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FOOD SECURITY AND THE CHALLENGE TO AGRICULTURE IN THE 21st CENTURY¹

by

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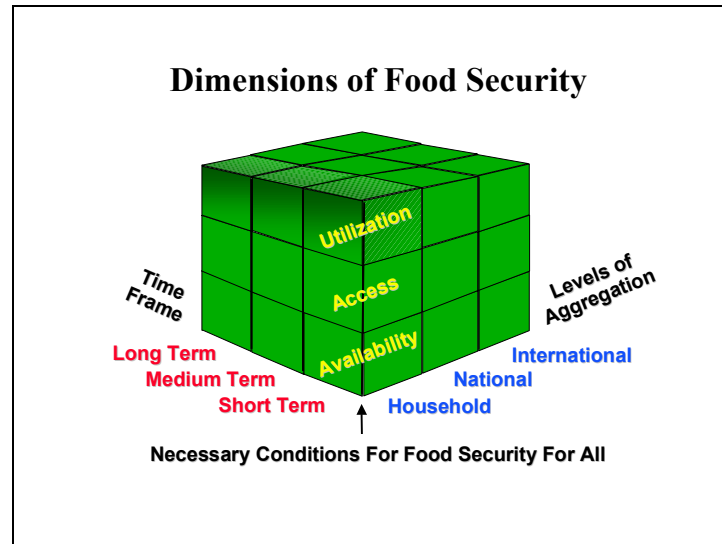
1. Introduction

The world will have approximately 8 billion people by 2025-2030. Despite improvements in health, nutrition and development, as many as 1 billion of those could be food and/or nutritionally insecure. The challenge of food security for all is therefore complex. It is about production, trade, income and social safety nets and much more. Many people approach it partially by considering only one element at a time. Some focus on supply issues—can the world produce enough food to meet the needs of a growing population. Some focus on the demand for food. Still others focus on technology or policies for food security and so on. But none of these approaches alone addresses two of the most pressing issues facing the world in the 21st century—namely global food security and economic and social development.

Given that world food needs could nearly double in the next 30 or 40 years, the challenge to the global agricultural system is enormous. But food security is about more than adequate supplies. It is about every human being having affordable access, on a continuing basis, to sufficient food to lead a normal, healthy and productive life. One must think of food security first at the household level. Can a family generate sufficient income to have access to needed food? Thus, food security is about reducing and eliminating poverty. The challenge of poverty reduction is both national and international. In the developing world it remains still a predominantly rural challenge.

It is now generally accepted that food security has three components: (1) availability of food, (2) access to food, and (3) effective utilization of food to achieve nutritional security (Figure 1). Each alone is a necessary condition but only when

Figure 1.



we have all three met is there a sufficient condition to assure food security for all. There are two other dimensions which also influence considerations of food security. These are the timeframe (short, medium or long) and the degree of aggregation (household, national and international). (Figure 1)

2. The Global Food Security Challenge

2.1 PERFORMANCE TO DATE

Before projecting into the future for the next 25-30 years, it is perhaps worthwhile to review how well we have done in the past 30 or so years in meeting the last doubling of food needs. This should give us some perspective on future challenges as shown under the three headings of availability, access, and utilization in Figure 2.

Figure 2.

Elements of Food Security - Retrospective			
Time Frame	Availability	Access	Utilization
Retrospective (1961-1990)	<p>Global</p> <ul style="list-style-type: none"> World Cereal production doubled Per capita food production increased 37% Calories supplies increased 35% real food prices fell by 50% <p>Regional difficulties</p> <p>Sub-Sahara Africa - per capita food supplies declined</p> <p>South Asia - slow growth</p>	<p>1969-1971</p> <p>920 million people were under nourished. This was 35% of developing country population</p>	<p>Close to 1 billion suffered from deficiencies in one or more micronutrients</p>

Availability. Despite periodic predictions of imminent shortages (1965-1966, 1972-1974, 1988) the world did remarkably well in expanding food production over the 30 year period 1960-1990. World cereal production more than doubled, per capita food production increased 37%, calories supplied per day increased 35% and real food prices fell by almost 50%. Regionally average calories available per day increased significantly in the Near East and North Africa, East Asia and Latin America to levels of 2 700 calories per day or higher. South Asia grew more slowly and still is a region with significant undernutrition. But Sub-Saharan Africa experienced a decline in per capita food availability. The increases in production came from three sources: biological yield increases, land use intensification—irrigated acreage in developing countries doubled—and expanded area.

