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MEMORANDUM

TO : All Members of the World Commission on Environment and
Development

FROM : Shimwaayi Muntamba
Senior Programme Officer

DATE : 5 September 1986

RE : Sixth Meeting of the Commission

Please find attached the draft chapter on Food Security, Agriculture, Forestry and Environment, entitled: SUSTAINABLE FOOD SECURITY - CHALLENGES AND STRATEGIES.

The point of departure for the analysis and proposals and final shape of the chapter was the Advisory Panel Report on Food Security. This has been enriched by Commissioners' reactions to the Report in Ottawa, by two of the Commissioners' comments on the first draft of this chapter and by the comments of about a dozen people from IGOs and NGOs and citizens who have read the Advisory Panel Report.

In its present form, the chapter does not contain a summary at the end, as suggested by one of the Commissioners. It was thought that this could be better effected after the discussion in Harare.

CHAPTER V

SUSTAINABLE FOOD SECURITY: CHALLENGES AND STRATEGIES

STRATEGIES FOR SUSTAINING FOOD SECURITY

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CHAPTER V

SUSTAINABLE FOOD SECURITY: CHALLENGES AND STRATEGIES*

I. THE CHALLENGE: TODAY AND TOMORROW

1. Many ancient centres of agriculture have thrived through the millenia, tending their ecological foundations in the face of all forms of natural and human strife. China, for example, is home to the "farmers of 50 centuries", whose adaptive methods of restoring soil fertility have enabled them to harvest crops from limited land for more than 7,000 years. In contrast, the once rich lands of some other early civilizations are today useless deserts, a process triggered by a mismanagement or neglect of their ecological foundations. And some areas that were considered hopeless wastelands at the turn of this century are now fertile farming areas, a consequence of human ingenuity and agricultural practice encouraged by enlightened policies designed to turn around centuries of neglect.

2. Yet, despite this accumulated knowledge, human ingenuity and enlightened policies, today we live in a world of cruel paradox. In 1985 the world produced over 1,800 million

*This chapter draws heavily on the Advisory Panel Report: Food Security, Agriculture, Forestry and Environment prepared by a Panel of specialists to guide the Commission's work in this area. The Commission is grateful to the Panel for its outstanding input.

metric tons (mt) of cereal, 582 million mt of root crops, 148 million mt of meat and 507.5 million mt of milk to feed 4.8 billion people.^{1/} In this year of record achievement, about 20 per cent of the world's population lived in absolute poverty, in conditions of unacceptable deprivation, squalor and misery, unable to produce or purchase food and other basic needs. Between 13 to 18 million recorded deaths resulted from hunger and hunger-related diseases; every minute saw the death of 18 children under five years of age; while over 500 million people were reported as chronically hungry.^{2/} In that same year, one of the world's six continents, Africa, experienced the worst recorded food crisis in history.

3. At the same time, the rising mountains of food in the industrialized market economies and some developing countries were seen as a problem which, in fact, they are. The real menace behind these mountains are the interrelated and ecologically blind agricultural, economic, trade and aid policies. Generating surpluses, they cause problems to the countries that produce and store them and also to countries in other regions. In the producing countries, rich subsidy structures impose a growing burden on budgets and induce farm practices which threaten the ecological base of agriculture, particularly soil fertility, vegetation and water. Concern about their impact on public finance has been growing for some time and their threat to the sustainability of agriculture is beginning to be recognized. Their adverse impacts on sustainable agriculture and associated livelihoods in many developing countries has, however, hardly registered.

4. The processes are complex and varied but the broad lines are clear and they are generally unsustainable.^{3/} The generation and distribution of subsidized surpluses, either on commercial or concessional terms, depress prices; compete unfairly with producers in developing countries who need to export to earn foreign exchange; reduce incentives for local food production; destroy the livelihoods of the poor; and add to the forces in many developing countries that push rising

numbers of rural dwellers into marginal areas and activities where, in order to survive, they are driven to damage the environment on which they depend.

5. In much environment thinking, conservation of resources is the prime aim, and poor people are seen as a problem to be managed, especially by limiting their access to natural resources. In much development thinking, production of food and other commodities is the prime aim, and the poor are supposed to benefit from the fact that food is available on the market. But neither of these approaches tackles the interdependent problem of the poor themselves, their livelihoods, resources and entitlements. Yet the two, conservation of the agricultural resource base and security of sustainable livelihoods* and resource entitlements for the poor, are interlocked and can be made mutually supporting. Indeed, looking to the year 2000 and beyond, food production cannot be sustained in pace with rapidly rising demands unless livelihoods and entitlements are.

6. The projected growth in food demand presents another formidable challenge. This growth in demand stems from two main sources: population and incomes. In the remaining 13 years of this century, about 1.4 billion members will be added to the human family. It will double 40 years later and could reach 10.2 billion, at medium-range projections, before stabilizing around the end of the next century. Rapidly

* Livelihood is defined as adequate stocks and flows of food and cash to meet basic needs. Security refers to secure ownership of or access to resources and income-earning activities, including reserves and assets to offset risk, ease shocks and meet contingencies. Sustainable refers to the maintenance or enhancement of resource productivity on a long-term basis. A household may be enabled to gain sustainable livelihood security in many ways - through ownership of land, livestock, or trees, or rights to grazing, fishing, hunting or gathering.

rising incomes in many countries will also fuel the demand for food. It may account for 30 to 40 per cent of the increase in developing countries and about 10 per cent in developed countries. This unprecedented growing demand means that over the next few decades, the global food system must be managed to secure 3 to 4 per cent annual increases in production which must be evenly distributed, and ecologically, socially and economically sustainable.

7. Increases in average income will not, however, quell the hunger of the many with very low incomes. The nearly 20 per cent of the world's population who suffer from starvation and malnutrition do so not because there is a shortage of food, but because they do not possess the income needed to command their share. The problem and challenge facing the world community today and will remain tomorrow unless fundamental changes in food production and distribution are made, is not insufficient food supplies nor is it one of global food production being outstripped by population. To the contrary, foodgrain production has been rising faster than population, although note should be taken that over the last decade production rates have slowed down from 3.1 to 2.2 per cent per year, narrowing the margin between growth in food production and that of population, at 1.8 per cent per year.

8. The problem is where the food is produced, by whom and who can command it. From Table I, we can see the imbalance between cereal production and population growth by region. Between 1970 and 1982 these imbalances were most serious in parts of Africa and Europe.

Table I: Cereal Production and Population Growth, 1970-82

	Average annual percentage change		
	Cereal production	population	Cereal production per capita
World	2.3	1.8	0.5
Developing economies	3.0	2.1	0.9
East Africa	0.8	3.0	-2.2
West Africa	1.9	2.7	-0.8
Middle East and North Africa	1.7	2.9	-1.2
East Asia and the Pacific	3.5	1.7	1.8
South Asia	2.7	2.4	0.3
Latin America and Caribbean	3.2	2.4	0.8
Industrial market economies	2.3	0.7	1.6
East European non-market economies	0.6	0.8	-0.2

Note: Cereal production includes wheat, rice, maize, rye, sorghum, millet, barley, oats, and mixed grains. All growth rates in all tables have been computed using the least-squares method.

Source: World Bank calculations based on USDA data.

9. Useful distinctions can be made between three types of food production systems. The first type is represented by industrial agriculture, which is capital and input-intensive and usually large-scale. It is dominant in North America, Europe, Australasia, the East European non-market economies and in their enclaves in developing countries. Second, there is the "green revolution" agriculture found in uniform, resource-rich, often flat and irrigated conditions. It includes 'core' or agricultural heartland areas in developing countries. It is more widely spread in Asia but is also found in parts of Latin America and North Africa. The third type is resource-poor agriculture in developing countries usually in rainfed and often ecologically diverse, complex and vulnerable conditions with undulating topography. This predominates over most of sub-Saharan Africa and the hinterlands and remoter areas in Asia and Latin America. Here, the per capita production has been declining and the lack of access to food is most menacing.

10. But to shift or increase production on a sustainable basis will depend on a secure resource base. Today, the threat to the agricultural resource base is in evidence everywhere: in industrialized market and centrally-planned economy countries, in their enclaves in the industrializing countries, in green revolution countries as well as in the hinterlands. Poor land-use patterns, unsustainable methods of production, over-exploitation of the resources such as forests, industrial pollution pushed on by short-term, ecologically blind agricultural policies which many governments follow all combine to undermine the life-support systems of land, water, flora and fauna - the basis of food security. Soil erosion, salinization and alkalization, soil and water contamination, deforestation, man-induced or at least man-abated desertification, acid rain, unfavourable climatic changes are observable everywhere.

11. At the global scale, the food security problem arises from the growing imbalance between the geographical patterns of food production on the one hand and population and income growth, the two major components of demand, on the other hand. At the national and local scale, and household level, the problem arises from unsustainable production systems and from the fact that growing populations lack the means to ensure access to food.

12. Global food security, then, depends on shifting the focus of food production to those continents and countries where it is most needed. The challenge of sustainable livelihood security, though widespread, is concentrated in certain developing countries and regions. The strategy of shifting production to the food deficit countries and to the resource-poor farmers within those farmers is a way of meeting this challenge. Many of these countries, especially in Latin America, possess the largest remaining reservoir of untapped agricultural resources. Others, including many in Asia with a far more unfavourable ration of population to resources, have managed to maintain or increase productivity at rates that compensate for falling population/resource ratios.

13. We see from Table II that Latin America and sub-Saharan Africa are especially well endowed with land resources, although aggregate figures mask the high variability of land quality between the land-abundant and land-short countries and the quality and vulnerability of the unexploited arable lands. The Soviet Union and part of North America have some significant amounts of frontier land left that is suitable for agriculture; only Asia and Europe are truly land-starved regions.

Table II : Total Land Area and Arable Land by Continent

Continents	Total land area	Cultivated land	Potential arable land	% of land area cultivated	Ratio of cultivated to arable land, %
	in millions of hectares				
Africa	3,010	158	734	5.2	22
Asia	2,740	519	627	18.9	83
Australia & New Zealand	820	32	153	3.9	21
Europe	480	154	174	32.1	88
North America	2,110	239	465	11.3	51
South America	1,750	77	681	4.4	11
USSR	2,240	227	356	10.6	64
Total	13,150	1,406	3,190	10.6	44

Source: Bradley. Report to the President of USA. (UN, 1982)

14. Global Food Security depends equally on ensuring access to food by all, even the poorest of the poor. Indeed, as mentioned above, the two are interdependent and can be made mutually supportive. It is worth noting that 50 per cent of the world's hungry people are found in just five countries, four in Asia where the green revolution has taken place, one of those a country recording surpluses nationally; and one in Africa which enjoys higher incomes per capita than most other countries in the region. Inequitable distribution of production assets and lack of access to income-earning activities by the poor against a background of population increases are at the heart of the problem of hunger in those countries.

15. Fighting the famine of jobs in these countries is allied to fighting the famine of food. Rapid agricultural development is crucial both to generate the livelihoods necessary to purchase food and to increase its availability. To a large extent, rural development in the developing world implies the generation of land and water-based occupations such as crop and animal husbandry, horticulture, fisheries and forestry. In view of this, if countries with untapped agricultural resources respond to rising food demands by increasing food imports, effectively they will be importing unemployment. They will be adding to marginalization and destructive poverty pressures on the resource base.

16. Shifting the locus of production to food deficit continents and countries will also reduce pressure on agricultural resources in the industrialized market economies and make possible a transition to more sustainable agricultural practices in these countries. Incentive structures can be changed so that they not only support the present and future income prospects of farmers, which is essential, but also encourage farm practices which sustain and even enhance rather than degrade the soil and water base for agriculture. At the same time, the enormous and growing budget burden of subsidies for the storage and export of surplus products can be reduced and eliminated. This would correspondingly reduce political pressures for protectionist measures against food products on which many developing countries depend and in which they have a clear comparative advantage.

17. The goals of shifting an increasing proportion of food production to food-deficit countries, and to the resource-poor farmers within those countries, as well as securing sustainable production everywhere and of ensuring greatly increased on- and off-farm employment must be at the heart of a global strategy for food security. If these goals are to be achieved, it is essential that the resource base for food production be generally sustained and enhanced and, where it has been diminished and destroyed, restored. This will require a steady

reorientation of the global and of national food systems, bringing ecological and social considerations to the centre of decision-making on economic, trade, agricultural and food policy generally. Can these systems be so managed? The challenge is colossal and the past three decades offer grounds for both hope and despair that it can be met. It will require an enormous effort and a coordinated pursuit of certain essential strategies. Among the most important of these, the Commission would stress:

Reorienting agricultural policy;
increasing yields and productivity;
sustaining and enhancing the resource base; restoring degraded lands;
reducing population stabilization levels; financing the transition to sustainable agriculture; and
reviewing institutional requirements and international cooperation.

18. Before we discuss these strategies, however, it will be necessary to digress, briefly, to look at the recent achievements and trends of crises to discern and reinforce experiences and developments that can be built on and those requiring special attention..

