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Prospects for food security in the 21st Century:[1] with special emphasis on Africa

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Abstract

Food security for the world in 2025 is possible and probable if the right set of things are done, starting now. But the task will not be easy. It is both a technology and a political/economic challenge. The challenge for sub-Saharan Africa is even greater. While other regions improved per capita food availability over the last 30 years, Africa's availability declined. But food security is about more than supply. It is also about access which means income generating employment is critical. Meeting future requirements in Africa and the world will require sustainable intensification of complex production systems, appropriate national and international policies and continued investments in agricultural research. Without these conditions and increased employment intensive growth, prospects for the future are less bright.

Keywords: Food security; Availability; Access; Nutritional security; Sustainable intensification; Sub-Saharan Africa; Prospects for 2025; Food and agricultural policy

1. Introduction

The purpose of this paper is to provide retrospective and prospective views on the challenges of food security in sub-Saharan Africa. It is often argued that sub-Saharan Africa is sufficiently different that it should be treated separately. But is it? In this paper Africa is reviewed in a global context. The paper is in three parts. The first addresses the issue of 'what is food security?' The second part reviews past Global, and African performance, and then discusses future projections. The third section identifies crucial issues that have caused problems in the past and comments briefly on the prospects for improvement in the future.

The paper begins with the basic proposition that food security for the world in 2025 is possible and probable, if the right set of things are done starting now. But the task will not be easy and represents an enormous challenge to the global community and particularly to the agricultural community. The challenge for sub-Saharan Africa is even greater. It has to reverse past negative trends and move forward at a very rapid rate. The critical issue for sub-Saharan Africa is rapid economic and social development on all fronts to generate income growth for poor people,

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so that they can have access to food and other necessary goods. Given the overwhelming agrarian character of most African countries, this requires sustained, broad-based, employment-intensive, rural growth with agriculture as the crucial engine of that growth. Dwelling on past performance is a sobering and necessary exercise, but we must also look forward. When we do so there are optimistic signs emerging in Africa.

2. What is food security?

What is meant by food security? In this paper, food security means that every individual has access to enough food to maintain a healthy and active life. Ensuring food security for all is a challenge with many dimensions. There are three critical dimensions of food security – (1) the level of aggregation, (2) the timeframe, and (3) the necessary and sufficient conditions – (*availability* of necessary supplies; *access* in terms of income and/or feeding programs, to food; and nutritionally appropriate *utilization* of food). These are displayed in Fig. 1 as a 3 × 3 × 3 matrix. First, we must recognize that ultimately the food security problem must be solved at the household level. It is at that level that people eat or do not eat. Nations have the responsibility of providing food security for their people. This does not mean that nations must produce their own food supply (i.e. be food self-sufficient), but they must have policies in place that make food available, accessible and nutritionally whole. There is a third level of food security at the international or global level. The global community can contribute to food security at the household and national levels, but household food insecurity cannot be solved by international action.

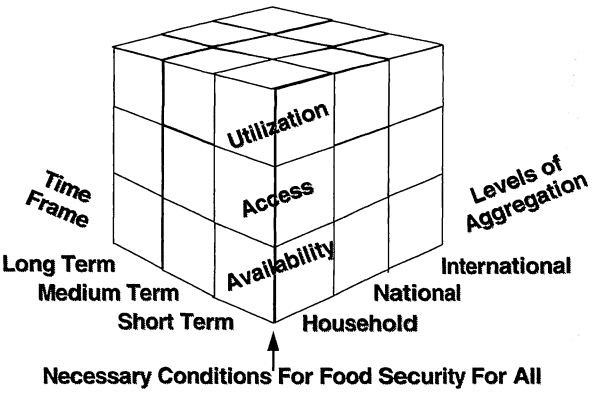

Fig. 1. Dimensions of food security.

