

North America and The World Grain Market

*D. Gale Johnson, Professor Emeritus
University of Chicago*

Special Report No. 2
November, 1997



D. Gale Johnson

D. Gale Johnson joined the faculty of the Department of Economics at the University of Chicago in 1944. He is currently the Eliakim Hastings Moore Distinguished Service Professor of Economics Emeritus. He received his Ph.D. from Iowa State College.

Dr. Johnson has published widely on world agriculture including books on China, the Soviet Union, and Eastern Europe. His recent works have focused on population and policy issues.

His research interests include economic development and change, agricultural policy and markets, and economic reform. He is the 1998 President-Elect of the American Economics Association.

North America and the World Grain Market

Special Report No. 2

D. Gale Johnson gave the keynote address for a Trade Research Center conference on "The Economics of World Wheat Markets: Implications for North America." In his talk, Professor Johnson developed a research agenda to assess North America's future role in the world grain market. Key points discussed in his address are summarized below.

The increase in world grain production in the past half-century was unparalleled in the history of the world. In that same period, the absolute increase in the world's population exceeded that of all previous history—it more than doubled. The supply of grain more than kept up with the rapid growth of demand—the per capita supply of calories in developing countries increased by 27 percent between the early 1960s and the early 1990s while the real price of grain in international markets declined by at least a third. In developing countries, grain supplies a very large fraction of all calories consumed, often as much as 80 percent.

The expansion of grain production since 1960 has been largely achieved through higher yields—the substitution of other inputs for land. Consequently the roles of land and the diminishing returns to land have been significantly attenuated by the results of research and the availability of nonfarm sources of inputs, such as chemical fertilizer. In developing countries, improving the productivity of labor may be more critical in determining the welfare of rural people than any limitation imposed by land. Over the next quarter century, improving the productivity of the world's land by 75 percent will probably meet the increase in demand for grain, but farm labor productivity will need to treble if there is to be rapid economic growth in developing countries.

The large differences in the rate of growth of grain production among developing countries over the past several decades have not been due primarily to differences in natural resources, but have resulted from differences in the structure of policies affecting agriculture and grain production. Where governmental policies have been supportive, grain production has not only kept up with demand growth but has exceeded it; where governmental policies have exploited agriculture through low prices for farm products and limited commitment to research, per capita grain production has grown slowly, if at all. Policies count—and count a great deal. The evidence supports the conclusion that national policies, including research support, have had a much greater influence on grain production than has the amount of available land.

The world grain market will be significantly influenced by developments in Central and Eastern Europe. In the 1980s, the region was a major importer of grain; it is currently at most a small net importer. The change in net trade in grain has resulted primarily from the decline, by approximately a third, in the production of meat and milk. Under the socialist system, these products were heavily subsidized and most of these subsidies have been eliminated. Livestock production has become very unprofitable and output has fallen. The decline in real per capita income also had an important effect, but the major source of the decline in meat and milk production resulted from eliminating the consumer price subsidies.

The growth in world demand for grain will be significantly slower in the next two or three decades than it was in the past three. This is due primarily to a slowdown in population growth. To some extent the slower growth of population will be offset by increased demand for grain as feed. How much the demand will grow will depend on the increase in demand for livestock products and the rate of improvement in the productivity of feed. Data from China indicate that there has been a major improvement in feeding efficiency in pork production, which has held in check the increase in feed required for a large increase in meat production.

In the past, the price policies in North America and the European community have contributed to the achievement of a relatively high degree of price stability, with some notable exceptions, such as 1972 and 1973. The stability was due to the large stocks that were acquired as a result of price support operations. Policy changes that have occurred since 1985 have resulted in a substantial reduction in the level of publicly held stocks. Private stocks cannot function to provide the same degree of price stability that existed when governmental stocks were large. Private stocks are held in anticipation of making money; this was never the objective of the public stocks. Since holding stocks is expensive, it can be anticipated that price variability will be greater in the future than it has been in the past.

We need to better understand the reasons for the comparative advantage of grain production in North America. Part is clearly due to the efficient organization of farm production units, to intelligent and well-educated farmers, and to bountiful supplies of land suitable for grain production. These elements are important, but it needs to be recognized that North America is endowed with the world's best infrastructure supporting grain production. The infrastructure consists of research, transportation, marketing institutions, repair services, and competitive input suppliers that have a tradition of adapting to change, whether it be in fertilizers, seeds, pesticides, or farm machinery.



Table of Contents

Introduction	7
Income and Food Production Growth	7
A Proposed Research Agenda	9
Land and Diminishing Returns	10
The Growth of Grain Production in Developing Countries	11
Diminishing returns to inputs applied to land	11
The productivity of labor	12
The role of government policies	13
Policies and Central and Eastern European Agriculture	15
Feed Use of Grains	16
Grain Price Variability	17
Conclusions: Comparative Advantage of North American Grain Production	18
Endnotes	
References	
Tables and Figures	
Table 1. Daily Per Capita Supply of Calories for Major World Regions, Selected Periods, 1961–1990	8
Table 2. Average Grain Yields for Developing and Developed Countries and the World, Selected Periods, 1934–1992	14
Figure 1. World Wheat Prices, Selected Periods, 1910–1995	17

NORTH AMERICA AND THE WORLD GRAIN MARKET

Introduction

Most discussions of prospective world demand and supply of food fail to recognize how much the last half-century differs from all previous history. In the last half-century, both food production and per capita food consumption have greatly increased. The absolute increase in the world's population since World War II has exceeded that of all previous history; in other words, the world's population more than doubled in a half-century. While the population was more than doubling, per capita food consumption increased by more than ever before. Except for famines induced for political reasons, by war, or from enormous mismanagement of resources, the poor people of the world were subjected to far less suffering from famines than in previous history.