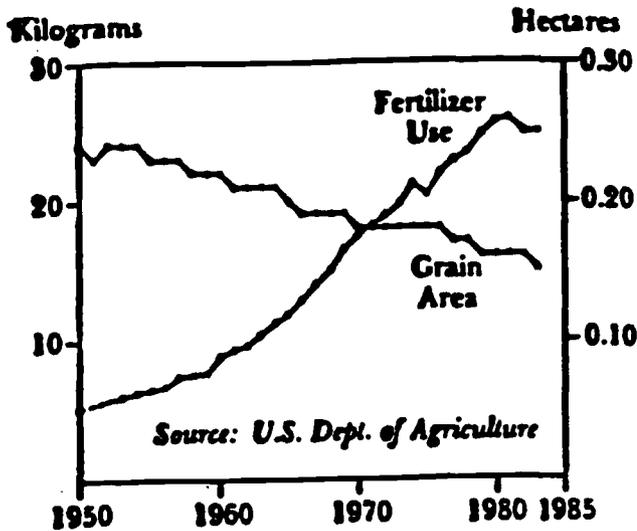
II. ACHIEVEMENTS AND SIGNS OF CRISES

19. Measured solely in terms of global increases in food production per capita, the past generation has been one of unprecedented progress in world agriculture. Between 1950 and 1973, production easily outstripped population growth and has continued to grow ahead of population even with slackened performance over the last 12 years. And, between 1950 and 1983, agricultural production increased by 900 million tons, from 248 kg per capita to 310 kg per capita. While this production record is impressive on a global basis, it hides wide variations in the output performance of different regions and countries. It masks even greater variations in the distribution of food among different socio-economic groups, especially in developing countries.

20. Before 1950, increases in food output came largely from expanding the area under cultivation. In 1950, when world population totalled 2.5 billion, the harvested area of cereals per person was 0.24 ha. By 1983, population growth had reduced the cultivated area per capita by one third, to 0.15 ha. Still, as noted above, a number of recent assessments suggest that on a global scale, the base of arable lands, forests and waters required to meet the demands ahead is available.

21. The potential for future productivity increases is also thought to be enormous, although the base of healthy, educated and skilled human resources needed to achieve this potential is weak in most of the world.

Figure I: World Fertilizer Use and Grain Area per Person. 1950-1983



With the growing scarcity of accessible arable land in North America, Europe and Asia, cheap chemical fertilizers and pesticides has been the major source of increased productivity. As Figure I demonstrates, the per capita consumption of fertilizer has risen five-fold in 33 years from about 5 kg in 1950 to 25 kg in 1983.

Fertilizers have been responsible for 55 per cent of the increase in yield in developing countries between 1965 and 1976.

22. The consumption of chemicals to control insects, pests, weeds, etc., showed an even sharper increase, rising 32-fold in 35 years. Starting with industrialized countries, pesticides soon found ready markets in developing countries where governments encouraged their use through subsidies. They have contributed significantly to increased yields in several food and cash crops obtained in all industrialized and many industrializing countries and in the short-term offer opportunities for conquering more land for agricultural expansion, provided they are applied in environmentally sustainable ways.

23. New varieties of rice, wheat and maize also figured prominently in the growth of output as did the doubling of the area under irrigation. Many of these varieties, responding well to good management, exhibit a high economic yield (ratio of usable to total plant weight), shorter maturing time (permitting multiple cropping), and/or higher disease

resistance. But the effectiveness of the high-yielding varieties depends heavily on irrigation and on the use of market-purchased inputs like mineral fertilizer and pesticides. A substantial portion of output increases in North America and Europe has depended on them as has those of industrial enclaves and the green revolution areas in the developing countries.

24. The response of crops worldwide to additional use is now diminishing, as shown in Table III. During the 1950s the application of an additional ton of fertilizer produced an additional 11.5 ton of grain. By the 1970s, the ratio had dropped to 5.8 tons. Other inputs bridged the gap and sustained increasing yields. But average figures are always deceiving. In this case, they reflect falling marginal productivity in North America and Europe. Most countries in Asia, Africa and Latin America still apply relatively little fertilizer and so still have quite high response ratios.

**Table III: World Grain Production and Fertilizer Use
1934-38 to 1979-81**

	World Grain Production*	Increment	World Fertilizer Use*	Increment	Incremental Grain/Fertilizer Response Ratio
(million metric tons)					
1934-38	651		10		
1948-52	710	59	14	4	14.8
1959-61	848	138	26	12	11.5
1969-71	1.165	317	64	38	8.3
1979-81	1.451	286	113	49	5.8

* Annual average for period.

Source: 1934-38 data from Food and Agriculture Organization Production Yearbook (Rome: various years); U.S. Department of Agriculture, World Indices of Agricultural and Food Production, 1950-82 (unpublished printout, Washington, D.C., 1938); Food and Agricultural Organization 1977 Annual Fertilizer Review (Rome, 1978); 1979-81 data from Paul Andrienas; compiled by World Watch

25. It has proved far more difficult to raise the world output by a consistent 3 per cent a year in the mid-1980s than it was in the mid-1950s. It might be even more difficult by the mid-1990s. Unless agriculture acquires a much higher priority in developing countries by adopting differential access to inputs in favour of resource-poor farmers and unless agricultural policy acquires an ecological foundation, the crises feared by the turn of the century will surely unfold. The changing land/water/forestry/energy/population relationship weighs heavily on the human prospect. A reorientation of agricultural development policy and research is essential if this prospect is to be improved in the direction of continuing and sustaining increases in the productivity, profitability and stability of the farming systems.

Regional Perspectives

Sub-Sahara Africa

26. In the 1950s and 1960s, the region was marked by increasing agricultural productivity, including food. Government intervention through provision of inputs and other productive resources - access to credit, technology, training - infrastructural development and higher involvement of peasants together with price incentives were the major factors behind the increases.

27. But signs of crisis could be noted from the beginning of the 1970s. By and during the 1980s, development in many of the countries in the region has gone into reverse. Deteriorating economies at a time of population increases; uneven distribution of land, capital and labour; inappropriate land-use patterns and methods of production in face of natural limitations - fragile soils and inadequate water supplies; far-reaching desertification and deforestation; insufficient scientific back-up alongside limited development and under/or misutilization of the human resources and poor management styles; and natural calamities such as drought have been some of the major driving forces of the crisis.

28. Since the beginning of the 1970s, the average food production per capita has been falling by about 1 per cent per annum and the capacity of the region to feed itself has been declining. Inadequate production of staple foods and growing urban tastes for non-traditional foods are creating a growing dependence on imported foods, which the precarious and/or deteriorating economic situation do not easily allow or do so at the expense of other needs.

29. The world economic crisis has hit the region with special force, undermining governments' efforts to deliver the necessary goods and services, including food, to their people. Unfavourable and unequal terms of trade on the international market aggravated the situation, directing production from food to cash crops and leading to the degradation of the agricultural resource base. Africa's debt crisis makes all future prospects, at least in the short and medium-term, rather grim.

30. The combination of declining per capita output, the land and environmental degradation and rising population growth, against a background of an adverse international economic environment, is laying the basis for a human tragedy of vast proportions. The first several acts of this tragedy have already been performed and others will surely follow. Widespread famine, internal strife, war and political instability add to the drama and divert resources essential to improve the African condition. Health and nutrition have deteriorated most rapidly. The number of severely hungry children has risen 25 per cent in the last decade. Malnutrition may now be so widespread that it will lead to increasing physical and mental impairment over the next decade. Child mortality in all of sub-Saharan Africa was 50 per cent higher than that in other developing countries in the 1950s; now it is almost 100 per cent higher.

31. Yet, the potential hidden in the region's physical and human resource base is enormous, exceeded only by the potential for increased yields and productivity. Less than 25 per cent of the arable land is cultivated, vast blocks remaining underutilized.

While the region has limited irrigation potential, at 33.6 million ha, only 15.7 per cent of this had been developed by 1982. If developed along sound, sustainable and equitable lines (C.vii), food production in the region could increase 24-fold. Moreover, fertilizer use as that of other inputs is low.

32. A few countries have been able to turn the tide and attain production levels in excess of population growth, as examples Tanzania, Rwanda, Ivory Coast and Niger. In a continent beleaguered by conflict, negation and despair, they provide grounds for hope that other countries can and could learn from them.

North Africa and West Asia

33. The region suffers from very limited arable land. Desert conditions prevail. This has posed great challenges to the countries' attainment of food self-sufficiency through self-reliance and have relied on imports.

34. Governments have invested in technology to cope with the conditions. Some, like Egypt, have for a long time exploited the potential of their water resources; others have been investing heavily in irrigation. Consequently, in recent years, improved and controlled irrigation has increased productivity and output since cultivation of high-yielding varieties became possible. The natural limitations have made this option, if it can be maintained in a sustainable way, even more appealing. To some countries, as demonstrated by Saudi Arabia, Libya and the Israel, the constraints have increased the need for and economic attractiveness of measures to restore lands lost to desertification. Israel's experience in the control of desertification is particularly valuable.

35. In the midst of this record of achievement, however, many poor people, without entitlements, have been experiencing a growing food poverty. They do not have access to land, nor to irrigation while their jobs have been threatened. This has left them without a source of access to food. The oil shocks of the early 1970s and

1980s coupled with unfavourable terms of trade for their agricultural products have emphasized the fragility of an import-dominated food security, have undermined the strength of the local economies and threatened the job security of many migrant labourers. To these economic factors are to be added political tensions threatening all forms of security, including food.

36. But the region has enormous human and technological resources. With them, it can increase its ability to provide and maintain livelihood security for its people. However, this can be achieved only if the land tenure systems are reformed to ensure equitable distribution and productivity.

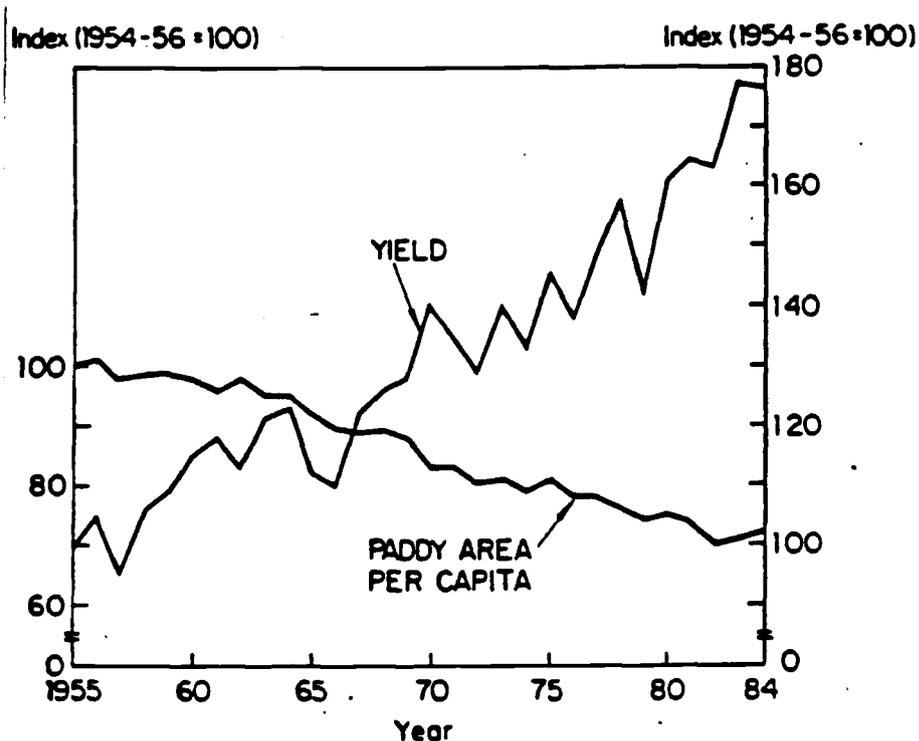
South and East Asia

37. This region is today home to more than half the world's people. Thus, its agricultural performance is of fundamental importance to global food security. In recent years, many of the countries in the region, as examples China, India, Indonesia, Sri Lanka and Pakistan have shown a remarkable ability to increase food production, catching up with and keeping ahead of population growth.

38. Given its past performance and recurring famines in some of the countries, the region demonstrates what can be done once the political will is there. In the bid to be self-reliant in food, governments willed to allocate money to agricultural research and to the development of technologies: national research centres emerged in many of the countries; irrigation spread; high-yielding seed varieties were developed; working with the producers, some scientists advanced location-specific technologies.

39. The new technologies have provided opportunities for increasing production through a vertical growth in productivity rather than through a horizontal increase in area, as Figure IV below demonstrates. Today, grain surpluses exist in some of the countries.

Figure II : Trends in Paddy Yield and Paddy Area per capita, South and Southeast Asia, 1955-54



Source: R.W. Herdt and C. Capule, 1983. Adoption, Spread, and Production Impact of Modern Rice Varieties in Asia.

40. But, Asia has little unused land. Within the time horizon of this discussion, the situation could be aggravated - seriously so in countries like Bangladesh and Indonesia - by land loss through sea-level rises resulting from climatic change. Deforestation continues unabated.

41. Despite the advantages of the green revolution technology itself, the strategy employed has tended to favour the resource-rich farmers, with larger plots of land, and who can afford costs of irrigation and other expensive technologies.

