

## **The Issue of Sustainability in Third World Food Production**

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### **INTRODUCTORY REMARKS**

In spite of the fact that food production in developing countries doubled over the last 25 years undernutrition is still widely spread. At the beginning of the eighties, according to FAO, 335 to 494 million people in developing countries suffered from serious undernutrition the difference being due to different concepts to determine undernutrition on which scientist were unable to find a consensus.<sup>1</sup> Unfortunately there is no recent comprehensive analysis of the food situation comparable to those of previous World Food Surveys but it can be taken for sure that the absolute number of undernourished has increased. According to unofficial FAO sources a figure of 870 million was estimated for 1990 (22 percent of the total population in developing countries) using the same concept that led to the figure of 494 million in 1979-81 (23 percent of the total population in developing countries) which means that most probably the number of undernourished increased at a rate slightly less than population growth.

This disappointing picture corresponds to statistics on the number of poor published by the World Bank.<sup>2</sup> According to the World Development Report 1990, 633 million people were classified in 1985 as extremely poor (with a per capita income of less than 275 U. S. \$) and 1116 million as poor (with a per capita income of less than 370 U. S. \$).

A look at the great geo-political regions reveals significant differences. The least successful case is represented by Sub-Saharan Africa, where the growth rate of food production was exceeded by population growth. In other regions like the Far East and Latin America the growth rate of food production exceeded population growth by about one percentage point but unequal access to food prevented large a

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<sup>1</sup>Food and Agriculture Organization of the United Nations: The Fifth World Food Survey. Rome 1985, p. 26.

<sup>2</sup>International Bank for Reconstruction and Development: World Development Report 1990, p.

part of the population to satisfy their needs.

It has to be noted that the increase in food production in developing countries was achieved despite a decreasing resource base. Global climatic changes, leading to an expansion of dry areas, reduced the potential to grow food in many developing countries. Quite often the increase in food production was itself achieved at the expense of the resource base by extending production of annual crops into marginal areas resulting in soil erosion, degradation and irreversible deterioration of soil fertility. The need for fuelwood, the major source of energy in rural areas, further reduced the natural resource base.

There is a direct link between the use of natural resources in a non-sustainable manner and poverty. The more limited the alternatives to satisfy the basic needs are, the more dominates the necessity of immediate survival over long term considerations. Farmers in developing countries are not short sighted and usually know quite well the effect of unsustainable production practices but cannot avoid them if that implies an additional risk for immediate survival. Only when this is assured makes it sense to weigh additional present satisfaction against an increased capacity to meet future needs.

### **HOW TO DEFINE SUSTAINABILITY?**

In a straightforward approach sustainable food production can be defined as a production which can be maintained infinitely at a certain level without decreasing the fertility of the soil. This implies that,

- The physical substance of the soil has to be conserved, i.e. wind and water erosion should not exceed the addition to the soil layer by weathering of the substrate;
- The offtake of plant nutrients either by harvest or by grazing should not exceed additions by weathering from the substrate, fixation of nitrogen from the atmosphere, application of fertilizer and manure or any other form of recycling organic material;
- The soil structure and the chemical characteristics of the soil should be maintained;
- The quantity, composition and activity of micro-organisms should be preserved; and
- An accumulation of toxic substances and/or noxious organisms should not take place.

The enumeration gives already an indication how complex the concept of maintaining soil fertility is, even in a static sense.

The question may be asked whether infinite agricultural production without any consumption of non-renewable resources is really possible. In a very strict sense the answer is no. The logical impossibility already results from the law of entropy. In practical terms, however, it is quite evident that agricultural systems have maintained their capacity to produce at a constant or even increasing level for long periods of time. How can this contradiction be explained?

One explanation may be that consumption of non-renewable resources within such systems was so minimal that its effect on the level of production was invisible or masked by technical changes which, even if they were small, compensated or overcompensated the effect of a minimal reduction of the resource base. Another explanation may be that a consumption of non-renewable resources took place somewhere else without being noticed. The concept of sustainability is meaningless if it does not refer to a well-defined system or area. For example, the fertility of arable land in large parts of Europe has been maintained over centuries by adding organic material withdrawn from forest or grassland, thus exploiting these ecosystems. Nowadays soil fertility is maintained by adding plant nutrients originating from mineral deposits (e.g. rock phosphate) or from the atmosphere, which means that these deposits and energy, mostly from fossile sources, are consumed. This should not *a priori* be considered as negative but one should be conscious about the connections between different systems and how they are influenced by the way in which food is produced.

It has already been mentioned, that the definition discussed so far is a static one. It is of limited use in a situation where food demand increases at such a rate that it cannot be met under the conditions defined by the static concept. To overcome this limitation, in new concepts of sustainability a dynamic aspect is included. This may be illustrated by a concept recently developed by the Technical Advisory Committee of the Consultative Group on International Agricultural Research, which states that "sustainable agriculture should involve the successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the quality of the environment and conserving natural resources".<sup>3</sup>

There are two new elements in this definition,

- Firstly: it does not limit itself to maintaining the quality of the environment but specifically mentions its enhancement; and
- Secondly: the concept of sustainability is linked to the capacity of an agricultural production system to meet changing, i.e. increasing human needs.

<sup>3</sup>Consultative Group on International Agricultural Research – Technical Advisory Committee: Sustainable Agricultural Production: Implications for International Agricultural Research. Rome 1988, p. 2.

