U.S. Agricultural Outlook Update and Projections for the West to 1985 and 2000

Leroy Quance, Gerald Plato, and Allen Smith

U.S. agriculture is the envy of the world. The abundance and quality of food and the low percentage of income consumers spend for food are obvious measures putting U.S. agriculture at the forefront.

In the 1960's, the world in general and Americans in particular grew complacent about food supplies. Althouth this complacency was not shared by millions who have never enjoyed adequate diets and live on the margin of inadequate food supplies, the bountiful capacity of high technology agriculture in developed countries and the green revolution in developing countries led to a global surplus psychology. And indeed, world grain production, the foundation of the world food supply, rose almost every year from 1960 through 1972, interrupted only by poor crops in the USSR in 1961 and 1963 and the great Indian drought of 1965-66. And this steady growth occurred despite production control programs in the United States [Hathaway, 1975].

But the winds of change can blow swiftly across agriculture. Food abundance is based on our great natural resources but has become increasingly unnatural as greater energy, chemical fertilizers, pesticides, and irrigation water inputs are used in increasingly concentrated and monocultured production processes very much in opposition to natural ecosystems. As these environmental concerns were becoming the focal point of public concern in agriculture, the rapid rise in agricultural productivity began to slow. The upward trend in agricultural exports accelerated during the late 1960's and early 1970's, and coupled with slower productivity growth and strong production controls, surplus commodity stocks dwindled.

In the last three years, we have witnessed severe turbulence in the world food and agricultural systems – severe famine in the sub-Sahara and other food deficit developing countries; the Arab oil boycott and skyrocketing prices in the energy supplies fueling U.S. agriculture; unexpected poor weather induced massive grain purchases by the USSR; and worldwide economic slowdown in many non-oil exporting countries.

In the U.S., we witnessed limited beef supplies in the supermarkets, $5 wheat, soybeans that exceeded $12 on the Chicago futures, food price increases of 14 percent per year from 1972 to 1974 and another 8.5 percent from 1974 to 1975, a decrease in per capita food consumption for the first time since 1967, a shift to a "free market" farm policy and increasing concern and calls for a national "food policy."

These phenomenal developments raise new concerns about the productive capacity of American agriculture to maintain food supplies in the domestic and world markets. This interest is shared by nations around the world concerned about the world food situation and at home by both farmers and consumers. Nations concerned about food for hungry people turn inevitably to the United States, already the bread basket of poor nations and the most promising source of export expansion. Our own nation, faced with higher outlays for oil and other imports, hopes that high grain exports will

Leroy Quance is program leader and Gerald Plato and Allen Smith are Agricultural Economists, Economic Projections and Analytical Systems, National Economic Analysis Division, Economic Research Service, U.S. Department of Agriculture.

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help balance our international accounts. Consumers, shocked by inflation in general, are concerned that increasing grain exports will mean higher food prices. And farmers would like to know about the future farm commodity supply-demand conditions in order to make better judgements about their increasingly capital intensive and high input cost businesses. [Brandow, 1974].

Food and Agricultural Scenarios

Scenario, originally a theatrical term setting forth the sequence of actions as well as describing characters and scenes, was introduced by Herman Kahn into the public dialogue about the future in his *The Year 2000.* published in 1969 [Kahn]. Kahn defines scenario as a hypothetical sequence of events constructed for the purpose of focusing attention on causal processes and decision points. Thus, a scenario is a consistent, well researched detailed set of events permitting the reader to understand the situation, conditions and strategies that prevail.

In ERS's Economic Projections Program, we give scenario a similar but probably more restricted meaning than does Kahn. We define scenario as a precise statement of assumptions and/or projections about the future required to define the environment in which the food and agricultural system will function. Scenarios provide information necessary to reduce the realm of future possibilities to a manageable range. Scenario statements, assumptions and/or projections are essential parts of our Economic Projections Program's total information system. They are inputs into econometric components of our National-Interregional Agricultural Projection (NIRAP) system rather than output from them. The resulting projections and analysis constitute alternative futures for food and agriculture.

Future possibilities are infinitely complex. Individual and collective private and public decisions will combine with natural forces to "invent" our food future. How could we possibly predict the future before these decisions or even their causal factors exist? The probability of any one single combination of events projected for the future approaches zero. Thus, we are experimenting with defining scenarios to bound a range of possible outcomes rather than a series of single points through time. And, if we are to project alternative futures based on scenarios differing with respect to major attributes of the supply and demand for food and fiber, we should give the users of such information our best estimate of the likelihood that agriculture will in fact adjust within the bounds described by various scenarios.

Historically, we've had a feast or famine attitude about the world food situation. With regularity of a clock pendulum, we swing from the position that agriculture has an inherent and chronic capacity for overproduction to the other extreme of viewing scarcity as a permanent characteristic of food production. For convincing evidence supporting the chronic overproduction hypothesis, see Heady et al., *The Roots of the Farm Problem* and Johnson and Quance (editors), *The Overproduction Trap in U.S. Agriculture.* For the scarcity theme, read almost any current literature on global food production, for the pendulum is at the extreme; but especially see Lester Brown's *By Bread Alone.* And for a near complete swing of the pendulum from feast to famine, read Brown's *Seeds of Change* before you read his *By Bread Alone.*

