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CHAPTER 5 - FOOD SECURITY

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## CHAPTER 5

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## CHAPTER 5

### FOOD SECURITY: SUSTAINING THE POTENTIAL

1. The world produces more food per head of population today than ever before in human history. In 1985, it produced nearly 500 kilogrammes per head of cereals and root crops, the primary sources of food.<sup>1/</sup> Yet amid this abundance, some half a billion people were chronically hungry, and hunger and hunger-related diseases killed millions.<sup>2/</sup> There are places where too little is grown by too few; there are places where large numbers cannot afford to buy food. And there are broad areas of the Earth, in both developed and developing nations, where increases in food production are undermining the base for future food production.

2. The agricultural resources and the technology needed to feed growing populations are available. Much has been achieved over the past few decades. Agriculture does not lack resources; it lacks policies to ensure that the food is produced where it is needed and in a manner that sustains the livelihoods of the rural poor. We can meet this challenge by building on our achievements and devising new strategies for sustaining food and livelihood security.

I. ACHIEVEMENTS

3. Between 1950 and 1985, cereal production outstripped population growth, increasing from around 700 million tons to over 1,800 million tons, an annual growth rate of around 2.7 per cent.<sup>3/</sup> This increase helped to meet escalating demands for cereals caused by population growth and rising incomes in developing countries and by growing needs for animal feed in developed countries. Yet regional differences in performance have been large (see Table 5.1).

4. As production has increased sharply in some regions

TABLE 5-1

## Two Decades of Agricultural Development

|                         | Per Capita<br>Food Production<br>(Index 1961-64 = 100) |         | Per Capita<br>Gross Cropped Area<br>(Hectares) |      | Per Hectare<br>Fertilizer use<br>(kg.) |       |
|-------------------------|--|---------|--|------|--|-------|
|                         | 1961-64  | 1981-84 | 1964   | 1984 | 1964                                   | 1984  |
| <u>World</u>            | 100  | 112     | 0.44   | 0.31 | 29.3                                   | 85.3  |
| North America           | 100  | 121     | 1.05   | 0.90 | 47.3                                   | 93.2  |
| Western Europe          | 100  | 131     | 0.31   | 0.25 | 124.4                                  | 224.3 |
| Eastern Europe and USSR | 100  | 128     | 0.84   | 0.71 | 30.4                                   | 122.1 |
| <br>                    |  |         |  |      |  |       |
| Africa                  | 100  | 88      | 0.74   | 0.35 | 1.8                                    | 9.7   |
| Near East*              | 100  | 107     | 0.53   | 0.35 | 6.9                                    | 53.6  |
| Far East**              | 100  | 116     | 0.30   | 0.20 | 6.4                                    | 45.8  |
| Latin America           | 100  | 108     | 0.49   | 0.45 | 11.6                                   | 32.4  |
| CPE's of Asia***        | 100  | 135     | 0.17   | 0.10 | 15.8                                   | 170.3 |

\* An FAO grouping that includes West Asia plus Egypt, Libya and Sudan

\*\* An FAO grouping that covers South and South-East Asia excluding the centrally planned economies of Asia.

\*\*\*An FAO grouping of Centrally Planned Economies of Asia which covers China, Kampuchea, North Korea, Mongolia and Vietnam.

Source: Based on FAO data.

and demand in others, world trade in foods, especially cereals, has changed radically. North America exported barely 5 million tons of foodgrains yearly before the Second World War; it exported nearly 120 million tons during the 1980s. Europe's grain deficit is very much lower now, and the bulk of North American exports are to the USSR, Asia, and Africa. Three countries - China, Japan, and the USSR - take half the world exports; much of the rest goes to relatively wealthy developing countries, such as Middle Eastern oil exporters. Several poor agricultural countries, especially in sub-Saharan Africa, have become net importers of foodgrains. Still, although one-fourth of sub-Saharan Africa's population relied on imported grains in 1984, that region's imports have accounted for less than 10 per cent of world grain trade thus far in the 1980s.<sup>4/</sup>

5. Other foods besides grains are changing the patterns of world food demand and production. Demand for milk and meat is growing as incomes rise in societies that prefer animal protein, and much agricultural development in the industrialized nations has been devoted to meeting these demands. In Europe, meat production more than tripled between 1950 and 1984, and milk production nearly doubled.<sup>5/</sup> Meat production for exports increased sharply, particularly in the rangelands of Latin America and Africa. World meat exports have risen from around 2 million tons in 1950-52 to over 11 million tons in 1984.<sup>6/</sup>

6. Producing a lot of milk and meat requires a lot of livestock. In 1984, the planet supported about 1.4 billion cattle and buffaloes, 1.6 billion sheep and goats, 800 million pigs, and a great deal of poultry - all of which weigh more than the people on the planet.<sup>7/</sup> Most of these animals graze or browse or are fed local plants

collected for them. However, rising demands for livestock feedgrains led to sharp increases in the production of cereals such as corn, which accounted for nearly two-thirds of the total increase in grain production in North America and Europe between 1950 and 1985.

7. This unprecedented growth in food production has been achieved partly by an extension of the production base: larger cropped areas, more livestock, more fishing vessels, and so on. But most of it is due to a phenomenal rise in productivity. Population increases have meant a decline in the area of cropped land in most of the world in per capita terms. And as the availability of arable land has declined, planners and farmers have focused on increasing productivity. In the past 35 years this has been achieved by:

- using new seed varieties designed to maximize yields, facilitate multiple cropping, and resist disease.
- applying more chemical fertilizers, the consumption of which rose more than ninefold,<sup>8/</sup>
- using more pesticides and similar chemicals, the use of which increased 32-fold,<sup>9/</sup> and
- increasing irrigated area, which more than doubled.<sup>10/</sup>

8. Global statistics mask substantial regional differences (see Box 5-1). The impacts of new technology have been uneven, and in some respects the agricultural technology gap has widened. For instance, average African foodgrain productivity declined in relation to European productivity from roughly one-half to about one-fifth over the past three and a half decades. Even in Asia, where new technology has spread rapidly, productivity in relation to European levels dropped.<sup>11/</sup> Similar 'technology-gaps' have emerged between regions within countries.

