

FUTURE OUTLOOK FOR WORLD FOOD PRODUCTION

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ABSTRACT

This Bulletin discusses the world food situation, and the probable effect of trade liberalization under WTO on future food security. It compares the food shortages of 1972-74 with the present situation of low global food stocks, and is cautiously optimistic about the current and future food outlook. It suggests that with more participants in the global trade in staple foods, a higher level of stability in prices and supplies will be achieved. While the long-term outlook for increased food production is quite favorable, this will depend on increased investment into research and rural infrastructure.

INTRODUCTION

Events in the last two or three years have led to increased concern about the ability of the world's agriculture to provide adequate diets at affordable prices for a global population projected to exceed 8 billion by 2025, an increase of 2.5 billion. There are widely differing opinions as to whether events of the last three years are a short-term aberration or the beginning of a new long-term trend, and there are different views as to the long-term productive capacity of global agriculture. This reflects differing views of the role of family farms, and also the role of markets at all levels, but especially international markets, in providing the framework to guide investment, production, marketing and consumption decisions in such a way as to assure increasing food security in the world into the next century.

This Bulletin is divided into three sections. In the first, I shall try to put the current world grain markets into perspective, in part by comparing market conditions in the early 1970s (the last time there was serious concern about long-term world food prospects) with those existing now. The second section summarizes the longer-term perspective on

global food prospects, taking mainly what has come to be known as the "optimistic view". This view is reflective of analyses and projections carried out by IFPRI, FAO and USDA, among others. In the final section, I shall attempt to identify those actions that must be undertaken immediately if the "optimistic view" is to prevail.

CURRENT SITUATION

The tight world grain markets in 1996, with sharp price rises and fall in stocks, have raised concern about possible global shortages and vulnerability to weather shocks. This situation has some obvious parallels with the turbulent "food crisis" period of 1972-74, with its trade uncertainties, rapid growth in demand, and extremely high prices.

However, there are also some marked differences today, particularly in how the world is responding. A key change is a more widespread reliance on market forces rather than governments to balance supply and demand. Signs of the market response are already evident, with sharp increases in the U.S. spring crop area and in foreign wheat plantings.

Key words: Farmland conversion, grain exports, grain stocks, long-term soil productivity, wheat prices, world food supply.

The Events of 1972-74

Developments in 1972-74 were triggered by an unexpected surge in world demand, combined with several other independent but mutually reinforcing events. These events included:

- A period in the late 1960s of low returns to agriculture and concomitant low levels of investment, particularly in research;
- Signs that the Green Revolution that had been so successful in Asia was faltering elsewhere;
- A 1972-73 monsoon failure in South Asia;
- Failure of the Peruvian anchovy catch, which provided a large part of the foodmeal used in livestock feed.
- A short-fall in cereal production in the Northern Hemisphere (including the former USSR).
- The first OPEC oil shock, which increased the prices of most agricultural inputs in 1973.

Global grain production fell by about 3.5%, while a change in USSR policy led to the entry of USSR into the world market to buy grain rather than reducing its livestock herd to deal with shortfalls. The USSR also bought grain in an attempt to maintain its grain stocks.

The market was shocked, not only by the size of the Soviet purchases, but also by the fact that the Soviets had completed buying before the market realized what had happened. Up until 1972, the USSR had not been importing much grain and was normally a small net exporter. The large and unexpected Soviet purchases largely depleted exporter stocks, and raised the prices of world food commodity prices by nearly 80 percent.

The turbulence extended across other commodity markets besides those for grain. The world oil crisis and skyrocketing petroleum prices played an important role in increasing inflation, and shaping the psychology of the day. There was widespread fear that depleted resources would place increasing constraints on economic growth and food production. The oil crisis contributed to short supplies and soaring prices for fertilizers. Agricultural prospects in less industrialized countries were especially worrisome.

Actions of the United States involving other commodities added to market uncertainties during this period. During 1973, the U.S. imposed an export embargo on soybeans, cottonseed, and their

products, in response to rapid increases in domestic oilseed prices.

