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Ending Hunger: 1999 and Beyond

Robert W. Kates[1]

According to the most-detailed computer simulation of the long-term future of food availability, a projection of current demographic, economic, and agricultural trends will find as many or more hungry people in the year 2060 as there are today (Fisher and others, 1994) For those of us who would halve hunger in this decade and end hunger in the decades to come, this is a sobering conclusion. But it should not and need not happen. It is possible to visualize a world without famine, with little seasonal or chronic undernutrition, and with virtually no micronutrient deficiencies and nutrient-depleting illness. But to end hunger will require a broad acceptance of food as a basic human right, an increased food availability far in excess of increased population, an extensive growth in household income, a pervasive safety net of emergency assistance, entitlements, and special needs programs, and a capability to cope with the surprises of the future. And all of this will need to happen in a warmer, more crowded, more connected but diverse world with its economy, environment and institutions under considerable strain.

THE HUNGER AGENDA FOR THE 90S

The onset of a new century or millennium such as will be marked by the year 2,000 has always been a time of hope and fear, with apocalyptic fears dominating for much of human history until the idea of progress began to take hold in the 18th century. Over the next five years, we will be bombarded with taking stock of the past, future visions and warnings, and agenda of tasks to be accomplished. As we assess the effort to date and contemplate the hunger agenda beyond the turn of the century, it may be helpful to recall the context of the effort to overcome hunger by half.

By one estimate, the proportion of the world population that was hungry was cut in half between 1950 and 1980, although the numbers that were hungry stayed about the same as population increased during that 30 year period (Grigg, 1985). But this progress against hunger slowed during what many have called the lost 80s. The conventional wisdom attributed this lack of progress to the worldwide slowdown of economic growth and development and to the failure of growth, where it had occurred, to benefit the poorest segments of society. The enormous increase in third world debt brought about a reversal of resource flows—a net flow of money from the south to the north. The euphemistically called structural adjustment of economies in

[1] In preparing this paper, I draw heavily on both the ideas and language from a recent paper jointly-authored with Bob Chen (Chen and Kates, 1994).

Africa and Latin America has almost invariably been accompanied by reductions in health, nutrition, and welfare programs. In Africa, this was exacerbated by agricultural decline, population growth, armed conflict, and environmental degradation. And in my own country the decade of the 1980s has been characterized as the "me" decade, the self seeking obverse of the "lost '80s" in hunger reduction and poverty elimination.

But as the decade closed, groups and agencies concerned with hunger came together to propose a renewal in the long struggle against hunger. In retrospect, 1989 can mark not only the end of the cold war but also the beginning of a great renewal in overcoming hunger. If words can do it justice, it was surely an auspicious year. In 1989, good words came from the intergovernmental World Food Council, The Interagency Task Force on Child Survival, and in September 1990 from the World Summit for Children. And they came from the 23 planners, practitioners, opinion leaders, and scientists meeting at the Rockefeller Foundation Center in Bellagio, Italy who produced the major nongovernmental initiative: *The. Bellagio Declaration: Overcoming Hunger in the 1990s* .

The message of the Bellagio Declaration was a simple one. It was possible to end half the world's hunger before the year 2000. through four achievable goals: (1) to eliminate deaths from famine; (2) to end hunger in half of the poorest households; (3) to cut malnutrition in half for mothers and small children; and (4) to eradicate iodine and vitamin A deficiencies. Together, these comprised a comprehensive yet practical program to end half of world hunger in the 1990s by building on the better and best of programs and policies for overcoming hunger. The most promising programs, the Declaration found, were those that empowered people to assess their own condition and to act in their own behalf, that provided short-term hunger relief while addressing deeply rooted causes, and that could be sustained over the long term.

In the 60 months since its production, the Declaration has been broadly disseminated, even emulated; the individual goals have been widely adopted, and major efforts at implementation are underway. That the task of halving hunger was enormous is shown by the numbers in Table 1. (UVIN WIL REVISE). And renewed conflict, slowed economies, and population growth have increased some of the numbers at risk of hunger and make the halving of hunger more difficult to achieve. But the need to end hunger is, as Ismail Serageldin has said, the modern equivalent of abolishing slavery. A vision of ending hunger needs to be formulated if it is ever to end. To begin, consider some of what we know of the world beyond the 1990s.