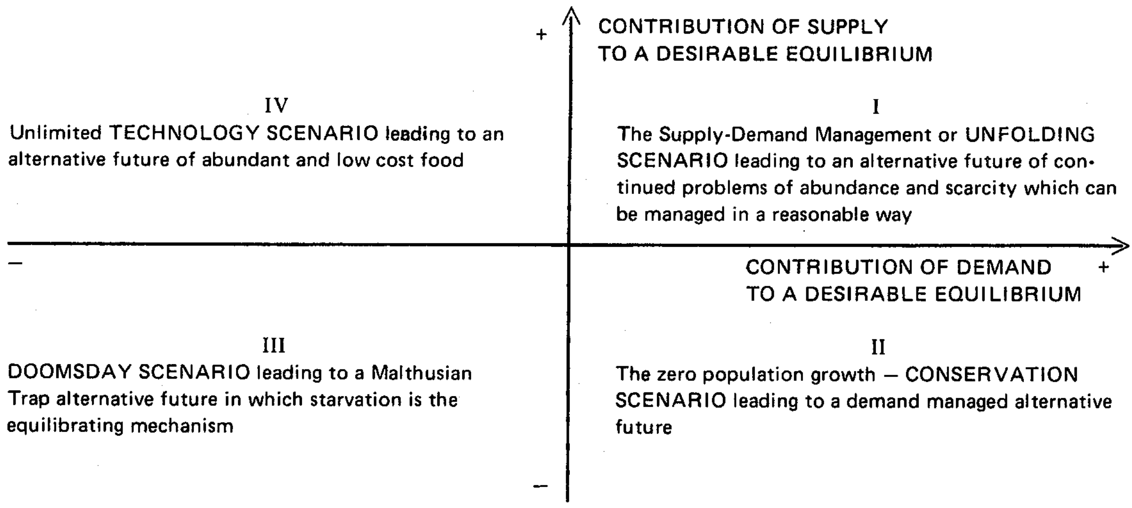
The feast or famine pendulum scenarios, although acknowledging demand for food in the form of population and income growth, emphasize supply as the positive or negative force in the world food balance. To more fully complete the broad scenario possibilities, we must give demand equal weight in a kind of four quandrant supply-demand scenario plane, as illustrated in Figure 1.[1]

Depending on the quandrant in Figure 1, supply and demand are positive or negative forces in the world food balance.

Malthus was the originator of the quandrant III *doomsday scenario* in which only starvation is effective in holding population in check and balancing food supplies with needs. in *Inquiry Into the Human Prospect,* Robert Heilbroner is a modern-day Malthus. He laments the human prospect resulting from horrifying population growth without sufficient food causing catastrophic starvation and disease throughout a large portion

[1] We are indebted to Jean Johnson, National Science Foundation, for the original supply-demand scenario plane concept used in this paper. Ms. Johnson originally developed this idea with respect to energy scenarios while she was with Forecasting International, Ltd., Arlington, Va., in "Societal and Political Implications of the Energy Crisis," April 1974 and has since extended it to the resource development field.

Fig. 1. The world food situation supply-demand scenario plane



of the developing world and unrestricted industrial growth eventually bringing about a serious threat of environmental collapse.

Advocates of the technology induced *abundance scenario* of quandrant IV view unchecked population growth and other negative aspects of demand as an alarm calling for greater technical research in food and agriculture. In the U.S., Michigan State University's Sylvan Wittwer, the whirling coordinator of the National Academy of Science's food and nutrition study, advocates a "Manhattan project" in food that would rival the atomic bomb effort. Through an impressive government commitment of agricultural research funds and technological breakthroughs of increased photosynthetic efficiency, genetic engineering and controlled environment, land grand experiment stations could remove production constraints and create an abundant food supply to meet demands [NAS, 1975].

Hans Linneman, a Dutch economist and leader of the Club of Rome's project on feeding a doubled world population by year 2000 is apparently also convinced that food constraints need not limit population growth in the foreseeable future.

The *conservation scenario* futurist in quandrant II ignore the possibliities for increasing conventional food supplies, placing emphasis on regulating population growth and conserving our limited resource and food supplies. Zero population growth advocates believe that the combined effect of population growth and continually rising affluence will put unbearable pressure on the earth's resources and ecosystem. Lester Brown's *In the Human Interest* advocates a population control strategy leading to a stable world population of 5.8 billion by year 2015. This compares to uncontrolled world population projections ranging from 10 to 16 billion in the same time horizon.

Teamed with population control advocates are those emphasizing conservation of our limited resources. For Mumford's *Pentagon of Power – The Myth of the Machine,* energy is forcing us to adapt civilization to the machine. He advocates that we all "plant, work and eat." In the cornbelt, Barry Commoner is investigating the output of organic farms. And in urban neighborhoods, Karl Hess is experimenting with basement trout fisheries and rooftop gardens as alternative food sources.

The unfolding *supply-demand management* scenario of quadrant I sees man in control of himself and his environment, a world in which both technologies and human values change. Rather than concentrating on either technological change to increase food supplies or population and resource use control and conservation to decrease food needs, a balanced future is sought in which both the quantity and quality of human existence is valued. Rather than accept Mumford's rejection of the machine, Wittwer's worship of the machine, or Helbroner's hopelessness, those of us in quadrant I have reasoned faith in a future where the machine and man are adaptive to a common rhythm in tune with our environment.

The unfolding scenario calls for bracketing the determinants of food supply and demand such as technological change, inflation, environmental conditions, population and income growth and world trade in likely ranges, estimating the probabilities of each reasonable combination and simulating the resulting alternative futures through a planning horizon. But we are not constrained to accept the results. Rather, we can stop the simulation as it advances through time, rewrite the "second act" of the scenario, making new policy decisions in reaction to undesirable events, should they appear likely, and then continue our journey through time with man in control of his destiny.

Let's examine U.S. agriculture at reasonable extremes within our supply-demand management scenario (i.e., quadrant I, figure 1) in the years 1985 and 2000. Previous ERS projections indicate it is unreasonable to speculate that the attributes of either supply or demand will be so negative as to result in no net positive contribution of supply or demand in the world food balance and thus cause our food future to fall on the boundaries of quadrant I or within quadrants II, III, or IV.

Low Demand-High Supply Scenario Bound

At our low demand-high supply or overproduction tendency extreme of the supply-demand management scenario, we match low domestic population and income growth and low export demand with trend environmental controls and high public support for agricultural research and extension programs.

A series F national population projection results in 231 million people by 1985 and 251 million by 2000 compared to 212 million in 1974. GNP, growing at 3.28 percent annually, would reach $1,136 billion by 1985 and $1,843 billion by 2000 in 1958 dollars, compared to an $817.6 billion average in 1972-74. The resulting real per capita disposable income would be $3,637 in 1985 and $5,529 in 2000, compared to an average $2,857 in 1972-74.