The second dimension of the 3 × 3 × 3 model is the time frame – short, medium and long. These first two dimensions are presented in more detail in Table 1. If we are talking about the short term, the focus of food security must be at the household level. It has to address the issue of how do households get access to food, either through improved income generation, safety net programs, or nutritional feeding programs. If one is going to address the 840 million undernourished people in the world today, it must begin at the household level. Nations can help with safety nets and national feeding programs. The role of the global community is limited to the availability of stocks and food aid to deal with famine situations.

Moving out of the axis to the medium term, the primary focus of food security must be at the national level. The nation must develop sets of policies, institutions, and investments, which allow broad-based

Table 1
The dimensions of food security: Critical variables

	Short-term (1–3 years)	Medium-term (5–15 years)	Long-term (25–30 years)
Household	Access to food Nutrition and health	Access to Income or Means to produce food	Poverty eliminated Social infrastructure
National	Safety nets Nutrition and health	Economic development Sustainable production systems Agriculture research	Rural and economic development Sustainable production systems Agriculture research
Global	Grain stocks food aid	International research Fair trading system Sustainable global supplies	International research Fair trading system Sustainable global supplies

income growth and also foster sustainable production systems which allow the development of rural areas. The international community can help in the medium term by providing a fair and freely working trading system and by providing international research, such as through the Consultative Group on International Agricultural Research (CGIAR). In the long term, moving towards the bottom right hand corner of the matrix, the issue of food security is important at all three levels (household, national and global). But now, the global community has a critically important role to play in terms of having a fairly working international trade system, available international technology, and sufficient stocks on a global basis. But let us be clear. Food security at the household level is not assured by sufficient food supplies at the national level nor by sufficient global production and stocks to provide necessary diets on the average.

The third dimension of food security asks three necessary questions: (1) is the food available? (2) do people have access to that food? and, (3) even if people have access to the food, do they utilize it correctly and eat the diets necessary to be nutritionally secure? Most discussions of food security focus primarily on the first of these three, availability. In the following sections we assess these three dimensions retrospectively and prospectively.

3. Historical performance – 1960–1990

3.1. Availability

If one pays attention to availability only, it can be argued that over the last 30 years the world has performed well in terms of food security. Table 2 presents a retrospective on performance from 1960 to the present. In the period 1960–1990, cereal production doubled, per capita food availability increased 37%, per capita calories available per day increased 35%, and real food prices declined 50%. But even with these good indicators of overall global performance, there were substantial regional differences. In the same period, for example, per capita food availability in sub-Saharan Africa decreased, as a result of a combination of high population growth rates and slow and sometimes negative growth rates in agricultural production.

Regionally, average calories available per day increased significantly in the Near-East and North Africa, East Asia and Latin America to levels of 2700 calories per day or higher. South Asia grew more slowly and is still a region with significant under-nutrition. But the stark fact in the summary is that sub-Saharan Africa experienced a *decline* in per capita calorie availability.

Table 2
Elements of food security – Retrospective

Time frame	Availability	Access	Utilization
Retrospective (1961–1990)	*Global*	*1969–1971* 920 million people were under-nourished. This was 35% of developing countries' population	
	World cereal production doubled Per capital food production increased 37% Calories supplies increased 35% Real food prices fell by 50% *Regional difficulties* Sub-Sahara Africa – per capita food supplies declined South Asia – slow growth		Close to 1 billion suffered from deficiencies in one or more micronutrients
Recent past	*1994–1996* > 70% increase in grain prices	*1990–1992* 840 million under-nourished, 20% of developing countries' population	1.6 billion at risk of iodine deficiency
	1995 – harvested area down 10% almost all of it in the 5 major exporters and the FSU stocks fell by 50 % Stocks-to-use ratio fell to 13.2%, lowest in history		About 2 billion people affected by iron deficiency (FAO, 1996)

3.2. Access

Despite an overall improvement in the global availability of food, under-nutrition has remained a serious problem. In 1969–1971, 920 million people were under-nourished, 35% of the developing countries' population. By 1990–1992, the FAO estimate was 840 million under-nourished people, now 20% of developing countries' population. In relative terms there was progress though regional performance varied widely. In 1969–1971, 76% of the under-nourished lived in Asia (51% in East Asia) and 11% in sub-Saharan Africa. In 1990–1992, 60% lived in Asia (30% in East Asia) and 25% lived in sub-Saharan Africa. But in absolute terms the number of under-nourished people diminished very little.