Access. Yet despite an overall effective global performance, under nutrition remained a serious problem. In 1969-1971, 920 million people were undernourished which represented 35% of developing country population. In the 1990s, the FAO estimate is 840 million undernourished people, now 20% of developing country population. In relative terms there was progress though regional performance varied widely. In 1969-1971, 76% of the undernourished lived in Asia (51% in East Asia) and 11% in Sub-Saharan Africa (SSA). In 1990-1992, 60% lived in Asia (30% in East Asia) and 25% lived in SSA. But in absolute terms the number of undernourished diminished very little.

Utilization. Though firm data is unavailable, it is likely that over 1 billion people suffered from a deficiency in one or more micronutrients (e.g. Vitamin A, iron, iodine, zinc & copper) in the 1960's. In the early 1990's, estimates are that 1.6 billion people are

at risk of iodine deficiency and about 2 billion people are affected by iron deficiency (FAO 1996, Paper 5, pp. 6-7).

In sum, there was improved performance on the supply side, relative but not absolute improvements in reducing undernutrition, but an apparent increase in the incidence of micronutrient deficiencies. Therefore, argue many, supply was not a constraint. It was, and is, poverty and the lack of employment opportunities.

2.2 THE DEMAND CHALLENGE

By the end of the first quarter of that 21st century, 2025, world population will approach 8 billion people, an increase of 2.5 billion from the 1990s. Recent projections suggest something less than 8 billion but still project a more than 2 billion increase. Nearly all of this increase will be in developing countries. The population of Sub-Saharan Africa will more than double.

But the increase in the number of mouths to feed is only part of the challenge. Income growth also drives the demand for food. With modest income growth, food needs in the developing countries could nearly double in the next 30 to 40 years. Further, by 2025, population in developing country cities will increase by about the same number, 2.5 billion people. With rising incomes and urbanization, the composition and characteristics of food demand will be significantly different.

The developments described above on the demand side raise fundamental questions. Can the world produce enough food to feed 7.5 to 8 billion people and at the same time hopefully reduce the number of undernourished to below the current level of 800 million? If so, where will it be produced? Will we break away from the mind set of equating food security with national food self-sufficiency and ask where the food should be produced? Can the food system of the future meet the challenge of processing, distributing and storing a nutritious food supply for billions more people in the next century. And finally, does the world have a trading system that will allow increasing quantities of food to flow from surplus to deficit areas?

2.3 THE SUPPLY CHALLENGE

Views of the challenge of meeting future food and fiber security diverge more strongly as the time frame of the projection is lengthened. Those using economic projections or simulation models, based significantly on history, tend to project sufficient global supply until at least 2020. Those projecting on the basis of resource availability

and environmental constraints—perhaps these should be called ecological modelers—are generally much more pessimistic. The most extreme view combines resource constraints with biological yield pessimism and foresees serious problems ahead, as does Lester Brown, for example. The very nature of projections using compounding growth rates of population and income compared to compounding growth rates in yield means that food gaps grow rapidly if the growth rate of demand exceeds the growth rate of supply. On the other hand, if supply growth rates exceed demand growth rates, food prices fall. The latter has been the predominant outcome in the 20th century.

2.3.1. *Medium Term: 2010-2015* (Figure 3)

Availability. Several recent simulation studies have projected global cereal or food balances to 2005, 2010 or 2015. Three studies done at the International Food Policy Research Institute (IFPRI), FAO and the World Bank make projections to 2010 and come to similar conclusions (Agcaoili and Rosegrant, 1995; Alexandratos, 1995; and Mitchell and Ingco, 1993). All three studies project grain yields to increase 1.5%-1.7% per year, area harvested is expected to increase modestly, global grain demand is projected to grow more slowly and trade in grains is expected to increase. All three studies expect real grain prices to remain constant or decline. Regional food problems are expected to persist in South Asia and especially in Sub-Saharan Africa.

In reporting on a conference at IFPRI, which reviewed the three projections to 2010, Islam (1995) concluded:

“There was general agreement the world food supply in 2010 would probably meet global demand but regional problems would occur. South Asia and Sub-Saharan Africa were recognized as the most vulnerable regions. The key to future food supplies was seen as increased productivity, that is, yields must continue to rise; to accomplish this, sustained support for investment in agriculture, including research expenditures, would be needed.”