What may have been even more remarkable about this half-century was that the most rapid population growth ever recorded occurred while real per capita incomes grew at annual rates that were multiples of any previous historical period, and the real prices of grain fell, not by a little but by a great deal. Slow increases in real per capita incomes and in consumption in the developed countries started in the mid- to late-eighteenth century in Europe, and significant increases in the developing world did not begin until a half-century ago. Until the middle of the eighteenth century, annual rates of world population growth did not exceed 0.5 percent (Kremer 1993). Prior to 1920, population growth rates in the developed world exceeded those of the developing world. Only after 1940 did the developing countries have significantly higher population growth rates than the developed countries.

Despite the most rapid populations growth ever recorded, and increases in per capita food consumption, the real price for grain fell by a great deal.

Income and Food Production Growth

Maddison (1995) provides estimates of real per capita GDP for most major countries from 1820. His estimates for eleven Asian countries indicate that from 1820–1950, the average per capita GDP increased by only 25 percent—from \$609 to \$863 (1990 prices)—while the population increased by 84 percent or at an annual rate of less than 0.5 percent. From 1950–1992, the Asian countries increased per capita income to \$5,300, increasing five times while population increased by 128 percent for an annual rate of almost 3 percent. The eleven Asian countries include Taiwan, South Korea and Japan. It may be useful to review the data for the two largest countries—India and China. In the 130 years after 1820, the per capita income in China increased by 17 percent and that of India by 12 percent. In 1950, they had nearly the same per capita incomes—\$614 and \$597.

But by 1992, the paths of economic growth between the two countries deviated, with China's per capita GDP increasing to \$3,098 and India's to

The growth of both total and per capita food supply in the developing world since 1950 has been unparalleled

less than half that amount (\$1,348), with most of the difference appearing in the last fifteen years. Even at its much slower pace, India more than doubled its per capita income while the rate of population growth was about four times greater than in the 1820–1950 period. Clearly, slow population growth was not enough to generate significant economic growth. After 1950, the developing world emulated the growth of the industrial countries a century or more earlier but at a much more rapid pace. In both instances, rapid population growth was associated with rapid growth in real per capita income following a period in which there was low population growth and little or no per capita economic growth, however measured. The growth of both total and per capita food supply in the developing world since 1950 has been unparalleled. During the decade of the 1970s per capita food production in developing countries increased by 8 percent, and during the 1980s, the increase was 13 percent. While grain production in the world may have stagnated during the 1980s, in the developing countries it increased by 9 percent. Perhaps the most striking development during the 1980s was the increase of per capita food production, in the three most populous developing countries—China, 28 percent; India, 20 percent, and Indonesia, 32 percent.¹

Table 1. Daily Per Capita Supply of Calories for Major World Regions, Selected Periods, 1961–1990

	1961–1963	1969–1971	1979–1981	1988–1990
Developing, all	1940	2117	2324	2473
Africa	2117	2138	2180	2204
Latin America	2363	2502	2693	2690
Near East	1825	2029	2245	2442
Other	2116	2292	2425	2626
Developed				
North America	3054	3235	3330	3603
Europe	3088	3239	3371	3452
Oceania	3173	3287	3157	3328
Former USSR	3146	3323	3368	3380
Other	2545	2722	2812	2975

Source: *FAO, Production Yearbook*

In developing countries, the most significant variable to consider is the per capita food supply in terms of calories, which increased by 27 percent from 1961 to 1990 (Table 1). The increase in available calories from the beginning of the 1960s to the late 1980s and early 1990s was due, in large part, to the nearly doubling of world grain production. From 1961–1965 world grain production was 985.5 million tons, nearly doubling to 1,907 million tons in 1990–1992 (FAO). The rate of growth in grain production over this period was about 50 percent greater in the developing countries than in the developed countries.

My recital of the achievements of the past half-century has a purpose, believe it or not, and the purpose is to provide a background for my topic,

namely a research agenda for better understanding the future of North American grain production in world markets. The background, as I shall argue, is highly relevant in a number of different ways. First, it emphasizes the enormous successes world food producers have achieved during the past half-century. In addition, those who make their living by presenting the future of food supply in very negative terms should be called upon to show conclusively why the remarkable record of the recent past will not continue.