The twofold widening of the concept has far reaching implications: The reclamation of degraded lands is part of the definition. Given the magnitude of such lands their contribution to achieving the goal of sustainability is of primary importance. Still more important is, however, the fact that according to this definition a production system should only be called sustainable if it has the potential of satisfying increasing human needs. Many systems which were able to satisfy static or moderately increasing human needs became unsustainable at the moment when human needs began to grow more rapidly. This happened to many systems of shifting cultivation, which were sustainable for centuries but became unsustainable when population density exceeded a certain level. The more population grew the more unsustainable such systems became. Maintaining them – mostly because of lack of alternatives – meant increasing deterioration of the resource base.

To satisfy increasing needs from the same area of land means higher yields, by which increasing amounts of plant nutrients are extracted from the soil. Sustainability can therefor only be achieved if the same amount of nutrients is brought back. This means that production systems with high output are necessarily open systems which require high inputs from outside. As demand increases they have to replace systems which were characterised by nearly closed cycles, sustainable but limited to low output.

Despite being dependent on inputs such production systems can be maintained infinitely (at least in theory) provided that the input supply is not interrupted and the system itself has no built-in deteriorating effects like soil erosion, salinisation, built-up of pests and diseases, accumulation of toxic materials or a negative impact on micro-organisms. It goes without saying that enumerating these conditions is far easier than fulfilling them in reality. If only one of them is violated the system becomes unsustainable.

This is what unfortunately happens quite often and what has led to the wrong perception that high input – high output systems are by themselves destructive. This is not necessarily the case. If they are this may be due to a variety of reasons.

One may be the extension of agricultural land use into marginal areas with fragile ecosystems which are not suitable for it at all, often coupled with an inability to satisfy increasing needs by food production in better endowed regions. This may be due to excessive population growth or to a regional distribution of population density which runs counter to the carrying capacity mostly because of historical reasons (e.g. retreat of indigenous population into hill areas under the pressure of invasion). Another reason may consist in inadequately adapted production systems. Hasty transfer of technologies which have been developed in a different environment is, unfortunately, not uncommon. Quite often the inputs which are required to make high output systems sustainable are not available or they are simply beyond the reach of a majority of farmers. Inadequate knowledge at the

farmers' level or at the level of extension agencies may also be mentioned.

### **MAJOR THREATS CAUSED BY INADEQUATELY ADAPTED PRODUCTION SYSTEMS**

The most common threat to the natural resource base caused by inappropriate agricultural production systems is erosion. As the example of the U.S.A. shows it is not limited to the Third World, but concern about its impact is rightly focused on developing countries. There, 14 to 18 percent of the land is threatened by man made erosion, more than half of it quite seriously.

In the lowlands, particularly under arid conditions the destruction of the natural vegetation and large scale ploughing without proper protection by wind breaks has resulted in massive wind erosion. In Third World countries 240 million hectares are affected, particularly in Africa and Asia.

In highlands water erosion is number one among the man made threats to the resource base. The steeper the slope of ploughed land the more rapidly erosion is progressing, particularly if anti-erosive measures like terraces, contour bunds, hedgerows etc. are inadequate or completely lacking. The situation is made worse by increasing population density. In the highlands of Asia 314 million hectares are affected by erosion, in Latin America 77 million hectares and in Africa 170 million hectares.<sup>4</sup> The magnitude of the problem becomes obvious if one compares these figures with the total arable land of Third World countries which is 870 million hectares.

Linked with, but not limited to erosion is the loss of soil fertility. Another reason for it is insufficient replacement of plant nutrients withdrawn with the crops or by grazing. Studies in Africa have shown that the net loss of plant nutrients may reach 80 kg per hectare per year ( $N+P_2O_5+K_2O$ ), based on country averages.<sup>5</sup> On individual plots it may be much higher. Depletion of plant nutrients became particularly acute under shifting cultivation when the original fallow period of about 25 years was more and more shortened and thus became insufficient to restore soil fertility.

Overgrazing is another area of major concern. Stocking rates which by far exceed the stocking capacity are reported from many countries. According to FAO estimates Africa was inhabited in 1950 by 219 million people and a livestock population of 295 million; in 1983 the number of inhabitants had increased to 515

<sup>4</sup>Oldeman, L. R./Hakkeling R. T. A./Sombroek, W. G.: World Map of the Status of Human-Induced Soil Degradation. International Soil Reference and Information Centre/United Nations Development Programme, Wageningen 1990.

<sup>5</sup>Stoorvogel, J. J./Smaling, E. M. A.: Assessment of Soil Nutrient Depletion in Sub-Saharan Africa: 1983-2000. Winand Staring Centre Report 28, Wageningen 1990.

million and the livestock population to 521 million. Once the stocking capacity is exceeded the process of deterioration starts and accelerators the more the actual stocking rate and stocking capacity are out of proportion.<sup>6</sup>

Of no less importance is the destruction of trees, bushes and shrubs by people in search for firewood. FAO estimates that more than 250 million people in developing countries are already suffering from insufficient availability of firewood. In 1980 consumption was 1300 million m<sup>3</sup>, which was at least 100 million m<sup>3</sup> below the estimated minimum requirements. Based on the present consumption the FAO estimates that in the year 2000 requirements will reach 2600 million m<sup>3</sup> but the quantity corresponding to annual growth will only be 1500 million m<sup>3</sup>. If the gap cannot be filled by other sources the problem of energy supply will become at least as important as food supply.<sup>7</sup>

The availability of sowlog is seen less critically by the FAO. Experts are of the opinion that the quantities needed can be withdrawn without destroying tropical forests. What is needed are regulations which guarantee non destructive forms of exploitation, which are feasible from a technical point of view but which require strong governments to enforce them against the commercial interest of private loggers. What is more destructive to tropical rain forests is its conversion to arable or grasing land, a process taking place in developing countries on a large scale. According to FAO estimates the annual loss of tropical rain forests has reached 17–20 million hectares compared to 10–11 million hectares in 1980.<sup>8</sup> Between 1981 and 1990 the area under tropical rain forests decreased annually by 1.7 percent in Africa, 0.9 percent in Latin America and 1.4 percent in Asia.<sup>9</sup>