This lower bound on demand attributes includes modified historical trends in economic development and agricultural trade policies around the world. The world's capacity for cereal production will increase faster than consumption; a rebuilding of grain stocks will result in downward pressure on commodity prices or programs to restrict production in major exporting countries; the Enlarged European Community (EEC), Eastern Europe, and the USSR will approach self-sufficiency in grains; and the People's Republic of China (PRC) continues to import wheat and export rice.

Export demand is also constrained by an assumption of an export demand elasticity of 1.5 where, with adequate world stocks, importing countries would be price conscious with alternative sources of supply.

On the supply side, the environmental control supply attribute basically recognizes environmental controls that are now law and looks to voluntary adoption of further environmental enhancing practices, selected banning of pesticides, and livestock waste restrictions applied only to larger feedlots.

High growth in public support for agricultural research and extension (R & E) programs means a 7 percent per year increase in real expenditures for agricultural R & E (1958 dollars). This was the annual average increment from 1944 to 1950. Here we also include the potentially unprecedented impact of three emerging technologies: twinning in beef cattle and bio-regulators and photosynthesis enhancement in crop production.

Inflation in prices paid by farmers for nonfarm produced inputs of 3 percent per year completes the supply attributes under this low demand-high supply unfolding scenario bound.

High Demand-Low Supply Scenario Bound

If the future of food and agriculture were governed by attributes approaching a scarcity scenario, we might define the unfolding scenario as having high demand attributes with environmentally restricted supply attributes not fully compensated for by public supported advances in agricultural productivity and supply restricting high input price inflation.

Domestically, a Census Bureau series D population projection results in 244 million Americans by 1985 and 286 million by 2000. A high GNP of $1,230 billion by 1985 and $2,246 billion by 2000 combines with the higher population projections to result in a real per capita disposable income of $3,739 in 1985 and $5,935 in 2000 (1958 dollars).

High export demand means higher world population and income growth; the USSR and Eastern Europe attempt to increase livestock production and consumption at a faster rate, even if it means substantially expanding imports from western countries; China becomes more trade oriented and imports more grain; and the EEC finds it advantageous to liberalize trade policies and lower internal farm price targets, thus permitting higher grain imports; and the world grows faster than under the lower export scenario bound, especially in developing countries and countries with large petroleum revenues and high economic growth rates.

Export demand would also be strengthened through a scarcity psychology. Thus, we assume export demand elasticities become zero as importing countries compete for limited supplies regardless of price.

The major domestic supply constraining attributes under this scenario bound are strict environmental controls and input price inflation. We would turn increasingly to mandatory adoption of environmental enhancing practices such as conservation and management, efficient use of plant nutrients, banning of whole groups of pesticides, absolute limits to irrigation discharge, and livestock waste disposal restrictions applied to much smaller units. A 6 percent inflation rate in prices paid by farmers for purchased inputs would also dampen output.

Support for agricultural research and extension programs would sustain the long-run trend of the 3 percent per year in 1958 dollars that occurred during 1937 to 1974. However, no impacts of unprecedented technological breakthroughs are included.

The above two scenario bounds were selected to describe the possible extremes of supply-demand management under a free market. The low demand-high supply conditions could find food and agriculture moving back toward a surplus production potential while the high demand-low supply scenario could lead to long-run food scarcity such as the short-run experiences of the 1972-74 period.

Let's now summarize some basic supply and demand structural relationships for U.S. Agriculture, our current production capacity, and the food and agricultural future within the bounds of the above supply-demand scenario.

Supply Response, Production Capacity and Market Projections

American farmers are fairly responsive to prices. They will increase output about .2 percent in the short run (1-2 years) and about 1.0 percent in the long run (many years) for each 1 percent increase in real prices received, i.e., the ratio of prices received by farmers for crops and livestock to prices paid by farmers for production items, including taxes, interest and wage rates. And at any price level, the quantity supplied is expected to increase about 1 percent per year due to productivity gains. But the quantity supplied at any price level will decrease about .2 percent per year for each 1.0 percent inflation in prices paid by farmers.

Given these supply relationships, the United States farm sector could have a feasible supply capacity by 1985 approximately double the 1967 output. But this would be costly, occurring at a relative price level 80 percent greater than the 1967 ratio. In "real" 1974 dollars, this would mean $4.94-per-bushel corn, $11.54-per-bushel wheat, $14.44-per-bushel soybeans and $103-per-hundredweight beef and veal. The feasible 1985 supply capacity for these commodities would be corn, 9.6 billion bushels; wheat, 3.5 billion bushels; soybeans, 2.6 billion bushels; and beef and veal, 38.2 billion pounds.

The above feasible supply capacity could require that 100 percent of the 95.7 million acres of noncropland with high potential for conversion to cropland and 48 percent or 27.4 million acres of medium potential noncropland be used in production. This could require some major investment and provide a constraint in the ten-year horizon to 1985.

The above is what appears feasible in terms of agriculture's supply response capability. But this feasible supply capacity will not likely be demanded. For output to double in the 18 years from 1967 to 1985 would require about a 4 percent annual increase in demand. Our most optimistic projection is for demand to increase about 2.0 percent per year.

Supply-Demand Management Alternative Future

In the decade of the 1960's, demand for U.S. farm output increased about 1.5 percent per year, on the average. The high demand attributes selected for our scarcity scenario bound implies total annual average demand shifts approaching 2 percent per year. Moving to the low demand conditions bounds the 1.5 percent of the 1960's is only slightly above 1 percent per year by 2000.

Similar to demand, the shift in the supply function for farm output averaged about 1.5 percent over the last 50 years. But the highest annual average shift expected over the next 10 years is about 1.2 percent. This shift could approach 1.45 percent over the next 50 years under high public support for agricultural research and extension programs with such unprecedented agricultural technologies as photosynthesis enhancement and bio-regulators in crop production and twinning in beef cattle coming on-stream as expected. But environmental controls, even under current trends, will likely cause significant cost increases and dampened yield increases to depress overall productivity growth.

