Population, Environment, and Food Security

M.S. Swaminathan

ISSUES IN AGRICULTURE 7
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Population, Environment, 
and Food Security

M. S. Swaminathan
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Population, Environment, and Food Security

M.S. Swaminathan

Introduction

Experience indicates that a demographic transition leading to low birth and death rates takes place when an enabling environment, where children are born by choice, prevails. The major components of such an environment are now widely recognized as rising female literacy and the status of women; decreased infant and maternal mortality rates; improved health, nutrition, livelihoods, and ecological security for all; and shared decisionmaking by couples. The world population could increase from current figures of nearly 6 billion to 10 billion by 2050 (World Bank 1992). About 97 percent of that increase will occur in developing countries. Since two-thirds of this growth is expected to take place in cities, the urban poor will need special attention.

The 1992 United Nations Conference on Environment and Development, held in Rio de Janeiro, Brazil, was unique in uniting the countries of the world through global conventions on biodiversity and climate change. The Desertification Convention, for which the founda-

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1 Based on a lecture delivered at the International Conference on Population and Development, Cairo, Egypt, September 9, 1994.

2 Chairman, M.S. Swaminathan Research Foundation, Madras, Tamil Nadu, India; laureate of the World Food Prize; and former Director General of the International Rice Research Institute.
tion was laid in Rio, is now in final form and will come into force when it has been ratified by 50 signatories. Above all, a plan of action for promoting environmentally sustainable development, known as "Agenda 21," was adopted.

Agenda 21, designed for implementation during the remaining years of this century and the first decade of the twenty-first century, is a blueprint for economic development without environmental destruction. The growing number of ethnic and economic conflicts indicates that development, even if environmentally benign, will not be socially sustainable if it ignores equity. In other words, a better common present is essential for a better common future.

Food Security

Food and safe drinking water are first among the hierarchical needs of human beings. This is why Thomas Malthus, in his "Essay on the Principle of Population as It Affects the Future Improvement of Society" (1798), wrote that "the period when the number of men surpass their means of subsistence has long since arrived." The global population is now nearly 6 billion, yet famines of the kind Malthus predicted have been averted in recent decades, except in regions affected by ethnic or civil strife, prolonged drought, or other natural calamities. Globally, the problem of hunger is now more related to what Amartya Sen, in the paper entitled "Population and Reasoning" (1994), refers to as "entitlements," not to food production lagging behind population growth.

My colleagues at the Centre for Research on Sustainable Agricultural and Rural Development at Madras and I are designing a Hunger-free District Program, starting with hunger-free villages and towns. This program aims at freedom from hunger at the level of the individual, because intrahousehold variability in food
intake exists, often to the disadvantage of women and girls. To eliminate endemic hunger at the level of the individual, it will be necessary to pay integrated and concurrent attention to:

- Sensitize and mobilize public opinion through the mass media to generate appropriate political action.

- Achieve agricultural intensification and diversification, so that the income and employment potential of small-farm agriculture is enhanced through economically and ecologically sustainable farm and off-farm enterprises.

- Ensure access to food at affordable prices by both maintaining food security reserves and operating an efficient public distribution system.

- Ensure universal and compulsory primary and secondary school education.

- Develop an integrated health security system that addresses sanitation, hygiene, preventive and curative health measures, reproductive health, and access to safe and acceptable contraceptive services.

- Initiate public action to provide: (a) **protective social security**, such as an employment guarantee and food for nutrition programs, for the assetless and vulnerable sections of the population, and (b) **promotional social security**, involving access to information, technological empowerment through training in new skills, credit, and remunerative self-employment and marketing opportunities.

- Mobilize the voluntary and private sectors to promote literacy, ensure health security, and foster a job-led economic growth strategy.
Such a program for achieving freedom from endemic hunger will succeed only where there is public commitment to political (i.e. democracy and independent judiciary and mass media), social (such as group action), and technological empowerment of all citizens, particularly the economically and socially disadvantaged sections of the population. The early achievement of this goal will be possible if, in addition to the needed public action, the private sector enters into a social contract with the economically and socially disadvantaged sections of the population to improve the livelihood security of the poor.