9. The past few decades have seen the emergence of three broad types of food production systems. 'Industrial agriculture', capital- and input-intensive and usually large-scale, is dominant in North America, Western and Eastern Europe, Australasia, and in some small areas in developing countries. 'Green Revolution agriculture' is found in uniform, resource-rich, often flat and irrigated areas in the agricultural heartlands of some developing countries. It is more widely spread in Asia but is also found in parts of Latin America and North Africa. 'Resource-poor agriculture' relies on uncertain rain rather than irrigation and is usually found in developing regions difficult to farm - drylands, highlands, and forests - with fragile soils. This includes most of sub-Saharan Africa and the remoter areas of Asia and Latin America. Here, per capita production has been declining and hunger is a critical problem. But today, all three systems of food production display signs of crises that endanger their growth.

BOX 5-1

Regional Perspectives on Agricultural Development

Africa

- \* a drop in per capita food output of about 1 per cent a year since the beginning of the 1970s
- \* a focus on cash crops and a growing dependence on imported food, fostered by pricing policies and foreign exchange compulsions
- \* major gaps in infrastructure for research, extension, input supply, and marketing
- \* degradation of the agricultural resource base due to desertification, droughts, and other processes
- \* large untapped potential of arable land, irrigation, and fertilizer use

(Box 5-1 continued)

West Asia and North Africa

- \* improvements in productivity due to better irrigation, the cultivation of high-yielding varieties, and higher fertilizer use
- \* limited arable land and considerable amounts of desert, making food self-sufficiency a challenge
- \* need for controlled irrigation to cope with dry conditions

South and East Asia

- \* increased production and productivity, with some countries registering grain surpluses
- \* rapid growth in fertilizer use in some countries and extensive development of irrigation
- \* government commitments to be self-reliant in food, leading to national research centres, development of high-yielding seeds, and the fostering of location-specific technologies
- \* little unused land, and extensive, unabated deforestation
- \* growing numbers of rural landless

Latin America

- \* declining food imports since 1980, as food production kept pace with population growth over the last decade
- \* government support in the form of research centres to develop high-yielding seeds and other technologies
- \* inequitable distribution of land
- \* deforestation and degradation of the agricultural resource base, fueled partly by foreign trade and debt crisis
- \* a huge land resource and high productivity potential, though most of the potentially arable land is in the remote, lightly populated Amazon basin, where perhaps only 20 per cent of the land is suitable for sustainable agriculture

North America and Western Europe

- \* North America the world's leading source of surplus foodgrain, though the rate of increase in output per hectare and in total productivity slowed in the 1970s
- \* subsidies for production that are ecologically and economically expensive
- \* depressing effect of surpluses on world markets and consequent impact on developing countries
- \* a resource base increasingly degraded through erosion, acidification, and water contamination
- \* in North America, some scope for future agricultural expansion in frontier areas that can be intensively farmed only at high cost

(Box 5-1 continued)

Eastern Europe and the Soviet Union

- \* food deficits met through imports, with the Soviet Union being the world's largest grain importer
- \* increased government investment in agriculture accompanied by eased farm distribution and organization to meet desires for food self-reliance, leading to production increases in meat and root crops
- \* pressures on agricultural resources through soil erosion, acidification, salinization, alkalization, and water contamination

II. SIGNS OF CRISIS

10. Agricultural policies in practically all countries have focused on output growth. Despite this, it has proved far more difficult to raise world agricultural output by a consistent 3 per cent a year in the mid-1980s than it was in the mid-1950s. Moreover, production records have been offset by the appearance of linked economic and ecological crises: Developed countries are finding it increasingly difficult to manage their surplus food production, the livelihood base of millions of poor producers in developing countries is deteriorating, and the resource base for agriculture is under pressure virtually everywhere.

1. Impact of Subsidies

11. The food surpluses in North America and Europe result mainly from subsidies and other incentives that stimulate production even in the absence of demand. Direct or indirect subsidies, which now cover virtually the entire food cycle, have become extremely expensive. In the United States, the cost of farm support has grown from \$2.7 billion in 1980 to \$25.8 billion in 1986. In

the EEC, such costs have risen from \$6.2 billion in 1976 to \$21.5 billion in 1986.<sup>12/</sup>

12. It has become politically more attractive, and often cheaper, to export surpluses - often as food aid - rather than to store them. These heavily subsidized surpluses depress the international market prices of commodities such as sugar and have created severe problems for several developing countries whose economies are based on agriculture. Non-emergency food aid and low-priced imports also keep down prices received by Third World farmers and reduce the incentive to improve domestic food production.

13. The environmental consequences of a heavily subsidized production system are becoming evident within developed nations as well:<sup>13/</sup>

- lower productivity as soil quality declines due to intensive production and over-use of chemicals, fertilizers, and pesticides,
- the destruction of the countryside, through clearing of hedgerows, parkbelts, and other protective cover and the levelling, occupation, and cultivation of marginal land and watershed protection areas, and
- nitrate pollution of ground-water aquifers due to the often subsidized over-use of nitrate fertilizers.

14. The financial, economic, and environmental effects of the current incentive systems are beginning to be questioned by many governments and groups, including farm organizations. It is in the interests of all, including the agricultural industry, that they be changed. Their financial and economic burden must be reduced. The harm that unwanted surpluses do to the economic and resource base of Third World agriculture must be eliminated.

## 2. Neglect of the Small Producer

15. The new technology behind increases in agricultural productivity requires scientific and technological skills, a system for technology extension and other services for farmers, and commercial orientation in farm management. In the developing world these pre-conditions could be created in some places but not everywhere. And ecologically disadvantaged areas and land-poor rural masses did not benefit from advances in technology and will not until governments are willing and able to redistribute land and resources.