42. Moreover, the more progressive-reinforcement approach which has accompanied the green revolution has made many marginal farmers poorer while dispossessing small landowners or tenants of their land

asset. At its height of agricultural success, many rural people found themselves landless. Inequitable social distribution systems have continued to deny access to hundreds of millions of people. Thus, over half a billion Asians live in absolute poverty and over 40 per cent of the world's hungry people live in four of the region's countries.

43. Clearly, entitlements of the poor, especially the landless, must be increased and sustained. Increasing national yields should permit a gradual improvement in nutrition levels, if they can be sustained and broadened and combined with further economic and social progress.

44. Growing land scarcity means that Asian countries will have to continue seeking future increases in production from higher productivity and even greater cropping intensity per unit of arable land, water, forests, energy, labour and time.

45. The potential for improved water-use is high, but this is not to be through the conventional measures of more big dam and irrigation projects. It rests with better management and coordination of existing large and medium-scale irrigation projects and a systematic extension of small projects and of efficiency measures to release water to them. Fortunately, these measures are the most cost-effective. The potential provided by ground-water must be explored and exploited.

46. Asia is a continent of small-scale farmers. Therefore, production projects must be designed to promote the active involvement of millions of small-farmer families. Because of high rates of landlessness, livelihood security must be assured through off-farm employment and equitable distribution of the production resources.

Latin America and the Caribbean

47. The region enjoys both a huge resource and a high productivity potential, South America having the highest proportion of land area that is potentially arable (46 per cent of which only 15 per cent is currently cultivated). On the average, food production in the region more than kept pace with population growth during the past decade. Since 1980, food imports have been declining.

48. Government policies, directed deliberately at increasing food production in some countries, have contributed to the increase. Moreover, farmers have themselves been responding to the increasing internal (and external) demand for food. The presence of regional and national agricultural research centres to develop high-yielding seed varieties of grain, to support irrigation measures and to help develop other technologies have all contributed markedly to food increases.

49. Despite the notable achievements and its potential, there are many challenges to food security. First, the region labours under a debt-crisis weight of high proportions which has found expression in further degradation to the agricultural-resource base. Second, except for few countries such as Cuba where land reforms have taken place, the region suffers from an inequitable distribution of land: huge latifundias which can be as large as 20,000 ha, often un or underused, coexist with minifundias of less than 1 ha. Here, large families struggle to eke out a livelihood, sometimes sending younger members out as permanent or seasonal workers on the latifundias, urban cities or abroad where they are given low wages or where they join the unemployed. Third, most of the estimated 535 million ha of potentially arable land is in the remote, lightly populated Amazon basin where it has been estimated that perhaps only 20 per cent of the lands are suitable for sustainable agriculture. Moreover, the knowledge base on which to select these lands is very weak. Fourth, colonization of the Amazon during the last decade has been, in general, ecologically destructive.

50. The insecurity to food the above factors pose find expression in low output levels and limited economic access to food. In 1983-1984, per capita food production in 19 of the countries in the region declined. Furthermore, the 7.7 per cent per capita regional expansion was mainly linked to exports. It had almost no impact on the lower-income social groups, whose members have less access to food and whose nutritional status has deteriorated markedly and is worse than for the average population.

51. Recently, some governments have been taking measures to mitigate the effects of the crisis upon the most vulnerable sectors, ranging from subsidizing food prices to food distribution programmes directly targeted upon the poorest groups.

52. The Amazonian forests with their high diversity and ecological productivity can also represent a huge untapped resource through the use of new technologies (particularly bio-technology). But to ensure the sustainability of production, a policy framework and the technical and institutional capacity to oversee a systematic process of settlement and, generally, broad social and economic reforms will have to be put in place.

Eastern Europe and the USSR

53. The region as a whole has experienced fluctuating food production levels over the last three decades due to a high degree of climatic instability and, in many cases, organizational difficulties.

54. In the last few years, government policy in many of the countries has been deliberately directed at increasing food production and agriculture's contribution to national economies. Governments have been investing more in agriculture while farm distribution and organizational structures have been eased to meet the desire for food self-reliance. These approaches and efforts have resulted in production increases of some food items such as meat and root crops, as reflected in declining figures of global

agricultural trade. Farm organization, such as the cooperative production system of Hungary, have contributed significantly to the increases.

55. But, even as the world's largest wheat producer, the USSR has become the world's largest grain importer, running at about 40 million tons per year, particularly high because of the need for feed grains arising from the nation's heavy intake of animal products. Despite increases in grain production noted in the USSR and other countries, the region continues to experience food deficits, meeting the demand through imports largely from the US. This transfers ecological pressures to the exporting countries. In the interest of ecological security of the surplus-producing countries of the West especially the US, in this case, this region should step up its own food production.

56. But the more menacing threat is posed by the soil and water degradation, some countries experiencing this more than the others. Acidification, salinization and alkalization are widespread and growing rapidly. The worse threat comes from ground and surface-water contamination resulting from industrial mismanagement, including over-use of chemicals. The region's technological resources and political structures can be directed to curtail a deterioration of the situation and avoidance of future occurrence.

North America, Western Europe and Australasia

57. Countries here represent the most advanced form of industrial agriculture and have seen remarkable increases in food production. Between 1970 and 1982, almost two-thirds of the additional volume of cereals entering world trade came from North America. While the European Community remains the world's largest importer of agricultural and food products, principally of tropical fruits and early vegetables, over the last few years, it too has increased volumes of grain surpluses for export.

58. As is well known, science and technology and good land-use patterns and practices plus market incentives have turned this region into the world's leading source for food security in terms of grain, a principal source of calories. The greatest single factor to increased production has been the interrelated and ecologically unsound agricultural, economic and trade policies. Aid policies have also added to the incentive package.

59. But, already, there are clear warnings for most of the countries - future increases in production of the same order of magnitude are not sustainable and cannot provide an enduring basis for food security. Subsidies as a basis of increased production are short-lived and ecologically and economically expensive; production methods, especially over-application of chemicals, are undermining the agricultural resource base; land surface for future agricultural expansion is limited particularly in Europe; and surpluses particularly if heavily subsidized by the public purse and tied to aid on a long-term basis have the effects in the receiving countries of reducing the bargaining power of local producers. A challenge countries in this region face and at once strategy for global food security is to throttle down surpluses.

60. Put in place since WW II, government intervention and subsidy systems have lost whatever coherence they may have had. Now, they encourage degradation of the agricultural resource base and in the long-run, pose more harm than help to the agricultural industry. Acid rain and acidification, soil depletion as well as the bankruptcy of many farmers are but enfolding externalizations of the threat. In fact, Western Europe (and parts of Eastern Europe) may be forced in the future to retire large acreages condemned by acidification, possibly involving extremely high future costs of rehabilitation.

61. Regarding resource and productivity potential, countries such as the US and Australia still have some frontier areas suitable for intensive agricultural production. However, their development poses very high costs and will advance slowly, at best. A significant

water potential which exists in the regions depends on efficiency measures which, in spite of their cost-effectiveness, have so far proved almost impossible to introduce. But the productivity-growth potential of North America and Western Europe is low compared to what it was 10 to 20 years ago and compared to what it is in most developing countries. In North America, the rate of increase in output per ha and in total productivity slowed significantly following the run-up in energy prices in 1973.

62. Some governments have initiated policies which will have long-term impacts on the sustainability of agriculture. For example, the US Government has recently taken steps to modify its structure of subsidies. The Canadian Government has received an alarming report on the economic costs of the environmental effects of its policies and should take similar steps. In 1985, for the first time, the European Community Commission's Green Paper on CAP raised serious questions about the environmental costs of the CAP as well as their economic costs. Some governments in the community are drawing up plans for ecological security. Public voice has been added to government concerns. However, these need to be concretized much more speedily.

III. STRATEGIES FOR ENDURING FOOD SECURITY

63. The potential for sustainable agriculture and livelihood security varies greatly between regions and countries. Latin America and Africa have a high potential in both resources and productivity; Asia has a low resource but high productivity potential; North America is comparatively low in both; Western Europe has neither. Therefore tapping the potential of Asia, Africa and Latin America should be one of the priority strategies for global food security. By so doing food production would also be relocated to countries in greater need of food security.

64. This will require throttling down the surpluses of the industrial market-economy countries and increasing productivity in the countries in need of food, particularly at the household level. But in all cases production must be sustained. Seven strategies have been identified as critical (see p.9), although the other six hinge on the first, i.e. reorientation of agricultural policies. This is the case because of governments' intervention in agricultural matters: form access to and exploitation of the resource base to storage and distribution including external trade. This makes this strategy central.

A. Reorient Agricultural Policies

65. Reorienting agricultural policies is essential in order to: promote ecological security for agricultural development and through which livelihoods in rural areas can be assured; encourage sustainable food production; foster fair terms of international trade; and to base international aid on long-term perspectives.

66. If the food security challenge is to be met through the year 2000 and beyond, it will be necessary to marshal and utilize the human and natural potential in the most effective and efficient way possible. To-date, in both developed and developing countries, efforts to accomplish the above have been overridden and undermined by policies characterized by their lack of ecological considerations. Agricultural, economic including trade, energy and

industry policies must be given "ecological eyes" in their conception, funding and implementation. Alone, this may not be sufficient. It is necessary to incorporate and meet the environmental cost of any activity and this without making invidious distinctions between environment and development.

67. In centrally planned economy countries, the challenge is to integrate agricultural investment into environmental policy and to restructure farm and labour organization. This would both ensure the necessary increased production and avoid over-industrialization of agriculture in some countries which in its present form leads to soil and water contamination. Meanwhile, greater efforts will have to go into reclaiming the land from acidification and pursuing irrigation systems that would avoid or at least minimize the risks of salinization and alkalization.

68. In developed market economies, the problem is over-rich incentive programmes that penalize the resource base in pursuit of short-term gains in productivity. Large numbers of farmers and their spokesmen are becoming concerned about the impact of subsidy-driven practices on the quality of the land they pass on to their children. But, the pressure to increase production at the cost of the resource base will remain as long as it is in the short-term economic interest of farmers to do so, and as long as the policy structure within which they operate reinforces and does not correct their necessarily short-term arithmetic.

69. While contributing to present global food security, a redesigning of these policies is essential to the goals of sustainable agriculture. Moreover, such a revision could serve not only to improve the resource base, enabling sustainable future gains in productivity, but also to reduce significantly existing levels of public expenditure on agricultural subsidies.

70. Food aid, too, because it is assumed to combine morality with political necessity, has acquired great appeal as a means of disposing surpluses. There is no doubt that food aid is essential

to ease hunger in an emergency situation. It does little, however, to prevent starvation after the emergency has ended. Moreover, in normal situations, the growing volume of food aid only compounds the real problems in receiving countries, reducing the pressure for policy change to their local production and relieve destructive poverty-induced pressures on the resource base. Coupled with low-priced imports, food aid depresses prices paid to local farmers, and makes it easier for governments to relax in their efforts to develop agricultural infrastructures. Donor and receiving countries should give aid long-term perspectives by, for example, channelling some of it to "food for work" programmes to help ecological and agricultural rehabilitation. It can also be used to purchase surpluses from small-scale producers and stimulate their increased production.

71. There are some positive signs of change, but they are few in number and still overshadowed by forces that would maintain the momentum of existing processes. For example, some multilateral and bilateral development assistance agencies have begun to re-examine their policies to ensure that they do not continue to support projects that are non-sustainable and that end up reducing rather than increasing the economic prospects of the receiving country. But the examinations have been conducted at a very low level and very few concrete changes can be identified. The top political and administration leadership of these agencies must become personally engaged to carry through the necessary reforms.

72. In many developing countries, trade is skewed against food production. Countries here are net food exporters in the wide sense. Some items such as beef and fish go to feed the very people in developed countries on whom they depend for their grain. In 1982, food imports by developing countries totalled \$52 billion against their exports of \$60 billion. Developing countries and regions must reappraise their policies on international food trade and address the contradictions they create. It may well be sensible for some countries to export some forms of food and import others, provided that in this process they are able to protect the interest of poor producers and consumers.

73. On the production level, the poverty of support systems in many developing countries leaves many small and subsistence farmers rationally reluctant to assume the risks associated with new seeds and productivity packages, and leaves agriculture without the essential support that it needs. Sustainable agriculture and food security demand policy action on a number of fronts: technical, developmental, social, political, as well as greatly improved and enriched incentive systems. Moreover, food security strategies can only be meaningful if they are associated with livelihood security requiring a greatly increased access to land and other assets: water, credit and new technology by all, especially small and female, farmers, in order to enable a shift of the global production locus to reach resource-poor farmers.

74. Agricultural production in many developing countries is the foundation for rural employment. Its viability, therefore, would ensure economic access to food in addition to physical access. Sustainable livelihood security is basic to food security for three reasons:

75. First, secure resources and adequate livelihoods lead to good husbandry and sustainable management. Secure long-term tenure and sustainability ability to satisfy basic needs encourage a long-term view and the investment of labour and funds in resource enhancement.

76. Second, sustainable livelihood security reverses destabilizing processes. Assuming, as it would, an acceptable rural life and particularly if secured against a background of rural development, it eases rural to urban migration, thus reducing pressure on urban services and jobs, and weakens the demand for low prices for the urban poor, thereby allowing incentive prices for food production. Increased crop production in turn generates secondary employment. Overall, livelihood security helps national economic development and reduces the need for food to be produced elsewhere, thereby encouraging surplus production in the producing countries.

