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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REVIEW: NATIONAL WATER COMMISSION'S EXPORT PROJECTIONS

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1. Introduction

This paper is concerned primarily with an evaluation of the projections of U.S. agricultural exports and imports used by the National Water Commission in its report, Water Policies for the Future.[2/] These projections were prepared for the Commission by researchers at Iowa State University and are contained in two reports: Agricultural Water Demands[3/] and Future Alternatives Affecting the Agricultural Demand for Water and Land; The Effects of Soy Protein Meats and Nitrogen Fertilizer Restrictions on Future Water and Land Use.[4/] My comments are organized

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[2/] Final Report to the President and to the Congress of the United States by the National Water Commission, Washington, D. C., June 1973.

[3/] Prepared by Earl O. Heady, Howard C. Madsen, Kenneth J. Nicol, and Stanley H. Hargrove, Center for Agricultural and Rural Development, Iowa State University, November 1971.

[4/] Prepared by Howard C. Madsen, Earl O. Heady, Stanley H. Hargrove, and Kenneth J. Nicol, Center for Agricultural and Rural Development, Iowa State University, June 1972.

into three parts. The next section of the paper deals with the adequacy of the projected exports and imports; the following section treats the implications of alternative projections employed by the National Water Commission; and the final section presents some suggestions for improving upon the projections used by the National Water Commission.

II. Export and Import Demand

We have witnessed a fantastic rise in the value of U.S. agricultural exports and, to a lesser extent, in the value of U.S. agricultural imports during the past two years. In fiscal year 1973 the value of U.S. agricultural exports increased by 60 percent--from $8.0 billion in fiscal year 1972 to $12.9 billion in fiscal year 1973. Furthermore, the U.S. Department of Agriculture estimates agricultural exports in fiscal year 1974 to be about $19 billion. It would be tempting to evaluate the projections used by the National Water Commission in light of these recent developments. But this would be unfair since the recent spurt in exports is due to a variety of unexpected developments that could not have been predicted at the time that the projections were made; e.g., bad weather in a number of major countries, two devaluations of the dollar, and major policy changes in the Soviet Union and the Peoples Republic of China. We do not expect any maker of forecasts or projections to be omniscient. Therefore, I will confine my remarks to the adequacy of the projections given the information available at the time they were made. It turns out that, in this context alone, the projections of agricultural exports and imports are grossly inadequate.

The projections of agricultural water demands employed by the National Water Commission and discussed in the three documents referred to earlier

are to the year 2000. There are eleven sets of projections based on alternative combinations of assumptions about farm policy, domestic population, the price of water, exports and imports of agricultural products, and technology. The export projections are for all agricultural products and import projections are made for beef and veal, lamb and mutton, and dairy products. In ten of the eleven projections, exports of the U.S. agricultural products are assumed to be at the 1967-69 average level in 2000; in one projection they are assumed to be double the 1967-69 average level; and in all eleven projections imports of beef and veal, lamb and mutton, and dairy products are assumed to be at the 1967-69 average level in 2000. In the following discussion I assume that the authors of these projections had access to U.S. agricultural export and import data through fiscal year 1971.

The export and import assumptions are incredibly naive by almost any measure. Anyone familiar with U.S. agricultural policy knows that the U.S. government has employed since 1954 purposeful measures to expand exports of agricultural products. These include Public Law 480, a vigorous set of programs of market development and export promotion, and the redesign of U.S. farm policies and programs in the 1960s and 1970s to increase the competitive position of U.S. farm products in world markets. Furthermore, the changing structure of livestock production in the United States, together with domestic feed-livestock policies and trade policies, inevitably resulted in growing imports of meat and meat products and dairy products.[5/]

[5/] The United States would appear to have a comparative advantage in grain-fed vs. grass-fed beef. Also, demand and supply conditions in the dairy industry have resulted in a stabilization, or even a decline, in milk production and a decline in the number of milk cows, a historically important source of lower grades of beef. These conditions have resulted in a growing import demand for lower grades of beef and for some dairy products.

The factual trade picture is equally clear. From 1955 through 1971, the value of U.S. agricultural exports increased from $3.1 billion to $7.8 billion, and at a fairly uniform rate. Similarly, imports of meat and meat products went from $149 million in 1955 to $1,012 million in 1971, again increasing at a fairly steady rate (table 1).

Furthermore, almost every study of the future world agricultural situation done by the U.S. Department of Agriculture, the Food and Agricultural Organization of the United Nations, and other organizations since the mid-1960s implies rapidly growing world trade in agricultural products and growth in U.S. agricultural exports.[6/] Yet the results of these studies are not reflected in the export assumptions employed in the projections of agricultural water demands in the United States.