16. Agricultural support systems seldom take into account the special circumstances of subsistence farmers and herders. Subsistence farmers cannot afford the high cash outlay of modern inputs. Many are shifting cultivators who do not have a clear title to the land they use. They may plant a variety of crops on one plot to meet their own needs, and are thus unable to use methods developed for large stands of a single crop.

17. Many herders are nomadic and difficult to reach with education, advice, and equipment. They, like subsistence farmers, depend on certain traditional rights, which are threatened by commercial developments. They herd traditional breeds, which are hardy but rarely highly productive.

18. Women farmers, though they play a critical role in food production, are often ignored by programmes meant to improve production. In Latin America, the Caribbean, and Asia they form a large agricultural labour force, while most of sub-Saharan Africa's food is grown by women. Yet almost all agricultural programmes tend to neglect the special needs of women farmers.

### 3. Degradation of the Resource Base

19. Short-sighted policies are degrading the agricultural resource base on almost every continent: soil erosion in North America; soil acidification in Europe; deforestation and desertification in Asia, Africa, and Latin America; and waste and pollution of water almost everywhere. Within 40-70 years, a warmer world climate may cause the flooding of important coastal production areas. Some of these effects arise from trends in energy use and industrial production. Some arise from the pressure of population on limited resources. But agricultural policies emphasizing increased production at the expense of environmental considerations have also contributed greatly to this deterioration.

#### 3.1 Loss of Soil Resources

20. Increases in cropped areas in recent decades have often extended cultivation onto marginal lands prone to erosion. By the late 1970s, soil erosion exceeded soil formation on about a third of U.S. cropland, much of it in the midwestern agricultural heartland.<sup>14/</sup> In Canada, soil degradation has been costing farmers \$1 billion a year.<sup>15/</sup> In the USSR, the extension of cultivation to the so-called Virgin Lands was a major plank of agricultural policy, but now it is believed that much of this land is marginal.<sup>16/</sup> In India, soil erosion affects 25-30 per cent of the total land area including the area under cultivation.<sup>17/</sup> Without conservation measures, the total area of rainfed cropland in developing countries in Asia, Africa, and Latin America would shrink by 544 million hectares over the long term because of soil erosion and degradation, according to an FAO study.<sup>18/</sup>

21. Erosion makes soil less able to retain water, depletes it of nutrients, and reduces the depth available for the roots to take hold. Land productivity declines. Eroded topsoil is carried to rivers, lakes, and reservoirs, silts up ports and waterways, reduces reservoir storage capacity, and increases the incidence and severity of floods.

22. Poorly designed and implemented irrigation systems have caused waterlogging, salinization, and alkalization of soils. FAO and UNESCO estimate that as much as half the world's irrigation schemes suffer in some degree from these problems.<sup>19/</sup> These estimates indicate that some 10 million hectares of irrigated land are being abandoned each year.

23. Soil degradation erodes the overall resource base for agriculture. The loss of croplands encourages farmers to overuse the remaining land and to move into forests and onto rangelands. Sustainable agriculture cannot be based on methods that mine and deplete the soil.

### 3.2 Impact of Chemicals

24. Chemical fertilizers and pesticides have played a large role in production increases since the Second World War, but clear warnings have been raised against over-reliance on them. The run-off of nitrogen and phosphates from excess use of fertilizers damages water resources, and such damage is spreading.

25. Using chemicals to control insects, pests, weeds, and fungi enhances productivity, but overuse threatens the health of humans and the lives of other species. Continuing, long-term exposure to pesticide and chemical residues in food, water, and even in the air is hazardous, particularly to children. A 1983 study estimated that approximately 10,000 people died each year in developing countries from pesticide poisoning and about 400,000 suffered acutely.<sup>20/</sup> The effects are not limited to the area where pesticides are used but travel through the food chain.

26. Commercial fisheries have been depleted, bird species endangered, and insects that prey on pests wiped out. The number of pesticide-resistant insect pest species worldwide jumped from 25 in 1974 to 432 in 1980,<sup>21/</sup> and many resist even the newest chemicals. The variety and severity of pest infestations multiply, threatening the productivity of agriculture in the areas concerned.

27. The use of agricultural chemicals is not in itself harmful. In fact, the level of use is still quite low in many regions. In these areas, response rates are high and the environmental consequences of residues are not yet a problem. Hence these regions would benefit by using more agrochemicals. However, the growth in chemical use tends to be concentrated precisely where they may be doing more overall harm than good.

### 3.3 Pressure on Forests

28. Forests are crucial for maintaining and improving the productivity of agricultural land. Yet agricultural expansion, a growing world timber trade, and woodfuel demand have destroyed much forest cover. Although this destruction has occurred worldwide, today the greatest

challenge is in developing countries, particularly in tropical forests. (See Chapter 6.)

29. Growing populations and the decreasing availability of arable land lead poor farmers in these countries to seek new land in forests to grow more food. Some government policies encourage the conversion of forests to pastures and others encourage large resettlement schemes in forests. There is nothing inherently wrong with clearing forests for farming, provided that the land is the best there is for new farming, can support the numbers encouraged to settle upon it, and is not already serving a more useful function, such as watershed protection. But often forests are cleared without forethought or planning.