Table 1. Recent Estimates of Hunger (Chen & Kates, 1994:195)

Dimension of Hunger/Food Security	Population Affected		Year	Source
	(millions)	(percent)		
Famine (population at risk)	15-35	0.3-0.7	1992	WHP
Undernutrition (chronic and seasonal)				
FAO food poverty (1.2 BMR)	477	9	1990	WHP
Updated FAO food poverty (1.54 BMR)	786	20	1988-90	FAO
Child malnutrition (weight below -2 s.d.)	184	34	1990	ACC/SCN
Micronutrient deficiencies				
Iron deficiency (women 15-49)	370	42	1980s	ACC/SCN
Iodine deficiency	211	5.6	1980s	ACC/SCN
Vitamin A deficiency (children <5)	14	2.8	1980s	ACC/SCN
Nutrient-depleting illness				
Diarrhea, measles, malaria (deaths of children <5)	6.5	0.8	~1990	UNICEF
Parasites (infected population)[a]				
Giant roundworm	785-1,300	15-25	1980s	World Bank
Hookworm	700-900	13-17	1980s	World Bank
Whipworm	500-750	10-14	1980s	World Bank

[a] Includes those people expected to have multiple infections.

Sources: WHP (World Hunger Program): Millman and others, 1991. FAO (Food and Agriculture Organization of the United Nations): FAO Statistical Analysis Service, 1992. ACC/SCN (Advisory Committee on Coordination—Subcommittee on Nutrition): ACC/SCN, 1992. UNICEF (United Nations Children's Fund): Grant, 1991. World Bank: Warren and others, 1993.

BEYOND 1999: A WARMER, CROWDED, CONNECTED, DIVERSE WORLD

A child born today has an average life expectancy of 65 years, in the course of which he or she will experience a warmer and more crowded, more connected but more diverse world.

Environmental change, population growth, and increasing connectedness and diversity are powerful trends as deep-running as the great ocean currents. Trends that will impact the task of ending hunger in different ways..

The world is already deeply committed to a warmer world unless there is some basic failure in present-day scientific understanding. In the lifetime of a child born today, there may well be a doubling of atmospheric carbon dioxide concentrations and other increases in trace gases that will lead to an average temperature rise of 1.5-4.5°C with much spatial and temporal variation from this mean. (Houghton and others, 1992) The resulting changes in precipitation, cloudiness, humidity, sea level, weather extremes, and other aspects of the environment will only add to the other human-induced changes in local and regional environments including the large scale introduction of pollutants : acid rain in the atmosphere, heavy metals accumulating in the soils, chemicals in the ground water and the massive assault on the biota, specifically deforestation in the tropical and mountain lands, desertification in the dry lands, and species extinction, particularly in the tropics.

There is much that we do not know about such a warmer, environmentally stressed world. What we do know suggests that the impacts might be very different in different parts of the world and even for any given place there may be offsetting phenomena. The CO_2 that will warm the climate may also make grow more and bigger plants.. The sulfates that create acid rain may also reflect the sun's heat and thus offset the warming trends. Indeed, several major studies of the effects of climate change on world agriculture finds that on balance the changes are small for a doubling of Carbon Dioxide (Fischer and others, 1994; Reilly, Hohmann, and Kane, 1994). But those same studies find important differences in impacts on developed vs. developing countries. The poor will grow poorer in a warmer world, while the rich may actually be richer or at least no worse off.

Also within the lifetime of the child are many more children. For almost two decades now the United Nations, the World Bank, and individual demographers that make 50-150 year forward population forecasts have projected a world population of between 8-12 billion that stabilizes sometime within the next century compared to today's 5.6 billion (United Nations, 1992). Such agreement needs to be taken with many proverbial grains of salt since all the forecasters seem to use similar methods and assumptions and upward creep is more likely than downward error. In recent years, expectations of future population growth have steadily increased as present trends toward lower fertility rates have slowed. In that more crowded world, the proportion of population living in what is now considered the developing world will have grown from 77% in 1990 to more than 85%. More than half of the world's population will be living in urban areas, and the populations of the largest cities will likely grow into the tens of millions. These trends will weigh most heavily on the children yet to be born. For in an

extraordinarily short period enormous numbers of clinic, creches, schools, and jobs will need to be produced.

The children of the future will also be much more closely connected by ties of communication, economic production and consumption, interlinked technologies, and migration. By the end of this decade, at least three major common-market, free-trade blocs are likely to emerge, each with associated blocs in the south. Such flows of goods, capital, and technology will most certainly be accompanied by flows of people. New information technologies and mass communication techniques will continue to penetrate many different geographic, temporal, linguistic, cultural, and political barriers. However, such connectedness will not necessarily make us all alike but may well increase the diversity of people and as well as the availability of things. Places of wealth or opportunity towards which people and products are drawn, actually become more diverse. In response, there are also strong counter currents that emphasize ethnic, national, and religious distinctiveness.