The danger connected with open, highly productive systems of agricultural production are illustrated by the development of irrigated land. The total area under irrigation in developing countries is about 165 million hectares, and it is obvious that this area makes a very substantial contribution to food production. Unfortunately, nearly half of this area is already suffering from salinisation and water logging. It has been estimated that 10 million hectares become unproductive each year.<sup>10</sup> Between 1960 and 1970 the area under irrigation increased annually by 4 percent. At the beginning of the eighties the annual net increase had come down to 1 percent, the main reason being that the potential of bringing new land under irrigation at low costs had been largely exploited and implementing new schemes at

<sup>6</sup>Brown, L. R.: *Sustaining World Agriculture*. State of the World, Worldwatch Institute, Washington, D. C. 1987.

<sup>7</sup>World Resources Institute: *Tropical Forests: A Call for Action*, New York, 1985.

<sup>8</sup>*Ibid.*

<sup>9</sup>Food and Agriculture Organization of the United Nations. *Assessing Changes in Tropical Forest Cover*. FAO's 1990 Reassessment. Unpublished Report, Rome 1990.

<sup>10</sup>*Our Common Future*. The Brundtland Report, Oxford-London 1987.

high costs has become uneconomical.

Open systems of agricultural production depending on high doses of fertilizer insecticides and pesticides may also become a threat to environment. To guarantee high yields usually makes the application of insecticides, pesticides and sometimes also herbicides unavoidable. Unfortunately many chemicals used in developing countries are toxic, highly persistent and therefore difficult to handle. Too high doses and inadequate techniques of application often lead to contamination of groundwater and surface water, intolerable residues in the final product and a high number of fatal accidents. Training, improved equipment and a selection of chemicals less toxic, less persistent and of a more selective impact can contribute a lot to reduce unwarranted and dangerous side-effects. More can be done by biological control methods. Negative side-effects of fertilizer are less probable. It may happen that the pH-value is reduced but this is not a widely spread phenomenon. The same holds true for the contamination of groundwater because the doses applied are usually small and farmers are keen to avoid uneconomical losses.

Since this paper deals with environmental problems related to agricultural production – be it traditional or modern – global environmental problems resulting from other sources are not its subject. It might, however, be appropriate to address them with some limited remarks because they influence the resource base for agricultural production in developing countries, mostly in a negative sense. Accumulation of carbondioxide and methan in the atmosphere, global warming and destruction of the ozon layer are commonly known and well documented phenomena. According to our present knowledge global warming will result in a worldwide increase in temperature in the order of 1.5 to 4.5 degrees centigrade over the next century. This will certainly lead to an expansion of the area covered by deserts which will affect 29 percent of the land mass of the globe, out of which 6 percent will be affected very seriously. At present already 6 million hectares of land are annually added to the deserts and another 21 million hectares become seriously constrained by desertification. The situation is most critical in the dry zones of Asia, Africa and Latin America which comprise an area of 870 million hectares and a population of 850 million out of which 230 million live in areas severely endangered by desertification.<sup>11</sup> Inadequate human activities such as destruction of the vegetative cover by over-grazing or excessive collection of firewood and land use systems which exacerbate erosion, contribute to accelerate the process of degradation. Where under increasing population pressure agricultural production is expanded into dry areas originally reserved to grasing and where at the same time traditional herders are forced to retreat from the desert expanding in the opposite direction violent clashes and irreversible destruction of the resource base are a

<sup>11</sup>*Ibid.*

frequent result. Another major area of concern is the increase of the sea level caused by melting of the ice masses of the poles as a result of global warming, which constitutes a major threat for countries with important coastal areas at sea level, for which Bangladesh may be mentioned as an important example.

### CAUSES OF NON-SUSTAINABLE AGRICULTURAL PRODUCTION SYSTEMS

In a somewhat simplistic way one can say that unsustainable agricultural production systems come into being when population grows and existing production systems do not develop in a way that would allow to satisfy increasing needs without deteriorating the natural resource base. Sustainability would require that a growing population – not only as an aggregate but also taking into account its major groups by regional or socio-economic disaggregation – has either direct access to natural resources sufficient to satisfy their needs without degrading them or access to sources of income sufficient to satisfy their needs by purchases on the market. The more restricted the possibilities to earn an income outside agriculture, the more limited the resource base in relation to the population, the more parts of the population are denied access to resources the greater the probability that those who have no other alternatives use whatever resources they have, irrespective of sustainability considerations, just to ensure immediate survival. Unsustainable production systems are to a large extent a result of poverty.

According to a World Bank estimate 90 percent of the 780 million people who lived in absolute poverty in 1980 (excluding China and the other centrally planned economies of Asia) lived in rural areas, the major exception being Latin America where 70 percent of the absolute poor lived in urban centres as a result of rural to urban migration.<sup>12</sup> Comparable data for a more recent point in time are not available but it seems quite obvious that no fundamental changes have taken place. All one can expect is some increase in the share of urban poor due to migration by which people try to escape from rural poverty.