30. Deforestation most severely disrupts upland watersheds and the ecosystems that depend on them. The uplands influence precipitation, and the state of their soil and vegetation systems influence how this precipitation is released into the streams and rivers and onto the croplands of the plains below. The growing numbers and growing severity of both floods and droughts in many parts of the world have been linked to the deforestation of upland watersheds.<sup>22/</sup>

#### 3.4 Advancing Deserts

31. Some 29 per cent of the earth's land area suffers slight, moderate, or severe desertification; an additional 6 per cent is classified as extremely severe.<sup>23/</sup> In 1984, the world's drylands supported some 850 million people, of whom 230 million were on lands affected by severe desertification.<sup>24/</sup>

32. The process of desertification affects almost every region of the globe, but it is most destructive in the drylands of South America, Asia, and Africa; for these

three areas combined, 18.5 per cent (870 million hectares) of productive lands are severely desertified. Of the drylands in developing countries, Africa's Sahelian-Sudano zones and, to a lesser extent, some countries south of this zone suffer the most. In their arid and semi-arid lands are to be found 80 per cent of the moderately affected and 85 per cent of the severely affected people.<sup>25/</sup>

33. By 1983, desertification was costing the planet an estimated \$26 billion in lost production. Land permanently degraded to desert-like conditions continues to grow at an annual rate of 6 million hectares.<sup>26/</sup> Each year, 21 million additional hectares provide no economic return because of the spread of desertification.<sup>27/</sup> These trends are expected to continue despite some local improvements.

34. Desertification is caused by a complex mix of climatic and human effects. The human effects, over which we have more control, include the rapid growth of both human and animal populations, detrimental land use practices (especially deforestation), adverse terms of trade, and civil strife. The cultivation of cash crops on unsuitable rangelands has forced herders and their cattle onto marginal lands. The unfavourable international terms of trade for primary products and the policies of aid donors have reinforced pressures to encourage increasing cash-crop production at any cost.

35. A Plan of Action drawn up at the 1977 UN Conference on Desertification has led to some slight, mainly local gains.<sup>28/</sup> But progress on the plan has been hampered by lack of financial support from the international community, by inadequacies of the regional organizations established to respond to the regional nature of the problem, and by the lack of involvement of grass-roots

communities. In addition, the plan of action deals more with the environmental effects of desertification than with its root causes.

### III. THE CHALLENGE

36. Food demand will increase as populations increase and their consumption patterns change. In the remaining years of this century, about 1.4 billion people will be added to the human family (see Chapter 4); rising incomes, however, may account for 30 to 40 per cent of the increased demand for food in developing countries and about 10 per cent in developed nations.<sup>29/</sup> Thus over the next few decades, the global food system must be managed to increase food production by .3 to 4 per cent yearly.

37. Global food security depends not only on global production, but on shifting the focus of production to food-deficit countries, regions, and households. Many of the countries not growing enough food to feed themselves possess the largest remaining reservoirs of untapped agricultural resources. Latin America and sub-Saharan Africa have much unused land, although its quality and quantity vary greatly from nation to nation and much of it is ecologically vulnerable.<sup>30/</sup> The Soviet Union and parts of North America have significant amounts of frontier land suitable for agriculture; only Asia and Europe are truly land-starved.

38. Global food security also depends on ensuring that all people, even the poorest of the poor, can get food. While on the world scale this challenge requires a re-appraisal of global food distribution, the task weighs more immediately and heavily on national governments.

Inequitable distribution of production assets, unemployment, and underemployment are at the heart of the problem of hunger in many countries.

39. Rapid, sound agricultural development will mean not only more food but more opportunities for people to earn money to purchase food. Thus when countries with untapped agricultural resources provide food by importing more, they are effectively importing unemployment. This marginalizes people, and marginalized people are forced to destroy the resource base to survive. Shifting production to food-deficit countries and to the resource-poor farmers within those countries is a way of securing sustainable livelihoods.

40. Conserving the agricultural resource base and livelihood security of the poor can be mutually supportive in three ways. First, secure resources and adequate livelihoods lead to good husbandry and sustainable management. Second, they ease rural-to-urban migration, stimulate agricultural production from resources that otherwise would be underused, and reduce the need for food to be produced elsewhere. Third, by combating poverty, they help to slow population growth.

41. Shifting the focus of production to food-deficit countries will also reduce pressures on agricultural resources in the industrialized market economies, enabling them to move towards more sustainable agricultural practices. Incentive structures can be changed so that instead of encouraging overproduction, they encourage farm practices that improve soil and water quality. Government budgets will be relieved of the burdens of storing and exporting surplus products.

42. This shift in agricultural production will be sustainable only if the resource base is secure. As indicated, this is far from the case today. Thus to achieve global food security, the resource base for food production must be sustained, enhanced, and, where it has been diminished or destroyed, restored.

#### IV. STRATEGIES FOR SUSTAINABLE FOOD SECURITY

43. Food security requires more than good conservation programmes, which can be - and usually are - overridden and undermined by inappropriate agricultural, economic, and trade policies. Nor is it just a matter of adding an environmental component to programmes. Food strategies must take into account all the policies that bear upon the threefold challenge of shifting production to where it is most needed, of securing the livelihoods of the rural poor, and of conserving resources.

##### 1. Promote a Global Perspective

44. Trade in agricultural products tripled between 1950 and 1970; it has doubled since then. Yet, when it comes to farming, countries are at their most conservative, continuing to think mainly in local or national terms and concerned, above all, to protect their own farmers at the expense of competitors.

45. Shifting food production towards food-deficit countries will require a major shift in trading patterns. But the search for more rational production and trade patterns is overshadowed by forces that would maintain the momentum of existing processes. Countries must recognize that all parties lose through protectionist barriers,

which reduce trade in food products in which some nations may have genuine advantage. They must begin by redesigning their trade, tax, and incentive systems using criteria that include ecological and economic sustainability and international comparative advantage.

46. The incentive-driven surpluses in developed market economies increase pressures to export these surpluses at subsidized prices or as non-emergency food aid. Donor and receiving countries should consider the impacts of aid and use it for long-term objectives. It can be beneficially used in projects to restore degraded lands, build up rural infrastructure, and raise the nutrition level of vulnerable groups.

47. The developing world is a net food exporter. It may be sound policy to import some foods and export others, provided that nations involved in this process are able to protect the interests of their poor producers and consumers. They often are not, and Third World countries must reappraise their international food trade policies from this point of view.