Superimposed on these great underlying currents, will be many other changes, some in the form of alternating tides of cyclical phenomena or fashion. These might range from short term recessions of the business cycle, multiple year fluctuations of climate, to decades-long swings. towards the left or the right of the political spectrum or the growth and decline of the economy by the introduction of clusters of new technologies. These in turn will be punctuated by the many surprises, the undertows, riptides, and storm surges that batter our conventional expectations. Indeed, since our initial meeting in Bellagio, some surprise has been the order of the day (Hyden, ref. this volume)

A TALE OF TWO SCENARIOS

The implications of these long-term currents can be examined through scenarios and models. Consider the contrasting implications of two sets of scenarios generated by the International Institute of Applied Systems Analysis in Laxenburg Austria..

The 2-4-6-8 Scenario

In 1989, an Institute study (Anderberg, 1989) explored the implications of a doubling of population under the assumption that the doubled world population (at that time 10 billion people) should have modest access to varied and nutritious diets, industrial products, and regular jobs. The study found that in this somewhat more humane and equitable world, a doubling of population would require a quadrupling of agriculture, a sextupling of energy, and an octupling of the economy, given the then current trends in economy and technology.

Since then, many have found this 2-4-6-8 scenario unbelievable and certainly unsustainable because of the extraordinary increases in production and consumption required by

"just" the doubling of population. Can the world economy grow rapidly enough, can the required technology be clever enough, and can the social institutions be both stable and innovative enough to provide what would be needed by a doubling of population? And if successful, could such increases be sustained in a human environment that already has seen substantial transformation of its atmosphere, soils, groundwater and biota?. Indeed, for some, a world of over 5 billion people is already overpopulated because they find that virtually every nation is depleting its resources or degrading its environment (Ehrlich & Ehrlich, 1990; , Meadows, Meadows, and Randers, 1992)

The 2-2.25-X-4.4 Scenario

A more likely scenario is the one employed recently to study issues of climate change and food security. It brings together the work of economists, agriculturists, geographers and others concerned with the supply and demand for food with the work of those involved in assessing climate change and its implications for agricultural systems (Fischer and others, 1994). It utilizes a set of 35 different country and country-group agricultural policy models designed to simulate the national or regional agricultural sectors linked together through trade, world market prices, and financial flows.

These linked models were used to generate a "reference" scenario for the year 2060 by integrating in the model annual changes in expected population growth, labor force participation, and technological change. Overall, this scenario projects that Gross Domestic Production (GDP) will increase by a factor of 4.4 over 1980 levels by 2060. Total cereal production will increase by a factor of 2.25 over this period, barely keeping up with population growth and assuming no change in income distribution, the number of undernourished (computed according to the older FAO methodology) will rise from 501 million in 1980 to 641 million in 2060. .

These models were also used to test global sensitivity to a changing climate. by linking models of global climate under conditions of doubled atmospheric concentrations of carbon dioxide (CO_2) with crop models for wheat, maize, rice, and soybeans and for different agricultural practices with the economic models described above. In the 12 different simulated cases, climate change leads to net declines in cereal production and in agricultural GDP in the developing world. There are modest increases in production in the developed world, but in most instances these do not fully counterbalance the developing world declines. Thus world market prices would increase at the same time that developing countries are forced to import more cereals. As a result, the estimated number of undernourished people is projected to increase in 11 of the 12 climate change scenarios examined. Under the most adverse climate changes considered, the number of undernourished could increase drastically to more than 2 billion, or 20% of the 2060 population.

Scenarios as cautionary tales

Scenarios of course are not forecasts of the future, but are systematically created "what if" statements. The two scenarios serve as contrasting cautionary tales as to the inadequacy of current trends to end hunger, even if we are willing to wait a lifetime in order to achieve it. The 2-4-6-8 scenario posits a world without hunger, with a modicum of economic justice and opportunity for all. But even if we could achieve such a daunting goal, we have reason to fear for the ability of the earth to sustain the enormous increases in production and consumption required under current institutions and technology. And in the more likely 2-2.25-X-4.4. scenario, there is reason to reject a prospect that, after a lifetime of change, there will be even more, and possibly many more, hungry people than today.

The scenarios, while cautionary, do not bound the possibilities for ending hunger in the future. It is possible to imagine a world without hunger that does not necessarily require, for example, the ending of poverty, only the raising of the poverty line above the level required to provide sustainable dietary sufficiency for most people. A goal that has already been partly achieved in a number of poor countries as well as in all rich ones. Equally, it is possible to imagine significant increases in production and consumption achieved in ways compatible with sustaining the ability of the earth to support human life. Indeed it is possible to go beyond imagination, to define a set of requirements for a world without hunger that go beyond "business as usual" or "current trends" and yet are consonant with some of these trends.