Thus, demand for food is expected to increase moderately faster than supply without price considerations. These relative shifts in the demand and supply for farm output should result in real increases in prices received by farmers and net farm income. But food supplies will remain quite adequate with domestic per capita food consumption remaining fairly constant and real food prices increasing moderately. And because real per capita disposable personal income is expected to increase significantly, the increase in the percent of per capita disposable income spent on food will be within reasonable bounds. Thus, continued food prosperity for American consumers.

The details are summarized in tables 1 and 2. Aggregate farm output is about the same under the two scenarios in 1985 (i.e., 120 for the scarcity

Table 1. Selected indicators of food and agriculture projected to 1985 under scarcity and overproduction bounds of an unfolding or supply-demand management scenario, with comparisons between scenario bounds and with the 1972-74 average, United States

			Projected, 1985				
			Scarcity bound		Overproduction bound		
Indicator	Units	Actual 1972-74	Quantity or value	% change from 1972-74	Quantity or value	% change from 1972-74	Percent change from scarcity to overproduction bound
Output							
Aggregate farm	1976=100	109	120	10.1	121	11.0	0.8
Beef and veal	Bil. lbs.	22.7	24.2	6.6	28.3	24.7	16.9
Pork	Bil. lbs.	13.4	13.1	-2.2	14.9	11.2	13.7
Corn	Bil. bu..	5.3	6.1	15.1	6.0	13.2	-1.6
Wheat	Bil. bu.	1.7	2.4	41.2	1.8	5.9	-25.0
Soybeans	Bil bu.	1.3	1.7	30.8	1.7	30.8	0
Exports	1967=100	150	167	11.3	150	0	-10.2
Prices received by farmers for:							
Aggregate farm output	1974 = 100	87	171	96.6	121	39.1	-29.2
Beef and veal	\$/cwt.[2]	34[1]	44	29.4	48	41.2	9.1
Pork	\$/cwt.[2]	33[1]	29	-12.1	30	-9.1	3.4
Corn	\$/cwt.[2]	2.36	2.34	-.8	1.99	-15.7	-15.0
Wheat	\$/cwt.[2]	3.25[1]	7.13	119.4	2.67	-17.8	-62.6
Soybeans	\$/cwt.[2]	5.58	5.30	-5.0	5.46	-2.1	3.0
Farm inputs	1967=100	101	103	2.0	99	-2.0	-3.9
Productivity	1967=100	107.7	116	7.7	122	13.3	5.2
Cropland harvested	Mil. acres	311	340	9.3	294	-5.5	-13.5
Gross farm income	1974 Bil. \$s	88.8[1]	99	11.5	96	8.1	-3.0
Production costs	1974 Bil. \$s	60.0[1]	66	10.0	65	8.3	-1.5
Net farm income	1974 Bil. \$s	24.8[1]	33	33.1	31	25.0	-6.1
Per capita food consumption	1967=100	102.7	95.2	-7.3	105.7	2.9	11.0
Consumer food prices (CPI)	1972=100	115.1	189.7	64.7	188.7	64.0	-.6
Percent of per cap. disposable income spent on food	percent	16.0	19.0	18.8	21.4	33.8	12.7
Environmental qual.	1976=100	—	112	12[3]	99.6	-.4[3]	-11.1

[1] Current dollars
[2] Real "1974" dollars
[3] Percent change from 1976

Table 2. Selected indicators of food and agriculture projected to 2000 under scarcity and overproduction bounds of an unfolding or supply-demand management scenario, with comparisons between scenario bounds and with the 1972-74 average, United States

			Projected, 2000				
			Scarcity bound		Overproduction bound		
Indicator	Units	Actual 1972-74	Quantity or value	% change from 1972-74	Quantity or value	% change from 1972-74	Percent change from scarcity to overproduction bound
Output							
Aggregate farm	1976=100	109	144	32.1	133	22.0	-7.6
Beef and veal	Bil. lbs.	22.7	27.4	20.7	31.8	40.1	16.1
Pork	Bil. lbs.	13.4	14.7	9.7	16.5	23.1	12.2
Corn	Bil. bu.	5.3	7.5	41.5	6.7	26.4	-10.7
Wheat	Bil. bu.	1.7	3.2	88.2	2.0	17.6	-37.5
Soybeans	Bil. bu.	1.3	2.6	100.0	1.9	46.2	-26.9
Exports	1967=100	150	314	109.3	175	16.7	-44.3
Prices received by farmers for:							
Aggregate farm output	1974=100	87	251	188.5	147	69.0	-41.4
Beef and veal	\$/cwt.[2]	34[1]	37	8.8	37	8.8	0
Pork	\$/cwt.[2]	33[1]	26	-21.2	23	-30.3	-11.5
Corn	\$/cwt.[2]	2.36[1]	2.29	-3.0	1.60	-32.2	-30
Wheat	\$/cwt.[2]	3.25[1]	8.10	149.2	2.04	-37.2	-74.8
Soybeans	\$/cwt.[2]	5.58[1]	7.13	27.8	4.42	-20.8	-38.0
Farm inputs	1967=100	101	107	5.9	81	-19.8	-24.3
Productivity	1967=100	107.7	135	25.3	150	39.3	11.1
Cropland harvested	Mil. acres	311	373	19.9	274	-11.9	-26.5
Gross farm income	1974 Bil. \$s	88.8[1]	112	26.1	83	-6.5	-25.9
Production costs	1974 Bil. \$s	60.0[1]	62	3.3	51	-15	-17.7
Net farm income	1974 Bil. \$s	24.8[1]	50	101.6	32	29.0	-36.0
Per capita food consumption	1967=100	102.7	91.1	-11.3	103.0	0.3	13.1
Consumer food prices (CPI)	1972=100	115.1	255.6	122.1	250.3	117.5	-2.1
Percent of per capita disposable income spent on food	percent	16.0	14.3	-10.7	18.4	15.0	28.7
Environmental qual.	1976=100	——	132	32.0[3]	97	-3.0[3]	-26.5

[1]Current dollars
[2]Real "1974" dollars
[3]Percent change from 1976

and 121 for the overproduction scenario bound, 1967=100). This is a 10 to 11 percent increase in output from the 1972-74 average. Aggregate output increases to 144 by 2000 for the scarcity bound and 133 for the overproduction. Farm output at the scarcity bound in 2000 is about 32 percent greater than the 1972-74 average.