48. International trade in agricultural inputs and technology - particularly products and technologies harmful to humans, animals, or plants - must also be re-examined to see how it fits in with the goals of sustainability. Each country should apply safeguards on the export of agricultural inputs and technologies that are banned or restricted in use within its own territory. Beyond this, some measure of international regulation is necessary when the harmful effects spill over national boundaries.

## 2. Reorient Government Intervention

49. Government intervention in agriculture is the rule in both developed and developing countries, and it is here to stay. Public investment in agricultural infrastructure is universal. Along with this infrastructure, agricultural research and extension services, assisted farm credit and marketing services, and a range of other support systems have all played parts in the successes of the last half century. In fact, the real problem in many developing countries is the weakness of these systems.

50. Intervention has taken other forms as well. Many governments regulate virtually the entire food cycle - inputs and outputs, domestic sales, exports, public procurement, storage and distribution, price controls and subsidies - as well as imposing various land use regulations: acreage, crop variety, and so on.

51. Present patterns of government intervention suffer three basic defects. First, the criteria that underlie the planning of these interventions lack an ecological orientation and are often dominated by short-term considerations. These criteria should discourage environmentally unsound farm practices and encourage farmers to maintain and improve their soils, forests, and waters.

52. The second defect is that agricultural policy tends to operate within a national framework with uniform prices and subsidies, standardized criteria for the provision of support services, indiscriminate financing of infrastructure investments, and so forth. Policies that vary from region to region are needed to reflect different regional needs, encouraging farmers to adopt practices that are ecologically sustainable in their own areas.

53. The third defect lies in incentive structures. In developed countries, tax reliefs, direct subsidies, and price controls as they apply to agriculture represent the accumulated result of annual responses to short-term pressures. In recent years, these systems have lost whatever coherence they may have had. They are now studded with contradictions that encourage the degradation of the agricultural resource base and, in the longer run, do more harm than good to the agricultural industry.

54. On the other hand, in most developing countries the incentive structure is weak. Market interventions are often ineffective for lack of an organizational structure for procurement and distribution. Farmers are exposed to a high degree of uncertainty, and price support systems have often favoured the urban dweller or are limited to a few commercial crops, leading to distortions of cropping patterns that add to destructive pressures on the resource base.

55. Strengthening food security from a global point of view requires reducing incentives that force overproduction and non-competitive production in the developed market economies and enhancing those that encourage food production in developing countries. At the same time, these incentive structures must be redesigned to promote farming practices that conserve and enhance the agricultural resource base.

56. Criteria now used to evaluate policy and monitor performance focus on production and input use. They need to be widened to cover impacts on the agricultural resource base. Thus each nation should strengthen its capability for monitoring the use of basic agricultural assets like land and water at all levels. The ecosystem concept should be built into the methodology and hierarchical structure of such a monitoring system.

### 3. Sustain and Enhance the Resource Base

57. Agricultural production can only be sustained on a long-term basis if the land, water, and forests on which it is based are not degraded. As suggested, a reorientation of public intervention will provide a framework for this. But more specific policies that protect the resource base are needed to maintain and even enhance agricultural productivity and the livelihoods of all rural dwellers.

#### 3.1 Promote the Best Use of Land and Restore Destroyed Areas

58. The initial task in enhancing the resource base will be to delineate broad land categories:

- enhancement areas, which are capable of sustaining intensive cropping and higher population and consumption levels;
- prevention areas, which by common consent should not be developed for intensive agriculture or, where developed, should be converted to other uses; and
- restoration areas, where land stripped of vegetative cover has either totally lost its productivity or had it drastically reduced.

59. Identifying land according to 'best use' criteria requires information that is not always available. Most industrial nations possess inventories and descriptions of their lands, forests, and waters that are detailed enough to provide a basis for delineating land categories. Few developing countries have such inventories, but they can and should develop them quickly using satellite monitoring and other rapidly changing techniques.

60. Selection of land for each category could be made the responsibility of a board or commission representing the interests involved, especially the poor and more marginalized segments of the population. The process must be public in character, with publicly agreed criteria that combine the best use approach with the level of development required to sustain livelihood. Classifying land according to best use will determine variations in infrastructure provision, support services, promotional measures, regulatory restrictions, fiscal subsidies and other incentives and disincentives.

61. Lands identified as prevention areas should be denied supports and subsidies that would encourage their development for intensive agriculture. But such areas might well support certain ecologically and economically sustainable uses such as grazing, fuelwood plantations, fruit farming, and forestry. Those redesigning support systems and incentives should focus on a broader range of crops, including those that enhance grazing, soil and water conservation, and so on.

62. In vast areas today natural factors and land use practices have reduced productivity to a point too low to sustain even subsistence farming. Treatment of these areas must vary from site to site. Governments should give priority to establishing a national policy and multi-disciplinary programmes and to creating or strengthening institutions to restore such areas. Where these already exist, they should be better coordinated and designed. The UN Plan of Action to Combat Desertification that is already in place requires more support, particularly financial.

63. Restoration may require limits on human activities so as to permit the regeneration of vegetation. This can be difficult where there are large herds of animals or large numbers of people, for the agreement and participation of the local people are of the highest importance. The state, with the cooperation of those living locally, could protect these areas by declaring them national reserves. Where these areas are privately held, the state might wish either to purchase the land from the owners or to provide incentives for its restoration.

### 3.2 Improve Water Management

64. Improvements in water management are essential to raise agricultural productivity and to reduce land and water degradation. Critical issues concern the design of irrigation projects and the efficiency of water use.

65. Where water is scarce, an irrigation project should maximize productivity per unit of water; where water is plentiful, it must maximize productivity per unit of land. But local conditions will dictate how much water can be used without damaging the soil. Salinization, alkalization, and waterlogging can be avoided by a more careful approach to drainage, maintenance, cropping patterns, the regulation of water quantities, and more rational water charges. Many of these objectives will be easier to realize in small-scale irrigation projects. But whether small or large, the projects must be designed with the abilities and aims of the participating farmers in mind, and then involve them in the management.