REQUIREMENTS FOR A WORLD WITHOUT HUNGER

A world without hunger, a food-secure world, would be a world where: .

> ..famine will be an historic occurrence of the past, less than 1% of the world's population would experience extremes of seasonal or chronic undernutrition, endemic micronutrient deficiencies would virtually disappear, and nutrient-depleting illness would be prevented or controlled. To move towards such a food-secure world requires a global implementation of food as a basic human right. Food supply would have to grow at rates as great as in the previous half century. International and regional welfare systems will need to be institutionalized to provide for famine prevention, emergency assistance, maintenance and supplementation of entitlements, and special programs addressed to the distinctive needs of women, children, and other groups vulnerable to hunger. And in a highly connected world of 2060, there should be much interest in learning how to cope with surprise, to achieve resilience by maintaining flexibility. (Chen and Kates, 1994:199)

The Right to Food

A world without hunger is a world in which the right to food is a human right that has become a norm of social behavior, an expectation upheld and enforced by all for all. There is a continuing trend in this direction with the elements for the international recognition of a human right to food coexisting in the form of the Universal Declaration of Human Rights, the International Covenant on Economic, Social, and Cultural Rights, and for armed conflict, in the 1977 protocols to the Geneva Conventions of 1949. Yet as one legal expert wrote in 1984:

> Few human rights have been endorsed with such frequency, unanimity, or urgency as the right to food, yet probably no other human right has been as comprehensively and systematically violated on such a wide scale in recent decades. (Alston, 1984:162)

The most widespread recognition of a right to food is in the provision of humanitarian assistance in cases of widespread disaster caused by natural or technological hazards or war. Indeed, preventing or mitigating famine is the oldest form of collective human assistance and may have been one of the bases for the early organization of urban society. The latest development in this long evolution has been the establishment of a human right to food by civilians in zones of armed conflict even when such conflicts are within national borders or are condoned or encouraged by national governments. Simply stated, there is growing agreement that no nation, governmental authority, or faction has the right to starve its own or neighboring people.

In the years since 1989, major precedents for the enforcement of such a right are found in Bosnia, Northern Iraq, and Somalia. But humanitarian assistance becomes increasingly complex as the cold war definitions of self-interest wither away and new agreements as to common interest have yet to emerge. With waves of human tragedy in Bosnia, Rwanda and Somalia overwhelming us, it is easy to lose sight of the continuing success in coping with famine as evidenced by the continuing decrease in the numbers affected by famine or the recent successful prevention of famine in southern Africa in the face of extraordinary drought.

The transition to a world where all nations and peoples live up to their responsibilities to ensure that everyone is adequately fed will be long and difficult one, but with uneven steps forward and occasional retreats a global ethic is emerging to serve as the ideological requirement for a world without hunger.

Sustainable Food Availability

A world without hunger has food enough for all. As we come to the close of the century and consider a future of doubled or perhaps tripled population, the classic Malthusian concern rises again. In the last two years there has been a sudden spate of books and papers asking the

question "Will there be enough food to feed the population of tomorrow?" (Bongarts, 1994; Brown and Kane, 1994; Crosson and Anderson, 1994; Ehrlich, Ehrlich, and Daily 1993; Mitchell and Ingco, 1993; Pinstrup-Andersen, 1994; Smil, 1994).

While there is widespread interest in the overall adequacy of a *future* food supply, there is much less *current* interest. It is generally accepted that currently there is actually plenty of food in the world. Hunger, it is argued, results mainly from lack of access to the available food supply. This seems to be the case for a nutritionally adequate, primarily vegetarian diet. In a recent paper Smil (1994) has estimated that current consumption (drawing on work by Bender,in press), if distributed according to need, comes close to meeting most nutritional needs requiring perhaps a 10% increase (200 calories) in current calorie availability.(Table 2). This could easily be met from the 1300 calories of grain that go into the feeding of animals.

.**Table 2. Estimated Global Per Capita Averages (kcal/day) of Food Harvests, Availabilities, Losses, Consumption, and Requirements in 1990** (Smil, 1994:266)

	Global average	Subtotals
Edible crop harvests	4,600	
Cereals		3,500
Tubers		300
Pulses		100
Vegetables, fruits, nuts		150
Oils		350
Sugar		200
Less Animal feed	1700	
Grain		1,300
Grain milling residues		300
Other crops and processing residues		100
Less apparent postharvest losses	600	

Available Plant Food	2,300
Available animal Food	400
Available food (FAO)	2,700
Less apparent restaurant, institution, and household losses	700
Food Consumption	2,000
Food Requirements	
Healthy, active smaller children (2.6% over consumption)	2,050
Healthy, active, taller children; active adults universal development (10% over consumption)	2,200
Healthy, active, taller children; active adults but current development (19.3% over consumption)	2,360

