly due to public projects in Washington and Oregon, and to full implementation of the State water plan in California.

In summary, harvested cropland could rise about 10 percent or 32 million acres from 318 million in 1973; irrigated acreage might increase about 8 percent or 3 million acres to a total of 38½ million by 1985.

2. Resource Productivity: Increased productivity of resources stemming from improved use and wider application of available or soon-to-be available technology could account for much of the growth in capacity projected in our study. We have assumed that technology of the type that boosted crop yields in the past two decades--hybrid seed; improved fertilizers, other chemicals and machines; higher plant populations per acre; continuous cropping of corn and other high yielding crops--in combination with improved managerial skills will make it possible for national average yields of major crops to increase at the trend rates of the past two decades.

We recognized that even under the"economically optimistic" assumptions of our analysis there would be some forces tending to retard increased crop yields: (1) some new land would be less productive than that now being farmed, (2) much of the increase in corn acreage would occur outside the Corn Belt where yields usually run lower, (3) most of the expansion in wheat acreage would come in fallow areas of the western half of the U.S. where yields are lowest, (4) some land in fallow would be continuously cropped which would reduce average yields. On the other hand, improved management practices, modification of cultural practices and adoption of technology likely to come on stream in the next decade would stimulate productivity. Leading producers are routinely getting yields of 50 percent or more higher than the national average in part as a result of superior management and combinations of resources. A major research and extension effort could probably bring a substantial expansion of double cropping, possibly 2-3 million acres or more. Wheat hybrids, with indications of yield increases of 15-25 percent, are now available in limited quantities and in another 5-7 years might have substantial impact. Increased protein content is possible with new grain varieties. Insect resistant plant varieties are appearing which reduce need for insecticides and moderate environmental problems from chemical residues.

The foregoing are factors undergirding our projections suggesting that national average corn yields could be increased 28 percent, grain sorghum 12 percent, wheat 14 percent, and soybeans 20 percent by 1985 relative to even the favorable yields of those crops in 1973.

3. Total Output: Combining projected land use and productivity projections suggests that capacity output under assumptions of our analysis could be sharply above output levels of recent years. For example, feed grain output was projected to 315 billion tons in 1985--some 50 percent above 1973 implying an average annual growth potential of nearly 4 percent. Wheat production could increase 32 percent, soybean production nearly 45 percent and cotton about 25 percent relative to 1973.

Production capacity for livestock products was also examined. There has been concern in recent years that range use has been near capacity and that cattle production was being limited at least in part by our forage availability. But our livestock specialists feel that the limitation has been more in economic incentives than in physical capacity. In fact, they feel that with strong economic incentives beef cow numbers could increase nearly 45 percent from 41 million in January 1973 to 59 million by 1985. These increases would come largely in the North Central States, Southern Plains, and the Southeast.

If inventories were to rise this much, beef production could increase enough to raise per capita supplies of beef and veal from 113 pounds in 1973 to nearly 160 by 1985, assuming net imports at recent levels. The important conclusion here is that forage capacity does not appear to be a substantially limiting factor in livestock production. Production of hogs and poultry is clearly tied to available supplies of feed concentrates. Beef production appears to be reaching the point where it too is largely dependent on grain production.

Overall, our projections imply a growth in production capacity of U.S. agriculture ranging from 2-5 percent per year for major commodities--rates well above projected growth rates in domestic demand for food considering both population and per capita real income projections.

2. Projected Trade in Agricultural Commodities, 1985

In a separate study completed in mid-1973 we projected world production, consumption and U.S. trade in major agricultural commodities in 1985. Like our projections of U.S. production capacity our trade study was completed before the dramatic onset of the Arabian oil embargo and rapid escalation in world prices of fossil-fuel derived energy forms and chemical fertilizers.

The inputs to this analysis were growth rates for population and income, demand and supply price elasticities and assumed policy constraints. Other trends taken into account included changes in tastes and preferences in consumption, such as the increasing desire for livestock products as people's incomes rise, and changes in resource constraints. Anticipated changes in yield were worked into the analysis and normal weather was assumed.

Specifically, we assumed: The medium growth variant of the U.N. population projections; continuing rapid growth of the world economy; world price levels inflating at the rate experienced in the recent decade; recent developments in production trends which capture the effect so far of the "Green Revolution;" and an essential continuity in present policies guiding domestic production, consumption and international trade. We term these Alternative I, a conservative projection.

Projections under Alternative I suggest that the world's capacity for production of cereals will increase faster than consumption and that there will likely be a rebuilding of grain stocks, downward pressures on prices, or possibly programs to restrict production in the major exporting countries, or some combination of these. The consumption and trade of wheat and rice should grow less rapidly than coarse grains because of the growing need for feed for livestock and poultry.

These projections also suggest that countries in the developed and in the centrally-planned parts of the world will continue to be the major producers and consumers of wheat and coarse grains. The developed countries would continue to supply the less developed countries (LDC's) with grain. The latter will import more wheat, while developed countries are increasing their feed grain imports. This is because the limited foreign exchange of LDC's will cause them to give food grains priority over feed grains. Projected production and trade of the LDC's should permit per capita consumption of grains to increase slightly over the base period. But any larger increase will most likely have to come from greater domestic production than from larger imports. Korea and Taiwan, however, are examples of areas where wheat is not grown and where significant growth in imports of wheat is projected.

The enlarged European Community would be expected to approach self-sufficiency in grains as would Eastern Europe and the USSR, even though right now they are substantial importers of feed grains. China would likely import wheat and export rice. Japan would remain the largest single import market for wheat and coarse grains.

Overall, the Alternative I scenario projects U.S. export volume to increase 46 percent relative to the base year of 1970 or about 7 percent relative to the recent very high levels of export.