66. In some areas excessive use of ground-water is rapidly lowering the water table - usually a case where private benefits are being realized at society's expense.

Where ground-water use exceeds the recharge capacity of local aquifers, regulatory or fiscal controls become essential. The combined use of ground and surface water can improve the timing of water availability and stretch limited supplies.

### 3.3 Develop Alternatives to Chemicals

67. Many countries can and should increase yields by greater use of chemical fertilizers and pesticides, particularly in the developing world. But countries can also improve yields by helping farmers to use organic nutrients more efficiently. Hence governments must encourage the use of more organic plant nutrients to complement chemicals. Pest control must also be based increasingly on the use of natural methods (see Box 5-2). These strategies require changes in public policies, which now encourage the increased use of chemical pesticides and fertilizers. The legislative, policy, and research capacity for advancing non-chemical strategies must be established and sustained.

68. Chemical fertilizers and pesticides are heavily subsidized in many countries. These subsidies promote chemical use precisely in the more commercially oriented agricultural areas where their environmental damage may already outweigh any increases in productivity they bring. Hence different regions will require different policies to regulate and promote chemical use.

69. Legislative and institutional frameworks for controlling agrochemicals must be greatly strengthened everywhere. In developed countries, governments should ensure that these systems are structured so that they are not subordinate to ministers and senior officials whose overriding aim is to increase next year's yield. Developing countries must possess the basic legislative

and institutional instruments to manage the use of agricultural chemicals within their countries. And they will need technical and financial assistance to do so.

BOX 5-2

Natural Systems of Nutrient Supply and Pest Control

- \* Crop residues commonly burnt in fields and farmyard manure are potential sources of soil nutrients.
- \* Organic wastes reduce run-off, increase the take-up of other nutrients, and improve soil's water-holding and erosion-resistance capacity.
- \* Using livestock manure, especially in conjunction with intercropping and crop rotation, can greatly lower production costs.
- \* Overall systems efficiency is enhanced if manure or vegetable biomass is anaerobically digested in biogas plants, yielding energy to run pumps, motors, or electric generators.
- \* Natural systems of biological nitrogen fixation through the use of certain annual plants, trees, and microorganisms have a high potential.
- \* Integrated pest management (IPM) reduces the need for agrochemicals, improves a country's balance of payments, releases foreign exchange for other development projects, and creates jobs where they are most needed.
- \* IPM requires detailed information about pests and their natural enemies, seed varieties tailored to pests, integrated cropping patterns, and farmers who support the approach and are willing to modify farm practices to adopt it.

3.4 Integrate Forestry and Agriculture

70. Forests can provide many different goods and services at the same time. (See Chapter 6 for a discussion of other forest policy issues.) Sound forest policies can be based only on an analysis of the capacity of the forests and the land under them to perform various functions. Such an analysis might lead to some forests being cleared for intensive cultivation, others for livestock; some forest land might be converted for

increased timber production or agroforestry use and some left intact for watershed protection, recreation, or species conservation. But the extension of agriculture into forest areas must be based on scientific land capacity classification.

71. Forestry can also be extended into agriculture. Farmers can use agroforestry systems to produce food and fuel. In such systems, one or more tree crops are combined with one or more food crops or animal farming on the same land, though sometimes at different times. Well-chosen crops reinforce each other and yield more food and fuel than when grown separately. The technology is particularly suitable for small farmers and for poor-quality lands. Agroforestry has been practised by traditional farmers everywhere. The challenge today is to revive the old methods, improve them, adapt them to the new conditions, and develop new ones.

72. International forestry research organizations should work in various tropical countries in various ecosystems along the lines now followed by the Consultative Group on International Agricultural Research. And new forestry research bodies are needed. The interrelationships between forests and agriculture should also be studied by these organizations, and more research done in increasing forestry's role in agricultural production. These research organizations should also work in agroforestry and should attempt to develop models that better predict the effects on water and soil loss, for example, of removing specific portions of forest cover.

### 3.5 Promote Aquaculture

73. Fisheries and aquaculture are critical to food security in that they provide both protein and employment. The greater part of world fish supply comes

from marine fisheries, which yielded 76.4 million tons in 1983. Landings have increased by 1 million tons per year over the past few years; by the end of the century, a catch of around 100 million tons should be possible.<sup>31/</sup> This is well short of the projected demand. There are indications that much of the naturally available freshwater fish stocks are fully exploited or damaged by pollution.

74. Aquaculture, or 'fish-farming', which differs from conventional fishing in that fish are deliberately reared in controlled water bodies, can help to meet future needs. Yields from aquaculture have doubled during the last decade and now represent about 10 per cent of world production of fishery products.<sup>32/</sup> A five- to tenfold increase is projected by the year 2000, given the necessary scientific, financial, and organizational support.<sup>33/</sup> Aquaculture can be undertaken in paddy fields, abandoned mining excavations, small ponds, and many other areas with some water, and on various commercial scales: individual, family, cooperative, or corporate. The expansion of aquaculture should be given a high priority in developing and developed countries.

#### 4. Increase Productivity and Yields

75. The conservation and enhancement of agriculture's resource base will increase production and productivity. But specific measures are required to make inputs more effective. This is best done by strengthening the technological and human resource base for agriculture in developing countries.

#### 4.1 Strengthen the Technological Base

76. Blends of traditional and modern technologies offer possibilities for improving nutrition and increasing rural employment on a sustainable basis. Biotechnology, including tissue culture techniques, technologies for preparing value-added products from biomass, micro-electronics, computer sciences, satellite imagery, and communication technology are all aspects of frontier technologies that can enrich rural professions.