3.3. Utilization – Nutritional security

Though firm data on *utilization* are 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 and copper) in the 1960s. In the early 1990s, 1.6 billion people were estimated to be at risk of iodine deficiency and about 2 billion people were affected by iron deficiency (FAO, 1996, Paper 5, pp. 6–7). Even these incomplete data suggest worsening nutritional security which in turn, as we know, leads to poor performance in many aspects of life.

In sum, over the 1961–1990 period, there was improved performance on the supply side (availability), relative but not absolute improvements in reducing food security (access), but an apparent increase in the incidence of micronutrient deficiencies (utilization). Therefore, argue many, supply was not a constraint. It was, and is, poverty, the lack of employment opportunity and education about diets.

4. The recent past to the present (1994–1997)

World grain prices experienced 'a spike' in 1994–1996 with wheat, corn and rice prices increasing 70–100% by April 1996. Since then prices of wheat and corn have returned to pre-1994 levels. As prices escalated, and the stock-to-use ratio plummeted to a historical low (13.2%), concerns broke out about whether this was the beginning of the period when demand finally *outruns* supply or simply a short-term perturbation. Those arguing the case for a prolonged period of shortages and rising prices cited declining growth rates on yields in the 1990s, losses of land from production and water and environmental constraints as powerful indicators for a difficult future. Others argued it was the market overacting to a bad 1995 U.S. crop and *policy* changes in the *European Union (EU) and the USA* which lowered farmers' prices and reduced stocks. They argued that production would expand in 1996 and prices would fall back and continue the long-term trend of *declining* real grain prices.

A more careful analysis of the events of those 2 years suggest a more complex set of causes (Ingco et al., 1996). The 1991 European Union (EU) Common Agricultural Policy (CAP) reform, followed by U.S. policy changes in 1995 and continuing adjustments to lower prices in Australia and Canada caused harvested grain areas to decline and stocks to decrease significantly. Between 1981 and 1995 harvested area in the five largest exporters – USA, EU, Canada, Australia and Argentina contracted by 34.5 million ha, accounting for 53% of the global decline in grain area harvested of 65.3 million ha. Another 41% of the decline is accounted for by reduced grain area in the Former Soviet Union (FSU). This contraction represented an almost 10% reduction in global harvested area. The resulting decline in output, coupled with policy changes which reduced public stock holding, contracted exporter stocks from 262 million metric tons to 58 million tons (88% of the decline in world stocks) and global stocks by 233 million tons, a more than 50% reduction. These trends coupled with lower 1995 production triggered a sharp run up in prices between May 1995 and April 1996. In 1996, a 15% increase of grain production in these five exporting countries, and a 7.5% increase globally, caused wheat and corn prices to drop sharply to pre-1994 levels by early 1997. Global grain supplies in 1997 reached record levels for wheat and rice and nearly record levels for coarse grains. "World grain production in 1997/1998 (July–June) is expected to rise 0.4% over the previous year and 8.95 over the preceding year" (World Bank, 1998, p. 17). Prices in nominal terms have continued to soften.

5. The future

5.1. The demand side

It is clear that food security is much more complicated than projecting adequate global supplies for the next 30 years. Understanding the challenge begins on the demand side. Most global projections suggest a world population of around 8 billion people in 2025, an increase of about 2.5 billion people from the 1990s. Population is one of the two drivers of aggregate food demand, income is the other. With modest income growth, food needs in developing countries could almost double in the next 30 years. The composition of aggregate demand also changes with rising income levels and with where people live. Most of the growth in population over the next 30 years will occur in developing countries.