Concern peaked about the time of the World Food Conference, held in November 1974. Recommendations by the Conference centered largely on improving food production and strengthening world food security. Commitments for money and grain to be used for emergency food aid were sought, the establishment of a global information and early warning system for basic grains was urged, and more effective stock-holding policies were called for. It also called for a progressive reduction of trade barriers, but participants agreed to pursue this goal through multilateral trade negotiations under the General Agreement on Tariffs and Trade (GATT).

The crisis atmosphere began to dissipate as world grain production rebounded in 1975 and hit a record high in 1976. Weather returned to normal, while the area planted in grain continued to rise in response to market signals. Global consumption and trade resumed growth after declining in 1974/75, and grain prices began to ease. By 1982, concerns about shortages had been replaced by worries about a grain glut. Grain stocks held directly by the U.S. government — stocks which had virtually disappeared by the mid-1970's — had begun to accumulate again. By the mid-1980's, global stocks had grown to a record high, and in the United States and European Union (EU) — the world's dominant grain stock-holders — stocks reached burden-some levels.

Why are Markets Tight in 1996

Global stocks of wheat and coarse grains carried into 1996/97 are the lowest since the mid-1970's, following three years in which consumption outstripped production. A number of factors have contributed to current tight grain supplies. Global grain production between 1993 and 1995 was lower than its 1992 peak, with some of the major grain exporters experiencing below-normal crops. The harvest in the United States reached a record high in 1994, but this was sandwiched between poor crops in 1993 and 1995. Meanwhile, the demand for grains continued to increase. In the face of sagging production, world grain stocks have been drawn down since 1992/93 to meet the growing demand.

Underlying these more recent developments has been a longer term decline in grain stocks, particularly in the United States. The reduction of stocks became a U.S. farm policy objective in the mid-1980's, because the level of stocks had grown to burdensome levels, reaching as high as 70% of

annual use. A sharp fall in EU stocks since 1992 has also been due largely to changes in agricultural policies. The dramatic contraction of demand for grain in the former Soviet Union (FSU) following its breakup significantly depressed global trade. In the wheat market, export subsidies were the order of the day as the EU and U.S. tried to export excess stocks, and export prices were quite low through to mid-1994.

By early 1995, the tone of the market began to change. Exportable supplies of grain were shrinking, due partly to poor or mediocre crops in a number of countries. Harvests in Australia fell sharply because of drought in 1994, and then Argentina's wheat crop was hurt by dry weather in 1995. The U.S. wheat crop was also relatively poor in 1995, and no other exporter was able (or willing) to increase exports to meet import demand. Grain export subsidies dried up, and the EU actually imposed a tax on wheat exports in mid-1995 to shield internal users from spiraling prices. As world wheat export supplies dwindled, problems with the 1996 U.S. winter wheat crop frightened the market and prices soared. Since spring, wheat prices have moderated due to a better-than-expected U.S. winter wheat harvest.

Coarse grain export supplies began to tighten around the same time. In late 1994, China, then the world's second-largest supplier, halted corn exports. This move increased the world's dependence on the United States for corn for livestock feed, but the 1995 corn crop in the United States was relatively poor because of adverse weather. Import demand for U.S. corn continued to strengthen, while domestic use also remained strong, helping to push prices to record heights in the spring and early summer of 1996.

Comparing 1974 and the Present

As in 1974, current concerns about the grain market focus largely on aggregate world supplies (stocks and near-term production forecasts). Comparisons between the 1970's and the current grain market reveal both similarities and differences.

The two periods are similar in that:

- Levels of stocks are at or near historic lows, and below levels that have been considered necessary to meet unexpected crises;
- Production has been lagging behind consumption for several years, and forecasts for the near term see little chance of rebuilding stock levels;
- Prices of grains on world markets have

risen rapidly to historic levels; *and*

- Some people are questioning whether we are entering an era in which the capacity to meet a growing demand for food can be met.