77. Third, livelihood security, combating as it would poverty, stabilizes human population. The poor lack secure command over resources and rationally have large families as a survival strategy: to spread risks by diversifying their sources of food and cash with members in different activities and places, and to have sources of support in their old age.

B. Increase Productivity and Yields

78. Food-deficit countries, the majority of which are located in the South, can assure sustainable food security in the short and medium-term, in particular, by focusing on ways to increase productivity and yields. Some of those fundamental to increased food production would be to:

i) Accelerate land reforms

79. In many developing countries a broad-based land reform, leading to equity and new rural power structures, is essential to sustainable increases in productivity and yields. The infinite variety, among and within countries in land ownership, land-use, farming systems, institutional structures and ecological conditions means that no universal approach to improved access to productive assets is possible. Redistribution of land is basic, however. Without it, the institutional and policy changes that come about, including those introduced to protect the resource base, may actually worsen distribution, serving the interests of a minority of large farmers who are better able to obtain the limited supplies of credit and other available services. In thus leaving hundreds of millions without options, they would instead ensure the continued violation of ecological imperatives and the collapse of the development process.

80. FAO has estimated that given existing patterns of land distribution, the number of small holders and landless households would increase by about 50 million to nearly 220 million by the year 2000. It points out that together, these groups make up

three-quarters of the total number of agricultural households in the developing countries. It is questionable whether the required increases in food production can be achieved if these people are excluded from the benefits of improved distribution of inputs and services. Where land reform has occurred from Eastern Europe to China, from Japan, Korea and Taiwan to India and Pakistan and Cuba, these aims have been largely achieved.

81. Land reform and the small farm backed by institutional support and other agricultural inputs are some of the fundamental instruments for achieving the sustainable increases in yields and productivity needed for future food security in many developing countries. Because increased productivity would reduce the need for food imports, land reform would also have a favourable impact on a nation's balance of payments and debt, releasing capital for other development priorities.

82. But, redistribution of land is the most difficult of all social reforms to carry through. Given experience to date, significant progress in this direction may be too much to expect. If that is the case, then, it is difficult to imagine the needed increases in food production being achieved through the turn of the century. It is even more difficult to imagine the gains achieved being sustained. A global food strategy guided by realism should pursue a two-track approach: first, to the degree possible, concerted economic, trade and aid policies to induce countries to carry through meaningful land reform and to support the necessary follow-through measures; and second, increase the capacity of designated international bodies to anticipate crises and to marshal resources both to respond to crisis and to transform the crisis into an opportunity, to force through land reform and related measures.

83. Multilateral and bilateral aid agencies should extend support to all land and livestock reform measures. Livestock reform is a neglected but extremely important area needing attention, particularly with a view to protecting the pastoral communities of Africa.

ii) Increase energy use

84. Agriculture is both user and producer of energy. Agriculture is usually the least energy-consuming sector in national economies. Globally, it accounts for about 3.5 per cent of commercial energy use in the industrial countries and 4.5 per cent in developing countries. A strategy to double food production in developing countries through increases in fertilizers, irrigation and mechanization would add only 140 million tons of oil equivalent to their agricultural energy use, only some 5 per cent of present world energy consumption.

85. Agriculture has the highest economic and social returns for each extra unit of energy input. Regarding countries with low levels of modern energy-intensive inputs, it is hard to find examples where adding energy to the farming system is not profitable in terms of extra yield and income. By increasing yields, or intensifying and extending the use of farmland, energy inputs also greatly increase employment, especially for the landless and other segments of rural populations who need work and frequently migrate to the cities to find it.

86. One of the most important energy-related needs is mechanical power for irrigation pumping. A large number of possibilities have been proved: wind mills, conventional internal combustion engines running on biogas produced from local biomass wastes or on producer gas resulting from the gassification of wood or charcoal. A number of developing countries command a substantial hydro-electricity potential. Where this has been developed, electric pumping provides advantageous options.

87. Post-harvest operations such as processing, storing and transporting also require energy. In particular, solar dryers and solar coolers and refrigerators are very important, and have been used extensively in some countries.

88. The role of agro-forestry systems must be emphasized here because they are so well suited for the production of food

and fuel by small-scale and resource-poor farmers. In these systems, one or more tree crops are combined with one or more food crops or animal farming on the same plot of land in spatial or temporal combinations. If the different crops are well chosen, they reinforce each other and the total food and fuel production is greater than in separate food and fuel growing systems. Especially good results can be achieved by the use of multi-purpose trees in such agro-forestry systems. Some tree species, such as acacia-albida and sesbania rostrata can fix nitrogen, and consequently fertilize the soil, roots and stem of the plant: some fruits are edible, while others are used as medicine; some leaves are used as animal fodder; and branches can be chopped off to provide firewood or to be used in basket making, etc.

89. Agro-forestry has been practised by traditional farmers everywhere. The challenge today is to revive the old methods and adapt them to the new conditions, in addition to developing some new ones. Agro-forestry practices can significantly reduce deforestation: they reduce the need to convert forest land into agricultural land and pastures; and they provide farmers with the means to produce their own firewood, timber, fertilizer, fodder, building poles, and other forest products.

iii) Increase use of fertilizers and pesticides*

90. Over-application of fertilizers and pesticides has contributed to environmental degradation in regions where industrial agriculture has been dominant. Its long-term ill-impacts on the agricultural resource base cannot be over-emphasized. However, some developing countries still have high response ratios for chemical fertilizers since todate they apply relatively little fertilizers. For example, in 1980 Africa consumed 5.8 of the total chemical nutrients

* includes herbicides, insecticides, fungicides.

used by developing countries, 1.7 of the world total. Much of this went to Egypt and South Africa and was scattered among big farmers, and hardly reached the majority peasant farmers. There is also a higher tolerance for pesticide consumption. More areas could be conquered for agricultural expansion through the application of pesticides.

91. In the short and medium-term, increases can be attained through the application of these chemicals. These countries have quite high response ratios, although lessons should be drawn of fertilizer's long-term ill impacts on the agricultural resource base. Moreover and despite the lower levels of fertilizer application compared with industrialized countries, the balance is shifting rapidly. Fertilizer use has been growing more than twice as fast in developing as in developed countries and the FAO projects future growth through the year 2000 at between 7.5 and 8 per cent per year, twice the projected increases in crop production.

92. While predominant in industrialized countries, the use of chemical-control agents for insects, pests, weeds, fungi etc., is also growing at a rapid rate in developing countries. If one superimposes on these projections the larger populations exposed, the greater institutional and educational barriers to safe use and the higher rates of interfarm spill-overs stemming from the smaller farm pattern prevalent in developing countries, the problems of pollution and contamination could reach or exceed those of developed countries.

93. The over-use and abuse of pesticides represent the greater threat to human health, to the genetic stock of the population and to sustainable and economically viable agriculture. Pesticides are a direct menace to human, animal and plant health. A 1983 study estimated that approximately 10,000 people died each year in developing countries and about 400,000 suffered acutely from pesticide poisoning.^{4/} Most victims are farm workers. Accidental poisoning from food contamination is common.

94. The effects of chronic exposure to pesticide residues in food, water - even in the air - are global and particularly hazardous to children. The evidence is manifest in analyses of human tissue and mothers' milk. PCB has been found in a large number of people in North America and Western Europe, while many lives are threatened in Eastern Europe and the USSR. In developing countries such as China and India where persistent organo-chlorine compounds are in use, medium concentrations in the fat of mothers' milk indicate that the consumption of breast-fed infants must exceed the limits established by WHO.

95. The impact on some other species has been quite dramatic. Commercial fisheries have been destroyed, bird species endangered and predatory insects wiped out. Disrupting nature's ingenious balancing act by indiscriminate pesticides use has often served to increase the resistance of the target pests, while at the same time destroying natural predators. The number of pesticide resistant species worldwide jumped from 25 in 1974 to 432 in 1980: many resist even the newest chemicals. The variety and severity of pest infestations multiply, threatening the very survival of agriculture in the areas concerned.

96. Water resources are particularly sensitive to the run-off of nitrogen and phosphates from excess use of fertilizers. Eutrophication of large and small lakes, irrigation, reservoirs and canals and other water bodies has become a world-scale problem; it destroys fisheries and ruins major sources of water for drinking, recreation and other purposes. The feared death of the great lakes of North America and Europe brought the question to the international agenda in the mid-1960s. Although the process has been reversed in a few areas, the phenomenon has spread steadily ever since.

97. The percolation of nitrogen into underground water sources can impose heavy costs on a community or region. Communities everywhere tap major aquifers for municipal, industrial and

agricultural purposes. Many have been and more will be faced with the need to abandon these aquifers in favour of more expensive alternatives such as deeper wells, tapping distant surface supplies through pipelines or using bottled water for drinking.

98. Therefore, even alongside increased use of chemicals in food-deficit countries of the South, other non-chemical ways of providing nutrients to crops and to control pesticides must be adopted, as proposed above (B.ii) and below (C.ii). In the interest of long-term food security, non-chemical ways should come to dominate even in these countries.

iv) Build up research and human resources*

99. Research and human ingenuity play a critical rôle in sustainable food security. Many academic and research institutions in developing regions especially Africa and Latin America continue to decline while there does not seem to be concerted efforts to upgrade them or establish new ones responding to the growing agricultural challenges. Developing countries should make greater investment efforts into research and human resource development to which we shall return. The following are a necessary strategy to food security:

establishment of more and expansion of existing rural agricultural and technical training institutes; with international support, if necessary, development of research in low-cost, small-scale irrigation and drainage schemes by national governments and regional groupings;

* Chapter IV of this Report contains a more substantive discussion on human resource development.

support of research on the integrated application of traditional and emerging technologies and encourage the growth of research programmes developed and undertaken jointly by scientists and technologists and rural families; and support of research on the refinement of early warning system relating to climatic and environmental events.

100. But institutional advancement should be matched by human resource development through formal education to take the stock of education and training in the population and to create the necessary scientists; through full utilization of the trained personnel and of the available labour in the field particularly women and youth; and by fair returns to labour.

101. South and East Asia are better endowed with scientists but other regions of the developing world still require sufficient numbers of scientists, well qualified to work in specific agro-ecosystems and with the right orientation towards the people with whom and areas in which they are to work. This is particularly the case with regard to the hinterlands and to the resource-poor farmers.

102. To acquire sufficient numbers of desirable scientists would require governments to readdress curricula found in schools, colleges and universities which, so far, often produce scientists who are incompatible with the local production systems and in the main do not meet the needs of the various productive sectors, including agriculture.

103. Youth. The problem posed by the preponderance of the young within the context of increasing populations can be turned into part solution for sustainable food security. Many young people have had primary education. These can be marshalled as link persons between scientists and producers. The world is beginning to appreciate traditional farming systems and the need for local-specific technologies. Both

these could be made more productive and facilitated by involvement of the local youth, who would also have an added advantage of remaining in the localities after the departure of scientists or extension workers. The youth can perform the function of "change agents" more effectively as they have the zeal, energy and commitment.

104. Along with other producers - farm and fish families and pastoralists - they could have opportunities for training to upgrade their locally derived knowledge and be better equipped to work with scientists and extension workers. This training could include simple mechanics, for example, so that they can both produce the needed tools locally and maintain them. Full utilization of the young will provide two solutions: curtail rural to urban migrations and contribute to increased but sustainable production.

105. Women. Women play a critical role in food production: in cultivation, seed selection, storage; in some regions they are the basis for successful afforestation efforts; they provide the main labour on the minifundias in Latin America; in Latin America, the Caribbean and Asia they form a large agricultural labour force. In sub-Saharan Africa, they provide the main labour force in food production. In some countries, their contribution to food production is as high as 73 per cent.

106. Despite their important role in ecological and agricultural rehabilitation and enduring food security, in many countries, they do not have direct rights in land and their access to it is being curtailed as titles are provided to men only. What little technology filters to peasants hardly reaches women; they form a tiny component of those peasants who receive training in the modern methods; their traditional knowledge is not sought or built upon.

107. In the interests of food security, land reforms should recognize women's crucial role in food production. They should be given direct rights in land especially where women are heads

of households. Women should be given as many educational opportunities as men. There should be more female extension workers; and women should participate in field visits. Women's organizations should be promoted in decision-making regarding agricultural and forestry programmes.

108. Labour Constraints. One of the problems facing resource-poor primary producers in Africa is the shortage of labour. Despite increasing populations, many rural households suffer from inadequate labour supplies as lack of rural development forces many young people to flock to urban areas. Human labour is critical to food security as labour-substituting technologies recede further. Therefore, labour must be retained in rural areas if agricultural productivity is to increase. This means, then, that agricultural development generally and food security in particular are intimately linked to the question of rural development, including its health aspects.

109. Returns to Labour. Three distinct approaches to this can be seen in the three developing regions. In Africa stagnation of food production can be closely related to the stagnation of the small holder sector. Low returns to small holder production dominated by food crops, in terms of producer prices and lack of physical infrastructures, have contributed to the marginalization of food crops and threaten food security. In Latin America and many Caribbean countries the inability of minifundias to support families has resulted in seasonal or permanent migration while in Asia many landless people are absorbed as part of the agricultural labour force. In all cases, the returns are not sufficient to provide purchasing power with which they can meet food requirements. Agricultural prices and wages must be at levels where they can stimulate production and ensure sustainable access to food.

v) Promote urban agriculture

110. Many families in Western cities are allotted plots for mostly vegetables but also poultry and small ruminants such as rabbits and guinea pigs. This supplements the food budget for some to whom this is necessary. In the majority of cases the loss of this resource would make little difference to financial security. To these people a driving force for kitchen gardening is a "green thumb" or the desire to be free of food contamination through chemicals.