Further in this same period, urban population in developing countries will increase by a number equivalent to total global population growth (2.5 billion). With rising incomes and urbanization, the composition and characteristics of food demand will be significantly altered. More of the food supply will have to be processed, transported and stored. In parallel, the share of the developing country dwellers who can depend on subsistence agricultural production will decline sharply. The implications of these trends are that a much larger share of food production will enter markets both within and between countries.

A further implication is that nutritional education and intervention programs will become more critical to nutritional security as the pace of urbanization increases. Further effectively functioning markets and quality and safety standards for processed and transported food become critical. The full consequences of 2.5 billion more city dwellers for the national food and nutrition systems is not fully understood. It is surely a challenge of enormous proportions.

5.2. The supply side

These developments on the demand side clearly raise challenges for the global food production system. The fundamental questions are: can the world produce enough food to feed 8 billion and at the same time hopefully reduce the number of under-nourished 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? And finally, does the world have a trading system that will allow increasing quantities of food to flow from surplus to deficit areas?

Views on the challenge of food security diverge more strongly as the time frame is lengthened. Those using economic projection or simulation models, based significantly on history, tend to project sufficient global supplies at least until 2010. Those projecting on the basis of resource availability and environmental constraints (perhaps these should be called ecological models) are generally much more pessimistic. The most extreme view combines resource constraints with biological pessimism and foresee serious problems ahead (Brown and Kane, 1994). Furthermore, there is often not even agreement on basic data such as the area of production, as the long running debate on China's area of grain production illustrates.

Picking one's way through this mine field is fraught with difficulty and occasional danger. The very nature of projections using compounding growth rates of population and income compared to yield growth rates, means that food gaps grow rapidly if the growth rate of demand exceeds supply. In the opposite case, if supply growth rates augmented by land expansion exceed demand growth rates, real food prices decline (the scenario of most of the last 100 years). The next section looks first at the medium term (10–15 years ahead) before turning to the more problematical longer term (20–25 years). Much of the analysis that follows draws from a recent World Bank publication (Ingco et al., 1996). An overview is presented in Table 3 which is a summary of the discussion that follows.

5.3. Medium term (2010–2015)

5.3.1. Availability

Several recent simulation studies have projected global cereal or food balances. Three studies done at IFPRI, FAO and the World Bank make projections to 2010 and come to similar conclusions (Mitchell and Ingco, 1993; Agcaoili and Rosegrant, 1995; Alexandratos, 1995). All three studies project grain yields to

Table 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 under-nourished by 2015	
	Difference between optimists and pessimists focus on yield potential, land expansion/loss and water availability	FAO projects 680 million in 2010	Forecast difficult will be conditioned by success in poverty reduction and improved nutrition delivery systems
Longer term 2020–2025	Food needs in developing countries could nearly double	Goal: to eliminate under-nutrition	
	Challenge is serious and will be impossible without appropriate polices and continued expanded investment in research for the development of new technology	This would increase projected food demand by 10%	

increase 1.5–1.7% per year, consistent with recent history, area harvested is projected to increase modestly, global grain demand grows more slowly and trade in grains increases. 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 (199), p.) 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.

A contrary view is represented by Brown and Kane (1994) who argue that there is little backlog of unused agricultural technology, that fish production has reached biological limits and that rangeland carrying capacity has been exceeded. They further argue that the demand for water is pressing hydrological limits, fertilizer responsiveness is declining and 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.

These striking differences are discussed later in the paper after a brief review of longer term scenarios.

5.3.2. Access

Access to food in the future very much depends on success in reducing poverty, especially in rural areas, and in a stimulating widely shared employment-intensive growth. The 1996 World Food Summit set as a target of reducing the number of under-nourished to 400 million by 2015. FAO projects, based primarily on a continuation of past trends, that the number of under-nourished would be 680 million in 2010.

5.3.3. Utilization – Nutritional security

Success in reducing nutrition deficiencies of all sorts in the future depends both on improvement in overall nutrition status (access) but also on expanded nutrition education programs and improved nutrition delivery systems. *What can be said with assurance is that overall economic growth will not eliminate nutrition issues.* Even if income growth improves caloric access for most poor people, reducing micro-nutrient deficiencies will require expanded efforts because evidence to date suggests that the aggregate numbers of people affected continues to grow.