The two periods are different in that:

- Despite the persistence of poor distribution and malnourishment, there is no major threat of famine at present;
- World agricultural trade has begun to move towards a more open environment, with fewer trade barriers and more "transparent" policy interventions. Trade should be better able to address shortages, and price signals will provide a more reliable basis for production decisions;
- Inflation in the United States and most other major economies of the world is quite low;
- Global commodity markets, including the oil market, are much more stable;
- Information is much better, due to faster global communications, increased private-sector market reporting, a USDA system for reporting U.S. export sales, and FAO's Global Information and Early Warning System that has improved the ability to track developments in regions outside the main markets;
- Important shifts in the policy orientation and trade position of many countries and in the world market have occurred since the 1970's — the United States, Canada, Australia, and Argentina have been joined by the EU (in the early 1970's, Western Europe was still a large importer) as leading exporters. India, with large gains in wheat and rice production, has moved from being a major importer to being a minor exporter;
- Even though there is uncertainty about China's future need for imports, there appears to be no immediate possibility of a sudden large surge in global import demand like the one derived from the change in import policy by the USSR in the earlier period.

Thus, while global stock-to-use ratios are lower now than in the early 1970s, and in spite of the unhelpful policy decisions of some countries to protect domestic consumers from rising world prices, world markets have handled the current tight supply demand situation with relative calm. Real price

increases have been much smaller than in the earlier period. This is illustrated by comparing U.S. price increases in the two periods. U.S. export prices of wheat (hard red winter) and corn hit record highs in May 1996, at \$262 and \$204 per metric ton, respectively. When adjusted for inflation, using constant 1992 dollar values, however, the 1974 prices were much higher. The peak monthly export price for wheat in 1974 was \$216/mt (equivalent to \$560 in 1992 dollars), and the peak monthly export price of corn reached \$152 (\$395 in 1992 dollars). At the farm level, the season-average U.S. price of wheat also hit a record high.

Relatively low stocks will persist through at least 1997, despite anticipated increases in global harvests that will ease immediate supply pressures. Low stocks will leave the world particularly vulnerable to major crop shortfalls or sudden food crises, and will probably mean more price fluctuations than in the past. However, there is little need for concern that this situation will lead to a world food crisis, and it is widely expected that global response to higher prices and more normal weather will result in stocks being replenished (but not to the levels of the late 1980s), and that prices will return to trend levels within a couple of years.

LONGER-TERM PERSPECTIVE

Over the past hundred years or so, the world has managed to increase food production faster than its population has grown. It has done so with increasing efficiency, resulting in ever greater per capita food availability and decreasing real prices. More recently, however, growth in agricultural production has slowed (3.0% per year in the 1960s, 2.3% in the 1970s, and 2.0% in the 1980-92 period). Margins between supply and demand are smaller, the fish catch is falling, some crops appear to be approaching their biological maximum yield, arable land is being lost to non-agricultural uses and degradation, water quality is being degraded, and irrigation has only limited potential for expanding production. The question is whether a turning point has been reached in the trend toward more plentiful and cheaper food.

Several recent studies have focused on the long-term (20-30 years) global food supply-demand balance. All generally agree that population will double in the next 40 years, reaching about 7 billion by 2010 and exceeding 8 billion by 2025. They agree that per capita incomes will continue to rise, further adding to food demand, and that the trend towards urbanization will continue. The combined effects of

population and income growth will mean that food demand will nearly double over the next 30 years.

As has been pointed out by McCalla (1994) in his review of world food supply-demand projections, studies are in reasonable agreement on demand, but opinions differ as to how global agriculture will respond. Three projections arrive at reasonably similar results: Mitchell and Ingco (1993), FAO's *World Agriculture: Towards 2010* (1995), and the International Food Policy Research Institute's (IFPRI) 2020 project (1995). U.S.D.A. (1996) has made projections to 2005 that are consistent. These studies are not predictions of the future, but descriptions of what can be expected under a very specific set of assumptions and circumstances. All assume small increases in cultivated area, with production gains coming primarily from yield increases. The models assume yield increases will continue at more recent, reduced levels (1.5-1.7%), and will not return to historically higher levels (2.4%). None foresees a global shortfall between supply and demand, because global demand is expected to grow at about the same rate as supply. All expect that real prices will be constant (FAO 1995) or decline in the future, although at a slower rate than in the past. All expect that developing countries will increase food imports, but that increased imports can be met by developed country exports.