**Demographic Trends and Famines**

In recent decades, several sources have predicted a growing imbalance between our ability to produce food from diminishing land and water resources and expanding biotic and abiotic stresses. If these predictions are correct, serious famines will result if efforts in the area of population stabilization do not bear fruit. In the 1960s, Paul Ehrlich predicted:

Some time between 1970 and 1985 the world will undergo vast famines—hundreds of millions of people are going to starve to death. That is, they will starve to death unless plague, thermonuclear war, or some other agent kills them first.

The United States should announce that it will no longer ship food to countries such as India where dispassionate analysis indicates that the unbalance between food and population is hopeless (Ehrlich 1968).

Ehrlich’s prophecy would have proven correct had it been made a century earlier. Between 1870 and 1900, nearly 30 million famine-related deaths occurred in
India—10 million during 1893 to 1894. The last big famine on the Indian subcontinent occurred during 1942 to 1943, when more than 2 million people died of starvation. However, the famine-prevention strategy of independent India has been very effective in avoiding calamities of the kind predicted by Ehrlich and others. This strategy comprises steps such as bringing more area under ensured irrigation, intensification of agricultural research, education and development, land reform, assurance of minimum prices, maintenance of food security reserves, operation of an extensive public distribution system, integrated rural development, and employment generation for both unskilled and skilled workers. Yet endemic hunger in India persists, largely due to the inadequate purchasing power of those living below the poverty line. The hunger problem is thus better described in terms of million person-years of jobs than in tons of food grains.

The packages of technology, services, and public policies that helped prove the prophets of doom wrong are described, in the case of wheat, in a book I edited entitled *The Wheat Revolution: A Dialogue* (1993). It is estimated that the total food demand in developing countries will increase by approximately 150 percent by 2025. The continuing population increase will result in a decline in available cultivable land per capita worldwide from 0.3 hectares in 1988 to 0.17 hectares in 2050, with only 0.11 hectares per capita in developing countries.

Only about 8 percent of the increase in food production in the last half-century has come from the expansion of cultivated area; 92 percent has come from higher yields per hectare. The main inputs have been new crop varieties, increased use of fertilizers and biocides, and a large increase in irrigated area, at about 3 percent per annum from 1950 to 1980. The world's total irrigated area increased from 80 million hectares
in 1950 to 237 million hectares in 1993. Today, 46.5 percent of all grain is produced under irrigation. The practical limit for full intensification under irrigated conditions is about 8.5 tons per hectare for a single crop. In the Punjab of India and in Egypt, farmers are obtaining yields of 6 tons per hectare under conditions of good water and soil fertility management. The challenges now are to sustain such yields in favorable areas and to expand good land, water, and crop management to more areas and farming systems, particularly in areas without irrigation.

Thus there is no time to relax. The Roman philosopher Seneca said long ago, “A hungry people listens not to reason nor cares for justice, nor is bent by any prayers.” On the eve of the International Conference on Population and Development (Cairo, September 1994), several dire predictions were again made on the impending food crisis in developing countries and the consequent potential for widespread famines and deaths from starvation. Lester Brown and Hal Kane, in their book entitled Full House: Reassessing the Earth’s Population Carrying Capacity (1994), calculated that China and India will face serious food shortages (Table 1). Such forecasts are based on the fear that the human carrying capacity of supporting ecosystems is being exceeded, particularly in developing countries where most of the population increase is taking place. There is scientific basis for such apprehensions. In per capita terms, the availability of land, water, and forest is shrinking (Table 2). The green revolution technologies that were based on chemical inputs gave us the breathing space to arrive at a balance between human population and the food production potential of available arable land and water resources. They have also led to adverse environmental repercussions. This is why Agenda 21 of the U.N. Conference on Environment and Development has emphasized the adoption of ecologically desirable technologies.
### Table 1. Grain Production, Consumption, and Net Trade in the “Big Four” Countries, 1950 and 1990, with Projections to 2030