The record is relevant in calling into question most of the versions of the neoclassical growth theory, which has long provided support for pessimistic views of the relationships between population growth and economic growth, including the food supply. By emphasizing the role of savings and technological change as exogenous variables combined with the diminishing marginal product of labor, the neoclassical growth theory gave implicit, if not explicit, support for those who want to accept the pessimistic prospects for improvement in the quality of life that so concerned Ricardo and Malthus in their early work.²

The world of the past half-century has proven to be far more complex and flexible than depicted by the neoclassical growth theory. The fact that we do not fully understand the interactions between population growth, the creation and utilization of scientific knowledge and invention, and productivity change does not mean that we should cling to a model whose apparent implications have clearly been contradicted by events. Until we are capable of making productivity change and investment, including investment in human capital, endogenous in our models, we fail to provide an appropriate understanding of how our world has generated such enormous economic growth, including improvements in the food supply and numerous measures of human well-being, as has occurred during the twentieth century. The New Growth Theorists have clearly pointed us in the right direction, but there is still a lot we need to learn before we know exactly what road is being traveled (Romer 1986, Lucas 1988).

A Proposed Research Agenda

What are some of the major directions that research on the role of North American grain production in the world market should take? I believe that the following are some of the important areas to be examined:

- the roles of land and diminishing returns in influencing the supply of grain;
- the factors affecting the growth of grain production in the developing countries with special consideration of the effects of governmental policies of market intervention, investment in human capital, and attention to the rural infrastructure;
- the development of supply and demand for grain in Central and Eastern Europe;
- the prospective growth of demand for grain in the world, with particular emphasis on the role of livestock use of grain;
- the effects of the probable increase in grain price variability in world markets due to policy changes in the European Union and the United States;
- our models of short run grain price movements; and

...North America's role in grain production will depend at least as much on developments outside the region as within it

- the factors influencing the comparative advantage of grain production in North America.

Admittedly, this research agenda says rather little about North American grain production. This is deliberate since North America's role in grain production will depend at least as much on developments outside the region as within it. In particular, the path of real grain prices will be determined to a large extent by supply and demand developments in the rest of the world. To a considerable degree, the suggested areas of research parallel the agenda topics of this conference. I shall comment on each of these in turn, with most of what follows emphasizing the first three.

Land and Diminishing Returns

The principle of diminishing returns to changes in factor proportions has had a powerful influence on thinking about the world's food supply. In Ricardo's and Malthus' time, the concern was real, and considerable pessimism was justified concerning the future of mankind. Malthus, however, in second and subsequent editions recognized that recent history provided a basis for a degree of optimism (Malthus 1992). At that time, perhaps 80 percent of the population of Europe was engaged in agriculture, with each farm family producing no more than enough food for itself and a fifth of another family. The potential impact of science on productivity had not yet emerged. Knowledge of the processes of agricultural production was based on common or folk knowledge, based on the experiences of people who farmed or observed farming, such as Arthur Young. This knowledge, accumulated over a very long time, resulted in minimal increases in the ratio of grain output to the seed used and in the productivity of labor over several centuries (Johnson 1997).

**It is quite surprising,
given the limited role
that land has had
throughout history, that
land is so often assumed
to be the primary factor
limiting food production**

At the beginning of the nineteenth century, the limitations on increases in food output were to be found primarily in the slow rate of improvement of labor productivity, not in limitations in the supply of land. Land was extensively used in most of Europe until the fairly recent past (Boserup 1965). Long fallow was a common practice. As population grew, albeit slowly, the periods of fallow were gradually shortened and practical alternative means of maintaining fertility were increasingly applied—manure, legumes, and field refuse. Labor productivity increased very slowly until well into the nineteenth century when the mechanical revolution transformed agriculture in Europe and North America. Harvesting methods changed little from at least the tenth century until the introduction of the reaper and the binder at the middle of the nineteenth century. Labor required to harvest an acre of wheat declined by 90 percent in the United States between 1840 and 1900 (Cooper 1947). The yield of wheat and other small grains per unit of cultivated land in the United States and Europe stagnated in the seventy years prior to World War II (Brown 1965). The increase in the world's food supply from the time the population of the world was a billion in 1815 until 1950, when it was 2.5 billion, came largely from increasing the amount of cultivated land; yield increases had a minor role. The biological and chemical revolutions were not significant factors in agricultural productivity until

the introduction of hybrid corn in the mid-1930s and did not significantly impact production until a decade or so later.

These facts are well known, yet the implications are inadequately reflected in much of the discussion of future food supply and demand. The yield revolution resulting from modern science has greatly reduced the importance of land in determining the fate of nations. It is quite surprising, given the limited role that land has had throughout history, that land is so often assumed to be the primary factor limiting food production. If land ever had a limiting role for a significant part of the world, it was perhaps for no more than one or two centuries. Its dominance was brief, except in the minds of those who doubt the ingenuity of mankind, when that ingenuity is not held in check by misconceived policies and misrule.

Of course, the principle of diminishing returns has not been repealed nor will it ever be. If all else is constant, a change in factor proportions changes marginal products. But what seems not to be generally understood is that it takes only a small increase in productivity to offset the effects of a significant change in the ratio of land to all other inputs used in crop production. Nor is it recognized that while aggregate nonland inputs may increase during certain periods of agricultural development, the success realized in finding effective substitutes for labor may result in little change in the ratio of land to all other inputs.