With respect to natural resources, our cropland base appears adequate to produce the projected output for 1985. But under the scarcity scenario bound, over 370 million acres of cropland will be needed by year 2000. This is some 40 million acres more than we are using now. But these acres could come from the 97.5 million acres noncropland with high potential for conversion to cropland.

And concerning environmental quality, a subjective environmental quality index developed at a recent ERS sponsored environmental quality workshop, indicated that environmental quality, under current trends, may only decrease a small 3 percent by 2000 but could be improved an appreciable 32 percent by 2000 under stringent environmental controls, compared to 1976.

All of the above are results of a preliminary appraisal relying on ERS and USDA-wide information and judgment currently incorporated in our National-Interregional Agricultural Projections (NIRAP) system applied to very specific scenarios constructed by our core projections program staff.

The world trade scenario attributes were provided by the Commodities Program Area led by Anthony Rojko of ERS's Foreign Demand and Competition Division and the environmental control attributes were provided by ERS's Natural Resource Economics Division under the leadership of William Crosswhite. But the authors assume responsibility for the way these major scenario dimensions were combined with other domestic supply and demand scenario attributes to form the supply-demand management scenario bounds.

And we have some problems in this respect. The food and agricultural system is almost infinitely complex and both our NIRAP system and scenario development are gross abstractions. These abstractions are perhaps less critical at the aggregate farm output level but possibly lead to greater distortions as the analysis proceeds to greater commodity and regional detail. For example, the $8.10 per bushel wheat price in 2000 under the scarcity scenario bound is probably too high relative to the $2.36 per bushel corn price. These kinds of price differentials look more like short-run disequilibrium than a long-run equilibrium.

Also, the projection of consumers increasing per capita food consumption so much under the low demand-high supply scenario bound that despite lower food prices, the percent of per capita disposable personal income spent on food is higher than at the high demand-low supply scenario bound, seems questionable.

We will be receiving greater ERS-USDA wide input into our scenario development over the next few weeks and will be revising our long-range projections for publication this fall.

But what are the implications of these preliminary projections for the West?

Implications for the West

The West in this analysis is defined as the 17 western states comprising the Mountain, Pacific, Northern Plains and Southern Plains farm production economic regions. These states produce almost 80 percent of U.S. wheat, over 90 percent of our sorghum, 85 percent of our sugarbeets, over 80 percent of our flaxseed, almost 60 percent of the Irish potatoes, over 60 percent of the dry beans and peas, and nearly 60 percent of the liveweight marketings of cattle and calves (1972-74 averages) (table 3). These western states are also important producers of sheep, citrus and noncitrus fruits, and vegetables.

Under the scarcity scenario bound, almost 100 million more acres would be needed for the U.S. by the year 2000 for cropland than under the overproduction bound (tables 4, 5, 6, 7). Wheat acreage would almost double from 42 million to 83 million acres and 13 million acres above the large 1974 crop. The West would expand wheat acreage from 34 million at the over-production bound to 68 million acres under the scarcity bound, the latter being some 16 million acres or 30 percent above the 1974 average. The 17 western states would have 48 million more acres of crops harvested under the scarcity than under the overproduction scenario bound in 2000.

Sugarbeet acreage in the West would increase 12 percent from the scarcity bound to the overproduction bound. The recent development of high fructose corn syrup could tend to reduce the need for sugar beets; per capita consumption of sugar from cane and beets has been dampened by increased use of corn syrups, and the potential for this substitution is greater than has been included in these projections. Both scenario bounds, however, project sugarbeet acreage in the West to increase above the 920 thousand acres harvested in 1974.

Flaxseed acreage would increase about 8 percent; Irish potatoes, 12 percent; citrus fruits, over 20 percent; and noncitrus fruits and vegetables, between 35 and 40 percent from the overproduction to the scarcity scenario bound. Sorghum acreage would decline slightly in the West.

Two major causes of increased cropland acreage under the scarcity scenario bound are stringent environmental controls and increased exports. Wheat yields in 2000 will decrease from 47 to 38 bushels per acre at the U.S. level where stringent environmental controls are applied. Since most wheat is produced in the West, the western yields almost parallel the U.S. average with the Northern Plains region increasing wheat acreage from about 19 to 37 million acres and yields decreasing from 45 to 37 bushels per acre. U.S. wheat exports increase from 1.1 million to 2.2 million bushels or 100 percent. The resulting production in the 17 western states increases from 1.6 to 2.5 million bushels, or about 60 percent, since domestic consumption does not increase as rapidly as exports.

Most other major crops in the West don't change as drastically by 2000 as wheat, but are affected

Table 3. Major commodity production, U.S. and 17 Western States* with comparison to 1972-74 average and projections to 1985 and 2000 for low demand-high supply (overproduction) and high demand-low supply (scarcity) scenario bounds