111. In many developing countries, however, the question of the urban poor is proving quite severe. In many cases their sources of livelihood, including the ability to command food, are steadily being eroded and foreclosing. Acknowledging this, some local authorities have been encouraging urban agriculture which is proving quite successful and an important means of livelihoods. A study on the feasibility of urban agriculture^{5/} found that in China, about 85 per cent of the vegetables consumed by urban people are produced within the urban municipalities. Hongkong produces almost 50 per cent its fresh vegetables and almost 75 per cent of its poultry; Singapore generates 27 per cent of its fresh vegetables, 30 per cent of its fish, 80 per cent of its chicken. Lusaka, Zambia has an urban agriculture and nutrition service to facilitate the formation of community cooperatives to secure inputs to complement the provision of land for the local government; Addis Ababa has provided land to the poor for gardening purposes.

112. Overall, in developing countries food accounts for 50 to 70 per cent of the total family income; kitchen gardening saves 10 to 20 per cent of the total food budget. It helps meet their nutritional needs. In addition, urban agriculture helps recycle organic waste, contributing to community health; reduce energy cost incurred through processing and transporting waste.

113. Urban agriculture is another strategy for access to food by the majority poor in urban areas. Governments should continue to encourage this when designing future cities.

vi) Promote fisheries and aquaculture

114. A sustainable development of fisheries and aquaculture is critical to food security because they are both a source of protein and of employment. Of the total food projections by the turn of the century, 10 to 15 per cent is expected to come from marine and inland fisheries. In addition to this important nutritional intervention, export of fishery products generates valuable foreign exchange, which in turn some countries use to import more food. Moreover, the small-scale fisheries can and do provide wage employment. Fisheries are also ecologically benign and in fact can help restore the soils. In efforts to rehabilitate the ecology, therefore, fisheries can contribute to land reclamation in that inland fisheries are an efficient way of exploiting the less productive soils.

115. Fresh water and marine fisheries have the economic advantage of yielding the highest return per ha. There are indications that this will improve or at least be retained over the next decades. In 1982, fresh water fisheries landed around 8 million tons: catches in Asia accounted for 70 per cent of this total; 14 per cent in Africa; 9 per cent in the USSR. North American waters contributed a small proportion because of low productivity and pollution.

116. Marine fisheries' landings amounted to 74.6 million tons in 1983, one half of this catch was concentrated in the North East Atlantic and North West Pacific. Statistics show that marine landings have increased by 1 million tons per year over the past few years. This growth rate could be maintained through the end of the century, when a catch around 100 million metric tons should be possible. Yields from aquaculture have

doubled during the last decade and represent about 10 per cent of world production of fishery products. As global yields increase, prospects remain optimistic. A 5 to 10-fold increase is projected by the year 2000 provided the necessary scientific, financial and organizational support are available. Countries such as Norway and Scotland have found aquaculture an effective way of resource utilization. It is comparatively economic-efficient, requiring as it does few inputs. It can be carried out at all levels of commercial scales - individual, family, cooperative or as a large business. Therefore, it provides a viable solution to food and job security in developing countries and can utilize otherwise un/underemployed labour efficiently.

117. Despite the growing contribution of fisheries to food security, future trends do not appear encouraging. There are indications that most of the fish stocks in man-made African lakes are fully exploited except certain swamp areas in Botswana and the Sudan. Over-fishing, particularly with commercial trawlers, has caused serious damage in several large lakes. Although reservoir development has increased fresh-water catches in Asia, some losses in production have been recorded mainly due to more intensive husbandry and increasing use of pesticides. Over enrichment and pollution have remained the principal causes of damage to European fresh-water fisheries. Of the 11 migratory species of fish that formerly occurred in the Rhine, for example, 9 had virtually disappeared by 1978 and practically no commercially useful fisheries remained. On the other hand, because of pollution control measures some of the migratory fishes have returned to the Thames. This provides a successful endeavour which other countries could learn from in the interests of food security.

118. Secondly, cases of hardships for the poor created by the development of inland fisheries have been documented. As an example, some landlords in South Asia saw in fisheries a more

profitable pursuit. They dislocated some of their former tenants and the indebted poor who became landless and unemployed overnight. Clearly, in the development of inland fisheries and aquaculture, developing governments will have to protect the interests of the landless poor.

vii) Protect and promote pastoralists

119. Pastoralism is an important activity in many developing countries, specifically in sub-Saharan Africa. Many rural families depend on it for their livelihoods: as a direct source of food and as a source of income with which to purchase other foodstuffs particularly grain. It also provides the needed protein to the urban dwellers.

120. But processes of dispossession and dislocation have been taking place must brutally on two fronts.

120.1 As crop agriculture gained prominence, especially as a source of foreign exchange, the more politically powerful cultivators have been pushing pastoralists off their heads and turning grazing into croplands.

120.2 The more economically and politically powerful urban dwellers have been buying lands and cattle from pastoralists, turning the latter into caretakers of their former properties. The lack of options which force pastoralists to sell their resources coupled with very low, irregularly meted out, wages kills motivation for proper management.

121. To curtail further deterioration and safeguard food security of pastoralists will entail policies and action on the part of governments to protect the pastoral way of life. It will mean acknowledging its important place in national economies. It will mean enhancing pastoral resources and quality of land through improving water supplies, providing credit, veterinary services and, where necessary, price incentives.

C. Sustain and Enhance the Resource Base

122. Enduring food security will depend on a sustainable and productive resource base. This resource base is already under attack and stress. The outcome of the attack and stress is observable through soil erosion, soil and water contamination, salinization and alkalization, deforestation. These result from improper land-use patterns, unsound agricultural practices of dictated by considerations for short-term grains and poor land management. While the onslaught is not yet complete and in some cases not yet set into motion, it is crucial that strategies be developed and adopted to sustain and enhance this resource base.

123. Many farmers and governments have recognized the threat to the agricultural-resource base as a result of some policies and production methods pursued. This consciousness and ensuring debate are important beginnings. Alas, the challenges are too formidable to the shelved much longer. More needs to be done on the ground by both the producers themselves and governments, but particularly the latter both in developed and developing countries. The following strategies are critical to the preservation of the agricultural resource base through which sustainable food security can be safeguarded.

i) Classify lands

124. The initial task in mechanisms to enhance the resource base will be to identify the lands through "best-use" approaches to delineate broad land categories. Enhancement and restoration areas are the two major categories, but equally important are prevention areas. Enhancement areas may include lands capable of sustaining intensive cropping, higher levels of livelihood intensity and with a potential for increased productivity and yields. Restoration areas consist of lands which, because of past land-use practices, productivity has either been totally lost or drastically reduced and where

vegetative cover has been removed. Desertified, deforested, salinized and alkalized areas are the best examples of this. Prevention areas are those which by common consent should not be developed for intensive agriculture or where developed, be converted to other uses.

125. Means for identifying lands according to notions of "best use" are now available or can be made available. Most industrialized countries possess detailed inventories of their lands, forests and waters describing surface and subsurface characteristics, soil quality and relationship to the watershed in which they are located. Most developing countries do not yet have such detailed inventories, but they can and should be put in place and at a much more rapid pace than heretofore. Indeed, improving the data base for agricultural planning at national, sub-national and local levels is one of the priority areas for action. Accelerated programmes are mandatory for inventories of soils quality and capacity, and land-use including land under forests, mapping forests and waters, delineating watersheds, not to mention improving agro-meteorology and weather forecasting. Satellite monitoring and other rapidly evolving techniques should both reduce the needed time and cost for such programmes and greatly increase their usefulness.

126. The politics of selection, which should range from farm unit to the watershed, could be facilitated by making it the special responsibility of a select board or commission, involving outstanding representatives of the interests involved, particularly in the case of developing countries the poor and more marginalized segments of the population. The entire process must be essentially public in character with publicly agreed criteria. In particular, the criteria must combine "the best-use" with the required levels of livelihood intensity.

127. The quality of soils could be preserved/enhanced, as indeed restored, through: adopting and shifting to production methods that would not degrade the soils; proper use of chemicals where necessary; shifting to organic farming; adopting integrated pest management; efficient use of energy; adopting anti-desertification and anti-erosion measures; and proper forest management.

ii) Develop alternatives to chemicals

128. As already stated (B.iii) over-application and abuse of chemicals have been chief agents in soil, water and ecosystem degradation in all agricultural systems, industrial agriculture to a greater extent than the others. There is so much momentum in the present systems that chemicals will prevail for some time. True, too, other regions of the world, particularly Africa and Latin America, can tolerate more chemical fertilizers; larger areas can be made more habitable by clearing them of pests through pesticides. But alternative strategies are in place that would gradually shift agriculture from almost exclusive dependence on persistent chemicals to natural systems of nutrient supply and pest control. They require a higher priority, however, and most of all, a change of public policies that now encourage the spread of chemical agriculture.

a) Promote organic farming

129. In the short to medium-term chemical fertilizers, because the environmental costs are always paid for by future generations, may be seen as a basis for increased yields. In the developing countries they will fulfil this task in the short to medium-term. But in the medium to the long-term, agricultural systems worldwide should see organic and inorganic sources of plant nutrients used increasingly to complement one another, with gradual and greater shifts to organic sources. Organic wastes such as crop residues are now commonly burnt in

the fields while industrial field lots are transforming farmyard manure. Such wastes are potentially significant sources of soil nutrients. Organic wastes are also important low-cost soil conditioners. They reduce run-off, increase the take-up of other nutrients and increase the water-holding and erosion-resistant capacity of the soil, qualities especially needed in the tropics. Application of only 2 tons per ha of organic mulch, for example, can reduce run-off by 80 per cent or more and reduce erosion by up to 95 per cent.

130. Contrary to prevailing assumptions and fears, organic farming is as productive and profitable as chemical farming. Studies in the UK, US and Holland have shown that organic food production can, when properly managed, produce up to 90 per cent of the yield per acre of conventional chemical agriculture at 66 per cent of the energy cost, particularly if the present producer oil prices are only transitory as they should be. Thus, the necessary increases to meet future demand would be assured. In industrialized countries, high production costs could increase the attractiveness of organic farming, the technologies for which are becoming increasingly sophisticated and competitive. Anticipatory policies might be designed to support and even induce such a response.

131. For many developing countries, organic fertilizers such as cattle/pig/chicken manure offer obtainable options because of their lower costs, especially when used alongside more resource-efficient cropping systems such as intercropping and rotation. That some commercial farmers in parts of sub-Saharan Africa, for instance, are advocating organic fertilizers as an answer to the astronomical costs of chemical fertilizers is a very encouraging sign in the interest of economic and ecological sustainability. More of this source of fertilizer could be developed communally or cooperatively. The overall systems efficiency is particularly enhanced if the biomass feedstock (animal manure and/or other wet vegetable biomass) is anaerobically digested in biogas plants. In this process the

potential health hazard of the original manure is destroyed, the slurry produced is an excellent fertilizer/soil conditioner. Moreover, in the process, biogas is formed which can be used to run internal combustion engines in pumps, motors or electric generators. The process has potentials particularly in medium to large-scale farm and agro-industrial units, where sufficient numbers of animals are available for efficient operations. But they can be well applied in small undertakings, for example, in urban plot and kitchen gardens. The Maya farms in the Philippines is a good example of how a large agro-industrial complex is able to produce all its energy requirements, and a great deal of its fertilizer requirements from animal manure through biogas plants.

132. Many more locally available sources of organic fertilizer can be more fully exploited. Additional 10 to 15 million tons of nitrogen and 5 million tons each of potassium and potash could be had in the developing world, if only half the available human and animal manure were used. A comprehensive composting or biogas programme throughout the developing regions could, in addition, provide an estimated 50 to 100 million new jobs and provide more means for livelihood security.

b) Integrate pest management (I.P.M.)

133. Initially employing an optimal combination of biological and chemical control technologies with gradual phasing out of the latter to rely on natural controls, IPM is the most promising of the sustainable strategies for pest control. But IPM requires a decentralized ecosystem approach, with detailed information about individual pests, their environment, life cycles and natural enemies. The future of IPM, therefore, rests more with institutional change than with a technological fix. IPM requires the awareness and full support of the farmers sharing an agro-ecosystem and the ability to modify farm practices to interrupt the life cycle of pests and aid

their natural enemies. It requires the development of seed varieties tailored to resist pests prevalent in different areas and integrated cropping patterns and farm organization to reinforce this resistance. The implications of this for decentralized research linked to expanded locally generated extension services and supported strongly by national policy and international cooperation are evident.