Alternative II projects U.S. exports to increase 70 percent in volume relative to 1970 or about 25 percent above recent levels based upon assumptions that agricultural and trade policies would be altered to permit a more rapid growth in livestock production than under Alternative I. Some of the key assumptions were:

- The USSR and Eastern Europe attempt to increase livestock production and consumption at a faster rate of growth even if it means importing grain and high overall levels of trade with the western world;

- The People's Republic of China becomes more trade oriented and imports more grain to improve diets;

- The enlarged European Community finds it advantageous to set lower price targets with a liberalizing effect on import restrictions;

- The livestock economies, particularly poultry, of the developing world grow faster, either in countries with enhanced petroleum revenues, or in countries with unexpectedly higher rates of economic growth;

- And fishmeal production stagnates at the 1969-71 level.

With the greater dynamism of Alternative II, the higher demand for livestock products should essentially translate into a substantial increase in demand for coarse grains with relatively little impact on the demand for wheat, although higher feed prices to encourage more feeding of wheat in the developed countries would be expected. Our projections show the United States meeting nearly all of the increased demand, with U.S. exports of feed grains reaching 56 million metric tons, or about 25 million tons higher than under the more conservative assumptions of Alternative I.

Since the production capacity and trade studies were conducted largely independent of each other and somewhat higher commodity price levels were assumed in the production capacity study, results of the two studies cannot be fully integrated. But they do provide some basis for comparing potential U.S. production capacity with world demand for U.S. products.

Alternative I consumption and trade projections imply that the U.S. would produce about 50 million metric tons of wheat, 233 million tons of feed grains, 58 million tons of soybeans, and nearly 30 million metric tons of meat of which about half would be beef. High consumption-high trade projections of Alternative II imply an additional 5 million tons of wheat, 38 million tons of feed grains, 1 million tons of soybeans, and about the same amount of beef would be produced in the U.S. Projected production of each commodity is well below that projected in the production capacity study.

3. Limitations of the Assumptions

The world food supply-demand balance is right now in a precarious, tenuous balance which in the absence of favorable crops in many parts of the world in 1974 could have serious consequences for a large part of the world's population in the immediate future. It is therefore appropriate to underline again that the purpose of the analyses was to project, not predict, possible future parameters of agricultural production, consumption and trade. It is also appropriate to recall the restrictive nature of our assumptions and methodology.

Turning first to projections of U.S. production capacity recall that the scenario was based upon assumptions of a technologically and resource unrestrained, capital-intensive industry with strong economic incentives to expand. A possible, even plausible, alternative

scenario might be developed around a technology and resource restrained agriculture including stringent regulations to enhance environmental quality, high prices of inputs and something other than the "lock-step" relationship between product and factor prices assumed in our projections. Such a scenario could yield much lower levels of projected output.

Similarly, if assumptions of continued extreme scarcity and high prices of fertilizer and energy were adopted for the developing countries, their projected output of agricultural commodities would be substantially reduced. Continuation or extension of the "Green Revolution" is highly dependent upon availability of a bundle of resources including fertilizer at prices relative to product prices which will provide incentive to farmers and which are within the foreign exchange means of the LDC's.

Our projections and most others focusing on 1985 or beyond abstract from uncertainty, cyclical movements in production and year-to-year instability which has typified agriculture and will undoubtedly pervade the path of adjustment to 1985. We should not overlook the costs of instability and uncertainty which attend world food production. Consideration of national and international policies and mechanisms to alleviate instability deserves very high priority today in any discussion of the world food situation.

Based even on the projections of ERS which by and large are consistent with those released recently at Iowa State University, there should be no complacency toward the world food situation. Immense investments will be required to develop, adapt and transfer technology and to improve economic and social infrastructure to make such technology socially and economically productive. And given the instability which attends world food production and that nearly 2/3 of the world population could be nutritionally vulnerable to that instability, it is better to err on the side of over-investment and excess capacity in agriculture than the reverse.

What about 1990, 2000 or 2020? Long-range projections of current rates of population growth simply run off the chart and beyond the range of agricultural solutions that are either possessed or conceivable. Bearing in mind that there may be a long lag between the initiation of research and some types of development projects and the time that such research and development comes into fruition in the form of increased output or more efficient output, we should be using a time horizon of not 12 years but 15, 20 or 30 years in planning current investments in research and development.

4. Summary and Conclusions

Substantial increases by 1985 are projected for U.S. and world output of agricultural commodities, and for U.S. agricultural exports. World food supply would be adequate to meet world demand by 1985, but only if certain recent favorable trends continue.

If one can assume that currently prevailing production systems may have to be altered substantially in the not-too-distant future to protect or enhance environmental quality and to ration use of non-renewable natural resources (and that seems like a realization we are slowly coming to), then policy recommendations based upon assumptions that the future may be simply extrapolated from the recent past are open to serious debate. Although our society may be prone to overreact to immediate crises, there are many who believe that the energy and environmental "crises" of today are manifestations of permanent modes of the future in many parts of the world. This leads in conclusion to two recommendations:

(1) We need to redesign or further redirect publicly funded research in both the physical sciences and in economics to develop new or adapt current food production systems on the premise of limited and increasingly costly fossil-fuel derived energy sources.

(2) We need more complete alternative scenarios for world agriculture under a technologically and resource constrained set of assumptions. In light of the implications of such analyses policies and programs related to U.S. and world agriculture should be reassessed.

Some work of this type has been initiated by economists in ERS and in some land grant universities. But that work needs to be broadened and enlarged to involve other disciplines upon which economists are dependent for input-output relations in new or modified production systems.