				High Demand-Low Supply Bound				Low Demand-High Supply Bound			
		1972-74 Average		1985		2000		1985		2000	
Commodity	Mil. Units	U.S.	17 West. states	U.S.	17 West. states	U.S.	17 West. states	U.S.	17 West. states	U.S.	17 West. states
Wheat	bu.	1,681	1,341	2,408	1,992	3,159	2,542	1,762	1,381	1,960	1,578
Rye	bu.	24.9	15.2	36.4	26.2	47.4	35.4	34.4	24.8	38.5	28.8
Rice[2]	cwt.	97.4	44.7	176.9	83.0	261.1	120.8	104.6	49.1	119.5	55.3
Corn	bu.	5,290	911	6,134	836	7,499	1,057	5,973	814	6,716	947
Sorghum	bu.	789	735	970	909	1,169	1,088	1,068	1,001	1,334	1,241
Oats	bu.	660	246	604	222	665	262	723	265	798	314
Barley	bu.	384	214	418	370	485	437	467	413	517	465
Soybeans	bu.	1,350	77.0	1,665	116	2,591	226	1,668	116	1,902	166
Sugarbeets[3]	tons	25.1	21.1	31.0	25.3	35.8	29.0	30.0	24.5	32.3	26.1
Flaxseed	bu.	14.4	11.8	28.1	25.5	27.2	25.8	24.9	22.6	25.5	24.2
Peanuts[4]	lbs.	3,472	710	3,980	975	4,984	1,296	3,856	945	4,480	1,165
Citrus fruits[5]	tons	14.0	NA	15.1	4.0	17.9	4.7	14.9	3.9	16.5	4.3
Noncitrus fruit[5]	tons	10.4	NA	11.6	8.1	13.3	9.2	12.4	8.6	13.2	9.1
Vegetables[5]	cwt.	509	NA	546	327	628	394	538	323	569	357
Irish potatoes[5]	cwt.	312	183	324	186	382	232	317	199	343	229
Dry beans	lbs.	1,844	1,084	1,878	975	1,842	914	1,945	1,010	1,948	966
Dry peas	lbs.	233	228	377	368	416	405	353	344	360	351
Beef and veal[6]	lbs.	41,686	24,877[1]	40,735	23,040	46,106	26,818	47,628	26,939	53,463	31,096
Pork[6]	lbs.	20,384	2,389[1]	20,285	3,361	22,618	3,778	22,975	3,807	25,355	4,235
Sheep and lamb[6]	lbs.	899	624[1]	772	591	652	508	851	651	737	574
Chickens[6]	lbs.	1,149	216[1]	1,478	333	1,787	402	1,466	330	1,669	375
Broilers[6]	lbs.	11,340	1,201[1]	13,041	1,374	15,763	1,605	10,938	1,364	14,730	1,500
Turkey[6]	lbs.	2,436	756[1]	2,560	780	2,992	845	2,829	862	3,305	934
Eggs	1,000	66.5	16.5	64.9	17.3	69.1	18.7	68.3	18.2	71.0	19.2
Milk[5]	cwt.	1,169	289	1,142	254	1,185	262	1,466	330	1,669	375

*17 Western States — Mountain Region: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada; Pacific Region: Washington, Oregon, California; Northern Plains: North Dakota, South Dakota, Nebraska, Kansas; and Southern Plains: Oklahoma and Texas.

[1] 1974 only.

[2] Rough basis.

[3] Farm weight.

[4] Farmers stock basis.

[5] Fresh equivalent.

[6] Liveweight.

Table 4. Harvested acreage and crop yields, Mountain, Pacific, Northern Plains, and Southern Plains farm production regions of the West, 1985, low demand — high supply overproduction scenario bound

		Mountain		Pacific		Northern Plains		Southern Plains		48 States	
Commodity	Unit	1,000 acres	Yields	1,000 acres	Yields	1,000 acres	Yields	1,000 acres	Yields	1,000 acres	Yields
Wheat	bu.	7045	35.2	3602	48.5	20054	36.5	6457	35.1	45962	38.3
Rye	bu.	77	24.0	87	27.4	593	31.9	75	22.4	1140	30.1
Rice[2]	cwt.	0	0	393	6229.8	0	0	460	5346.3	1952	5356.9
Corn	bu.	407	117.4	322	122.1	7072	100.8	113	127.5	54248	110.1
Silage	tons	805	15.7	197	27.2	2974	10.4	503	7.2	10413	13.5
Sorghum	bu.	818	65.9	465	82.2	6094	65.9	8644	58.7	17011	62.8
Oats	bu.	360	57.6	170	62.1	4051	52.1	618	37.1	12412	58.2
Barley	bu.	2754	54.3	2149	51.3	2583	48.9	747	36.8	9262	50.4
Citrus fruit[3]	tons	52	12.6	230	11.8	0	0	119	4.6	1372	10.9
Noncitrus fruit[3]	tons	32	4.2	961	8.7	1	4.7	175	.2	1981	6.3
Vegetables[3]	cwt.	175	185.6	1157	227.7	2	100.8	204	129.4	3465	155.3
Hay	cwt.	6936	2.8	3832	3.6	18962	1.3	4979	1.7	61442	2.2
Soybeans	tons	0	0	0	0	3460	27.1	728	30.6	53397	31.2
Flaxseed	bu.	5	12.8	—[1]	51.2	1689	12.8	71	14.0	1919	13.0
Peanuts[4]	bu.	8	4115.8	0	0	0	0	326	2797.4	1146	3364.9
Sugarbeets[5]	lbs.	513	19.1	413	24.6	213	17.8	31	26.0	1468	20.4
Irish potatoes[3]	tons	369	249.9	212	396.8	112	161.5	21	233.6	1199	264.3
Sweet potatoes[3]	cwt.	—[1]	90.2	7	125.0	0	0	7	96.7	102	126.1
Dry beans	cwt.	282	1493.7	190	1883.2	120	1915.7	0	0	1251	1553.8
Dry peas	lbs.	78	2024.9	76	2405.6	2	1510.6	0	0	162	2176.5
Total crops harvested		21962		16474		68520		29110		298424	
Total cropland harvested		21847		16265		68069		28867		294186	

[1] Less than 500 acres.
[2] Rough basis
[3] Fresh equivalent.
[4] Farmers stock basis.
[5] Farm weight.