77. Providing sustainable livelihoods for resource-poor farmers presents a special challenge for agricultural research. The major advances in agricultural technology in recent decades are better suited to stable, uniform, resource-rich conditions with good soils and ample water supplies. New technologies are most urgently needed in sub-Saharan Africa and the remoter areas of Asia and Latin America, which typically have unreliable rainfall, uneven topography, and poorer soils, and hence are unsuited to Green Revolution technologies.

78. To serve agriculture in these areas, research has to be less centralized and more sensitive to farmers' conditions and priorities. Scientists will need to start talking to poor farmers and basing research priorities on growers' priorities. Researchers must learn from and develop the innovations of farmers. More adaptive research should be done right on the farm, using research stations for referral and with farmers eventually evaluating the results.

79. Commercial enterprises can help develop and diffuse technology, but public institutions must provide the essential framework for agricultural research and extension. Few academic and research institutions in

developing regions are adequately funded. The problem is most acute in the low-income countries, where expenditure on agricultural research and extension amounts to 0.9 per cent of total agricultural income, as against 1.5 per cent in the middle income countries.<sup>34/</sup> Research and extension efforts must be greatly expanded, particularly in areas where climate, soils, and terrain pose special problems.

80. These areas particularly will need new seed varieties, but so will much developing-country agriculture. At present, 55 per cent of the world's scientifically stored plant genetic resources are controlled by institutions in developed countries, 31 per cent by institutions in developing countries, and 14 per cent by International Agricultural Research Centres.<sup>35/</sup> Much of this genetic material originated in developing countries.

81. These gene banks must increase their inventories of material, improve their storage techniques, and ensure that the resources are readily accessible to research centres in developing countries. Private companies increasingly seek proprietary rights to improved seed varieties, often without recognizing the rights of the countries from which the plant matter was obtained. This could discourage countries rich in genetic resources from making these internationally available and thus reduce the options for seed development in all countries. The genetic research capabilities of developing countries are so limited that agriculture there could become excessively dependent on private gene banks and seed companies elsewhere. Thus international cooperation and a clear understanding on the sharing of gains are vital in critical areas of agricultural technology, such as the development of new seed varieties.

#### 4.2 Build Up Human Resources

82. The technological transformation of traditional agriculture will be difficult without a matching effort to develop human resources. (See Chapter 4.) Educational systems must be reformed to produce researchers more attuned to the needs of rural peoples and agriculture. These programmes can also provide a vital link between researchers and producers by helping young people to act as agents for change.

83. Illiteracy is still widespread among the rural poor. But efforts to promote literacy could coincide with efforts to teach a 'technical literacy' covering the efficient use of land, water, and forests. Non-formal education centres, indigenous drama presentations, and the modern mass media should all be used to spread the word.

84. Despite women's critical role in agriculture, their access to education and their representation in research, extension, and other support services is woefully inadequate. Women should be given the same educational opportunities as men. There should be more female extension workers, and women should participate in field visits. Women's organizations should be given more power to take decisions regarding agricultural and forestry programmes.

#### 4.3 Increase Input Productivity

85. In traditional agriculture, local organic material provided farmers with sources of energy, nutrients, and ways of controlling pests. Today, these needs are increasingly met by electricity, petroleum products, chemical fertilizers, and pesticides. The cost of these

inputs forms a growing proportion of agricultural costs, and wasteful use does economic and ecological harm.

86. One of the most important energy-related needs is mechanical power for irrigation. The efficiency of pumps could be greatly improved by providing appropriate incentives for equipment producers and farmers, and through effective extension work. Energy for irrigation pumps can also be provided by wind generators or by conventional internal combustion engines running on biogas produced from local biomass wastes. Solar dryers and solar coolers can save agricultural products. These non-conventional sources should be promoted, particularly in areas poor in energy resources.

87. All farmers using pesticides and chemical fertilizers need to learn how best to use them. Nutrients are lost when fertilizers are improperly applied. Often they leach away with the flow of water in a field and degrade local water supplies. Similar problems of waste and destructive side effects occur in the use of pesticides. Hence extension systems and chemical manufacturers should undertake programmes to promote careful and economical use of these expensive, toxic materials.

#### 5. Ensure Equity

88. The challenge of sustainable agriculture is to raise not just average productivity and incomes, but also the productivity and incomes of those poor in resources. And food security is not just a question of raising food production, but of ensuring that the rural and urban poor do not go hungry during the short term or midst a local food scarcity. All this requires the systematic promotion of equity in food production and distribution.

### 5.1 Accelerate Land Reforms

89. Land reform is basic. Without it, institutional and policy changes meant to protect the resource base can actually promote inequalities by shutting the poor off from resources and by favouring those with large farms, who are better able to obtain the limited credit and services available. By leaving hundreds of millions without options, such changes can have the opposite of their intended effect, ensuring the continued violation of ecological imperatives.

90. Given institutional and ecological variations, a universal approach to land reform is impossible. Each country should work out its own programme of land reform to assist the land-poor and to provide a base for coordinated resource conservation. The redistribution of land is particularly important where large estates and vast numbers of the land-poor coexist. Crucial components include the reform of tenancy arrangements, security of tenure, and the clear recording of land rights. In areas where holdings are fragmented into many non-contiguous plots, land consolidation can ease the implementation of resource conservation measures. Promoting cooperative efforts by small farmers - in pest control or water management, for instance - would also help conserve resources.

91. In many countries women do not have direct land rights; titles go to men only. In the interests of food security, land reforms should recognize women's role in growing food. Women, especially those heading households, should be given direct land rights.

## 5.2 Protect Subsistence Farmers and Pastoralists

92. Subsistence farmers and pastoralists threaten the environmental resource base when processes beyond their control squeeze their numbers onto land or into areas that cannot support them. Rather than further eroding their security, public policy should instead provide them with sustainable livelihoods.