For many of the non-sustainable forms of agricultural production, the connection to poverty is evident. Intrusion of agricultural land use into fragile areas which are unsuitable for being used for that purpose takes place when needs increase and land use systems in better endowed areas fail to respond by higher production because farmers there cannot afford the investments required to shift to a more open system. It may also result from the fact that part of the farming population is denied access to land suitable for farming by institutional barriers, as it is the case in Latin America with its dualism between latifundium and minifundium. While many of the latifundia are often used at a level of productivity inferior to

<sup>12</sup>FAO: Agriculture: Toward 2000. (Revised Version) Rome 1987.



what it could be without violating the rules of sustainability, most of the minifundia – usually pushed into marginal areas – are used at a level of intensity which is detrimental to the resource base. This is particularly the case if minifundistas do not have financial resources or access to credit required to make investments by which the process of degradation can be reduced. On the other hand non-sustainable production can also take place in the latifundia. There, however, it is not the result of lack of alternatives but that of neglect of the need to maintain the resource base, or the reaction to wrong incentives. Similar examples could also be mentioned from countries in Asia or in Africa.

Depletion of plant nutrients is often not the result of lack of understanding the principles of replenishment but of insufficient economic means. Many poor farmers simply do not have access to the inputs which are required to increase soil fertility and to maintain it at the increased level, either because the necessary inputs are physically not available – at least not at the right time and in the right composition – or their financial resources including access to credit do not permit them to buy the necessary inputs. Moreover, lack of access to credit is one of the main obstacles to investments by which the productivity of land can be increased in a sustainable manner.

If the transition to a more productive open system of agricultural production is thus excluded the only answer to increasing needs is an expansion of the area under cultivation. In areas where shifting cultivation is prevailing this means a reduction of the fallow period. If this exceeds a certain level the system collapses and irreversible deterioration of soil fertility is the immediate result. Besides institutional barriers or lack of knowledge about production systems which may be sustainable under the same ecological conditions poverty may be the main factor for setting in motion the downward spiral.

Overgrazing largely has its origin in the fact that many people in developing countries are exclusively dependent in their livelihood upon the production of their herds. That production systems which were sustainable over long periods now became unsustainable is – among other factors, which have already been mentioned – largely due to institutional barriers. Communal property is often cited in this context. If no individual can be sure to benefit from actions he takes to prevent degradation either by reducing his flock or by soil conserving investments, nobody will take such actions. The fear that others will increase their share at the expense of those who give consideration to sustainability aspects makes that nobody does it. This is in essence what is known to economists as the so-called prisoners' dilemma. Traditional institutions to successfully manage common property have often become weak and ineffective. Those who are most hurt are the poor for whom common property regularly constitutes a major part of whatever little access to natural resources they have. Structural weaknesses in marketing and credit supply

may lead to similar results. In many regions where pastoral production systems constitute the major basis of living the marketing system for cattle is not well developed or disturbed by external influences like beef exports from industrialised countries (primarily the EEC) at highly subsidised and therefore extremely low prices. The result is that only to maintain the level of income more cattle has to be raised which automatically leads to an increased pressure on pastures. Inexistence of a banking system which would allow rural people to keep monetary savings makes cattle the only means to accumulate wealth in spite of the danger that the price at which it can be sold is inferior to that when stocks were built up. Lack of access to credit implies that all major expenditures require a previous accumulation in the form of livestock.

The problems just described are largely due to wrong political decisions. Food prices for a long time kept at an artificially low level to the advantage of industry and the disadvantage of agriculture offered little incentives for investments in agriculture and the use of yield increasing inputs. The stronger such distortions were the more unsustainable were the production systems which developed under these conditions. Encouragements offered by governments also led in a wrong direction. In many developing countries the state claims property rights for uncultivated land and in many countries concessions to use that land were granted without much scruples to commercial enterprises which were primarily interested in short term gains and left the areas handed over to them after some years of exploitation totally devastated. Sometimes the activities of such enterprises were facilitated by subsidies given for tractors and agricultural machinery or by overvalued exchange rates. The wish to achieve an immediate and substantial increase in food production explains such policies but even in the short run this aim was hardly achieved. In the long run the resource base was deteriorated primarily at the detriment of the rural population which is dependent on these resources for their livelihood.

### **GENERAL SETTING FOR FUTURE DEVELOPMENT**

Since population growth is the main reason for sustainable production systems becoming unsustainable a substantive reduction in the growth rate of population may be considered as the first best solution. It is, however, difficult to be achieved, at least in the short and medium run. The age composition of the population in developing countries already indicates that measures of birth control, even if they are really wanted by governments and therefore rigorously implemented can have an impact only in the long run. It goes without saying that such measures are of utmost importance and therefore have to be asked for with increasing strength, but it would be unrealistic to expect from them an immediate solution.

According to recent estimates by the World Bank and by FAO the population in developing countries will increase from 4.0 million reached in 1990 to 5.7

million in 2010, which corresponds to a growth rate of 1.2 percent. That the growth rate is not higher is due to a rather low growth rate of 1.48 percent in Asia and a modest one of 1.72 percent in Latin America whereas the growth rate in West Asia and North Africa reaches 2.24 percent and in Sub-Saharan Africa even 3.10 percent.

Emigration, the classical reaction in Europe to increasing population in the 19th century, does not represent a feasible solution for today's developing countries. It is partially substituted by temporary labour migration which reduces population pressure in rural areas and channels financial resources into these areas by remittances which means a further relief because this contribution to the regional income is independent from the regional resource base. If soil conserving investments are financed by remittances, they positively add to sustainability. The effect may, however, be adverse, by reducing the availability of male labour required to physically maintain anti-erosive infrastructural works, particularly terraces.

Assuming that food production should increase at a rate which corresponds to the combined effect of population growth and increase in per capita demand resulting from income growth a growth rate of 2.23 percent on average is aimed at, the average of all Asian countries being 1.91 percent and that of all Sub-Saharan African countries 3.38 percent. If the world market offers favourable conditions for tropical products the rates at which the availability of food should grow can include benefits originating from the exchange of tropical products against food, particularly cereals by making use of comparative advantages.