These three studies can be characterized as optimistic, in that they see no serious problems in meeting foreseen food demands over the next two to three decades. They generally find that global production will, in fact, increase faster than population, so that global food availability measured in calories per capita will increase. However, even with adequate global supplies, recent studies have all projected serious food problems in developing countries, primarily Sub-Saharan Africa and South Asia. Food insecurity will grow significantly in these regions, resulting either in higher food aid requirements or more serious malnutrition. Globally, it is projected that both the absolute number and the proportion to the population suffering from undernutrition will decrease, although FAO (1995) projects that by 2010 some 800 million people will still lack food security.

This relatively optimistic global outcome will not happen without continued investment in research, infrastructure, and human capital, and continued movement toward appropriate policies. These projections do not assume any weather trends outside the range of recent experience (e.g., they do not anticipate any significant effects from global warming).

Projected changes in global food supply, demand, and prices are very sensitive to assumptions made about trends in population growth and agricultural productivity. For example, a 25% decline in the global growth rate for cereal yields leads to a rise in the world price by 70% for wheat, 40% for rice, 50% for maize, and 58% for coarse grains (IFPRI 1995, p.2). A 20% increase in population is expected to result in increased demand and a rise in world prices of 30% for wheat, 18% for rice, 11% for maize, and 18% for other coarse grains (IFPRI 1995, p.2).

A fourth study of global food prospects, Brown and Kane in *Full House: Reassessing the Earth's Population Carrying Capacity (1994)*, and a follow-up by Brown in *Who Will Feed China? Wake-up Call for a Small Planet (1995)*, come to quite different conclusions, and might be characterized as the pessimist's view. They see as new constraints on production:

- A shrinking backlog of unused technology;
- Food demand pressing against the limits of possible contributions from fisheries and forestry;
- Water demands approaching the hydrologic limits;
- Declining response to fertilizer;
- Loss of cropland to non-agricultural uses; *and*
- "Social disintegration", undermining governments and efforts to expand food production.

Combined with the generally accepted demand projection, these constraints are seen to be leading towards a generally dismal picture for world markets. These studies, especially *Who Will Feed China?*, expect China's grain production to decrease, and the resulting high demands for imports by China to destabilize markets and attract food away from poorer consumers. Many analysts disagree with this pessimistic outlook, especially with respect to China. Regardless of their validity, however, Brown's analyses offer an important warning against becoming complacent about the future food situation. With respect to fishery resources in particular, it should also be noted that many experts agree that unless major steps are taken, world food production from fishery resources could decline over the next 15 years, while demand — especially in the developing world — will increase by approximately 50%. Even under optimum conditions, we cannot expect significant increases in world fisheries production by 2010. To a large extent, the limits of the productive capacity of the oceans have been reached. World produc-

tion from ocean fisheries can be increased through improved conservation and management practices, a reduction in fishing capacity, and better utilization of what are now wasted parts of the catch. The one fisheries sector that is subject to global increase is aquaculture. Resources should be applied to the development of aquaculture, as well as to assuring that this development is environmentally sensitive and sustainable.

Since there is relatively little disagreement on the demand side, it is useful to look at the supply factors differentiating the optimistic and pessimistic views. These can be grouped into firstly, agricultural productivity — with its link to natural resources and the environment and secondly, food and agriculture policy.

PRODUCTIVITY, NATURAL RESOURCES AND THE ENVIRONMENT

Agricultural production is a biological process which depends on the natural resource base, especially soil and water, and on favorable climatic conditions. While the world's supply of land and water is finite, its capacity for supporting agricultural production can be modified over time through investment. The productivity of land (or the degree to which physical land and water availability constrains agricultural output) can be affected by technology (the substitution of knowledge-based inputs for natural resources). Much of the disagreement between the optimists and the pessimists is fundamentally about the rate at which knowledge-based inputs can be developed, and the degree to which natural resources can be replaced by knowledge-based inputs.

Most land that is well adapted for agricultural production is already being used, and easily harnessed supplies of irrigation water are being exploited. For some years, the proportion of growth in global agricultural production derived from expanding both the cultivated area and irrigation has been declining.