5.4. The longer term (2020–2025)

IFPRI (1995) also makes projections to 2020 which show a relatively good global food supply and demand

balance in 2020. Real grain prices continue to fall (20% between 1990–2020) and real meat prices fall by 10%. Trade expands substantially, with imports by developing countries doubling. Food problems persist in sub-Saharan Africa where imports are projected to triple, in all likelihood beyond the region's capacity to pay for them.

IFPRI also reports an alternative scenario where there is lower investment in agricultural research combined with slower income growth. This decline in public investment in agricultural research has severe consequences for the global food situation, causing real prices to rise and malnutrition to increase. The IFPRI scenario highlights how sensitive long-term projection models are to small changes in particular parameters, in this case research investment.

5.5. *Who is correct?*

How then can the economic modellers and the ecological pessimists reach such different conclusions? The reason is found in but four critical projection parameters (assuming they generally agree on the demand side) (McCalla, 1994). These are:

1. the rate of increase in biological yields over the next 30 years
2. the amount of land added or lost from agricultural production
3. land subject to intensification through irrigation and/or changed cropping patterns
4. the impact of environmental degradation on food production capacity

Being relatively optimistic by projecting even a modest decline in past growth rates on the first three, produces an optimistic scenario, given declining population growth rates. Alternatively, projecting the observed decline in yield increases during the 1990s (less than 1%) to 2025 plus land loss, no new irrigation, and severe resource constraints, can lead one to be very pessimistic.

But there are several things both sides agree on – the need for: (1) continued investment in technology-generating agricultural research; this will require reversing the downward trend in public research investment in most developed countries and in international research; (2) an appropriate policy environment; (3) farming systems that do not degrade the environment; and (4) increased efficiency of resource use.

In my judgment the optimists are too optimistic and the pessimists are too pessimistic. Reality suggests that feeding 2.5 billion more people well is an enormous challenge. Growth in agricultural output in the longer 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.

Doubling yields in complex and intensive farming systems without damaging the environment is a significant challenge. The challenge is worldwide and both technological and political in nature. We require new technologies to allow the development of high productivity and environmentally sustainable production systems. It cannot be more of the same with purchased input-intensive monoculture. "The challenge can only be met if international and domestic policies, institutional frameworks, and public expenditure patterns are conducive to cost-effective and sustainable agricultural development." (World Bank, 1996, p. 10)

6. The special challenge of sub-Saharan Africa

But these same global models project a continuation of current trends in sub-Saharan Africa, suggesting that the region will have an increasingly large food deficit. Thus, the challenge for Africa seems even greater. Are there special issues about Africa, and what are the prospects for Africa? In some sense looking at sub-Saharan Africa presents us with a conundrum. Relative to Asia, Africa seems well endowed with natural resources. It has a much higher land-to-person ratio than either of South and Southeast Asia. However, it has significantly less land area irrigated, that is, less than 6% compared to more than 40% in Asia. Yields are low and growing relatively slowly and fertilizer use is very low. Yet enormous quantities of aid and technical assistance have gone into the sub-Saharan region. Given abundant land and

substantial technical and aid assistance, why has Africa's performance been less good than the rest of the world?

Several comments seem relevant in addressing this question. First, sub-Saharan Africa is not a homogeneous area of similar resource endowments. Rather, it is an incredibly complex and heterogeneous continent with great variations in natural resource endowments, temperature, rainfall, soil quality, and crop and plant canopy. Secondly, by far the most complex farming systems in the world exist in Africa. Many African countries have fragile and deficient soils which when combined with erratic rainfall and little irrigation lead to substantial production variability. Third, African countries, like many others, maintained a policy environment in the pre-1990s that was extremely negative to agricultural development. These policies were characterized by macroeconomic strategies that taxed the agriculture and rural sector through overvalued exchange rates and high levels of protection for industrial goods and inputs. Many also maintained regimes of export taxes, either implicitly through parastatals or directly, which lowered producer prices. In addition, several countries directly requisitioned food at below-market prices. Overall, there was a substantial urban bias in the way in which development was approached in Africa (Lipton, 1982; Schiff and Valdes, 1992).