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Grain Production (millions of tons)</th>
<th>Grain Consumption (millions of tons)</th>
<th>Net Trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>1950</td>
<td>133</td>
<td>121</td>
<td>+12</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>290</td>
<td>214</td>
<td>+76</td>
</tr>
<tr>
<td></td>
<td>2030</td>
<td>377</td>
<td>295</td>
<td>+82</td>
</tr>
<tr>
<td>China</td>
<td>1950</td>
<td>109</td>
<td>109</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>329</td>
<td>335</td>
<td>-6</td>
</tr>
<tr>
<td></td>
<td>2030</td>
<td>263</td>
<td>479</td>
<td>-216</td>
</tr>
<tr>
<td>India</td>
<td>1950</td>
<td>57</td>
<td>55</td>
<td>+2</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>158</td>
<td>158</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2030</td>
<td>222</td>
<td>267</td>
<td>-45</td>
</tr>
<tr>
<td>Former Soviet Union</td>
<td>1950</td>
<td>79</td>
<td>80</td>
<td>-1</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>182</td>
<td>219</td>
<td>-37</td>
</tr>
<tr>
<td></td>
<td>2030</td>
<td>237</td>
<td>262</td>
<td>-25</td>
</tr>
</tbody>
</table>

Source: Data from U.S. Department of Agriculture, cited by Brown and Kane (1994).

### Table 2. Population Size and Availability of Renewable Resources, 1990, with Projections to 2010

<table>
<thead>
<tr>
<th></th>
<th>1990 (million)</th>
<th>2010 (million)</th>
<th>Per Capita Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>5.290</td>
<td>7.030</td>
<td>-</td>
</tr>
<tr>
<td>Fish Catch</td>
<td>85</td>
<td>102</td>
<td>-10</td>
</tr>
<tr>
<td>Irrigated Land</td>
<td>237</td>
<td>277</td>
<td>-12</td>
</tr>
<tr>
<td>(hectares)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cropland (hectares)</td>
<td>1,444</td>
<td>1,516</td>
<td>-21</td>
</tr>
<tr>
<td>Forests</td>
<td>3,413</td>
<td>3,165</td>
<td>-30</td>
</tr>
</tbody>
</table>

Sustainable Food Security

In my view, there can be enough food for feeding a global population of about 10 billion if the six-pronged strategy outlined below is widely adopted. Even if food is available on the market, however, the poor will have no access to it unless they have opportunities for remunerative employment. Hence, sustainable food production and consumption need integrated attention in national and international food policies.

1. **Bridging the gap between potential and actual yields with the technologies that are currently available.** In most farming systems in developing countries, there is a large gap between potential and actual yields, even with currently available technologies. In India, for example, the average yield of rice from about 40 million hectares is only a little more than 2 tons per hectare. This yield can be at least doubled. Through a combination of location-specific technologies, timely delivery of appropriate inputs, public policies in land reform, input-output pricing, and marketing, it will be possible to tap the untapped yield reservoir that exists in most farming systems.

2. **Upgrading the biological potential of wasted lands.** This effort is of the highest priority. Globally, more than 15 percent of good farmland is now degraded from a variety of human-induced causes (Table 3). In the population-rich but land-hungry countries of South and Southeast Asia, nearly 20 percent of farmland remains unproductive due to a variety of causes such as salinity, alkalinity, waterlogging, and loss of topsoil from erosion. The Desertification Convention can provide an opportunity for launching a mass movement to protect and improve soil health.