New lands recently brought into production tend to be fragile, and their productive life under certain technologies appears quite limited. In many cases — the Amazon area of Brazil is a good example bringing land into agricultural production is thought to have serious negative long-term effects on the world's environment and climate. There is evidence that misuse of land and water in agricultural production is degrading the world's resource base. Concern is growing that, in some cases, this process may be irreversible, and could therefore reduce long-term

productive capacity.

As the supply of additional land and irrigation water to be brought under production has diminished, increases in food production have derived increasingly from the application of new technology. Much of this technology has depended heavily on intensive use of chemicals (including fertilizers), and has led to the pollution of ground and surface water and, in some cases, the atmosphere. The effect of chemicals on the safety of the food supply is of increasing concern.

As agriculture has become more dependent on technology, questions have been raised about the ability of science to provide a sufficient stream of new technology to keep pace with increasing demands for food. A related, but fundamentally different, concern is raised with respect to the ability of new technology to provide food security in the low-income, food-deficit developing countries of the world. This concern has two dimensions. First, the more impoverished developing countries are poorly prepared, in terms of human capital and physical and institutional infrastructure, to support the adoption and use of modern technology. Thus, technology may not be able to increase domestic supply in these countries to keep pace with rapidly growing populations. Second, and possibly more important, is the concern that poverty, both rural and urban, cannot be eliminated by technology alone. Lack of purchasing power may mean that large segments of the population have no access to food supplies, either domestic or imported, even though these may be increasing.

There is growing acceptance that the economic activity of humankind is changing the composition of the earth's atmosphere, and that this is causing long-term climatic change. Most experts believe that climate change will be in the direction of global warming. Most analysis to date indicates that global warming will be a slow process, is not likely to have serious consequences for decades, and will have both positive and negative effects. The rise in global temperature, and the associated changes in rainfall pattern, may cause some regions of the world to become less suited to agricultural production and others to become more productive. In addition to changes in temperature and rainfall patterns, carbon dioxide levels are expected to increase, and this is expected to promote plant growth. The net effect on global agricultural productivity is difficult to anticipate. It is almost certain that global climate change will require change and adaptation in production patterns and technologies, if its negative consequences are to be minimized.

It is a fact that the supply of land and water

for agricultural production is limited, and that the resource base is being degraded in many areas by improper use. However, technologies already exist which, if adopted more broadly, could increase greatly the efficiency of water use. With appropriate technology and practices, much of the land currently being lost through erosion and salinization could be preserved, and additional marginal lands could be brought into production in an environmentally sound manner. It is also important to recognize that much of the concern about loss of agricultural potential due to land degradation and non-agricultural uses is based on very weak, often anecdotal evidence, trends based on projection of "snapshots" rather than "motion pictures". Until a recent study by Lindert (1996), there has been no systematically collected data of soil quality over long periods of time in comparable locations — therefore, no basis for evaluating or projecting soil degradation, its effects on production or the degree to which man's economic activity affects it.

Lindert's analysis of soil survey data collected over 50 or more years in Indonesia and China offers encouraging evidence that

- Depth of topsoil has not declined;
- Organic matter and nitrogen content have declined on cultivated land but this has had no impact on yields, evidently because of ease of substitution of fertilizers;
- Phosphorus and potassium levels have increased;
- Alkalinity and acidity have fluctuated; with no overall worsening of the pH;
- The shift in food demand, due to economic development, away from staple foods toward legumes and animal products, leads to the replenishment of soil nutrients;
- Development means cheaper capital and clearer property rights, which improve conservation; *and*
- Urbanization and industrialization raise the productivity of soils at the urban fringe. (Data from China suggest that this effect cancels the loss of farm soil endowment from urban encroachment).

If these results prove to be applicable to other parts of the world, this puts a much more positive perspective on the world's long-term agricultural productivity.

While land and water degradation poses serious problems in some instances, it is not serious enough to destroy our ability to produce an adequate

food supply over the next two or three decades. Corrective action is necessary, however, if many of the less industrialized countries are to achieve a sustainable agricultural production base. It is important to remember that increasing agricultural production and productivity in poor countries is necessary, not only as a source of the domestic food supply, but more importantly, as a source of income growth and thus increased access to food by poor rural residents who have few if any employment alternatives.