The Growth of Grain Production in Developing Countries

There should be serious reconsideration of the commonly accepted assumption that land is a major factor in limiting output growth in the low income countries. First, there should be reconsideration of the empirical role that diminishing returns to inputs applied to land has in influencing output. Second, the assumption that labor is “surplus” in the agriculture of low-income countries should be vigorously rejected. Third, the role of policies and institutions in influencing the rate of growth of farm output needs much greater exploration than it has received.

Diminishing returns to inputs applied to land. With respect to the role of diminishing returns to resources applied to land, there needs to be exploration of the magnitude of the changes in factor proportions and the extent to which the nonfarm inputs introduced over the past two centuries were labor saving rather than land substitutes. Actually, many of the nonfarm inputs introduced in the last 150 years are both labor and land saving, but the degree of labor saving has far outpaced land saving. Perhaps something can be learned from the experience of the United States. If we review the changes in inputs and outputs over the past eighty years, we find that the ratio of nonland inputs, such as fertilizer, machinery, and labor, to land inputs has remained unchanged while the ratio of nonlabor inputs to labor has increased sharply over the same years. It may be concluded, therefore, that the primary effort of research, development, and investment has been to increase the productivity of labor rather than of land.

It may be concluded, therefore, that the primary effort of research, development, and investment has been to increase the productivity of labor rather than of land

**In terms of research
agendas...is it perhaps
time to consider giving
much greater emphasis
to finding ways to
increase labor
productivity?**

Japan is considered to be a country in which land has had a dominant role in determining output growth, though currently approximately a quarter of its paddy land sits idle. From 1880–1940, the arable land area increased by 29 percent, contributing substantially to the 96 percent increase in crop output (Hayami and Ruttan 1985). During this period, the labor input in agriculture declined by only 13 percent. The annual growth in labor productivity for these six decades was 1.68 percent, more than the 1.01 percent growth in land productivity. Both labor and land saving occurred at greater annual rates in Japan than in the United States since labor productivity in the latter grew at an annual rate of 1.16 percent and land productivity increased a mere 0.22 percent (Hayami and Ruttan 1985).

The productivity of labor. For the period from 1940–1980, the annual growth in labor productivity increased to 3.55 percent in Japan and 6.1 percent in the United States while the annual growth in land productivity was very nearly the same, namely 2.12 percent in Japan and 1.90 percent in the United States. In Japan, the amount of arable land decreased by 11 percent while there was no change in the United States. These data do not indicate that land was any more of an obstacle to output expansion in Japan than in the United States. The slower growth of labor productivity, measured in physical terms, in Japan than in the United States since 1940, was a predictable result of the differences in the agricultural price policies followed in each country.

I believe that the above comparison of changes in labor and land productivities in such diverse agricultures as Japan and the United States at least raises questions about the relative importance of land in limiting output growth. In terms of the research agendas of the agricultural research institutions in the developing world, including the international centers, is it not perhaps time to consider giving much greater emphasis to finding ways to increase labor productivity rather than allocating nearly all resources to increasing land productivity? After all, the increases in labor productivity will determine the real incomes of future generations of farm people though one could hardly believe this to be the case from the way public research resources are now allocated.

If one accepts the Chinese data on labor used per hectare* of corn, rice, and wheat, labor in developing countries may well not be readily available in certain peak seasons, such as planting and harvesting. The days per hectare range from 185 for wheat to 293 for rice, with corn being intermediate at 215 (Colby 1992). Farm employment in China appears to have peaked and is now very slowly declining absolutely because of the large difference between the value of the marginal product of labor in agriculture and in other employments, especially in urban areas. If food output is to continue to grow, labor productivity in farming must increase through finding substitutes for labor. This is a well known phenomena illustrated by the experience of the industrial countries where labor employment in agriculture has declined while output has continued to grow.

Surplus labor, in the sense that it can be withdrawn from agriculture without an adverse effect on farm output, does not exist in developing countries and it is time that this should be universally recognized. Thus, as I have argued

elsewhere, China needs to create an economic environment in which capital will be substituted for labor in the years ahead (Johnson 1996). Such substitution must occur if two desirable results are to be achieved—continued growth in agricultural production, in labor productivity, and, above all else, in returns per unit of farm labor.

Researchers have neglected emphasizing labor saving innovations because of the general view that still prevails, even after *Transforming Traditional Agriculture* (Schultz 1963), that there is surplus labor in agriculture; therefore, increasing labor productivity will only increase the amount of surplus labor and farm output will not increase. But perhaps more important, there is general acceptance of the view that nothing should be done to promote an increase in the flow of rural to urban migrants, which is believed would result from saving labor in farming. After all, cities are overcrowded, and any way, there will not be jobs for them once they leave agriculture, or so it is alleged. Pessimism about job creation seems to be a universal phenomena in developing countries, as it now also seems to be in the majority of industrial countries.

Land is but one input in the production of food. It is important that there be increases in the efficiency of all resources used in agriculture, not just land. If our interest is in improving the well-being of rural people in developing countries, it is clearly important to increase labor productivity. Such improvement should not be restricted to finding substitutes for labor in farming. Even greater emphasis should be given to increasing investment in human capital so that farm people will enhance their prospects as they continue to shift out of agriculture into nonfarm employment.