3. **Introduction of ecologically sound practices in agriculture and in capture and culture fisheries.** Here, Mahatma Gandhi's dictum, "Nature pro-
vides for everybody's need but not for everybody's greed," will need to be kept in view in the exploitation of land, inland river, reservoir, and ocean resources. Programs that are environmentally destructive and socially disruptive should be avoided.

Table 3. Human-induced Land Degradation, 1945 to 1992

<table>
<thead>
<tr>
<th>Region</th>
<th>Total Degraded Area (millions of hectares)</th>
<th>Degraded Area as a Percentage of Total Vegetated Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>746</td>
<td>20</td>
</tr>
<tr>
<td>Africa</td>
<td>494</td>
<td>22</td>
</tr>
<tr>
<td>South America</td>
<td>244</td>
<td>14</td>
</tr>
<tr>
<td>Europe</td>
<td>220</td>
<td>23</td>
</tr>
<tr>
<td>North and Central</td>
<td></td>
<td></td>
</tr>
<tr>
<td>America</td>
<td>158</td>
<td>8</td>
</tr>
<tr>
<td>Oceania</td>
<td>103</td>
<td>13</td>
</tr>
</tbody>
</table>


4. **Promotion of group cooperation among families with smallholdings to empower them with the economic and ecological advantages of scale in farm operations.** This strategy will be particularly important in water harvesting and the efficient on-farm management of water, inland and coastal aquaculture, integrated pest management, and improved postharvest technology. It will enable families to benefit from producer-oriented marketing arrangements so that a fair share of the consumer's money goes to the producer.

5. **A new trade ethic that leads the industrial nations to buy agricultural commodities from the developing world at fair prices and on a long-term basis.** Without such an ethic, several features of the recently concluded world trade
agreement, under the General Agreement on Tariffs and Trade (GATT), particularly those involving trade-related intellectual property rights, will work against the interests of the poor. Today, industrial nations have capital and technology-driven advantages in both agriculture and industry. They also enjoy leadership in the services sector. This is why the gulf between rich and poor continues to increase year after year. Developing countries, which are predominantly agricultural in terms of economy and livelihood, should improve their agriculture and not depend on imports. Only then will rural employment and prosperity improve.

6. **A “New Deal” for the self-employed through credit, technology, training, technoinfrastructure, and trade.** This approach calls for public and private action that will result in harmony between public good and private profit. Non-governmental organizations and the private sector can play a pivotal role in this area.

At present, the number of people living on 1 ton of food grain per year varies from one to six. If the food is efficiently used and if health foods are encouraged, about four people can live on 1 ton of food grain per year. (This number will be three per ton per year where the plant-animal-man food chain is widely prevalent.) Therefore, to feed a population of about 10 billion—the

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3 The statistics on the number of people living on 1 ton of food grain per year are the author's own calculations based on an analysis of grain consumption in different countries with varying total population and dietary habits. For example, the former Soviet Union imported nearly 30 million tons of grains, although internal production was over 200 million tons. This was due to the heavy dependence on the plant-animal-man food chain. In India, by contrast, the food grain needs of the present population of over 900 million are met by domestic production of about 180 million tons. About 15 percent of this production goes for seed or spoilage during storage.
Earth's estimated population by 2050—we will need about 3,500 million tons of food grain. This figure includes provision for seeds and spoilage. Producing this amount should be possible if we step up research and development efforts on sustainable intensification and diversification of farming systems. Diversification of foods consumed will further improve the nutritional status of children and adults.

**Local-level Sociodemographic Charters**

The “Draft National Population Policy” statement submitted in May 1994 to the Government of India by an Expert Group on Population Policy I chaired suggests an approach to promoting development based on concurrent attention to the principles of ecology, economics, equity, and employment. The Expert Group's major recommendation was the promotion of an environment that will enable couples to decide for themselves the size of their families. Such planning will have to come from an awareness of the obligations of parents to their children as well as to society.