One other encouraging event is the recent evidence (Crook 1992) that the arable land area of China has been under-estimated by as much as 30% in official statistics, and thus that yields have been over-estimated by a similar amount. This is encouraging from two perspectives. It means that available land area in China is significantly less of a constraint than had been thought. It also means that yields are not as close to the perceived biological maximum as had been feared, so there is more potential for further yield increases.

Another positive development for the long-term agricultural outlook, which is related to the water resource issue, is aquaculture. While the global commercial fish catch has stagnated during the 1990s, ERS analysis (Harvey 1995) indicates that aquaculture has the potential to supplement a stagnant or declining fish catch. Aquaculture already accounts for approximately 25% of world shrimp and salmon production. As harvesting limits are reached or more curbs are placed on the wild catch, aquaculture has the potential to fill the gap.

Technology breakthroughs are always difficult to predict. However, a significant stock of technology has yet to be adopted, especially in low-income countries. Of the 2% annual growth in productivity in the developed countries over the past 20 years, almost all has been derived from technological change. In the United States and Canada, agricultural production has doubled since World War II, while total input use (land, labor, machinery, chemicals, etc.) declined slightly. This growth in productivity has come largely from technological and biological innovation, with strong investment in new varieties of crops, breeds of animals, machinery, and equipment, including a rapid expansion of information systems. Studies of sources of growth in other countries and regions show similar strong growth in productivity, and the increasingly dominant role of technology in increasing production (Pingali and Heisey 1996).

Slower growth in agricultural production in the United States and Europe in recent years has

been interpreted by some as evidence that the technology well is running dry. More serious analysis reveals that it is more likely that this slowing has been the rational reaction of farmers to lower prices (prior to the last two years), changes in agricultural policies (reduced incentives and taking land out of production) and bad weather in the last two or three years. There is no indication that this trend in technological change and improved productivity must diminish over time—particularly as biotechnological innovations such as genetic engineering appear to offer great potential for increasing agricultural productivity. Biotechnology is not often given prominence in the food supply-demand debate, but it may well, in the more distant future (25-50 years), make agriculture as we know it much less important as food production moves from the field into the factory. However, Pingali and Heisey (1996) note a narrowing of the gap between yields obtained on experiment stations (maximum potential) and those obtained by the best farmers in the most intensive production regions, especially in the case of rice. This points to the critical need to continue and increase investment in research, if productivity growth is to be sustained in the future.

Two serious problems must be dealt with if technological development is to fulfill its potential and have a long-term positive impact on the world's food supply. One is the possible negative effects of new technology on the environment, and on the safety of food for human consumption. The other is whether the new technology can be applied in low-income countries, and help alleviate food shortages where they are most likely to occur. The answer to the second question is not so much one of technology as of achieving policy, institutional and economic environments conducive to adoption.

POLICIES FOR FOOD AND AGRICULTURE

Food and agricultural policies (both internal and international) constitute the second major determinant of the long-term outlook for world food supplies. Policies which insulate domestic producers and consumers from world market forces restrict the ability of the world to adjust to changing supply/demand conditions. They may even lead to misuse of the natural resources base and the environment, particularly in some areas of the world. A policy environment that distorts prices and other incentives for producers and consumers away from the true social values of natural resources (including the environment) and other inputs leads to inefficient production (use of resources) and raises further

concern about the long-term future of the global food supply.

Food and agricultural policies, including trade policies, are almost universally adopted for good and noble reasons. However, governments often fail to understand that policies have multiple effects which are often inconsistent with, and sometimes contrary to, the original policy objective. This has led to a global policy environment which is badly distorted, and has contributed to a global agriculture that was once referred to by Professor D. Gale Johnson as being “in disarray”. Some examples of policies adopted for “good” reasons that lead to “bad” results are:

- Countries protect domestic producers in the name of food self-sufficiency to provide “food security” and reduce variability in supply and prices. In fact, global supplies and prices are less variable than national ones, unless the domestic variability is dumped onto the world market. Dumping national variability onto the world market makes the world market more variable for remaining participants. Protection of domestic producers leads to inefficient use of resources, reduces aggregate welfare, and increases the cost of food to consumers, thus reducing food security.
- Countries subsidize prices to producers of selected commodities to increase producer income. This distorts production and resource use, decreases efficiency and national welfare, and creates surpluses which are often dumped on world markets, depressing world prices and incentives for producers in other countries. To reduce the costs of disposing of surpluses, restrictions are placed on production (often by limiting the area planted). This distorts resource use and increases the cost of production, which in turn reduces the income of producers while raising the cost of food to consumers.
- Countries subsidize “modern” inputs to increase the productivity of domestic agriculture. This has the unintended effect of favoring technologies that make intensive use of inputs and resources that are scarce, and penalizing technologies that make intensive use of inputs and resources that are plentiful in the country. Subsidizing machinery and capital inputs in countries that have surplus labor leads

to unemployment and lower wages. This is a frequently observed pattern in less industrialized countries.

- Government policies that favor urban consumers with cheap food, and provide low prices to producers, often stifle the adoption of productivity-enhancing technologies. They also stifle development of the agricultural sector, increase imports, raise taxes and lower welfare (often of the urban consumer who is the principal taxpayer).

This emphasis on misguided agricultural policies is not meant to imply that all government intervention is bad, and that “just leaving it to the market” would lead to a sustainable solution to the long-term food supply-demand problem. There are two supply problems that are not handled satisfactorily by markets:

- Private costs and returns as captured in market prices are not always consistent with social costs and returns, leading to socially inefficient use of resources and the environment. (Taxes and subsidies or regulations are necessary to correct for this).
- Markets do not always adequately value the long-term consequences of resource use and misuse, and thus may not lead to substitution away from scarce resources before irreparable harm has been done. (Here, also taxes and subsidies or regulations may be needed). It is especially in this latter case that there is some reason for caution in asserting that technology and the market (with limited help from policy-makers) can take care of long-term growth in the global demand for food and fiber. We don’t really know the degree to which knowledge based inputs (technology) can be substituted for natural resources and environmental quality.

Almost as difficult to predict as technological breakthroughs are major policy breakthroughs. Nevertheless, significant evidence exists that a major shift is occurring in the global policy environment. After decades of increasing levels of protectionism, the agreement reached in the Uruguay Round of the GATT negotiations — particularly on agriculture, tropical products, and intellectual property — offers real promise of reducing distortions and resource inefficiency in the marketplace. This agreement could significantly increase the movement of goods

and technologies between countries.

Another positive sign for policy improvement has been the significant unilateral reform undertaken by many countries, both industrialized and less industrialized. The United States' latest farm legislation is a very significant move away from direct government involvement in providing production and consumption incentives, and puts much greater reliance on markets. New Zealand has made the most complete transition to a market directed agriculture, but Australia and Canada, as well as the European Union, have all made significant moves towards liberalization. Many less industrialized countries have also made structural adjustments in the direction of greater market orientation. Such reforms, as applied to the agricultural sector, should provide market incentives for producers to adopt new technologies. The productivity gap between the industrialized and the less industrialized countries could begin to narrow.

The former Soviet Union, and East and Central European countries, have undergone some of the most dramatic structural change of all, but the positive effects are only just beginning to be seen in most countries. Many observers believe that with further reform and development of appropriate institutional and physical infrastructure, these countries can become significant exporters of agricultural commodities.

WHAT MUST BE DONE

On balance, it appears that over the next two to three decades, we need not expect any major threat to the world food system. Over this period, food crises will probably be localized—the result of war and civil strife, short-term weather problems, policy-induced inflexibilities in the global food system and a lack of effective demand—rather than failure of supply. However, this optimistic outcome is not automatic, and countries must not become complacent. Growth in demand as a consequence of population and income growth will place increasing pressure on the global natural resource base and the environment. Low incomes for large numbers of people will continue to leave an important gap between the “need” for food and “effective demand” for food. In order to meet the challenge of providing greater global food security over the next two or three decades, without detracting from the capacity to meet the same challenge in the even more distant future, we must:

- Increase investment in agricultural research, especially in less industrialized

countries, to ensure a continuing stream of new and appropriate technology;

- Adopt policy frameworks that are conducive to production and consumption decisions that make efficient use of resources and the environment, and provide incentives for future investment.
- Continue to remove barriers to trade in food and agricultural commodities, inputs and technology between countries, so as to achieve maximum efficiency in use of global productive capacity, and maximum flexibility to adjust to shocks in supply and demand occurring in individual countries; *and*
- Stimulate more rapid economic development in poor countries, so as to eliminate the root cause of food insecurity—poverty.