The role of government policies. While there is general recognition that national policies have a significant effect on agricultural production, this is seldom a significant consideration in most efforts to project growth of grain production. In other words, it is seldom asked how policy changes might affect the growth path. Yet there is overwhelming evidence that policies do matter, and they matter a great deal. The World Bank studies of the effects of rates of protection on agriculture in eighteen developing countries show conclusively that national policies have large effects on the growth of agricultural production. These studies show conclusively that high rates of negative protection of agriculture not only adversely affect the growth of farm output, but also have major impacts on the growth of gross national product (Schiff and Valdes 1992).

Strong confirmation of the role of policies on farm production is provided by the effects of the Chinese agricultural policy reforms undertaken since 1978. From about 1955–1978, the growth of grain production barely kept pace with population growth. In the first six years of the reforms (1979–1984), farm output grew at an annual rate of 7.6 percent for an increase of 56 percent and for the next decade continued to grow at 5.4 percent, a rate seldom attained elsewhere. These growth rates contrast to the 2.56 percent

**...policies do matter and
they matter a great
deal...strong
confirmation is provided
by the effects of the
Chinese agricultural
reforms...**

*one hectare equals 2.5 acres

Is there any reason to believe that yields in developing countries cannot increase to the level in the developed countries?

for the 1956–1978 period. For the first six years of reform, grain production grew at an annual rate of 4.9 percent; since then, the rate has been only 0.9 percent. This decline in the growth rate has often been alleged to indicate that the reforms had pretty much run their course by 1984.

Was the use of grain in China constrained by its production from 1984 to 1994? The answer is in the negative. China had net annual grain imports of 13 million tons for 1980–1984 and net annual exports of 5 million tons for 1992–1994 (SSB 1996). In addition, farmers increased their year end stocks of grain by more than 150 million tons. The probable answer to the apparent inconsistency between the large increase in meat production and the small increase in grain production is that grain production is significantly underestimated. The annual household surveys indicate that the underestimate may be at least 10 percent.

The land and people of China did not change in some miraculous fashion after 1978. What changed were the policies affecting agriculture—the abandonment of the communes and their replacement by the household responsibility system or private farming, the removal of restraints on markets and nonfarm activities of farm people, higher farm prices and increased supplies of nonfarm inputs. Up to half of the increase in output from 1978–1984 can be attributed to the change in incentive structure resulting from the institutional changes (Lin 1992).

The emphasis on understanding the effects of national policies on the growth of grain production is especially relevant to projections of food production in Sub-Saharan Africa. It seems to me that the potential of grain and food production in that region may be grossly underestimated by emphasis on recent trends because national policies have definitely been adverse to the growth of agricultural output. What seems to be forgotten is that the decline in per capita food production began after 1970 when the emphasis on taxation of agriculture to support industrialization became the basis for national policies in much of the region.

While the adverse impacts of policies affecting agriculture in Sub-Saharan countries have been studied and criticized, I don't believe there has been a systematic effort to indicate what the food production potential of the region would be if more appropriate policies were followed. That the potential is much greater than current realization is suggested by Mitchell and Ingco (1994):

African farmers have already demonstrated that they can increase production with present resources when there are incentives to do so. Food production in many African countries rose significantly due to the stimulus of higher prices after the drought in 1983–1984. In addition, agricultural growth in countries successfully adjusting economic policies has reached more than 3.5% per annum in 1987–1990, compared to less than 0.5% in countries that maintained poor policies.

Table 2. Average Grain Yields for Developing and Developed Countries and the World, Selected Periods, 1934–1992

	(Metric tons per acre)						
	1934- 1938	1952- 1956	1961- 1965	1969- 1970	1979- 1981	1985- 1987	1990- 1992
Developing ^{a)}	.46	.46	.49	.56	.76	.88	.99
Developed ^{b)}	.46	.55	.78	.86	1.05	1.23	1.27
World	.46	.49	.58	.68	.88	1.03	1.09

Source: *FAO, Production Yearbook, Various Issues.*

a) Includes China for all periods.

b) Includes USSR and succeeding republics for all periods.

I find the data on grain yields in Table 2 further striking evidence of what has been achieved in the last five decades and what is likely to be achieved in the developing countries over the next few decades. Grain yields per hectare of seeded area were the same in the developing and developed countries from 1934–1938; land and nature were the dominant determinants of yields, and neither the developed countries nor the developing countries had superior resources.³ The chemical and biological agricultural revolutions had not yet come into play. Over the next half century, grain yields increased significantly in both groups of countries, though significantly more in the developed than in the developing countries. Is there any reason to believe that yields in developing countries cannot increase to the level in the developed countries? The developing countries have closed the yield differential from 51 percent in 1979–1981 to 29 percent in 1990–1992.

Policies and Central and Eastern European Agriculture

The future developments in the demand and supply of grain and food in Central and Eastern Europe cannot be understood without an analysis of the potential effects of policy changes now underway. The agricultural policies of these countries, prior to the transition to market economies, had major impacts on the commodity composition of production, on resource use in agriculture, and on the productivity of those resources. Projections based on the pre-reform period, without modifications for the policy and institutional changes that have occurred or are likely to occur as market economies are established, are misleading. Under the old systems, live-stock production was heavily subsidized and consumption was significantly greater than would have been the case without subsidies; in many cases the subsidies exceeded the prices consumers actually paid in the retail stores.