Table 5. Harvested acres and crop yields, Mountain, Pacific, Northern Plains, and Southern Plains farm production regions of the West, 2000, low-demand — high supply overproduction scenario bound

		Mountain		Pacific		Northern Plains		Southern Plains		48 States	
Commodity	Unit	1,000 acres	Yields	1,000 acres	Yields	1,000 acres	Yields	1,000 acres	Yields	1,000 acres	Yields
Wheat	bu.	6205	45.1	3138	60.7	18988	44.8	5565	46.1	41605	47.1
Rye	bu.	80	28.2	92	32.0	568	38.1	73	27.1	1076	35.8
Rice[2]	cwt.	0	0	392	7282.2	0	0	420	6368.8	1871	6388.0
Corn	bu.	445	146.3	347	143.1	5281	151.8	255	119.7	47673	140.9
Silage	tons	714	20.2	199	32.8	2398	13.2	150	11.4	9077	16.5
Sorghum	bu.	742	85.1	490	97.2	5940	84.4	9681	65.0	17931	74.4
Oats	bu.	356	68.1	139	78.0	4220	60.0	612	42.3	12033	66.3
Barley	bu.	2831	63.5	1802	60.8	2365	59.9	792	43.7	8637	59.9
Citrus fruit[3]	tons	55	14.2	225	13.1	0	0	111	5.4	1426	11.5
Noncitrus fruit[3]	tons	26	4.2	954	9.4	1	5.1	131	.2	1911	6.9
Vegetables[3]	cwt.	157	206.0	1121	267.9	2	98.1	154	155.7	3128	181.8
Hay	cwt.	6967	3.2	3493	4.4	18857	1.5	5111	1.9	58356	2.5
Soybeans	tons	0	0	0	0	4043	31.5	1195	32.0	50004	38.0
Flaxseed	bu.	2	14.6	—[1]	59.2	1605	14.3	71	16.4	1760	14.5
Peanuts[4]	bu.	9	4912.4	0	0	0	0	377	2973.0	1157	3872.4
Sugarbeets[5]	lbs.	501	20.3	412	26.3	214	19.9	28	30.9	1456	22.2
Irish potatoes[3]	tons	374	274.2	220	455.4	111	177.0	21	284.7	1142	300.0
Sweet potatoes[3]	cwt.	—[1]	90.9	5	144.1	0	0	5	113.7	72	149.7
Dry beans	cwt.	207	1814.4	168	2057.7	117	2104.1	0	0	1114	1748.5
Dry peas	lbs.	66	2516.3	58	3153.2	1	1692.7	0	0	131	2748.4
Total crops harvested		20896		15148		65224		29280		277138	
Total cropland harvested		20784		14936		64810		29040		273931	

[1] Less than 500 acres
[2] Rough basis.
[3] Fresh equivalent.
[4] Farmers stock basis.
[5] Farm weight.

Table 6. Harvested acres and crop yields, Mountain, Pacific, Northern Plains, and Southern Plains farm production regions of the West, 1985, high demand-low supply (scarcity) scenario bound

		Mountain		Pacific		Northern Plains		Southern Plains		48 States	
Commodity	Unit	1,000 acres	Yields	1,000 acres	Yields	1,000 acres	Yields	1,000 acres	Yields	1,000 acres	Yields
Wheat	bu.	11487	29.5	5990	39.9	31736	31.5	11091	27.9	74167	32.5
Rye	bu.	94	20.8	105	23.8	722	27.7	92	19.5	1388	26.2
Rice[2]	cwt.	0	0	779	5320.9	0	0	911	4566.3	3865	4575.4
Corn	bu.	555	88.3	392	103.0	9123	80.2	134	110.4	65119	94.2
Silage	tons	899	13.2	234	21.5	3250	8.9	569	6.0	11372	11.6
Sorghum	bu.	753	65.0	436	79.6	5644	64.7	8094	56.9	15855	61.2
Oats	bu.	347	49.9	165	53.3	3928	44.9	599	31.9	12036	50.2
Barley	bu.	2887	46.3	2320	42.5	2686	42.1	777	31.6	9740	42.9
Citrus fruit[3]	tons	59	11.0	165	10.4	0	0	137	4.0	1579	9.6
Noncitrus fruit[3]	tons	34	3.7	1169	6.7	1	4.1	187	.2	2262	5.2
Vegetables[3]	cwt.	211	156.1	1382	193.4	2	88.4	248	108.2	4068	134.1
Hay	cwt.	6401	2.9	3888	3.3	17784	1.3	4677	1.7	57871	2.2
Soybeans	tons	0	0	0	0	3767	24.8	802	27.7	58544	28.4
Flaxseed	bu.	5	12.8	325	51.1	1911	12.8	80	14.0	2172	12.9
Peanuts[4]	bu.	9	4109.7	0	0	0	0	352	2673.5	1200	3317.6
Sugarbeets[5]	lbs.	531	19.0	427	24.6	220	17.8	32	26.0	1519	20.4
Irish potatoes[3]	tons	378	249.5	217	396.2	115	161.3	22	233.2	1228	263.9
Sweet potatoes[3]	cwt.	—[1]	90.1	6	124.8	0	0	7	96.6	94	125.9
Dry beans	cwt.	267	1521.9	201	1724.7	116	1914.4	0	0	1222	1537.4
Dry peas	lbs.	85	1985.4	83	2341.9	2	1508.4	0	0	177	2128.7
Total crops harvested		26445		20393		81658		34581		344948	
Total cropland harvested		26313		20168		81099		34288		340141	

[1] Less than 500 acres.
[2] Rough basis.
[3] Fresh equivalent.
[4] Farmers stock basis.
[5] Farm weight.

Table 7. Harvested acres and crop yields, Mountain, Pacific, Northern Plains, and Southern Plains farm production regions of the West, 2000, high demand-low supply (scarcity) scenario bound