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DISCUSSION

A participant from the Philippines agreed with Dr. White about the need to emphasize the role of research and development, and suggested that support for research is a particularly difficult problem in developing countries, where research funds might be only 2-3% of the GNP. She asked Dr. White whether he expected any increase in research expenditure in developing countries. Dr. White referred to some promising efforts from the World Bank and other organizations to promote regional cooperation between countries. He pointed out that while this might not increase the funding available for research, it would increase its efficiency. Every country wants to have a full set of research facilities, but this is in fact very wasteful. He suggested that it would be very beneficial if regions could find ways to identify areas where each country had the greatest interest and concern, and follow these in dividing up research institutes and facilities amongst the member countries.

Several Korean participants commented on food stability and free trade. One pointed out that while developed countries could help developing ones by transfer of technology and capital, there is no sign of this actually happening under GATT. He suggested that developing countries would be at a great disadvantage under trade liberalization, because developed countries want direct payment for technology and intellectual property, as well as for food exports. Since Western European countries have an annual per capita income of around US\$20,000, they will be able to maintain food security in the long term, while developing countries will have problems in doing this without food aid. Another pointed out that in an open market system, if there is no domestic production base, any fluctuations in international prices are outside the control of the national government, and can be very serious. If food security is based on domestic production, however, a government should be able to achieve stability in prices by its own efforts. He emphasized that what is important is not production availability, but price availability. If price fluctuations occur in the future, can there be any guarantee that these will be within acceptable limits? What would be the effect of marked fluctuations on the overall economy of the importing nation?

Dr. White replied that while there is no guarantee that food aid or technical support from developed to developing countries will increase in future, this is independent of the Uruguay Round GATT agreement. He pointed out that producers of surpluses will no longer maintain large stocks, so that if they give food aid, it will

be explicitly given as such, and not be the disguised disposal of surplus stocks. He added that a decline in food aid is not necessarily a bad thing, if it is no longer needed, and that ideally there would be no need for any food aid at all. As for intellectual property rights, he suggested that to the extent that this will protect across borders, it will promote technology transfer. To the extent that it makes new technology prohibitively expensive, it will constrain it. Which of the two occurs will be a pragmatic question, to be answered by events.

Dr. White suggested that political problems from food prices occur when governments keep prices artificially low to the point when their funds can no longer support such a policy, so that there is then a rapid price rise almost overnight. However, if all economies participate in the world market, we would not expect a 3% change in production to result in an 80% change in price, as happened in 1974.

Dr. Kyung-Joo Park of FFTC pointed out that while the United States is a major leader in stabilizing world free trade, so that production is very important, on the other hand concern over the environment is also increasing, as is the amount of land covered by the "set-aside" policy. He asked whether the ideas of increased production and environmental protection were to some extent contradictory, and how the United States could reconcile the two.

Dr. White explained that under U.S. agricultural policy, "set-aside" was not a conservation program but a supply-control program. Under the current farm legislation there is no set-aside. The U.S. does have a conservation program called the Conservation Reserve Program (CRP). Even under the CRP the original allocation of land to be included was, in part, politically based to ensure that every state received a fair share. Thus, the most threatened or marginal land was not necessarily brought under conservation. Under the new legislation, the type of land to be brought under the CRP will be more restricted. This will free land for agricultural use that should never have been included and will allow for more of the truly threatened land to be protected. There is a growing understanding of farming among followers of the Green Movement in the United States. Environmentalists are less inclined to feel that agriculture is a threat to the environment: they are beginning to feel that farmers protect and conserve the environment, rather than degrade it. Environmentalists and farmers have a mutual interest- conservation is not necessarily bad for agriculture and agriculture is not necessarily bad for conservation.

A participant from Malaysia asked Dr. White whether he saw the growing commercialization of agriculture as inevitable. Dr. White replied that he believed that commercialization has to be one of the necessary structural changes, if we are to depend on markets rather than governments to provide incentives.