Of the projections I have seen, other than my own, only Rod Tyers (1994) has emphasized this point, though Karen Brooks (1991) warned us that the transition to a market economy would be extremely difficult due to the

The future developments in the demand and supply of grain and food in Central and Eastern Europe cannot be understood without an analysis of the potential effects of policy changes now underway

If the increases in productivity and decline in livestock production are of the order indicated, the shift in the net trade position of the area might be as much as 75 to 80 million tons at some time in the future in contrast to the high imports of the late 1980s

enormous distortions in the prior agricultural economy, with particular emphasis on the price distortions related to livestock products. The otherwise excellent 1994 studies of world food developments by researchers at FAO, IFPRI and the World Bank gave limited or no emphasis to the effects of past price distortions or the negative productivity consequences of socialized agriculture (Islam 1995). Throughout the region, except in Poland, per capita meat consumption has fallen by a third or more primarily because of declining real incomes and the drastic decline in the relative farm prices of meat and milk. The elimination of the subsidies did not result in higher prices of meat relative to consumer prices because farmers bore the full impact of the elimination of the subsidies.

However, as livestock production returns to profitability, retail prices will be much higher relative to other prices than in the past. It will take many years of real per capita income growth to offset the consumption effects of higher retail prices for livestock products. We need much more information than we now have to determine when the two effects will be offsetting and when per capita consumption will once again start to increase. Until that time occurs, the demand for grain for livestock feed will remain low, and any recovery in grain production will find its way into international markets. The future of international grain prices will be greatly influenced by developments during this transition period.

We should not ignore the potential increases in productivity that are highly probable as the organization of agricultures are stabilized. With respect to the republics of the former Soviet Union, overall productivity may increase due to increases in the productivity of feed, reduction in the high rates of seed use, increased yields due to improvements in seed quality, more effective grain combines, and reduced waste in transportation and marketing. Without any changes in the yield of grain in the field, these changes could increase the available supply of grain by as much as 55 million tons (Johnson 1993). Changes in exportable supplies due to higher yields and reduction in consumption of livestock products would be over and above this figure. The reduction in livestock production could release some 35 million tons of grain. In the late 1980s, the former Soviet Union imported as much as 40 million tons of grain and 1 million tons of meat. If the increases in productivity and decline in livestock production are of the order indicated, the shift in the net trade position of the area might be as much as 75 to 80 million tons at some time in the future in contrast to the high imports of the late 1980s.⁴ Obviously, these changes are going to take longer, perhaps much longer, than anticipated. Nor do I want to argue that others who address these possibilities should come to the same conclusions as I have. But I do argue that analysis of these issues needs to be addressed if we are to better understand the future of international trade in grains.

It should also be noted that little useful information concerning future levels of agricultural production can be derived from the post-1990 experience of the Central and Eastern European economies. In most countries, agricultural production has been very unprofitable for almost the entire

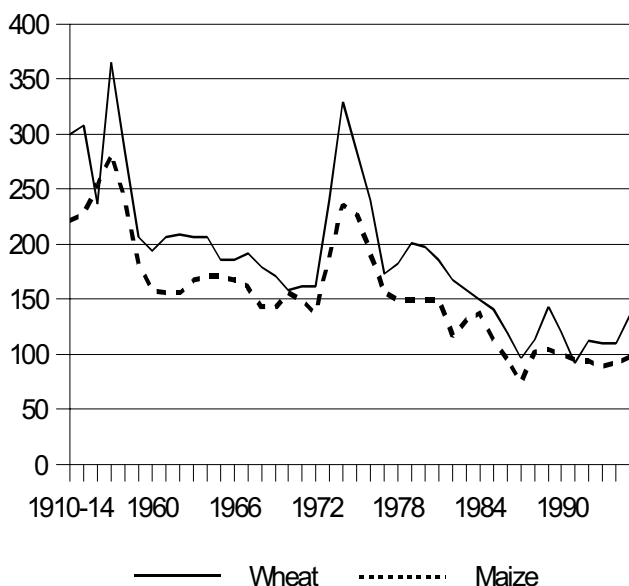
period since 1990. The sharp decline in inputs that has occurred will eventually be reversed when agriculture returns to profitability.

Feed Use of Grains

As real per capita incomes increase in the developing countries, the per capita demand for livestock products will increase, and the demand for grain and other feeds will expand. Since the income elasticity of demand for livestock products seems to be of the order of unity in developing countries, the growth of per capita livestock production is often thought to result in a rapid growth in the demand for grain and to compete with the production of grain as well. The evidence is very clear that from 1960–1993 the world's supply of grain more than kept pace with all sources of the increase in demand, including demand due to expanded livestock production, since real grain prices fell by a great deal over that span of time (*Figure 1*). Note that the recent increase in real export prices, which has already abated significantly from the last data in the figure, was modest compared to the early 1970s and did not bring prices back to the levels of the 1960s or the late 1970s.