According to FAO estimates the possibilities to increase production by an expansion of agricultural land is limited. Theoretically there is a reserve of 1.3 to 1.4 billion hectares with a potential to be used as arable land (which is 1.6 times the actual area used as arable land in developing countries) but the major part of the potential expansion is subjected to severe constraints such a low and unreliable rainfall or low soil fertility. Making use of the potential expansion would imply increasing risks not only of crop failure but also, and more importantly, deteriorating the resource base. Moreover, the possibilities to expand the area used for crop production is unequally distributed. About 700 million hectares are located in Latin America (most of them in Brazil), 600 million hectares in Sub-Saharan Africa (largely concentrated in Zaire) but not more than 50 million hectares in Asia (excluding China). This means that in Asia where between now and 2010 34 percent more people have to be fed, the area under cultivation can at the maximum be expanded by 20 percent. In West Asia and North Africa, where population will increase by 61 percent the possibility to expand the area under cultivation is practically nil.<sup>13</sup> The logical conclusion is that with few exceptions an increase in food

<sup>13</sup>FAO: *Agriculture: Toward 2000*. (Revised Version) Rome 1987.

production which fulfils the requirements of sustainability cannot come from a simple expansion of the area under cultivation but must come from a shift in production systems to allow an increased production per unit of land. Obstacles to this, including the poverty barrier, have therefore to be removed.

## POLICY OPTIONS TO SUSTAINABLE FOOD PRODUCTION

It has already been mentioned that price distortions are among the causes responsible for the development of unsustainable production systems. Following independence many developing countries pursued policies like price controls for agricultural commodities, high rates of protection for industrial goods, export taxes on agricultural raw materials and overvaluation of their own currencies, which discriminated against agriculture and in favour of industry with the intention to speed up industrial growth. In the early beginning such policies were partially successful but the industrialisation process thus induced came to an end when the agricultural sector failed to produce sufficient food which was essential because of its role as principal wage good.

The necessary conclusions have, however, not yet been drawn by all developing countries. A study made for the OECD in 1988 came to the conclusion that developing countries could achieve a welfare gain of not less than 28.2 billion US \$, at the purchasing power of 1980, by liberalising their trade primarily by abolishing the mostly negative rate of protection for their agricultural sector.<sup>14</sup> This clearly shows that the protectionism of industrialised countries, how important and how harmful it may be, is not the only culprit. By reducing their own price distortions developing countries have a powerful means at their disposal to increase economic performance to reduce the importance of poverty and thus threats to sustainability which are linked to poverty.

The role of agricultural protection practiced in industrialised countries deserves a special consideration. According to the OECD study already cited the removal of this protection, all other things being equal, would lead to a welfare loss of developing countries. This result is due to the fact that the positive effect which increasing world market prices have for net exporters among the developing countries is outweighed by the negative effect they have for net importers. Before drawing hasty conclusions it has, however, to be taken into account that the results have been achieved by a comparative static analysis which did not adequately incorporate the changes in production by which economies will adapt themselves to the new world market situation. Moreover it does not include distribution effects in developing countries. Even in the short run farmers in developing countries will

<sup>14</sup>Tyers, R./Anderson, K.: Liberalizing OECD Agricultural Policies in the Uruguay Round: Effects on Trade and Welfare, in: *Journal of Agricultural Economics*, Vol. 30 (1988).

gain from a reduction of agricultural protection in industrialised countries, whereas urban consumers will be the losers. It should also not be forgotten that industrialised countries protect other sectors of their economies such as textiles and all sorts of manufacturing as is clearly demonstrated by the escalation of tariffs, to the detriment of income and employment in developing countries.

The negative role of distorted factor prices in developing countries has been mentioned previously. From the analyses follows clearly that a correction of these distortions can contribute a lot to sustainability either directly or indirectly through additional employment and income generation.

As a rather general statement it may be said that chances for sustainable agricultural production systems are the better the market functions, i. e. the better it performs in bridging time and space. Market interventions have more often reduced than improved efficiency, particularly if they were ill conceived. Insufficient seasonal differentiation of prices led to unnecessary and costly interventions and insufficient regional differentiation made food artificially cheap in remote deficit zones and artificially costly in remote surplus zones. In the first case consumers were subsidised which may imply stabilisation of an ecologically dangerous population density. In the latter case producers were encouraged to produce more than they would have done in the absence of such implicit subsidies.

Obvious shortcomings of government price regulations have led to the proposal to completely refrain from such interventions and to leave marketing of agricultural commodities entirely to the private sector. There are merits in this argument but one has to be cautious particularly in countries with large year to year variations in their agricultural production. If competition among private traders is not strong enough they may – in the absence of government interventions – try to withhold supply after a below average harvest in the hope to drive up prices and refrain from buying after a bumper crop, being sure that their abstinence will result in still lower prices. Price fluctuations will thus be increased not dampened.

The most economic way to compensate for year to year variations is external trade. This possibility is, however, not always available for land-locked countries, separated from sea ports by long distances which implies high costs of transportation. If such a country is at the fringe of self-sufficiency exportable surpluses can only fetch extremely low prices (selling to neighbouring countries is not a solution because, being subjected to the same climate, they usually are in a similar situation) whereas deficits can only be matched at extremely high prices. In the absence of government interventions and publicly managed bufferstocks it may happen that after an extraordinarily good harvest prices may collapse to such an extent that farmers will be discouraged to continue market production, with the inevitable result that in a year with insufficient yields the situation of scarcity is more severe than it would have been otherwise. It is a situation experienced by many land-

locked countries in Africa. A certain degree of price stabilisation, skilfully managed, is essential under these conditions.