Let me illustrate some, but by no means all, of the possible range which might have been built into the export and import projections. The historical data on U.S. agricultural exports for the 1955-71 period can be approximated reasonably well by a linear trend. An extrapolation of this trend to 2000 would give a level of exports of $14.1 billion. This projected level is 2.2 times the 1967-69 average of $6.3 billion assumed in ten of the eleven sets of projections, and more than the high level of

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6/ Some examples of available studies are: Martin E. Abel and Anthony S. Rojko, World Food Situation: Prospects for World Grain Production, Consumption, and Trade, FAER No. 35, Economic Research Service, U.S. Department of Agriculture, September 1967; Agricultural Commodities--Projections for 1975 and 1985, Vols. I and II, Food and Agricultural Organization of the United Nations, Rome, 1967; Anthony S. Rojko, Francis S. Urban, and James J. Naive, World Demand Prospects for Grain in 1980, FAER No. 75, Economic Research Service, U.S. Department of Agriculture, December 1971; and Richard S. Magleby and Edmond Missiaen, World Demand Prospects for Cotton in 1980, FAER No. 000, ERS, U.S. Department of Agriculture, January 1971.

Table 1

U.S. EXPORTS OF ALL AGRICULTURAL PRODUCTS
AND IMPORTS OF MEAT AND MEAT PRODUCTS
1955-1973

Year	Exports of all Agricultural Products	Imports of Meat and Meat Products
	-------- million dollars --------	
1955	3,144	149
1956	3,496	149
1957	4,728	138
1958	4,003	234
1959	3,719	383
1960	4,519	341
1961	4,946	330
1962	5,142	417
1963	5,078	498
1964	6,068	499
1965	6,097	379
1966	6,676	527
1967	6,771	606
1968	6,311	688
1969	5,741	792
1970	6,721	970
1971	7,758	1,012
1972	8,047	1,093
1973	12,894	1,360

Source: Foreign Agricultural Trade of the United States, U.S. Department of Agriculture, November 1973, and U.S. Foreign Agricultural Trade Statistical Report, U.S. Department of Agriculture, various annual issues.

exports assumed in the other projection of double the 1967-69 average level of exports.[7/]

The projections of U.S. imports of meats and dairy products employed by the National Water Commission are also unrealistically low. A trend projection to 2000 gives projected imports of $2.3 billion compared with the 1967-69 average value of $695 million, or an increase of over 7 times.[8/]

One would have thought that, taking into account the historical record of U.S. agricultural exports and imports and the results of other projection studies dealing with world trade, the agricultural export and import projections used by the National Water Commission would have reflected a wider and more realistic range of assumptions about exports and imports in the year 2000. In the absence of highly detailed analyses of demand, supply and trade of agricultural products on a worldwide basis, a rather simple projection methodology must be employed. One such methodology is the projection of historical trends. The National Water Commission could have used three sets of assumptions about agricultural exports and imports, all based on trend analysis. One assumption would

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[7/] The estimated equation for total U.S. agricultural exports for the 1955-71 period is

$$X = 3164 + 242.68T \qquad R^2 = .87$$
$$(9.85)$$

where

X = agricultural exports in millions of dollars
T = 1, 2, . . . starting in 1955
and the number in parentheses is the estimated t-value.

[8/] The estimated equation for imports of meat and meat products for the 1955-71 period is

$$M = 25.69 + 50.17T \qquad R^2 = .90$$
$$(11.48)$$

where

M = imports of meat and meat products in million dollars
T = 1, 2, . . . starting in 1955
and the number in parentheses is the estimated t-value.

be a projection of historical rates of growth as was done earlier in my paper; the other two assumptions could be a higher and a lower growth rate than implied by the projection of historical trend. Unless we have specific knowledge that future changes in the factors affecting U.S. agricultural exports and imports will be significantly different from the past, an extrapolation of past trends is a reasonable projection technique when one is forced to use a simple methodology.

In their simplest forms, exports can be viewed as the excess of domestic production over domestic consumption, and imports as the excess of domestic consumption over domestic production, ignoring changes in stocks. Thus, what one assumes about levels of exports or imports should be related to alternative assumptions about factors which affect levels of domestic demand or supply. There is no evidence that the projections employed by the National Water Commission considered these interrelationships.

Two factors which affect levels of domestic demand are income and population. Only one level of income is assumed for the year 2000 so that the influence of variations in the level of this factor is not considered. However, alternative population projections are employed ranging from 280 to 325 million, or a difference of 16.1 percent. This wide a range of population assumptions should affect levels of domestic demand, domestic production, exports and imports, and prices. Yet, the projections of agricultural exports and imports do not reflect the possible impact of alternative rates of population growth in the United States. And, it is not clear how, in the absence of changes in exports and imports, changes in domestic demand affect domestic supplies and prices.