134. Both organic recycling and IPM are labour-intensive, a further attraction in developing countries needing to generate hundreds of millions of livelihoods in rural areas. And in purely economic terms, IPM would reduce the need for inorganic fertilizers and pesticides, improve the balance of payments problem and release precious foreign exchange for other purposes. Falling commodity prices and other forms of control will continue to create constraints on farmers' access to imported chemical fertilizers.^{6/} A study carried out in 1983 found that only 15 per cent of the money realized from Third World food exports reached the producing country.^{7/} Commodity prices continue to fall. Ten years ago, 10 tons of tea bought 17 tons of fertilizers; 8 years later it bought 8 tons.

135. The transition to organic farming and IPM will take place only if certain key distortions in the decision systems are reversed. Several pre-conditions must be met.

136. First, the legislative and institutional framework for controlling and regulating agro-chemicals must be greatly strengthened. In developed countries, where such systems are already in place, they must be provided with structural autonomy, ensuring 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 agro-chemical age within their countries. But new forms of international cooperation are also mandatory because of the

international nature of the agro-chemical industry, and most developing countries are almost totally dependent on imports in addition to the inherent weakness of their institutions.

137. Second, the legislative, policy and research capacity for advancing non-chemical strategies must be established and sustained. The most important single step should be to redesign the subsidy systems that now induce farmers to over-use and abuse chemical fertilizers and pesticides in both developing and developed countries.

iii) Integrate forest management

138. Forests and their ecosystems constitute a fundamental factor of stability. Their destruction can exert serious long-term effects on the biosphere, particularly on the ecology, hydro-meteorology, hydrology and on the human, animal and plant life they support. Indeed, the widespread droughts which have so tragically affected Africa over the past two decades can be directly attributed to the indiscriminate removal of the protecting and nurturing forest vegetation in many parts of that continent. And although this destruction has been taking place in an unprecedented manner throughout the world, today the greatest challenge to forests and woodlands is to be found in developing countries, particularly in their rain forests. This century has seen a reduction of forests by almost a half; every year 11.3 million hectare are destroyed.

139. The causes of deforestation in the developing world are well known, complex and deeply rooted in the patterns of their developmental evolution. Non-existent or inadequate forest policies, inequitable distribution of land, the marginalization of the majority of the poor, rapid population growth, unregulated timber exploitation, agricultural and ranching expansion, the demands for fuelwood, unscientific forest management and the absence of overall land-use plans have all

contributed to the diminution of the forest estate in the developing world and to the tragedies which have, in consequence, occurred.

140. The effects of deforestation can be far-reaching: indigenous forest dwellers and forest-based economies are sometimes displaced; a valuable development and renewable resource capable of assisting in the process of industrialization, in absorbing labour and in earning foreign exchange is destroyed; soils are degraded; water regimes are upset; and many wildlife species lose their habitat. Forest recession also causes human suffering and loss of productivity. For example, in certain rural areas great hardships have been placed on women who must now walk long distances, to collect fuelwood and fodder. The burden this places on them dictates the number and quality of household meals and threatens nutritional security. In urban areas, wood scarcity pushes prices up which the main users, who are already impoverished, can hardly afford.*

141. To the above, immediately felt results of deforestation are added those whose effects on food security are long-term. One of these is the disruption to and loss of genetic resources (C.v).

141.1 Another far-reaching effect of deforestation is soil degradation. Forests are to the soil a self-perpetuating nutrient factory. Their removal causes a breakdown in the self-sustaining process. It is therefore not surprising that in many parts of the world where forests have been removed, soil degradation and lower productivity have been recorded as for example in Mexico, Colombia, Peru and Ecuador and in many parts of Africa.

* See Chapter VI for a detailed discussion on the fuelwood crisis.

141.2 To the above effects is to be added that of climatic change. There are strong indications that when forests are removed, more solar heat is reflected back into space (the "albedo" effect). Many scientists believe that this can lead to changes in global patterns of air circulation, with a potential impact on agriculture.

141.3 Finally, disruptions to the ecosystem are more acutely felt in upland watersheds. The uplands play a very important role in the hydrological cycle: they influence the precipitation of moisture in the form of snow or rain: at the global macro-scale, the water-distribution system can be viewed as the interaction of dominating winds from evaporation centres in the ocean with the high mountain ranges that induce precipitation. They are the source of all major river systems of the world and provide the potential energy for the maintenance of flows in streams and rivers in the plains. Since the stability of the water flow is largely a function of the state of the soil-vegetation-system, the most stable upland watersheds are those where human intervention has been the least and where the natural vegetation is adapted to the local microclimatic variation and acts as an instrument in soil and water stabilization. On the other hand, destabilization changes the flow characteristics of the streams and rivers, in terms of distribution of the yield and seasonality.

142. Floods and droughts occurring everywhere are linked to deforestation and consequent destabilization of upland watersheds. In the words of one peasant farmer in Zambia:

"These (charcoal traders) are the causes of our problems. They have denuded the whole area from village A to village B of vegetation cover. As a result we had more intense drought two years ago, last year the area was flooded. Producers could not produce and our children went hungry."

And the Chipko Movement slogan:

"What do forests bear?

Soil,, water and pure air".

143. Yet local populations, making such utterances, do not control their resources. In almost all cases these are controlled by governments who enunciate policies or allow practices which undermine the forestry resource base. A beginning to any programme to preserve this important resource must start with the local grassroots people who are both victims and agents of destruction. They should be at the centre of integrated forest management which is the basis of sustainable agriculture.

144. On the basis of the land capability classification, the integrated management of forests might provide: a portion of land for annual crops under intensive cultivation; a portion for permanent crops; a portion for livestock; low-quality land for agro-forestry; and where necessary areas devoted exclusively to the provision of such forest services as waste regulation etc. It must also be understood that many forests can be used to provide, at one and the same time, a multiplicity of both goods and services. There is therefore often no need to manage forests on a single-purpose basis. The number of uses to which a particular forest area will be subject would depend upon the scientific analysis of the forests, soils, topography and climate.

145. Such an approach would obviously entail changes in the way development priorities are set by the affected government and greater evolution of responsibilities to local governments and communities. Existing treaties will have to be negotiated to ensure sustainability of forest exploitation and overall environmental and ecosystem conservation. Prices for forest produce will have to reflect the actual and environmental value of the products.

146. All this will have to be underpinned by solid research. Therefore international forestry research organizations should be established as soon as possible, in various tropical countries in selected ecosystems. Where they exist, such as ICRAF, they should be strengthened.

147. Portions of forest areas may be designated prevention areas. These are predominantly national parks which could be set aside from agricultural exploitation to perform essential soil and water conservation functions as well as wildlife. They may also include marginal lands whose exploitation accelerate land degradation through erosion, desertification etc. Conservation areas or national parks could perform the important function of conservation of genetic resources in situ. In view of the fast rates at which forests are being depleted, this task becomes an urgent one.

iv) Encourage soil conservation practices

148. Some practices such as agro-forestry already mentioned (B.ii) and general reforestation (D.i), organic farming (C.ii.a) all conserve and enhance the soil's fertility. Other technologies have been and are now in place to conserve the soil. What is needed is a concerted effort to publicize and adopt them.

149. True, careless technology can cause unmitigated environmental disasters. But technologies carefully tailored to specific agro-ecological and socio-economic conditions can help increase food production and at the same time ensure freedom from environmental degradation. Thus, soil's productivity can be kept at high levels through adequate soil-health monitoring and care. Soil's fertility can be replenished through an integrated nutrient-supply system consisting of organic recycling, green manuring, crop rotations and the use of the minimum essential mineral fertilizers. The leguminous plant sesbania rostrata from Senegal is a wonderful

nitrogen-producing factory since it fixes atmospheric nitrogen both in the roots and stem. Other countries in the region can adopt this and/or identify and fully utilize similar trees.

150. Because of the unusual possibilities now open for raising productivity of both crops and farm animals, marginal lands can be released from annual crops and be placed under sylvi-pastoral or sylvi-horticultural or other agro-forestry systems of land and water management.

v) Preserve genetic resources

151. Genetic improvements have resulted in increased agricultural yields in industrialized countries, and Asia and other industrial enclaves. It is this growing knowledge of the usefulness of genetic resources which creates concern for the wanton destruction of their habitats through deforestation. Species diversity increases from the temperate to the tropical regions. Within the tropics, the moist forests have the highest number of both plant and animal species. While they cover only 7 per cent of the earth's land area, they harbour 40 to 50 per cent of all the species and some 100,000 of those of the higher plants.

152. The magnitude of the threat to this resource is brought home by the rate of tropical deforestation. Unfortunately, we do not have reliable figures for the current extinction rates of invertebrates and plant species generally, but the extinction rate for flowering plants is known to be extremely high. Moreover, most of the domesticated crop plants and animals originated in the so-called Vavilov centres of genetic diversity located in developing countries. Today, they are distinguished by marked germ-plasm diversity of the cultivars and land races of their domesticates. These are being lost under modern processes and habitat change. For example, African centres of domestication (Barbary, Sudan-Sahel,

Ethiopia, East African highlands, West-Central forest belt) are all areas experiencing marked environmental stress and modification.

153. Clearly, campaigns now in progress to conserve the biota in situ are a matter of priority for national governments. In addition, efforts to preserve the biota a germ-plasm ex situ in banks must be multiplied as a matter of urgency for the future of sustainable agriculture. Advances in molecular biology will promote this development of an integrated genetic conservation strategy. Efforts in place range from the establishment and protection of biosphere reserves and national parks and other forms of in situ conservation, to the creation of DNA libraries, particularly in the case of species threatened with extinction. This technology should be shared with all governments particularly research centres in developing countries.

154. Seed collection being pushed for by organizations such as the International Board of Plant Genetic Resources should receive greater co-operation through the establishment of national and regional laboratories to preserve all local genetic material.

155. Governments should encourage plant breeders to step up their collections for adaptive genes of major crops for local use. This will be facilitated by a shift away from the commercialization of plant breeding research which has developed in industrialized countries, supported by patent rights. This has long-term effects of privatization of resources, which would work against food security particularly in developing countries.

vi) Prevent salinization and alkalization

156. Salinization, alkalization and waterlogging result from badly planned and executed irrigation systems. They have been observed in many parts of the world. The critical role

irrigation plays in food security can not be denied and has been demonstrated. To give a few examples: the dramatic rise in Indian grain production in the late 1960s was due as much to irrigation as to improved seeds, while China's production increases recorded over the last five years owe to irrigation substantially. In Mexico, more than half of the total commercial farm output measured in monetary terms come from land under irrigation, although only 30 per cent of the cropland is irrigated. In the irrigated Japanese rice culture, 0.045 hectare of land suffices to provide 2,500 cal/day/person whereas in USA twice as much land is needed for the same purpose. By contrast, rainfed agriculture dominates Africa with irrigated land amounting to only 3 per cent, utilizing only 15.7 per cent of its potential irrigation area. If this was exploited, yields would increase 24-fold. Looking to the future, there is general agreement among agronomists that more land must be irrigated if food production is to increase. The International Food Policy Research Institute has estimated that three-fifths of the food increase, if projected for all developing countries over the next decade, would result from extending land under irrigation.

157. The role of irrigation in increasing yields is not in question. What is in question is its sustainability, its socio-economic effects and economic costs. Two main socio-economic costs of badly planned irrigation systems are discernible: diseases arising from the prevalence of water-borne, water-based and water-related vectors; and socio-economic disruptions.

158. Salinization, alkalization and waterlogging result from badly planned and executed irrigation systems. The size and location of irrigation systems have had serious implications for the ecosystems in many cases: changes in land-use patterns; introduction of foreign plants. Irrigation may have an impact on plants and animals well beyond the area circumscribed by project boundaries. Irrigation always removes some habitats of

the native species but, in general, it tends to favour the most aggressive plant and animal species.

159. The greatest irrigation-derived threat to sustainable food security, however, is presented by waterlogging, secondary salinization and alkalization which ill-designed and poorly implemented irrigation results in. It appears this is one of the areas where mankind has failed to draw lessons. Throughout history, salinity has been rendering once-productive soils or less-productive. FAO and UNESCO estimates show that as much as half of all existing irrigation schemes of the world are more or less under the influence of salinization, alkalization and waterlogging. These estimates translate to a global abandonment of some 10 million ha of irrigated land annually. At present, no continent using irrigation schemes in the conduct of its agriculture has been able to escape from the occurrence of salinization. In Argentina, nearly 50 per cent of the irrigated lands show signs of salinization. A survey carried out in Pakistan in 1965 showed that one-seventh of the irrigated land was salinized after a few years; in 1980, 40 per cent of the irrigated areas in Iraq and Iran were similarly affected. The Nile Delta is exhibiting degradation of this once very fertile area. The area is plagued with problems of salinity, alkalinity (in addition to rising water table, and industrial and chemical pollution caused by fertilizers and pesticides). In Australia, salinization and alkalization are taking place in the Valley of the River Murray; in Northern Victoria about 80,000 ha have already been affected. Alberta, Canada, and the northern states of the USA are experiencing similar stresses.

160. Some of the above effects could have been avoided if substantial research had been carried out in the planning and execution stages of the scheme to:

- measure the amount of soluble salt the soil at the beginning and at the end of the project;
- measure the rate of leaking; and
- measure the rate of salt accumulation in the soil.