The negative impact of erratic price variations on sustainability can be clearly demonstrated by pastoral systems in Sahelian countries. A drought regularly leads to a dramatic collapse in cattle prices and an increase in foodgrain prices. It may happen that the purchasing power of cattle with respect to foodgrain declines to about 10 percent of its original level. Cattle holders may be forced to sell the majority of their stock just to survive and grain producers are encouraged to move into drier zones with fragile eco-systems to reap short term windfall gains, knowing about the disastrous effect of their doing. Cattle holders who lost practically all their wealth are forced to build up their stock as soon as possible in order to have reserves when the next drought comes, irrespective of the effect this may have on the eco-system. Marketing systems which allow pastoralists to sell part of their stock before the price has collapsed completely, and governments interventions that dampen price fluctuations of foodgrain could certainly contribute to avoid situations which constitute extreme threats to such a fragile eco-system.

It has been mentioned repeatedly that sustainable production systems require inputs. The less farmers are able to accumulate their own financial resources the more they are dependent on credit. An effective credit system is, therefore, essential to overcome the poverty barrier to sustainability. Leaving aside extreme interest rates charged by private moneylenders, access to credit is usually more important than the actual height of the interest rate. Subsidies are, therefore, not the central point. What really matters is that credit systems evolve which themselves are sustainable. Credit systems which only channel financial means made available by the central bank down to the farmers and try to recover the amounts due, do not fulfil this requirement. The major sources of credit have to be created within the system by savings and deposits. To achieve this a positive real rate of interest or other incentives which have a similar effect, are essential.

Public investments are also important. This holds equally true for the classical areas of public investment, infrastructure and development schemes, particularly irrigation.

The weaker the physical infrastructure the more acute is the danger that markets are segregated which means that regions cannot specialise according to their comparative advantages. The role of bufferstocks has already been mentioned. To fulfil this role sufficient storage capacity must be available in the critical centres of demand. To create such capacity is also a task of public investments. Nobody will deny the importance of land development schemes despite the fact that the way in which such schemes have been planned and implemented in the past gave them a bad reputation particularly under sustainability aspects. On the other hand there are also many positive examples including rural roads or structures to prevent erosion,

whose scale goes beyond the capacity of individual farmers. Irrigation projects can make a major contribution to reduce the pressure on fragile lands, provided they do not themselves become unsustainable by water logging or salinisation. An area which will become more and more important is the rehabilitation of degraded irrigation schemes.

Another important subject for government activities is the development of appropriate technologies. Besides the inadequateness of economic and institutional conditions unsustainable production systems may also be due to the fact that for many fragile ecologies technologies which fulfil the requirements of being sustainable are simply not available. Technologies which looked promising at a first glance often failed to stay the final test. Wherever an expansion of the area under cultivation is not feasible, all depends on the possibilities to increase yields per unit of land without putting the resource base at risk. A variety of measures may add to this objective, including an increase in labour input, a better combination of crops either within rotations or intercropping, planting of varieties which give higher and more reliable yields. Regular replenishment of soil nutrients is also an important aspect of such technologies.

Shortcomings in the land tenure system have been mentioned as one of the important causes of poverty as well as of unsustainable production systems. Common property may be a major constraint. There is no general answer to the question whether private ownership will be the most appropriate solution or revitalisation of traditional systems which have been proven successful in effective and non-degrading management of common lands.

Agrarian reforms can be decisive particularly in Latin America where the dualism between latifundium and minifundium is the predominant cause of poverty and unsustainable production systems. Unfortunately, however, such reforms have been hardly implemented despite a certain pressure by the international community on Latin American governments and quite a bit of lip service paid to the issue by these governments. Ruling elites see some of their privileges at stake and those who would gain from a reform have no chance to articulate their wishes in a politically relevant manner other than violent actions. It would be optimistic to assume fundamental changes unless the international pressure on reluctant governments is considerably increased, including sanctions that hurt the economic interest of those who are in power.

That population policy is crucial is nearly a trivial statement. A growth rate of 3.1 percent which is found on average in Sub-Saharan Africa, cannot be sustainable. With growth rates of more than 4 percent as they are found in individual African countries, the situation is still worse. To bring growth rates of food production to corresponding levels and to maintain them at these levels or above, allowing for an increase in per capita consumption, in a sustainable manner is a task

extremely difficult to fulfil. To influence population growth from outside is, however, nearly impossible. What is first of all needed is the political will of the governments to control population growth, which is not always there. To console oneself with the hope that increasing standards of living will also in Africa reduce the desire to have many children, comes near to putting the head into the sand. Where should increases in the standards of living come from, and even if they materialise sometime, what are the damages to the resource base occurring meanwhile?

In many countries the regional distribution of population does not correspond to the population carrying capacity. For historical reasons high population densities which clearly exceed the population carrying capacity, are to be found in some regions, whereas other regions are but thinly populated. As an illustration Burkina Faso can be mentioned where the Volta valleys, despite their high potentials, are thinly populated because of the threat of riverblindness prevailing there until recently, whereas a high population density in the Mossi-Plateau has already led to severe ecological damages.

If in the relatively overpopulated areas the income generated outside agriculture is insufficient, the population can only be maintained there if there is a permanent alimentation from outside. This is costly, and from an ecological point of view, problematic. Another, perhaps more appropriate, solution may be controlled resettlement, a solution which has become highly discredited by forced actions as they took place for example in Ethiopia and which were really unacceptable. Despite the bad examples controlled resettlements may have some role to play in the future. Needless to say that they have to be preceded by adequate infrastructural investments and implemented in such a way that social hardships are minimised.