On the supply side, two elements of the projection framework other than the price of water should play an important role in influencing agricultural exports and imports--namely, agricultural policy and technology assumptions. Ten of the eleven projections assume that the rate of technological change in U.S. agriculture continues at historical rates, and one projection assumes an "advanced" rate of technological change. Nowhere is mention made of the possibility of a deceleration in the rate of technological change. I should think that slower rates of growth in future agricultural productivity from those which have prevailed are a possibility and would have a significant impact on the future demand for water by the agricultural sector and certainly influence the level of agricultural exports and imports. A slower rate of productivity growth in U.S. agriculture could result from restrictions on the use of chemical inputs other than fertilizer, reduced funding of biological research, etc. The only restriction on productivity growth which was analyzed was limits on fertilizer use.

Nine of the eleven sets of projections assume a free market set of agricultural policies and two sets of projections assume annual land retirement programs. (The restrictions on beef consumption and fertilizer use are not treated here.) Having recognized the importance of alternative agricultural policies for the future demand for water,[9/] it is curious that the Commission settled on so narrow a range of policy alternatives. Furthermore, the dominance of free market policy assumption is hard to understand when one recognizes that we have not had anything approaching free market conditions in U.S. agriculture in over 40 years. The reason

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9/ Water Policies for the Future, pp. 11-12.

given for the free market policy regime is that "other types of farm programs are more difficult and costly to set up and evaluate in a linear programming model of the size and nature of that used in the analysis."[10/] Then pick another form of analysis more in line with reality! It is indefensible to base major analyses and policy conclusions on such a thin analytical base when a wide variety of alternative analytical approaches is available.

But just as important as the narrow range of policy alternatives is the fact that the projections analysis does not seem to recognize the major impact that a free market would have on domestic agricultural output and U.S. agricultural trade. Under a free market regime, which I interpret to mean the absence of government intervention in the domestic market and the absence of trade restrictions, there would be a significant change in the agricultural output mix, particularly for agricultural commodities which are heavy users of water.[11/]

The commodities whose production is most likely to be affected under free market conditions are sugar, cotton, rice, and dairy products. Numerous studies of sugar show that the United States is presently a very uneconomic producer. With a free market, free trade situation there would be very little sugar (and practically no beet sugar) produced in the United States; we would have to rely heavily on sugar imports to meet

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[10/] Water Policies for the Future, p. 15.

[11/] For more detailed discussions of this point, see Martin E. Abel, "The Developing Countries and United States Agriculture," Staff Paper P72-25, Department of Agricultural and Applied Economics, University of Minnesota, October 1972; (also in G. S. Tolley, ed., Trade, Agriculture, and Development, Cambridge: Ballinger Publishing Co., March 1974); and D. Gale Johnson, World Agriculture in Disarray, London: Fontana, 1973.

our domestic demands. Yet the projections employed by the National Water Commission show significant acreages in sugar beets under the alternative sets of assumptions.

Several studies have also predicted a significant decline in cotton and rice acreage under a free market situation, although the relative decline would not be as dramatic as in the case of sugar. It is not clear that the free market, free trade implications for cotton and rice acreages were taken into account in the various projections.

Finally, the U.S. dairy industry is highly protected. Under a free market, free trade situation there would be a considerable rise in dairy imports. This does not square with the assumption employed in all the projections that dairy imports in 2000 would be at the 1967-69 average level.

Before the conclusions of the Commission are accepted as dictum, alternative and more realistic assumptions about exports and imports should be more fully explored. These alternative assumptions should reflect not only different demand and supply conditions for agricultural products in world markets, but also the interrelationship between factors which influence domestic demand and supply conditions and U.S. agricultural exports and imports. Furthermore, recent changes on the world agricultural scene involving agricultural policies and agricultural inputs, most notably for fuels and fertilizer, should be carefully examined as well.

III. Implications of Alternative Projections

Having reviewed the adequacy of the agricultural export and import assumptions which went into the alternative projections of future water

demands, I turn to some general comments about the projections while still staying within the framework of world agricultural trade.