The point I wish to emphasize here is that we need to improve our understanding of the interrelationships between economic growth, policy changes, and the productivity of feed used in livestock production. The rapid expansion of livestock production in China since 1978 could not have been

Figure 1. World Wheat Prices, Selected Periods, 1910-1995



The holding of grain stocks has been returned to the market...small shocks in supply or demand will create significant price variability

achieved without significant changes in feeding efficiency. The average age of slaughter pigs, the major source of meat production, has fallen significantly since the early 1980s as evidenced by the increase in pork output

relative to the hog inventory at the beginning of the year. In 1980, the annual pork output per hog in the inventory was 37 kilograms; in 1995 the output more than doubled to 88 kilograms (SSB 1996). This has clearly resulted in reducing the amount of feed required to produce a kilogram of pork though it is not clear how much the use of grain has declined since there has been substitution of grain for other feed sources over time. The other possibility is that grain production is significantly underestimated in China and that the degree of underestimation has increased during the reform period.⁵

Grain Price Variability

Due to policy changes in the European Union and the United States, grain price variability in international markets will be much greater than it has been over the past quarter-century. Politicians have apparently discovered that grain stocks are very expensive and that price stability is no longer as important to farmers as it was once thought to be. As a result, the holding of grain stocks has been returned to the market which will hold but a minor fraction of the amount of stocks that resulted from recent governmental price support policies. Consequently, small shocks in either supply or demand will create significant price variability.

Further reductions in trade barriers will reduce price variability, but it will be a long time before the transition to relative free trade in grain will have a significant dampening effect on price variability. Both the European Union and the United States still intervene in grain markets through export manipulations, such as export subsidies or the unconscionable action of the European Union in imposing export taxes on wheat in 1995 to prevent their domestic grain users from fully participating in the increase in world grain prices. The United States behaved only somewhat less badly by halting its export subsidies on wheat which it has either renewed or will do so soon.

We clearly need better models of price behavior for periods of three or four years. Whenever there is a price spike, there are those who rush to the press with claims that a new period of high prices and stringency has occurred. Since 1970 there have been three such spikes; the first two were dissipated in about two years (*see Figure 1*) and the third has now been reversed. Surely we have the wit to devise a short term model that at least will reflect the responses to the price spikes and indicate how long it is likely to take to return to the long term trend. I am not sure we have the wit to create a model that will tell us when the price spikes will occur though I suppose that we should have anticipated that the low level of real grain prices in 1990 to 1993 might not have been sustainable. After all, Lester Brown kept telling us that world per capita grain production declined after 1984 and I fear that we failed to ask why this was occurring—whether the decline was in fact a response to the sharply declining real prices of grain or due to something else. Since real prices were declining, most of us apparently assumed that slow output growth would not have any undesirable consequences. In this instance, more of us should have listened to Lester Brown,

not because there was a long run imbalance between the growth of food demand and supply but because we were witnessing too much of a good thing, and like most things that are too good, it came to an end with the sharp, though temporary, grain price increases in 1994 and 1995.

Conclusions: Comparative Advantage of North American Grain Production

I come, at long last, to what the organizers of this program probably thought I was to discuss. I have saved it to the last because I have the least to say about it. The comparative advantage of North America in grain production rests on efficient organization of farm operating units and intelligent, well educated and experienced farm operators combined with bountiful supplies of land well adapted to grain production. This is the first basis; the second basis is that North America is probably blessed with the world's best infrastructure supporting grain production. This covers the gamut: research, transportation, marketing institutions, repair services (including prompt availability of spare parts), and competitive input suppliers who have a tradition of adapting to change whether it be in seeds, fertilizers, pesticides or farm machines.

While during the last few decades there have been government interventions that limited the gains in trade that could have been achieved, grain production overall was probably more responsive to market forces than anywhere else in the world. Mostly, North American grain producers operate in a highly supportive policy structure. If U.S. farmers cannot maintain their comparative advantage in grain production, they do not warrant any expressions of pity. For the next several years, grain producers each year will receive a significant sum of money for every hectare that they have devoted to grain over the past years. While these payments will not directly contribute to either lowering marginal costs of production or increasing marginal revenue, the payments will provide a nice cushion against many of the adversities that farmers face. In this world of money for nothing, their only rivals will be the farmers of the European Union who will receive even larger payments. But in the rest of the world, few producers will be able to match such an economic and policy environment.

How well North American grain producers will fare, as measured by land prices, will depend primarily on what happens to world market prices and the rate of farm productivity improvement compared to producers elsewhere. If the trend of real prices since 1980 reasserts itself, then grain farmers should not be encouraged to hold unattainable expectations concerning the future economic environment. Departments or ministries of agriculture present a biased view of the world to their farmers. When the news is good, such news is trumpeted, but when the news is bad, speech is muffled. There is a political incentive to foster a sense of good feeling even if it is obvious that the not-so-good is only just over the horizon or around the proverbial corner.