Figure 3.

Elements of Food Security - Prospective			
Time Frame	Availability	Access	Utilization
Future: Medium term 2010-2015	Most projections suggest adequate global supplies but some are concerned about resource constraints	World Food Summit target of 400 million undernourished by 2015	Forecast difficult, will be conditioned by success in poverty reduction and improved nutrition delivery systems
	Differences between optimists and pessimists, focus on yield potential, land expansion/loss and water availability	FAO projects 680 million in 2010	
Longer Term 2020-2025	Food needs in developing countries could nearly double Challenge is serious and will be impossible without appropriate policies and continued expanded investment in research for the development of new technology	Goal: to eliminate under nutrition This would increase projected food demand by 10%	

A contrary view is presented by Brown and Kane (1994) who argue that there is little backlog of unused agricultural technology, that fish production has reached its biological limits and that rangeland carrying capacity has been exceeded. They further argue that the demand for water is pressing hydrological limits, that fertilizer responsiveness is declining and that much cropland (especially in China) is being lost to degradation, urbanization and industrialization. The resulting conclusion is very pessimistic with the only possible solution being greatly expanded trade which they see as problematic.

Access. Access to food in the future very much depends on success in reducing poverty, especially in rural areas, and a stimulating widely shared employment intensive growth. The World Food Summit which was held in 1996 set as its target, reducing the number of undernourished to 400 million by 2015. FAO projections, based primarily on a continuation of past trends are that the number of undernourished would be 680 million in 2010 without significant changes in policy.

2.3.2 Longer Term

IFPRI has done a long run projection to 2020, which shows relatively good global food supply and demand balances through 2020. Real grain prices continue to fall, trade expands substantially with imports by developing countries doubling. Food problems persist in Sub-Saharan Africa where imports are expected to triple.

The IFPRI study also reports an alternative scenario where there is lower investment in agricultural research combined with slower income growth. This decline in public investment agricultural research has severe consequences for the global food situation, as it causes real prices to rise and malnutrition to increase. The IFPRI study, and models using the more pessimistic assumptions of Les Brown, show how sensitive projections are to modest differences in assumptions.

How can these economic optimists on one hand and the ecological pessimists on the other hand reach such different conclusions in projecting food supply potential to the future?

Assuming that they agree generally in the demand side scenario, the reasons can be found in the four critical projection parameters: yields, area harvested, intensification and resource constraints.

- (1) What are they assuming about the rate of the increase in biological yields? Economic modelers point to 2%-3% increases in production in 1960-1990 but even projecting lower rates of 1.5%-1.7% per year in the future still produces more rapid growth in supply than demand because the population growth rates used have fallen even more rapidly. They are also optimistic about the potential of biotechnology. Biological modelers on the other hand point to yield increases in 1990s of less than 1%, yield stagnation in intensive irrigated systems, e.g. triple cropped rice in the Philippines (IRRI), and a decline in yields in rice/wheat systems in South Asia. They are very skeptical about biotechnology solving all problems.
- (2) How much land is to be added to or lost from agricultural production over the next 30 years? Area expansion contributed significantly to output increases in last 30 years. Modelers continue to assume some increases but less than in the previous period. Ecologists and Les Brown argue that land lost to urban and industrial use, plus degradation of existing land, means less available land than in the past. They argue that any new land brought into production would be ecologically fragile and environmentally sensitive.
- (3) How much land can be subjected to increased intensification through irrigation and/or changed cropping patterns? This had a big impact in last 30 years as irrigated acreage in developing countries doubled. Cropping intensity increased as shorter duration varieties were bred to allow 2 instead of 1 crop per year, or 3 instead of 2 crops per year. This, combined with irrigation, had a significant impact. The economic modelers project continuance of this trend though at lower

- levels. Ecologists argue that there will be no more new irrigation, increased competition for water and significant land degradation.
- (4) And what will be the impact of environmental degradation on food production capacity? Economic modelers tend to ignore this issue. Ecologists see it as a big issue—land loss, through erosion, and water pollution, will be constraints. Water quality will decline. Range lands are over grazed and fisheries are depleted. In their mind this will be a major constraint to future production growth.