To implement a population policy based on the methodology “think, plan, and act locally and support nationally and internationally,” the Expert Group recommended that elected grassroots democratic institutions prepare sociodemographic charters for their villages or towns. The principal aim of such charters is to stimulate action on meeting the unmet minimum needs of the local population, including the provision of high-quality contraceptive services based on informed choice. Another major purpose of the sociodemographic charter is to create greater awareness of the need to improve quality of life while living within the carrying capacity of supporting ecosystems. The Expert Group emphasized that “it is high time the limits to the human carrying capacity of the supporting ecosystems are recognized.” These limits are becoming increasingly clear for water, good quality farmland, and forests (Table 2, see page 7).
The blueprint for such action is the local-level sociodemographic charter prepared by the people themselves. Rural appraisal studies in which local people participated have amply demonstrated that, whether literate or illiterate, rural families can articulate their priority needs in social and human development.

The major components of a sociodemographic charter are:

- Gender equity and problems relating to women and children, including sex ratio, crèches, and child care.
- Habitat, including housing, environmental hygiene, garbage and sewage recycling, and equitable management of common property resources.
- Education for all at the primary and secondary school levels.
- Health security, including the reproductive health of women and the availability of high-quality contraceptive services.
- Environment, with particular attention to the human carrying capacity of land and water and the conservation of flora and fauna.
- Access to balanced diets and safe drinking water at the level of each person in a household.
- Opportunities for skilled employment in the primary, secondary, and tertiary sectors of economic activity in both rural and urban areas. People living in urban slums need urgent attention as the coexistence of luxury and misery in cities and towns ignites social unrest and conflicts.

Such a charter, prepared by the principal stakeholders and based on appropriate training modules and manuals, will help in setting priorities for unmet needs.
The sociodemographic charter will help to place population goals in the context of health, livelihood, and ecological security. It will help to specify the kinds of support that state and national governments and bilateral and multilateral donors should extend for achieving low birth and death rates and gender equity.

The Expert Group suggested the establishment of a National Population and Social Development Commission and a National Population and Social Development Fund to respond to the needs and priorities articulated in the sociodemographic charters. The commission and fund would help to achieve a proper match between response and the generic and specific needs of villages and towns. This suggestion, made in the context of emerging grassroots democratic institutions in India, merits examination by all countries that have a system of decentralized and democratic decisionmaking.

The example of Kerala, India, where the birth rate fell from 44 per 1,000 in the 1950s to 18 per 1,000 by 1991, has been the subject of many studies. All the studies have shown that where coercive deterrents were replaced by an enabling environment, such as emphasis on universal education, primary health care, and environmental hygiene, population growth was limited on its own. In many regions, the population problem is serious because of environmental reasons, not because of the relationship between the natural increase in population and food. For this reason, the sociodemographic charter places emphasis on local communities studying the relationship between human and animal populations and the supporting capacity of the ecosystems in which they live.

Population Policies for Human Happiness

The preceding agenda for giving our children and the children yet to be born not only existence but also
happiness will need substantial financial, managerial, and infrastructural resources. For efficient implementation, it will need the active involvement of non-governmental organizations and both the private and public sectors.

Thus far, we have been able to ensure that the predictions of Malthus and Ehrlich do not come true. To continue to ensure that the rate of growth in food production remains higher than the rate of population growth, we must implement the action plan I have outlined. Table 4 provides estimates of the total funds required to implement programs to achieve sustainable development. The total is less than a trillion dollars. From where will this new money come?

A world in which 20 percent of the population enjoys 84 percent of annual income, while another 20 percent...
percent struggles for survival on a mere 1.4 percent of annual income, as emphasized in the 1994 Human Development Report of the United Nations Development Programme (UNDP), can never provide a secure and sustainable way of life for humankind. Mahatma Gandhi urged that those who possess and enjoy affluence should hold it in trust, with a responsibility to use it to build a better world for all. A one-time contribution of US$1,000 per capita by the one billion people living in luxury in all countries of the world would help to form a Trillion Dollar Trust Fund to create a world with an enabling environment for achieving the desired demographic goals. I cite these figures to illustrate the vast scope for voluntary action in ensuring that both unsustainable lifestyles and unacceptable poverty become anachronisms of the past. We should foster a new human ethic that sensitizes us to the dual need for a population that does not exceed the human carrying capacity of supporting ecosystems and for enhancement of the human caring and sharing capacity.