161. Moreover, because of water's central position in agricultural production, it is imperative to:

vii) Integrate water management

162. Irrigation's adverse effects as seen above and water's critical role to food security demand the most effective land-water management systems. Integrated water management which takes into account the ecological, biological, social and economic factors should be a priority concern to all governments. In designing irrigation and energy projects, the role of watersheds, potential for aquaculture, provision of drinking water, navigation and transport possibilities should also be integrated while emphasizing the primary objective of water for crop irrigation.

163. It is almost accepted in the industrialized countries (Canada, US for example) and in some developing countries such as Mexico that big dams are no longer possible. In our view, this is moving irrigation in the right direction. In developing countries, it may well be economically and socially desirable to convert large systems to cater for the needs of small farmers. Conversion has an added advantage of causing less disruption to the local populations and economies. Where irrigation systems have not been developed such as in much of Africa, there must be a shift in emphasis away from major reservoir-based irrigation toward small-tank/reservoir mine irrigation. This has the added advantage of involving the local people in planning, designing, construction and direction. Chances of disease are also minimized. The socio-economic interests of people, the supposed beneficiaries, would be assured on a more sustainable basis. But the climatic, ecological, economic, and social factors have to be well examined and established for irrigation schemes to be on long-term advantage.

D. Restore Destroyed Lands

164. These are largely represented by deforested (C.iii) and desertified lands. Therefore, it will be necessary to forest the earth and green the deserts.

i) Forest the earth

165. Three generic methods or combinations of these are generally employed in denuded and eroded areas: protection of the area in order to permit the natural regeneration of the vegetation; establishment of vegetation (trees, shrubs, grasses etc.) through planting; seeding etc.; and the construction of bunds, terraces, etc.

166. Marginal lands could be put to more effective and productive use other than crop farming: forestry, fuelwood plantations and, in some cases, fruit farming.

ii) Green the deserts

167. The World Desertification Map identifies 29 per cent of the earth's land area as subject to varying degrees of desertification* - slight, moderate and severe. An additional 6 per cent is classified as extremely severe. The process of desertification affects every region of the globe - Australia, China and Mongolia, Mediterranean Africa, Mediterranean Europe, Mexico, North America, South America, South and West Asia, sub-Sahara Africa and USSR in Asia, but it is more menacing in the drylands of South America, Asia and Africa where 18.5 per cent (870 million ha) of all productive lands is severely

* Desertification is defined as largely man-made processes which can destroy or diminish the biological potential of land.

desertified and completely denuded of vegetation. The most extensive desertification occurs in the rangelands where 82 per cent of the land surface is moderately to severely desertified. All told, a total of 75 per cent of all the productive land within drylands is desertified. Map I shows the global extent of desertification and Figure III indicates trends.

168. The large populations supported on these lands further illustrate the significance of the problem. In 1984, 850 million people were reported to be living in drylands, of whom 500 million were rural. Of these, 230 million were on lands affected by severe desertification.

169. Twenty per cent of the population on irrigated lands is moderately affected, while 15 per cent is severely struck by desertification.

170. The prospects to the year 2000 and beyond are not encouraging. On the contrary, they are frightening. Land lost as a result of desertification or degraded to desert-like conditions continues to grow at an annual rate of 6 million ha. And each year, 21 million additional ha of land provide no economic return because of the spread of the desertification process. Projections indicate that present rates of desertification will be maintained in irrigated areas and in rangelands but will accelerate in the rainfed croplands. Overall, although there will be local improvements, gains will be offset by losses. The countries most severely affected by desertification are in the South, the worst hit being those which not only experience adverse climatic conditions, but are also economically weak. The agricultural sector, which provides the vital life-support systems of the bulk of the populations, is the worst effected. Of the drylands in the developing countries, the Sahelian-Sudano zones of Africa, and to a less extent those countries to their south, are low-income countries with unfavourable climatic regimes. Therefore, they



LEGEND

STATUS OF DESERTIFICATION
 Areas under desertification
 Areas not under desertification

DEGREE OF LAND DEGRADATION
 Very severe
 Severe
 Moderate
 Slight

CLIMATE
 Areas under desertification
 Areas not under desertification

POPULATION DENSITY
 Very high
 High
 Moderate
 Low

WATER RESOURCES
 Very high
 High
 Moderate
 Low

SOIL FERTILITY
 Very high
 High
 Moderate
 Low

VEGETATION
 Very high
 High
 Moderate
 Low

TOPOGRAPHY
 Very high
 High
 Moderate
 Low

The map shows the distribution of desertification in the world. The areas under desertification are shaded according to the degree of land degradation. The map also shows the distribution of climate, population density, water resources, soil fertility, vegetation, and topography.

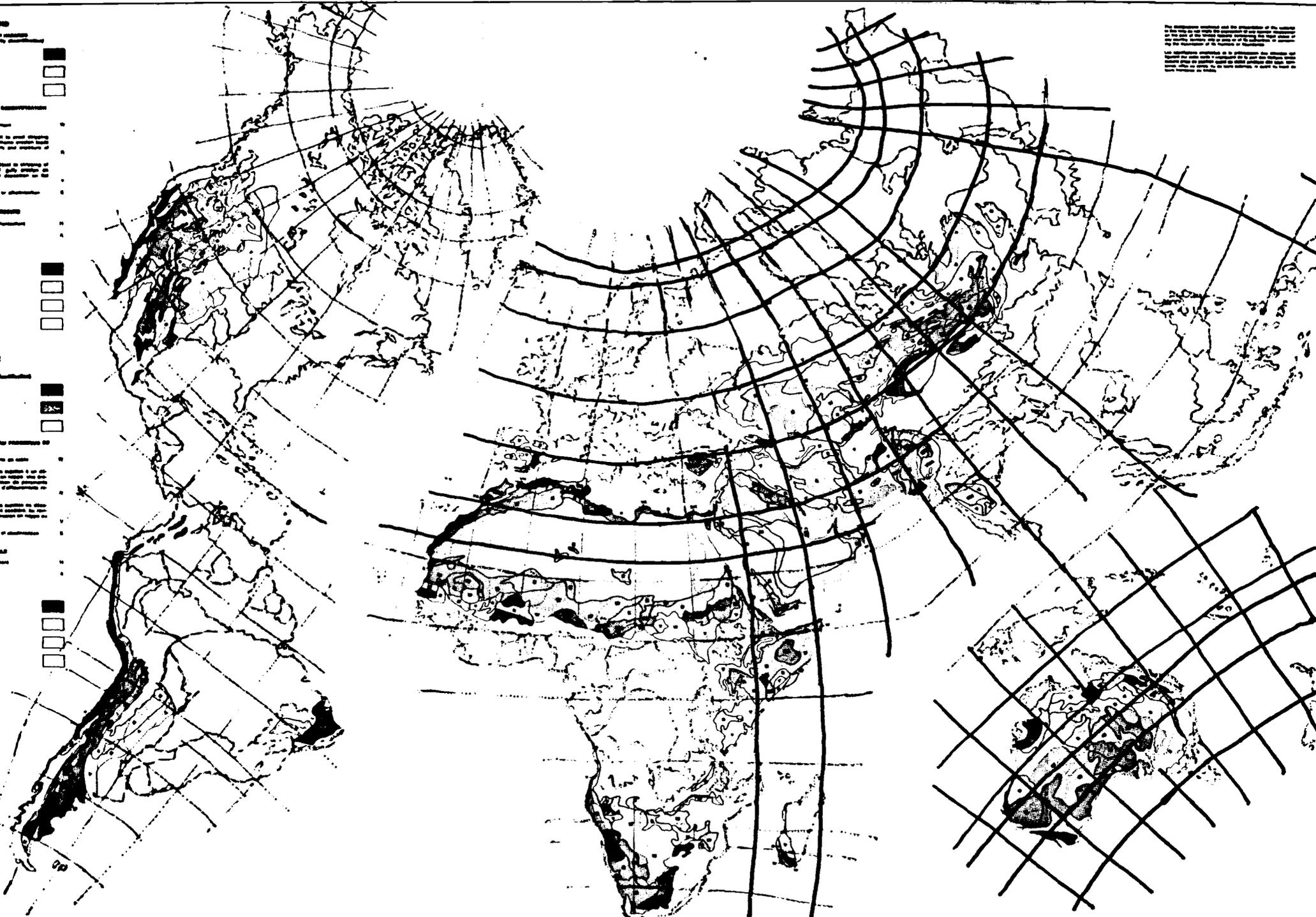


Figure III Regional trends of desertification within land-use categories and major natural resources

Region	Rangelands	Rainfed croplands	Irrigated lands	Forest woodlands	Ground-water resources
Sudano-Sahelian region					
Africa South of Sudano-Sahelian region					
Mediterranean Africa					
Western Asia					
South Asia					
USSR in Asia					—
China and Mongolia					—
Australia					
Mediterranean Europe					
South America					
Mexico					
North America					

accelerating desertification
 continuing desertification

desertification status unchanged
 status improving

suffer most from desertification. 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 hit people, as Figure IV shows.

171. To this human tragedy are to be added other consequences shared by the international community and countries neighbouring the desertified ones: loss of genetic resources; hydrological disruption; increase of atmospheric dust; and loss of production and markets. In 1983, annual losses in production due to desertification were estimated at US\$26 billion of which \$7.4 represented desertified rangelands.

172. Accepting that desertification is a natural process, man's contribution to this cannot be denied and has been well publicized particularly since the 1977 United Nations Conference on Desertification. The United Nations Environment Programme (UNEP) has done much to raise the international communities' awareness of the extent of desertification and what can be done.

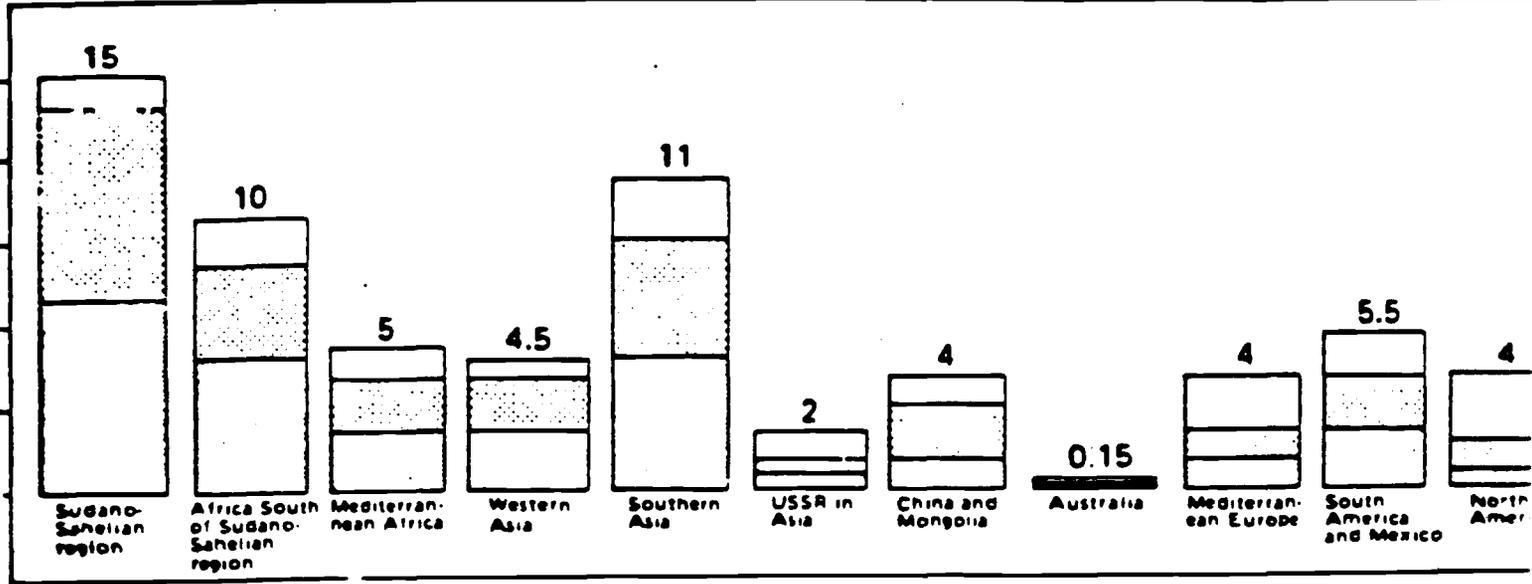
173. Chiefmost of these causes have been human and animal population growth; wanton destruction of the vegetation cover; civil strife expressing itself in the form of wars; and the unfavourable international terms of trade for primary products, reinforcing government-engineered pressure for increasing cash-crop production at any cost.

174. The Plan of Action to combat desertification drawn up at the UN Conference has made some slight, mainly localized, gains on the ground. On the whole, realization of its goals is yet to go some way: lack of financial support from the international community; inadequacies of the regional organizations established to respond to the regional nature of the problem; and absence of involvement of the local, grassroots communities in the whole process of attempts to combat desertification have all contributed to the non-effectiveness of the Plan.