In my judgment the optimists are too optimistic and the pessimists are too pessimistic. Reality suggests that feeding 2 to 2.5 billion more people will be an enormous challenge. Growth in agricultural output in the long term must come primarily from rising biological yields, rather than from area expansion or intensification through irrigation. Why? Because most fertile land is under cultivation and the really suitable and low cost areas for irrigation have already been exploited. With population growth and urban expansion, there will be rising competition for land and water from urban and industrial uses. Therefore, doubling yields in complex farming systems without damaging the environment is an enormous challenge.

Because of the projections of population and income growth, the composition of consumption will clearly change. IFPRI projections, for example, forecast a 180% increase in meat demand in developing countries. Where will the feed come from? Will China for example expand feed grain production to produce their meat or will they import meat directly? New demands for fruits and vegetables will also shift cropping patterns. Overall, there could be significant shifts in the location of global production.

The challenge ahead is worldwide and is both technological and political/economic in nature. We require new technology that allows the development of new high productivity and environmentally sustainable production systems. It cannot be more of the same, with purchased input intensive monoculture. And the political/economic challenge can only be met if international and domestic policies, institutional frameworks, and public expenditure patterns are conducive to sustainable agricultural development.

2.4 THE ACCESS CHALLENGE

Supply is only part of the food security challenge. The third challenge of food security is about access to food. Here the issue is clearly the reduction and elimination of poverty. In the developing world, in which the World Bank operates, that remains a predominantly rural challenge (World Bank, 1997). Seventy percent of the poor people in

the developing world still live in rural areas. For this challenge to be met, it will require improving the productivity and profitability of millions upon millions of small farmers.

To do this, farmers will need new, appropriate technology. The role of biotechnology should be critical if it can be applied to the crops of complex farming systems in the tropics and subtropics. As we break away from heavy focus on basic food crops—rice, wheat, maize—to more diversified production system involving all crops, animals and trees, research needs are likely to be very large.

Profitability will come from increased market orientation as farmers produce food and fiber for domestic and international markets. Here the critical issues are appropriate policies and incentives.

If we can meet the challenge of improving the well being of farmers, we will also have the additional benefit of encouraging farmers to be more effective stewards of the world's natural resources. Virtually all of the arable land in the world is managed by farmers and most of the fresh water in the world is used by farmers. Therefore the issue of improving the welfare of rural communities, by improving the profitability of agriculture, is a triple win situation. It contributes to poverty reduction, it contributes to food security, and it contributes to improved natural resource management. Surely these are daunting challenges that we must take seriously, as we move into the 21st century.

Can these challenges be met? On the production side, I believe we can do it, but there are four *big ifs*:

- (1) *If we can develop sustainable production systems capable of doubling output; this requires attacks on all fronts, ecology, soils, agronomy, breeding, farm management, pest management, etc. all in a systematic way which increases the productivity of complex farming systems. We cannot focus only on the yields of single commodities. It is an unprecedented challenge for agriculture and biological science. The challenge is particularly strong in tropical and subtropical areas.*
- (2) *If we have in place domestic and international policies and institutions that do not discriminate against agriculture and provide appropriate incentives to hundreds of millions of farmers around the world; we must do away with policies that tax agriculture e.g. over valued exchange rates, industrial protection, and low priced food requisitions, as well as policies which distort farmers incentives (Schiff and Valdes).*

- (3) *If we continue to invest in public agricultural research such as through the CGIAR; and build stronger partnerships with the private sector to tap the enormous potential of modern molecular biology for the small and poor farmers around the world.*
- (4) *If we stay the course with removing distortions to freer agricultural trade. The Marrakech Agreement of 1994 put agriculture under rules of GATT/WTO for first time. It requires: (a) tariffication of all non-tariff barriers (NTBs); (b) reductions in domestic support; (c) reduced import barriers; and (d) lower export subsidies. This will make a leveler playing field for developing countries. This is critical because as countries move away from self sufficiency, they must be able to use world markets. They must be assured of access and should expect reasonably stable markets. Therefore the agricultural negotiations scheduled for 1999-2000 should focus on reducing levels of protection in OECD countries thereby providing improved access for developing countries.*

These will all help in making food supply available. On the access side, clearly the challenge is to improve education and rural well-being and focus on income generation policies of poor people, most of whom are still rural. This will require particular attention to education, particularly of women, to health, to infrastructure and to increasing the productivity of the agricultural sector.

The challenges are enormous, but I believe they can be met. If they are not met, the prospects for long term food security could become quite gloomy.

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