## CONCLUSIONS FOR DEVELOPMENT COOPERATION

Most of the arguments developed in the preceding sections demonstrate that efforts to make markets more efficient in performing their functions do not only increase welfare and thus have a tendency to reduce poverty but – contrary to what is generally believed – also contribute to sustainability. There is at least a general tendency in this direction, but it has to be tempered by qualifications some of which have already been mentioned. More will be added in the following paragraphs.

To correct existing distortions on factor and product markets caused by economic policy, particularly by trade and exchange rate policies, and to implement institutional reforms by which inefficient institutions on the input and the output side of the agricultural sector are substituted by more efficient ones, are among the main purposes of structural adjustment programmes supported by the World Bank and the IMF. Their beneficial effect on sustainability finds its limit where a totally free market implies a high risk to either discourage producers or to put too high a



burden on low income consumers. Taking sustainability seriously means that an ultimate responsibility to stabilise prices by market regulations should rest with national governments. Fundamental reforms by which barriers in the access of the poor to land and water resources would be removed are usually not part of structural adjustment programmes where realistic chances to get them implemented do not exist. Distortions caused by policies of industrialised countries are completely left out.

A problematic issue is the way in which development projects are evaluated. The general approach is a cost-benefit-analysis. There are increasing attempts to combine this approach with explicit consideration of distributional effects or at least an assessment of the effects on specified target groups. The most recent evolution is an assessment of environmental impacts, made obligatory by an increasing number of donor agencies, including the World Bank.

A fundamental problem of cost-benefit-analyses is the treatment of costs and benefits which occur in a distant future. The usual practice of discounting them is justified by the argument that individuals as well as the society as a whole have a time preference for consumption because it is more urgent to satisfy present than future needs. If immediate survival is at stake the validity of the argument cannot be denied but on the other hand one can ask the question, early raised in the debate by Pigou, whether individuals and societies do not tend to be myopic with regard to their future needs. If applied uncritically the practice to discount future costs and benefits leads to a priority of fast maturing projects and a neglect of long term effects. If donor agencies require high internal rates of return this effect is nearly inevitable. It cannot be denied that this has influenced the selection of development projects in the past.

One may argue that a possible way out of the dilemma might be to critically assess the potential impact a project may have on the environment and to exclude all projects which would imply a consumption of non renewable resources. As already mentioned this would be an extreme approach. If applied in a strict sense no project would stand the test.

In real life one has to look for a compromise. As a principle all repercussions of a project on its environment should be assessed carefully in quantitative terms as it is already required by several donor agencies. Negative effects should be minimised. Projects for which they cannot be lowered beyond a certain limit should be excluded. For all others potential gains in terms of additional production should be weighed against the unavoidable consumption of resources which in this case have to be valued and treated as costs. Conceptual tools are available but to use them in practice many difficulties have to be overcome. These difficulties should, however, by no means be used as an excuse not to go as far as one could in economic assessment of environmental effects.

There are some other fields in which development cooperation can contribute to achieving the goal of sustainability. One is creating an awareness of the problem which does not exist everywhere. Another is exchange of knowledge about sustainable production systems and deepening our understanding of the mechanisms which make them sustainable. There is already a tremendous wealth of knowledge about threats to fragile ecosystems caused by agriculture as well as about methods by which these threats can be reduced and the economic and social conditions which make them workable.<sup>15</sup> It is of utmost importance to create an understanding of the underlying problems among policy-makers to enable them to give due weight to sustainability in their decisions.

Of equal importance is the broadening and deepening of our understanding of sustainable production systems and the development of new technologies which fulfil the requirements of sustainability in a dynamic sense. This is one of the tasks of the Consultative Group on International Agricultural Research which today finances 16 international agricultural research centres with an annual budget of about 315 million US \$. They have been quite successful in developing varieties superior to local ones under a wide range of agro-ecological conditions. Without the green revolution induced by major break-throughs in the genetic improvement of wheat and rice the food situation in Asia, North Africa and parts of Latin America would be much different from what it actually is.<sup>16</sup> Unfortunately, similar break-throughs in Sub-Saharan Africa did not take place. The development of sustainable production systems, for example systems composed of annual crops and trees which are particularly promising in the humid and sub-humid tropics plays an increasing role in the research programmes of the international centres. Those which have mandates for agro-ecological zones have shifted their research thrusts from component research toward the development of sustainable production systems.<sup>17</sup>

Another important question is, how different approaches can be combined at the project level in such a way that a contribution to sustainability is achieved simultaneously with an immediate improvement in the living conditions of the local population, particularly the poor. Results from pilot projects are encouraging.<sup>18</sup> One of the most important lessons learnt from pilot projects is that ecologically sound

<sup>15</sup>Dover, M./Talbot, L. M.: To Feed the Earth: Agro-Ecology for Sustainable Development, World Resources Institute, New York 1987.

<sup>16</sup>Consultative Group on International Agricultural Research. International Agricultural Research Centers: A Study of Achievements and Potentials, Washington, D. C. 1985.

<sup>17</sup>Consultative Group on International Agricultural Research – Technical Advisory Committee: A Ecoregional Approach to Research in the CGIAR, Rome, April 1991.

<sup>18</sup>Towards an Approach to long-term Sustained Mountain Region Development in the Western Himalayas. The Dhauladhar Experience, Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, Eschborn 1990.

production systems also have to be socially acceptable. They can never be introduced against vital interests of the local population but only in cooperation with them. Their efficiency ends where economic and social conditions, which cannot be changed at the project level, act as a barrier.