		Mountain		Pacific		Northern Plains		Southern Plains		48 States	
Commodity	Unit	1,000 acres	Yields	1,000 acres	Yields	1,000 acres	Yields	1,000 acres	Yields	1,000 acres	Yields
Wheat	bu.	12820	35.2	6644	46.2	36797	37.3	11999	34.4	82857	38.1
Rye	bu.	115	24.2	132	27.4	817	32.6	105	23.2	1547	30.6
Rice[2]	cwt.	0	0	1018	6133.4	0	0	1089	5364.1	4853	5380.3
Corn	bu.	962	75.6	494	112.2	8471	105.7	361	94.4	66357	113.0
Silage	tons	863	16.4	263	24.3	2811	11.0	199	8.4	10553	13.9
Sorghum	bu.	689	80.3	465	89.8	5538	79.3	9337	59.1	17044	68.6
Oats	bu.	349	57.9	138	65.3	4141	51.0	601	36.0	11811	56.3
Barley	bu.	3208	52.6	2160	47.6	2618	50.8	876	37.1	9800	49.5
Citrus fruit[3]	tons	69	12.3	283	11.4	0	0	140	4.7	1788	10.0
Noncitrus fruit[3]	tons	31	3.6	1356	6.7	1	4.4	153	.2	2471	5.4
Vegetables[3]	cwt.	206	173.7	1496	221.6	2	85.0	214	123.8	4077	154.0
Hay	cwt.	6940	3.1	4319	3.5	18765	1.4	5120	1.9	58960	2.4
Soybeans	tons	0	0	0	0	6207	28.0	1830	28.4	78590	33.0
Flaxseed	bu.	2	14.4	—[1]	58.2	1738	14.1	76	16.1	1907	14.3
Peanuts[4]	bu.	10	4847.4	0	0	0	0	462	2703.9	1341	3718.1
Sugarbeets[5]	lbs.	563	20.0	463	25.9	241	19.6	32	30.5	1640	21.9
Irish potatoes[3]	tons	423	270.6	248	449.4	125	174.6	24	280.9	1289	296.1
Sweet potatoes[3]	cwt.	—[1]	90.9	5	142.2	0	0	4	112.2	68	147.7
Dry beans	cwt.	192	1849.4	164	1984.2	112	2078.9	0	0	1065	1729.8
Dry peas	lbs.	83	2335.5	74	2840.2	1	1670.4	0	0	165	2525.1
Total crops harvested		28983		22122		98096		38377		377421	
Total cropland harvested		28841		21881		88491		38053		373039	

[1] Less than 500 acres.
[2] Rough basis.
[3] Fresh equivalent.
[4] Farmers stock basis.
[5] Farm weight.

by the higher exports and reduced yields due to environmental constraints. Sorghum yields in the Southern Plains are projected to drop from 65 to 59 bushels per acre. Citrus from 13.1 to 11.4 tons per acre, and vegetables from 268 to 222 hundredweight per acre in the Pacific region. Other major crop yields drop only slightly in regions where that crop is produced.

Production of livestock would also be quite different at the two scenario bounds. High feed prices under the scarcity bound tends to dampen livestock consumption and production. Beef production would drop 14 percent in both the U.S. and in the 17 Western states in 2000 from the overproduction to the scarcity bounds (table 3). Milk production would drop about 30 percent in both the U.S. and the West. Pork production would drop about 10 percent in the U.S. and the West, with eggs falling only slightly.

At the scarcity extreme of our unfolding scenario, the 17 Western states will have 179 million acres of crops harvested in the 22 crops listed in table 5 for year 2000. This is 48 million acres more than under the overproduction scenario bound and the difference would have a major impact on Western agriculture.

In short, the West will be an important factor in increasing farm output to meet expanding domestic and world markets. But environmental relationships and competing demands on the West's natural resources could cause our food and agricultural future to be quite different than that projected in the unfolding scenario. Irrigation is essential to a large part of Western agriculture. Declining groundwater, salinity and competing demands for water may not permit the significant increases in the acreage and productivity of irrigation necessary for the projections in this study. On the other hand, irrigation reduces much of the climatic uncertainty associated with crop production. Thus, national choices could be to emphasize research and development to solve the problems facing irrigated agriculture such that the West would play an even greater role in food and agriculture than that projected herein.

The Likelihood of the Unfolding Scenario and an Optimistic Conclusion

We have not synthesized collective USDA judgement about the likelihood that the future of our food and agriculture system is bounded by the unfolding supply-demand management scenario and thus by the projections summarized above. But our personal judgment is that it is 75 percent likely that our supply-demand scenario will bound the future of food and agriculture. Further, there is about a 20 percent chance that we will face a food and agricultural future with even higher demand-lower supply attributes than the scarcity bound of our unfolding scenario and about a 5 percent likelihood that our food future will involve lower demand and higher supply attributes than the overproduction scenario bound. Our confidence in these likelihood statements is about .7. Because there is so much opportunity to substitute commodities in production and consumption and between regions in production, these likelihood statements are much more accurate for the aggregate farm relationships at the national level than for the commodity or regional projections.

But whatever direction our food future takes, our agricultural capability both at home and abroad can be shaped into a bright future. This seems like a pretty reasonable scenario. It has held for over 4,000 years and Genesis records:

> As long as the earth remains, there will be springtime and harvest, cold and heat, winter and summer, day and night" and "man–the master of all life upon the earth and in the skies and in the seas.

We think this optimistic forecast ought to hold for at least another 10 to 25 years. And the West will retain its leadership role in our food and agricultural system.

References

Brandow, G. W. (1974). "American Agriculture's Capacity to Meet Future Demands," The 1974 Fellows Address, *American Journal of Agricultural Economics,* (56) 5:1093.

Frey, Thomas H., and Robert C. Otte (1975). "Cropland for Today and Tomorrow," *Agricultural Economics Report No. 291,* Economic Research Service, U.S. Department of Agriculture, Washington, D.C.

Fox, Austin (1975). "Projecting Fertilizer Use in Crop Production," Paper presented at the AMA Ag-Chem Marketing Research Conference, Arlington, Virginia.

Hathaway, Dale E. (1975). "The World Food Crisis–Periodic or Perpetual?", Paper presented at the 25th National Policy Conference, Clymen, New York, September 11, 1975.

Johnson, Jean (1974). "Societal and Political Implications of the Energy Crisis," Forecasting International, Ltd., Arlington, Virginia.

National Academy of Sciences (1975). Report of the Board on Agriculture and Renewable Resources. *World Food and Nutrition Study: Enhancement of Food Production for the United States,* Washington, D.C.

Smith, Allen G. (1975). "Projections of Selected Agricultural Commodities, Prices, and Inputs to 1985," Paper presented at the Animal Health Institute Conference, Williamsburg, Virginia, November 21, 1975.

U.S. Department of Agriculture, Soil Conservation Service (1971). "Basic Statistics–National Inventory of Soil and Water Conservation Needs," *Statistical Bulletin 461,* Washington, D.C.