Or in a somewhat different calculation, Chen (1990) has shown that if we could distribute food to all according to each person's nutritional need, then the vegetarian food supply plus meat and dairy production from naturally grazed animals could feed as much as 120% of the world's current population. However, there is only enough food produced at present to meet the nutritional needs of about three-quarters of the world's population if they were given access to a diet that contains a modest amount of products from animals fed with cereal grains. And there would be only enough food for a little more than half of the world's population if they were fed with a healthy but animal-rich industrialized nation diet

This does not mean that there is or will be a global food shortage. Economists and others rightly point out that the world has much unused capacity for producing food. If poor countries and poor people had greater purchasing power then more food would be produced and made available. Nor does it mean that a vegetarian solution, eliminating in particular animal products fed with cereal grains is a practical solution. Direct consumption of grain would still require increased purchasing power or food aid. And there is a clear preference in most parts of the world for diets with some animal products. With increased income, most poor people want to spend some of that income for a diverse diet that includes animal products except where restricted by religious preference.

It is this recognition of unmet nutritional need and the desire for more varied diets that led to the 2,4,6,8 scenario, in which a doubling of world population might require as much as a

quadrupling of agricultural production to provide both for food and evolving alternative uses for biomass. Such a quadrupling of food production could be attained in 70 years at a rate of 2% per annum which is a little below the historic (1934-1989) rate of food production growth of 2.1%.

How likely are we to achieve such increases in the next century? Some recent trends have raised questions as to maintaining the historic rate of growth in food production. For example, Ehrlich, Ehrlich, and Daily (1993) offer eleven "biophysical" constraints to maintaining the growth in food production: 1) losses of farmland, 2) limits to freshwater supplies, 3) erosion and degradation of soils, 4) biological limits to yields, 5) diminishing returns from fertilizers, 6) problems associated with chemical control of pests, 7) declining genetic diversity, 8) increased ultraviolet radiation, 9) air pollutants, 10) climate change and sea-level rise, and 11) a general decline in the free services of natural ecosystems.

These biophysical constraints are in addition to the many socioeconomic constraints . For example, in the short term, Pinstrup-Andersen (1994), reflecting mainstream agricultural economic thinking, cites the dependence of increases in food production on economic policies that would: 1) complete structural adjustment and economic reforms, 2) remove subsidies, trade and market distortions in developed and developing countries, 3) enhance access by the poor to land, capital, and technology, 4) expand investment in rural infrastructure, health, education, and agricultural research and technology, 5) facilitate sustainability in agricultural production, and 6) reverse the decline in international assistance to agriculture.

As alternatives to these specific biophysical and socioeconomic constraints, agricultural scientists are quick to point out at least four major opportunities for increased production: 1) the unrealized potential to increase yields from the application of current techniques and technologies; 2) the possibilities provided by the biotechnological revolution just underway; 3) the development of organic and sustainable agriculture techniques; and 4) the opportunity to increase efficiency in the end use of food.

While the increases in yield potential from improved seeds, fertilizer, pesticides, and water has slowed in both industrialized and the developing countries of Asia, considerable opportunities exist for yield increases by the application of readily available technology. Yields of cereals in Asia and Latin America are twice those of most African countries. It is argued that even modest increases in seed quality, fertilizer, pesticide and water use, encouraged by appropriate policies, prices and markets, could lead to a rapid increase in yields. For example, Smil (1994) argues that it would be possible by 2050 to increase by 35% current food availability with no additional inputs just by improving the efficiency of production through the use of better agronomic practices, increased uptake of available nitrogen, and more efficient use of the available water (Table 3, line 1). All told, an additional equivalent of three quarters of

current production could be had, he claims, from very conservative assumptions as to agricultural progress between now and 2050 (Table 3).

Table 3. Conservative estimates of additional harvest achievable by the year 2050 in harvest equivalents (MT unmilled grain/per year). (Smil, 1994:280)

Agronomic Measures	Million metric tons
Intensification of existing cropping practices (raise yields 35%)	700
Extension of cultivated land (20% increase compared to 1990)	500
Cultivation of idle land	75
High-efficiency irrigation	100
No beef production with intensively grown feed	50
Irrigation with saline waters	25
Agrisilviculture, aquaculture, and new crops	50
Total	1,500