93. The traditional rights of subsistence farmers, particularly shifting cultivators and pastoralists, must be protected from encroachments. When their traditional practices threaten the resource base, their rights may have to be curtailed, but only when alternatives have been provided. Most of these groups must be helped to enter the market economy on reasonable terms.

94. Research should give early attention to the varied requirements of the mixed farming typical in subsistence agriculture. Extension and input supply systems must become mobile to reach shifting cultivators and nomads. The cash income required by these households must be provided through employment programmes and some cash-crop production. Public investment should be used to improve their cropland, grazing areas, and water sources.

## 5.3 Promote Integrated Rural Development

95. Rural populations will continue to increase in many countries. With existing patterns of land distribution, the number of smallholders and landless households will increase by about 50 million, to nearly 220 million, by the year 2000.<sup>36/</sup> Together, these groups represent three-quarters of the agricultural households in developing countries.<sup>37/</sup> Without adequate livelihood

opportunities, these resource-poor households will remain poor and be forced to overuse the resource base to survive.

96. Land reform can help, but alone is not enough. Distribution of inputs and services to these groups must be improved. Smallholders, including and especially women, must be given preference in developing new land and irrigation schemes and in using technology. Small farmers must be given more say in formulating agricultural policies, with their experiences and views on resource management being sought through associations and clubs linked to central seats of power through local governments.

97. Agricultural development by itself cannot absorb the large increases in rural working populations expected in most developing countries. Hence to minimize resource degradation and to avoid an unmanageable rural-urban drift, non-agricultural work opportunities should be promoted in rural areas. Successful agricultural development and the growth in incomes will open up opportunities in service activities and small-scale manufacturing. Public policy should support such development and assist the rural poor to avail themselves of these opportunities.

98. The pursuit of sustainable agriculture must be one part of the broad-based, integrated development of rural areas. Key elements of this integrated pattern include:

- resource conservation and production increase,
- area development and anti-poverty programmes,
- agricultural and non-agricultural work opportunities,
- small town and village development, and
- increases in private and public investments.

#### 5.4 Insure Against Fluctuations in Food Availability

99. Environmental degradation can make food shortages more frequent and more severe. Hence sustainable agricultural development will reduce the season-to-season variability in food supplies. But such systems cannot eliminate it. There will be weather-induced fluctuations, and the growing dependence on only a few crop varieties over large areas may amplify the effects of weather and pest damage. Often it is the poorest households and the ecologically disadvantaged regions that suffer most from these shortages. Agricultural policy at the national and global level must be designed to cope with the effects of these production variations.

100. Food stocks are crucial in dealing with shortages. At present, the world stock of cereals is on the order of 20 per cent of annual consumption: The developing world controls about one-third of the stock and the developed world, two-thirds. More than half the developing-country stock is in two countries - China and India. Stock levels in most of the others provide only for immediate operational requirements; there is little by way of a reserve.<sup>38/</sup>

101. The food stocks of the developed countries are essentially surpluses, and provide a basis for emergency assistance, which must be maintained. But emergency food aid is a precarious basis for food security; developing countries should build up national stocks in surplus years to provide reserves for deficit ones. To do this, they will need an effective system of public intervention in the purchase, storage, transportation, and distribution of food. Special attention must be paid to the needs of poor

households, of regions prone to weather stress, and of areas where a shift away from subsistence food production is ecologically desirable.

102. During most food shortages, poor households not only cannot produce food but also lose their usual sources of income and cannot buy the food that is available. Hence food security also requires that purchasing power be put in the hands of disaster-struck households, perhaps through contingency plans to quickly establish an emergency public works programme.

#### 6. Provide Financial and Institutional Support

103. Only national governments and local people can take the actions needed to reverse the steady deterioration of the resource base. Outside assistance, however large, cannot substitute for essential national action. Nevertheless, any such effort by developing countries to put agriculture on an ecologically and economically sustainable footing will continue to require external finance. Governments will need assistance to invest in the agricultural development of raw lands in Africa and Latin America and in sustainable means of increasing yields and productivity; to finance infrastructural needs, research institutes, extension services, and human resource development; to control erosion, desertification, and deforestation; and to promote understanding of approaches that ensure sustainable livelihoods.

104. Donor agencies and international institutions must help more with projects that promote these objectives. Countries providing support must take care that it does not distort national and regional priorities. Receiving governments and communities are now often stretched to the limits of their capacity in coping with the many

well-intentioned but often poorly coordinated helpers and projects.

105. Governments must recognize, and then build into their institutions the recognition, that ecological security is a priority goal of all manifestations of agricultural policy. Reaching this goal will involve broadening and reinforcing the mandates of the economic, finance, planning, trade, and other central agencies of government, making them individually and collectively responsible for ensuring that their policies enhance the ecological basis for food security, now and into the distant future.

106. Regional technical support and information are needed for ecologically oriented agricultural policies, especially when and where ecological causes and effects spill across national boundaries. Regional organizations should be strengthened by member governments, with the help of donor countries. These organizations should monitor environmental development on a regional basis and stimulate regional cooperation. The goal of ecological security should be embedded firmly in agricultural, trade, and other relevant mandates of all appropriate international agencies.

#### V. FOOD FOR THE FUTURE

107. The challenge of increasing food production to keep pace with demand, while retaining the essential ecological integrity of production systems, is colossal both in its magnitude and complexity. But we have the knowledge that we need to conserve our land and water resources. New technologies provide opportunities for increasing productivity while reducing pressures on resources. A new generation of farmers combine experience with education.

With these resources at our command, we can meet the needs of the human family. Standing in the way is the narrow focus of agricultural planning and policies.

108. The agricultural systems that have been built up over the past few decades have contributed greatly to the alleviation of hunger and the raising of living standards. They have served their purposes up to a point; but they were built for the purposes of a smaller, more fragmented world. New realities reveal their inherent contradictions. These realities require agricultural systems that focus as much attention on people as they do on technology, as much on resources as on production, as much on the long term as on the short term. Only such systems can meet the challenge of the future.