If the trend of real prices since 1980 reasserts itself, then grain farmers should not be encouraged to hold unattainable expectations concerning the future economic environment

1. In the 1970s per capita food production increased in China by 16 percent, India, 2 percent, and Indonesia, 18 percent. The increase in per capita food consumption increased in the 1980s, and generally favorable trends in per capita food production continued into the 1990s. Comparing per capita food production in 1992–94 with 1982–84, the increases were: China, 27 percent, India, 16 percent and Indonesia, 36 percent. The data are from FAO, Production Yearbooks, various years.
2. Malthus modified his views concerning the role of food in limiting population growth after his first edition, but one almost never sees a reference to what he said in the second and subsequent editions. Only the first, pessimistic edition is noted. After noting the recent growth in Europe's population, he wrote: "...fewer and fewer famines and fewer diseases arising from want have prevailed in the last century than in those that preceded it. On the whole, therefore, though our future prospects respecting the mitigation of the evils arising from the principle of population may not be as bright as we could wish, yet they are far from being entirely disheartening and by no means preclude the gradual and progressive improvement in human society which, before the late wild speculations on the subject, was the object of rational expectations." (Malthus 1992, pp. 330–331). He failed to note that he had been largely responsible for the "...late wild speculations on the subject..."
3. The developed countries include the USSR in all time periods. The developed countries consist of Europe, Oceania and North America, except for the area south of the Rio Grande, and Japan. China is included with the developing countries. In 1934–38 the average grain yield in the USSR, according to FAO, was 1.02 tons per hectare. In 1990–92 the average yield on the territory of the former USSR was 1.80 tons per hectare, well below the developing country average.
4. The change in net trade is not quite the sum of the reduction in feed use and productivity improvements in livestock production since the estimated effect of the productivity improvements are based on the previous level of livestock production.
5. The rural household surveys in China indicate that in recent years national grain output has exceeded the estimates published by the State Statistical Bureau by at least 50 million tons or about 10 percent.



R E F E R E N C E S

- Boserup, E. *The Conditions of Agricultural Growth: The Economics of Agrarian Change Under Population Pressure*. Chicago: Aldine, 1965.
- Brooks, K. *Decollectivization in East/Central Europe*. Draft. Washington, D.C.: TheWorld Bank, 1991.
- Brown, L.R. "Man, Land, and Food: Looking Ahead at World Food Needs." *Foreign Agricultural Economic Report No. 11*, U.S. Department of Agriculture, Economic Research Service, Washington DC, 1965.
- Colby, W.H., F.W. Crook, and S.E. Webb. "Agricultural Statistics of the People's Republic of China, 1949–90." *Statist. Bull. No. 844*, U.S. Department of Agriculture, Economic Research Service, Washington DC, 1992.
- Cooper, M.R., G. T. Barton, and A. P. Brodell. "Progress of Farm Mechanization." *Misc. Pub. No. 630*, U.S. Department of Agriculture, Washington DC, 1972.
- Hayami, Y., and V. Ruttan. *Agricultural Development: An International Perspective*, revised ed. Baltimore: The Johns Hopkins University Press, 1985, pp. 480–481, 486–87.
- Islam, N., ed. *Population and Food in the Early Twenty–First Century: Meeting Future Food Demand of an Increasing Population*. Washington, DC: International Food Policy Research Institute, 1995.
- Johnson, D.G. "Agriculture and the Wealth of Nations," *American Economic Review* 87, no. 21 (1997): 1–11.
- . "China's Rural and Agricultural Reforms: Successes and Failure." Working Paper no. 96/12, Chinese Economy Research Unit, The University of Adelaide, Australia, 1996.
- . "Trade Effects of Dismantling the Socialized Agriculture of the Former Soviet Union." *Comparative Economic Studies* 36, no. 4 (1993): 21–31.
- Kremer, M. "Population Growth and Technological Change: One Million B.C. to 1990." *Quarterly Journal of Economics* 108, no. 3 (1993): 681–716.
- Lin, J. "Rural Reforms and Economic Growth in China," *American Economic Review* 82, no. 1 (1992): 34–51.
- Lucas, R.E. Jr., "On the Mechanics of Economic Development." *Journal of Monetary Economics*, 22: 3–42.
- Maddison, A. *Monitoring the World Economy 1820–1992*. Paris: OECD, 1995.



R E F E R E N C E S

- Malthus, T.R., *An Essay on the Principle of Population*. Selected and introduced by David Winch. London/New York: Cambridge University Press, 1992, pp. 325–332.
- Mitchell, D.O., and M.D. Ingco. “The World Food Outlook.” Mimeo, The World Bank, Washington DC, 1993, p. 130.
- Romer, P. “Increasing Returns and Long-Run Growth.” *Journal of Political Economy* 94 (1986): 1002–1037.
- Schiff, M., and A. Valdes. “A Synthesis of the Economics in Developing Countries” in *The Political Economy of Agricultural Pricing Policy* vol. 4, part 2. Baltimore: Johns Hopkins University Press, 1992.
- Schultz, T.W. *Transforming Traditional Agriculture*. New Haven: Yale University Press, 1964.
- State Statistical Bureau of China. *China Statistical Yearbook*. Beijing: China Statistical Publishing House, 1996, p. 377.
- Tyers, R. “Economic Reform in Europe and the Former Soviet Union: Implications for International Food Markets.” Report No. 99, International Food Policy Research Institute, Washington DC, 1994.