Beyond the intensive utilization of what is already available, are the new possibilities provided by the promise of the biotechnological revolution just getting underway. A new set of molecular, cellular, and whole-plant biology techniques are tailoring plants used in agriculture to respond more efficiently to nutrients and moisture, to tolerate heat and drought, and to resist pests. For example, pest-resistant seeds for legumes widely used in developing countries has just been genetically engineered to provide post-harvest protection against weevils (Schmidt, 1994). While the first biotechnology products in the marketplace will primarily benefit farmers in rich nations, progress into the next century will depend greatly on improved capabilities on the part of developing country scientists and farmers. (Messer & Haywood 1990)

Whether we take comfort from the technological optimists or concern from the biological pessimists, there is widespread agreement that trebled or quadrupled food production could not be sustained under current practices with the additional burdens of soil and water loss, pesticide and fertilizer use, and the potential for changing climates. Thus there is much interest in developing a “sustainable” agriculture of the future. But there is also much division in the directions such a sustainable agriculture might take, roughly divided between those who would

encourage "natural" or organic methods, often built on indigenous knowledge, and those that would apply technology, including biotechnology, to developing farming techniques that minimize negative environmental impacts while still maintaining high productivity.

Finally, the global food system is not very efficient in transforming raw agricultural products into usable food.(Chen 1990). Bender (in press) has shown that over 50% of the available food is wasted, most of it in richer countries and most of it in waste at "end uses"—food sold retail and used in restaurants, institutions, and households.. The least wasteful systems found in developing countries can keep such waste to 30%. An estimated 62% of the world's population lives in countries where waste is over the 30% best-practice threshold. Diets rich in fat from animal sources are harmful and are wasteful as well because of the grain required to feed the animals. Thus Bender estimates that an amount almost equal to a quarter of the world's food consumption could be created by using the current best practice in limiting waste and adopting the minimal healthy diet of 30% or less fats from animal sources.

It is clear that trebling or quadrupling food production is within the range of the possible. But to do so, much that is different will need to happen in farmer's fields, in research institutions, in agricultural markets, and in consuming households.

Adequate Household Income

For most of the world's hungry people, the major determinant of their hunger is poverty or inadequate income. The largest source of entitlements for the food required by the household is from income obtained by the sale of household labor or the sale or trade of household products that are made, grown, fished, or hunted.(Sen, 1982). As of 1990 such income is currently inadequate in households with a total population of more than 786 million (Table 1). Inadequate household incomes also indirectly affects the size of the available food supply by failing to provide the market required to encourage greater production.

Poor countries are also among the most inequitable. While the gap between the amount of wealth commanded by the upper and lower fifths of society diminishes with rising national income from 15-20:1 in poor countries to the 5-7:1 found in wealthy countries , the process is slow and inequitable. For the poor, trickle down is not very efficient. So for example, in the 2-2.25-X-4.4. scenario, after 70 years of GNP growth to 4.4 times that of 1980, there would still be more hungry people in the world in 2060 than in 1980. This suggests that in a world of somewhat more than doubled population, national income will have to increase four to six fold (depending on the pattern of income distribution) in order to meet the food requirements and modest expectations of improved diets in the poorest households.

Increasing income as a prime mode of ending hunger is also not enough. Some of the additional income is spent on more diverse but costly foods and some on non-food related

expenditures. From a number of studies, it appears that in general a 10% increase in income increases dietary calories only by 4-6%, even though the poorest households spend up to 85% of household income on food (Marek, 1992). And within the household there may be an inadequate distribution of food to household members, favoring some and not others. Even after most household income is raised on average above the poverty level, there is still need for a pervasive safety net.

Safety Net

A world without hunger will still continue to have natural and technological disasters that will require emergency assistance. Poor people, even those whose average income is above the food poverty level, will nonetheless require occasional income maintenance and supplementation as the cycles of crop production, income, illness, and family creation and loss will continue to generate a need for additional entitlement. Within the individual life course, the special needs of women and children will have to be met by responsive maternal and child care systems just as such systems are required in the wealthiest of countries today. Ending hunger will require a pervasive safety net .

It is difficult to know how such a safety net will evolve and be supported decades in the future, or whether the nation-state would still constitute the basic unit of social organization required for its implementation. However, the elements of a pervasive safety net can be foreseen, both in the prototypes now operating within many developing countries and the advanced systems in place in the wealthiest countries. They include famine prevention, emergency assistance, entitlement maintenance, and special needs programs.