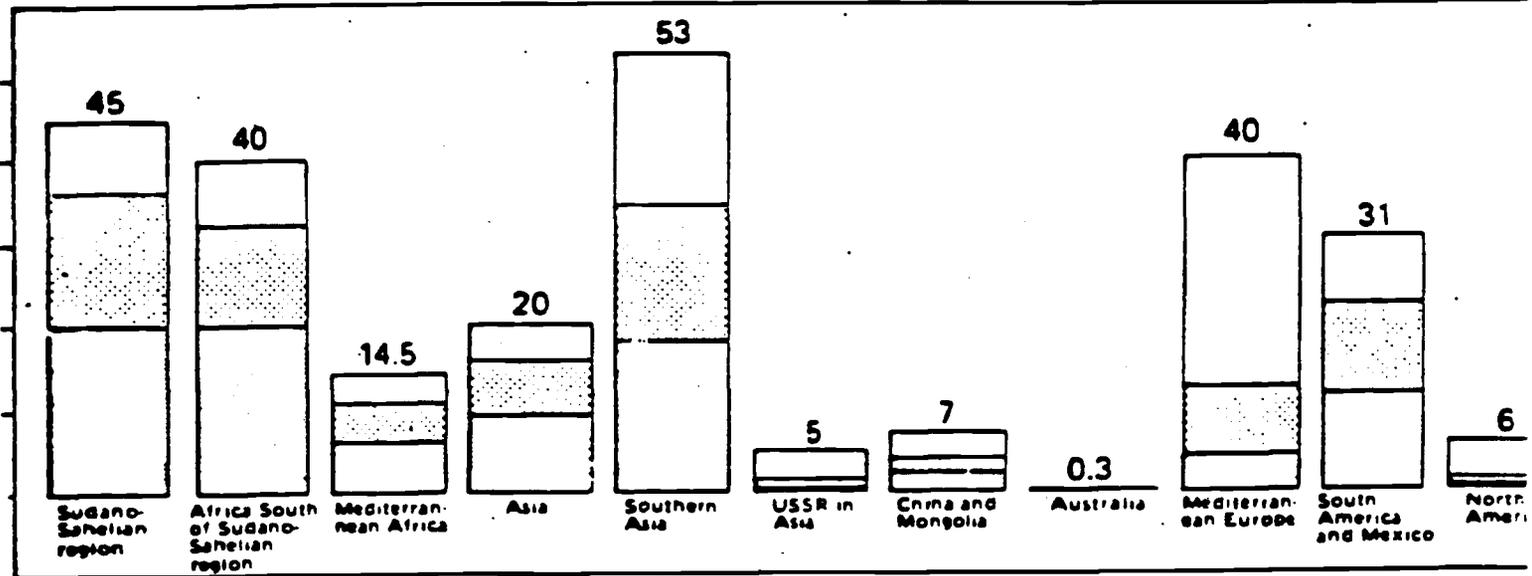
Figure IV Rural population affected by moderate or severe desertification respectively in the major regions and subregions of the drylands under main types of land use (Millions)

Population not affected by desertification
 Population moderately affected by desertification
 Population severely affected by desertification

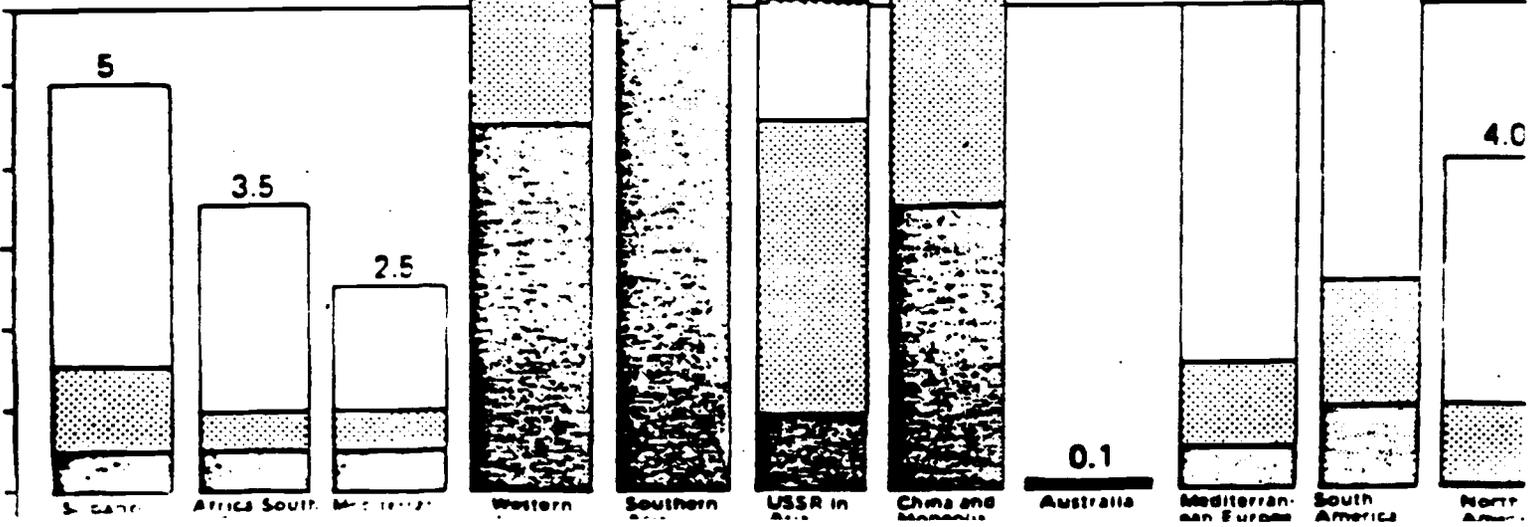
Rangelands



Rainfed croplands



Irrigated lands



175. Clearly, the international community, national governments, NGOs and the grassroots people have to rethink their strategies and make a more united front to deal with this menacing problem.

176. National governments in affected areas should give priority to establishing national policy and multi-disciplinary programmes to combat destructive processes, especially desertification, and to creating or strengthening national machineries for implementing such programmes. Where these already exist, they should be better coordinated and better designed to act in the field. The current UN Plan of Action to Combat Desertification is an example of a strategy already in place that requires more concerted and committed support particularly financially.

177. People's participation should be encouraged so that the programmes which are formulated are in harmony with existing social, cultural and ecological systems. The role of NGOs in implementing action-oriented projects should be acknowledged and encouraged. If carried out in practice, the strategies adopted in foresting the earth (4.1) will turn today's deserts into fertile lands.

E. . Reduce Population Stabilization Levels and Change Wasteful Consumption Patterns*

178. Under present resource and economic management, population growth in relation to the production resources and food may well pose another threat to enduring food security. In a number of countries, including some in Africa, West Asia and Latin America, the population problem is not that there are too many people for the resource base. There are not. The

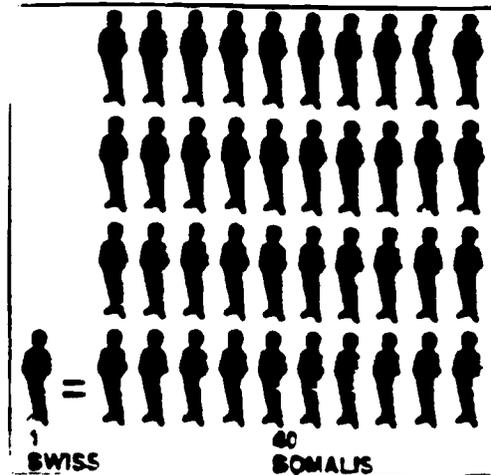
* A more substantive discussion and analysis of these issues are contained in Chapter IV
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problem is that growth and migration rates appear greatly to outstrip present and future prospects to develop the capacity to produce more food. In many other countries, especially in Asia, the problem is that there are too many people for the resource base.

179. At the beginning of this century, the world's family numbered 1.7 billion people. Almost as many, 1.6 billion, will be added in the 5000 days remaining to the end of this century. Of this increase, about 56 per cent will occur in Asia, 25 per cent in Africa and 11 per cent in Latin America. Industrialized countries as a group will grow by 8 per cent. Present rates are projected to continue well into the next century. Asia could double its 1980 population to 5.0 billion before stabilizing; Latin America could triple from 360 million to 1.2 billion while Africa's population is projected to increase six times before it stabilizes. In many cases, these increases take place against a background of underdevelopment or at best economic stagnation.

180. Another dimension to the food/natural resource issue is that of resource consumption. It is well established that poorer people have a tendency for large families and that poverty leads to over-exploitation and therefore depletion of the resource base, often marginal in this case. It cannot be denied that damage caused by the poor in its quantitative and qualitative dimensions pales into insignificance when compared to operations carried out to meet consumerism of the affluent in both in developing-country cities and in industrialized countries. The Figure V below prepared over ten years ago will demonstrate this. The ratio if anything, should be worse now.

Figure V: Disproportionate consumption of resources
by the affluent



Source: R.H. Strahm, Pays Industrializes, Pay Sous-Développés: faits et chiffres (1974). Cited from IUCN: World Conservation Strategy (1980)

181. The need to link the population issue with the stock of natural resources, economic development and food security has been established and is widely accepted by governments and communities. From the early 1970s, a slow deceleration of population growth has been noted in all regions except Africa. No other nation matches the Chinese in their efforts to limit their numbers, but others have been quite successful, notably Sri Lanka, India, Mexico, etc. in reducing their growth rates.

182. And attitudes even in sub-Sahara Africa are beginning to change. In 1984, 36 countries adopted the Kilimanjaro Programme of Action on population which recognized that access to nutrition, health and education services, especially for women was fundamental to family planning. All countries should give higher priority to such programmes in all countries as part of an integrated attack on the food security challenge. At the grassroots level, attitudinal changes have been noted particularly among rural women. Not so long ago, many poor women in Africa wished to have more daughters to help them fetch water and wood and sons to see to their needs in old age. Now, an impressive numbers see that as the land degrades, they face greater hardships

in bringing up children. Governments and non-governmental organizations should build on such changes through open discussions.

183. The other part of the population/food equation is, of course, the possibility of increasing the supply of food while rates of population growth are contained. If all or part of the strategies for sustainable food security contained in this chapter are adopted, this should work.

184. Comfort-derived pressures on the agricultural resource base is the other side of the population coin. Governments and communities in industrialized countries and their enclaves in the South should address this issue. Investing in regeneration of the depleted resources may not be enough. Curtailing their initial depletion is what is needed. But this is an area where individuals and organizations can take the initial steps by curbing their wasteful habits.

F. Finance the Transition to Sustainable Agriculture and Food Security

185. A regionally differentiated, ecologically oriented agricultural policy may constrain short and medium-term income potential in some areas and generate high earning in others. The basic approach should be to compensate those whose earnings are constrained in the interest of sustainability and raise the resource for this purpose by cutting back on unnecessary subsidies to those who are not so constrained. This will require a redirection of existing programmes. But, in developing countries major investments will be required and the financing of this cannot come from such readjustments.

186. Only national governments and peoples themselves can take the fundamental actions needed to reverse the steady deterioration of the agricultural base. No outside assistance, however massive, can possibly substitute to these essential national actions.

However, the success of any strategy to put agriculture, in developing countries, on an ecologically and economically sustainable footing will continue to require external finance. Increasing assistance is needed to: support the transitional requirements to long-term sustainable growth; invest in the development of raw lands for agriculture in Africa and Latin America and in sustainable means of increasing yields and productivity; invest in infrastructural needs, research institutes and extension services and human-resource development; arrest current trends in erosion, desertification, deforestation and degradation of the resource base for agriculture; and promote knowledge of approaches with high sustainable livelihood intensity.

G. Review National and International Institutional Arrangements

187. The institutional changes required, nationally and internationally, must begin with recognizing ecological security as a priority goal of agricultural policy in all its manifestations. This goal must become manifest in several ways, but most importantly by 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 do not undermine but rather enhance the ecological basis for food security in the short, medium and long-term.

188. This goal should also be reflected in a strengthening of the agricultural, trade and other relevant mandates of all appropriate international agencies. In turn, the agencies could, for example, strengthen mechanisms for technical cooperation in research among developing countries within regions and among regions by greater support to the existing Technical Cooperation among Developing Countries (TCDC) and Economic Cooperation among Developing Countries (ECDC) mechanisms; and support programmes to establish both national and international data banks. At the same time,

donor agencies and international institutions must place higher priority on projects which establish linkages between conservation and development in their aid policies and programmes.

189. Regional organizations should be strengthened by both member governments and donor countries, the latter taking care that their support does not distort national and regional priorities. These organizations can also monitor ecological and environmental development and problems on a regional basis.

190. Such a strengthening at national and international levels should be reflected in budget lines in all national and international agencies. This means that external agencies must coordinate their efforts in the interest of effectiveness and efficiency. To date, receiving governments and communities are often stretched to the limits of their capacity to cope with many well intentioned helpers and projects.

FOOTNOTES

- 1/ World Hunger Project: Ending Hunger: An Idea whose time has come. (New York, 1985)
- 2/ Food and Agricultural Organization, 1984 Production Yearbook, Vol. 38 (Rome, 1985)
- 3/ See World Development Report, 1986.
- 4/ Alan Gear, ed.: The Organic Food Guide (Essex, 1983)
- 5/ Dana Silk: "Urban Agriculture" (Paris, 1985. Mimeo)
- 6/ Although developing countries as a group produced two-thirds of their fertilizer requirements in 1978-1979 (17.5 per cent of world output), this was concentrated in the oil exporting countries. This will remain true even if, as a group, they reach self-sufficiency by the turn of the century. See Alan Gear, ed: The Organic Food Guide (Essex, 1983).
- 7/ Ibid.

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