The Commission report states that:

> Although the full range of possibilities should be considered in planning, development, and management of water resources, the Commission believes it is unrealistic to develop water policy on the basis of a "crisis scenario" such as a severe worldwide drought extending over many years. Rather than base national water policy on such speculation, it is better to provide for the possibility of the occurrence of such events by more direct measures, such as, for example, a national or even a world food bank. For this reason, the Commission did not try to encompass all possible alternative futures in its background studies, but selected for illustrative purposes only a reasonable number of possible combinations of policies for study. . . .12/

This statement impresses me as being overly restrictive. One would think that precisely because we are unable to predict 30 years ahead with any degree of accuracy that one would want to explore the implications of "extreme" possible outcomes, as best one can formulate them, to determine the limits to possible outcomes within which one must plan for the use of water resources. Certainly, there are a number of long-run forces on the world agricultural scene other than a "crisis scenario" based on bad weather which are worth exploring. Several developments on the world scene could have profound impacts on the future agricultural demand for water in the United States. There are three major areas of world agriculture on which I would like to focus.

The first deals with the rapid growth in the demand for livestock products and the derived demand for feed grains and protein in the developed countries of the world and in the more rapidly growing less

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12/ Water Policies for the Future, p. 3.

developed countries. A continuation of reasonably rapid rates of economic growth and policies to expand consumption of livestock products in a large number of countries would lead to rapid expansion in the demand for feed grains and proteins for animal feed. Since the United States is a major producer and exporter of both of these products, we might very well see a rapid expansion in these exports and possibly significantly higher world and domestic prices than prevailed in the 1960s. We might also see U.S. agricultural output more heavily weighted by grains and protein than was true in the past. This is one element of the world food and agricultural picture which warrants careful attention.

Another is the implications of alternative rates of growth of food production in the less developed countries. We can be fairly certain that the demand for food in these nations will grow rapidly because of generally rapid rates of population growth together with some likely increases in per capita incomes. But the prospects for increasing agricultural output in the less developed countries is less clear. The large jump in grain production in the latter part of the 1960s, generally referred to as the "Green Revolution," now appears to be behind us. No new major breakthroughs in agricultural technology are envisioned for at least the near future, although there will continue to be progress in improving agricultural technology in the less developed countries. But equally important is the recognition that the influence of new agricultural technologies on production is conditioned by the availability to farmers of modern production inputs, marketing and credit systems which facilitate the use of these inputs, adequate marketing systems for farm output, and the development of land and water resources. These are problems which, by their very nature, require considerable amounts of time and resources

to solve. Thus, the agricultural demand and supply prospects in the less developed countries also deserve careful scrutiny.

Finally, we have seen some dramatic changes in the world energy and fertilizer situation. A permanent increase in the real cost of energy and fertilizer could have dramatic impacts on the demand and supply of agricultural products in both developed and developing countries, and on the agricultural demand for water in the United States. It would be very useful to explore the effects of alternative levels of fuel and fertilizer prices on the supplies and prices of agricultural outputs in different parts of the world.

The agricultural demand for water in the United States is influenced by, among other things, prices of agricultural output and prices of other inputs which substitute for water. A constellation of forces which lead to higher world prices for agricultural products would certainly increase the demand for agricultural uses of water. Increases in the prices of non-water production inputs such as fuel and fertilizer could lead to either increases or decreases in the demand for irrigation depending on whether they are substitutes for or complements to irrigation. The differential impact of changes in product and input prices on production from irrigated and non-irrigated land will also have to be considered. I would certainly recommend that any revision of projections of agricultural water demands in the United States explore alternative assumptions in the three areas of world food and agriculture just discussed.

IV. Conclusions

I have provided an ample measure of criticism of the assumptions underlying the projected agricultural water demands employed by the National Water Commission. This might be reason enough to withhold

treatment of the Commission's Report as a definitive work until more meaningful demand projections are made.

But the recent developments on the world food and fuel scene would also dictate a fresh look at future agricultural demands for water as well as demands in other sectors of the economy. Let me pose several issues which I think should be carefully examined.

1. Has there been a basic change in the world food situation which will put strong pressure on American agricultural resources? If the era of surpluses is behind us and if additional land resources will have to be brought into production, probably at considerable cost, what does this mean for the demand for water in the agricultural sector?
2. What are the implications of higher fuel and fertilizer prices for the future demand for water in the agricultural sector? To what extent are fuel and fertilizer substitutes or complements to water and to what extent will higher fuel and fertilizer prices significantly change the demand for water in the United States? Will higher fuel and fertilizer costs increase the cost of bringing more land into production sufficiently to shift the comparative advantage to irrigated land?
3. Finally, how would increased fuel prices affect the demand for water in nonfarm uses and how would this affect the availability of water to the agricultural sector? For example, expanded use of western coal deposits for gasification purposes would require diversion of water resources away from agricultural uses.

In conclusion, a fresh look at the projected water demands employed by the National Water Commission would appear to be in order.

Summary

The projections of agricultural imports and exports contained in the National Water Commission's Report are reviewed. These projections are found to be unrealistically low in terms of (a) information available at the time they were made, and (b) trade developments since the original projections were made.