Famine Prevention

In 1992-93, a major drought affected southern Africa, reducing in some countries crops by as much as 50%. Yet there was no famine. Indeed, the remarkable achievement in preventing famine in Botswana, Malawi, Mozambique, South Africa, Zambia, and Zimbabwe was further evidence for the maturity of national and international efforts to end famine deaths. These efforts, beginning in the 1980s and designed to cope with drought, flood, war, and famine had led to great improvement in the global system for providing emergency food aid. International early-warning systems coordinated by the United Nations Food and Agriculture Organization were established in 1975, and national early warning systems are in operation in many countries. Efforts to improve understanding of the underlying vulnerability of particular groups to famine and to coordinate development, response, and relief efforts based on this understanding hold promise of more timely and effective interventions before famine conditions spread. The

importance of providing income and not just food to prevent famine is increasingly recognized and the use of emergency works program has increased in both Asia and Africa.

Thus it is now possible to anticipate widespread food shortages and to bring food quickly almost anywhere in the world. It is increasingly possible to identify vulnerable groups and famine potential even where national food stocks may be sufficient (Downing, 1991; Bohle, Downing, and Watts, 1994; Babu and Quinn, 1994). It is also increasingly possible to rally international concern when justified even in the face of national denial. It is only in zones of armed conflict that the major obstacles to eliminating deaths due to famine remain.

. The rudiments for international protection of civilian rights to food are provided by the 1977 protocols to the Geneva Conventions of 1949 that prohibit the starvation of civilians as a means of combat. Recent interventions in conflicts in Angola, Bosnia, the Kurdish regions of Turkey, Iraq, and Iran, Liberia, Mozambique, Rwanda, Somalia and the Sudan have had mixed success in alleviating mass starvation but do provide a series of precedents in which humanitarian concerns can overcome the barriers posed by national sovereignty if necessary to prevent famine. But they also provide a series of cautions as to how difficult it is to intervene in these renewals of political, ethnic, religious, and even clan-based rivalries and civil wars, how narrow is the line between humanitarian assistance, peacekeeping, and enforced peacemaking; and how easily the commitment of even the greatest of powers can be diverted by armed resistance. Nonetheless, it is clear that in this painful search for a new post-cold war standard of international responsibility, there is also the opportunity for a major breakthrough in the standards of international conduct.. Indeed, hunger cannot be ended without it.

Emergency food assistance

Along with effective early warning and response mechanisms, famine prevention requires emergency food assistance from national and international sources. In recent years, the international community has distributed some 2-4 million metric tons (mmt) of food aid annually for emergency situations in developing countries, and an additional 1-2 mmt to feed a growing number of refugees and other displaced peoples. It has also been possible to place emergency stocks nearer to where they may be most useful and to deliver them when and where needed. Food aid availability in the future will depend on a range of factors, including national agricultural and trade policies, world food markets, and international use of food aid as a tool for humanitarian assistance, socioeconomic development, and foreign policy, but emergency aid seems to have a high priority.

As noted above, progress in emergency assistance efforts are still spotty however in just those situations related to armed conflict or political repression. In developing countries, local capacity to assist those in need in times of disaster is often limited not by concern but by

resources. International responses to such disasters are frequently haphazard, delayed, and at times counterproductive, as evidenced by the latest tragedy in Rwanda. Nevertheless, there appears to be a slow but steady improvement in the logistical, institutional, and legal capabilities to deal with complex humanitarian situations. Whether this trend will be reversed by the burgeoning number of refugees and other displaced persons around the world and the unwillingness of developed nations to accommodate them remains to be seen.

Entitlement maintenance

The need to subsidize or distribute food or their income equivalents is at least as old as the Roman empire. Maintaining a general entitlement to food can be quite costly, whether done as a direct subsidy or gift or whether by mandating an artificially low consumer price, which if not directly costly to governments, can discourage needed food production. But food or income maintenance can be quite effective when targeted to the truly needy.

The most effective distributions utilize existing markets to distribute food through food stamps, ration shops, or specially subsidized foods. This is more difficult in rural settings where it may be harder to reach households on a sustained basis with food-welfare programs. Notwithstanding, even in rural areas, there has been considerable success in providing work opportunities during drought and flood crises that provide some income in return for labor to construct needed agricultural infrastructure and to restore environmental resources. This has been harder to do in Africa where low densities of population and smaller numbers of technicians make the organization of such projects more difficult. Nonetheless they have succeeded in Botswana and elsewhere.

All told some xx-xx mmt of food aid has been distributed annually in recent years to both developing and transitional countries, only a quarter of which has been used for emergency assistance. Aid if maintained at that level can serve as a core for entitlement maintenance programs, whether monetized (sold commercially) to provide general assistance or distributed directly or through employment schemes. But the total amount is still much below the 20-60 mmt that might be needed in this decade both to provide emergency assistance and to stabilize food prices in developing countries. (BOSTID, 1989; Bender, 1990)

Creating diverse sources of income can also help maintain the entitlements of the poor by making them less vulnerable to post-harvest seasonal hunger or the threat of natural disaster imposed by the sole reliance on agriculture. In encouraging such diversity, community and women's banking programs that provide self-sustaining sources of credit to start small businesses or to produce handicrafts and services have proven very effective.