The peace dividend from an easing of tensions between the superpowers is now regarded as an emerging opportunity for the redeployment of resources. In its 1994 Human Development Report, UNDP calculated that the actual peace dividend between 1987 and 1994 was US$935 billion. The report of the International Commission on Peace and Food, entitled Uncommon Opportunities: An Agenda for Peace and Equitable Development (1994), calculated that an additional US$460 billion may be saved from military expenditure in the period 1995 to 2000. For such redeployment to occur on a sustained basis, however, we must have greater understanding, tolerance, and love of diversity and pluralism—whether in religion, language, color, culture, ethnicity, or political belief. This must be a major task for 1995, which has been declared the International Year for Tolerance. Although we should be tolerant of diversity in human societies, we must be intolerant of inequity in terms of either gender or economic well-being.
In the ultimate analysis, the efforts of the development community should not be merely to explore how to limit population growth or to promote food and environmental security. They should be to consider how to achieve what the Marquis de Condorcet, the French mathematician-cum-social scientist, emphasized in his paper of 1795: "Population growth can be limited if people have a duty towards those who are not yet born, that duty is not to give them existence but to give them happiness." To make Condorcet's aspirations come true, we need a global movement for integrated population and social development. We need a Global Trust Fund for Population and Social Development that will help all women, men, and children, wherever they are, to meet their minimum needs of food, education, health care, employment, and housing. Only then will we witness the desired global demographic transition as well as harmony between humankind and nature. If urgent steps are not taken to curb the unsustainable lifestyles and consumption of the world's billion rich and to mitigate the poverty and deprivation experienced by another billion children, women, and men, we will be living in a world of social, economic, and technological apartheid far worse in its human implications than the skin color based apartheid that has just ended.
References


About the CGIAR

The Consultative Group on International Agricultural Research (CGIAR) is an informal association of 48 public- and private-sector donors that supports a network of 16 international agricultural research centers. The Group was established in 1971.

The World Bank, the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP), and the United Nations Environment Programme (UNEP) are cosponsors of the CGIAR. The Chairman of the Group is a senior official of the World Bank, which provides the CGIAR System with a Secretariat in Washington, D.C. The CGIAR is assisted by a Technical Advisory Committee, with a Secretariat at FAO in Rome.

Japan, the United States, Germany, and Canada are the leading donor countries of the CGIAR. Developing country members are Brazil, China, Colombia, Côte d'Ivoire, Egypt, India, Indonesia, Iran, Kenya, Mexico, Nigeria, the Philippines, and the Republic of Korea. The total annual CGIAR budget is some US$270 million.

The mission of the CGIAR is to contribute, through its research, to promoting sustainable agriculture for food security in developing countries. International centers supported by the CGIAR are part of a global agricultural research system. The CGIAR conducts strategic and applied research, with its products being international public goods, and focuses its research agenda on problem solving through interdisciplinary programs implemented by one or more of its international centers in collaboration with a full range of partners. Such programs concentrate on increasing productivity, protecting the environment, saving biodiversity, improving policies, and contributing to strengthening agricultural research in developing countries.

Food productivity in developing countries has increased through the combined efforts of CGIAR centers and their partners in developing countries. The same efforts have helped to bring about a range of other benefits, such as reduced prices of food, better nutrition, more rational policies, and stronger institutions. CGIAR centers have trained more than 45,000 agricultural scientists from developing countries over the past 20 years. Many of them form the nucleus of and provide leadership to national agricultural research systems in their own countries.