There was also likely greater government intervention in African agriculture than in other regions of the world. Knowledge gained from experience over the last 30 years is that high levels of government intervention in productive activities is generally less effective than when the private sector undertakes the same activities. Further, despite high levels of foreign assistance there have been less effective investments in Africa in human resource development and education and health.

A recent study by Kevin Cleaver (Cleaver, 1997) at the World Bank on rural development strategies for poverty reduction and environmental protection in sub-Saharan Africa suggests that for the 1990s there are some signs of improvement. Reviewing policies in 32 African countries, the basic conclusion of his analysis is that bad policies greatly influence the performance of the agriculture sector. The analysis looked at five sets of policies: (1) agriculture sector; (2) general economy; (3) fertilizer; (4) extension; and (5) infrastructure. The study rated countries based on how many of those policies were headed at least in the right direction. Countries that had three or more of these policies 'right' experienced far better growth during the period 1988–1995 than did the rest. Included on this list are countries such as Benin, Burkina Faso, Guinea, Tanzania and Uganda which experienced growth rates in 1992–1995 ranging from 3.7 to 5.5%. But even in the best 15 performers, the average rate of growth was still only 3.2%. Given continuing high population growth rates, if you really want to move Africa you will have to have agricultural growth rates of 4% or more. The message is clear: policy matters. But policy reform is only a necessary condition. The long term-crucial one remains technology development and productivity improvement.

There have to be substantial improvements in institutions in several African countries but there still remain major issues in terms of technology generation and dispersion. In the 1990s, more and more governments seemed to understand that agriculture development is absolutely essential to poverty reduction in sub-Saharan Africa. However, translating this rhetoric into sustained government commitment has come more slowly.

There are, however, encouraging signs. A growing number of African countries have undertaken policy reforms and institutional changes that move in a direction of encouraging the millions of small farmers in sub-Saharan Africa to be productive and profitable in their activities (e.g. Uganda, Tanzania and Guinea). There is some evidence of redirection of public expenditure for the rural sector. There is growing recognition that participation of rural people in a decentralized policy process leads to more sustainable development. Africa, at last, seems to be questioning the predominant import substitution, industrialization development paradigm of the 1960s, 1970s, and 1980s which clearly discriminated against the rural sector. Therefore, progress is being made but a long and difficult road remains ahead.

7. Conclusions

For the world and Africa, the food security challenge ahead is substantial but not impossible. Future global, national and household food security in the

long run can be accomplished: (1) if we can develop sustainable production systems capable of nearly doubling output; (2) if we have in place domestic and international policies and institutions which do not discriminate against agriculture and provide appropriate incentives to hundreds of millions of farmers around the world; (3) if we continue to invest in public agricultural research such as through the Consultative Group on International Agricultural Research (CGIAR); and (4) if we stay the course with removing distortions to freer agricultural trade in all countries. These are four big 'ifs' but they must be met. For without them the long-term prospects are not very pleasant to contemplate.

Based on past performance, one has to be cautious about African chances. The continent has experienced negative per capita food supply growth for most of the past three decades. It still has the highest population growth rates in the world which could lead to an almost tripling of population by 2025. And many countries remain destabilized by civil strife and authoritarian regimes. But Africa has significant natural resources which give the continent substantial potential. An improving policy environment and refocused priorities on rural development in a growing number of countries offer hope of developing this potential. But ultimately food security in Africa will be accomplished only when poverty is eliminated. For Africa more than other continents, this means reducing rural poverty is absolutely critical. This will require the right policies and institutions; appropriate investments in health, education and infrastructure; and appropriate technology and efficient functioning markets for inputs and outputs. This is a tall order for Africa.

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