Many of the world's food-poor households still raise much of their own food. For them, maintaining access to the natural resource base and the inputs needed for agriculture, herding, or

fishing is becoming increasingly difficult in the face of growing population and increased competition for land. In some places, there are still opportunities for redistribution to smallholders of land that are little used. Everywhere, there are low-cost techniques that can be used to sustain productivity, provide fuelwood, limit soil erosion, and increase food and income. Nonetheless, agricultural smallholders are still at the mercy of "too perfect" markets as well as the imperfect ones economists frequently complain about. In such markets, what smallholders have to sell is at low prices in highly competitive markets and what they have to buy is at high prices from relatively restricted ones. Thus, it seems likely that the developing countries will have to follow the path of the developed countries in providing subsidies and basic entitlements to their rural populations in order to stem the flow of population into urban areas and retain a viable agricultural economies.

Special needs programs

The special needs of women, children, and the sick for additional food will always have to be met, if hunger is to be ended. Such systems need to be maintained even in wealthy countries. For children, immunization and low-cost treatment of diarrhea, malaria, and measles promise to reduce the impact of disease on nutrition even as early as the end of this century. In many developing countries, the use of breastfeeding remains stable or is even increasing, possibly as a result of continuing efforts to encourage and maintain the practice. Sustained breastfeeding, in combination with limiting the effects of childhood illness, expanded supplemental feeding, and growth monitoring, could eliminate much childhood wasting and stunting. Most of these needs—breaking the disease-nutrition nexus and meeting the special dietary needs of women and children—can be handled well within the context of effective low-cost systems of maternal and child health care supported by adequate nutrition education.

More troublesome for the health of women is anemia, especially among pregnant women, as it requires regular iron supplementation. Universally troublesome are the burdens imposed by intestinal parasites on two billion or more people which prevent them absorbing the full nutritional value of the food that they ingest. For those most severely affected, deworming drugs hold much promise. But to end hunger, basic improvements in sanitation and safe drinking water will be necessary. To date, while there has been much progress, the pace of improvements has not kept up with the growth of population in rapidly growing cities, densely populated watersheds, and environmentally threatened rural areas.

Coping with surprise

Ending hunger will be easier and harder, and certainly different because of unexpected surprises. The surprises themselves are by definition unpredictable, but the mechanisms are

easily imaginable. New breakthroughs in biotechnology can provide substantial improvements in yields and nutrition while new disease outbreaks can seriously disrupt plant or animal production. Social and religious movements can enhance the development of global responsibility while unexpected sources of conflict may well interfere with the flow of food, people, and caring. Some of today's so-called "basket cases" will confound the conventional wisdom while some favored regions will prove more troublesome in outlook. Thus, ending hunger will require a capacity to deal with surprise—to take advantage of surprising opportunities and to maintain social and technical flexibility to cope with surprising adversity.

HUNGER AND THE GREAT GLOBAL CONCERNS:

A world without hunger must not only have plenty of food, but food produced in ways that are sustainable to the environment and supportive of the income needs of poor people. A world without famine requires not only a surplus of food and a willingness to distribute it in times of emergency but also a widespread recognition of the human right to food and effective mechanisms to prevent armed conflict. A world with relatively low levels of undernutrition must not only be more wealthy, but also willing and able to provide food entitlements and to poor and vulnerable groups as needed. A world without the wasting and stunting of children and the exhaustion of their mothers requires a rate of population growth that provides adequate spacing between children sufficient to allow for their and their mothers' nutrition and for society's ability to provide the needed services, education, and jobs to support them. A world with virtually no micronutrient deficiencies and nutrient-depleting illness must not only have more diverse diets, but also the income to support widespread access to adequate sanitation, safe water, public health and primary care services, and nutritional and health education.

Thus to end hunger, the other great global concerns over population, economy, environment, and world order need to be addressed. In turn, addressing the great concerns can also provide great opportunities to end hunger. The focus on women that has emerged from the Cairo Conference on Population and Development will hasten the end of maternal anemia and child wasting and stunting. The painful but inexorable restructuring of the global economy will provide new sources of income to many parts of the world. The vision of sustainable development arising from the Rio Conference on Environment and Development can only assist the effort to create a sustainable, but much enlarged food production system. The struggle to strengthen the United Nations and for collective action for human rights and international order can make the elimination of famine more feasible. To end hunger none of the problems from which these concerns arise need to be fully solved, but all need to be engaged, now, in 1999, and beyond.

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