This brings us to the question whether such barriers can be removed by what is called political dialogue between developed and developing countries. Not surprisingly the question is highly controversial. Developing countries claim that developed countries should refrain from interfering with what they perceive to be their internal affairs whereas developed countries argue that they cannot justify development expenditures imposed on their taxpayers if they are ineffective because of institutional deficiencies or wrong policies in recipient countries. There are few extreme cases in which some donor countries have already decided to cut down their assistance. In the majority of cases, however, things are less clear and there are elements of truth in both arguments. Whether developing countries like it or not there is a trend toward increasing conditionality of development assistance among industrialised countries.

Willingness of recipient countries to create an economic and institutional environment conducive for sustainable agricultural production is one of the yardsticks used and one can predict that it will gain in importance. This is partly due to the industrialised countries' own interest because of the global effects of some forms of non-sustainable land use systems. On the other hand it is an expression of an increasing sense of stewardship for the resources of the earth which are destroyable but not renewable. To use them in a way which is sustainable and at the same time allows to satisfy human needs in Third World countries to the maximum possible extent should be a major concern for developed and developing countries and they should combine their efforts to achieve this aim.

## **Comments on “The Issue of Sustainability in Third World Food Production”**

The basic issue is how to increase significantly food and agricultural production in developing countries without degrading environment or depleting natural resources, in response to rising demand for food generated by increasing population and income. In recent decades increases in production were obtained through (a) increases in yield per hectare as well as per capita, depending upon the relative scarcity of land and labour, and (b) to a limited extent, through the expansion of area under cultivation or increase in cropping intensity. In the future, in view of limited opportunities of expansion of land area or cropping intensity, much greater emphasis than in the past will need to be placed on increasing yield or productivity in order to obtain the required increase in production.

The relevant question, therefore, is whether it is possible to expand greatly food and agricultural production, let us say, at 3 percent to 5 percent per annum by increasing yield per hectare without at the same time depleting natural resources or degrading environment, i.e., without causing soil erosion, loss of soil nutrients, contamination and pollution of water, such as water logging or salinity and hazards to or deterioration in health through pollution caused by chemical inputs.

Advances in biological, chemical and mechanical technology in the past led to the expansion of the world food supply at a declining real price. In other words, technological advances more than offset the diminishing return to land. The question has now been raised as to whether it is possible to repeat the past experience in the future. For two reasons doubts have been expressed. One, is that the pace of technological progress slowed down since the 1960s. In fact, no significant breakthrough has occurred since 1960s in the development of high yielding varieties of seeds for most foodcrops. Second, it is apprehended that the continuation of the high input technology of the past will cause environmental degradation. Agricultural technology available currently or in the foreseeable future is based on highly intensive use of chemical inputs and mechanical equipment; this has seemed to have caused the varying degrees of environmental degradation. A breakthrough in biotechnology which will significantly raise yield without heavy reliance on chemical and mechanical inputs does not seem to be highly probable in the foreseeable future.

Looked at the point of view of technology, therefore, a pessimist may conclude that there is no way that the required increases in food production can be

obtained in the foreseeable future without some amount of depletion of natural resources or degradation of environment. This, therefore, places the burden on the optimists as well as on the policy-makers to expand considerably the support for agricultural research to develop technology which is both growth stimulating and environment friendly. To advise developing countries to reduce dependence in the short to medium run on high input and growth stimulating technology as some environmentalists tend to do would not meet the challenge facing the developing countries. Given the urgent need of increase in food supply, improving nutrition and alleviating poverty, there is a challenge which remains unmet. Apart from developing environmental friendly technology, what is needed is an improvement in the management of natural resources through the use of existing technology while avoiding its excessive environmental costs. Much depends on institutions and policies – sectoral, national and international. Policies affect the choice of technology, the cropping pattern and the intensity with which inputs are used. Secondly, since the main actors are farmers, herders, and foresters, it is necessary to understand and examine the structure of incentives and constraints facing them; the latter determine the way in which and the intensity with which the natural resources are managed.

It is necessary to find appropriate policy and institutions which will modify the incentives governing behaviour of the households in such a way as to minimise the adverse impact on environment. The primary concern of the household, i.e., the attainment of food security and higher income need to be consistent with what is required for environmental safeguard.

Much has been said in the past about the relationship between poverty and environmental degradation. It is a complex relationship; not enough is known about it and more research should be done. There is a two-way relationship between poverty and environmental degradation each aggravating the other. With environmental degradation the productivity of land and water declines and, therefore, output and income is reduced and consequently poverty is accentuated. The poor have urgent needs for the present and discount the future more heavily than the rich. Given the pressing current needs, they tend to mine the soil or overgraze the land in order to extract as high an output and income as possible from the use of resources at its disposal; they move to marginal and fragile areas as productivity on the better endowed lands declines and demand for food increases; they have no resources to replenish soil once it is mined or depleted, nor do they have ability to undertake soil and water conservation measures.

With an income increase in income, they require command over resources and technology to undertake conservation measures; the incentive to conserve resources for the future increases as the pressure to discount the future becomes less urgent. It is not clear that under all circumstances increase in income or resources at the disposal of the farmers will necessarily lead to investment in soil conservation.

It depends, for example, on alternative investment opportunities, including the investment opportunities in non-farm activities in rural or urban areas. However, as the productivity of and income from the existing land or better endowed areas increase, the pressure to move to marginal fragile areas will be reduced.

The poverty-environment nexus emphasise the need for promoting poverty alleviating measures in developing countries; this is also the reason why a labour intensive and employment generating programme which has beneficial effects on poverty reduction is also a very environment friendly strategy.

Closely linked to the issue of poverty-environment interrelationship is the issue of agricultural intensification in low potential areas *vis-à-vis* or in relation to high potential areas. Even though high potential areas, i.e., agrieologically more favoured regions have a high density of population and frequently have the very large absolute number of the poor, the low potential areas also have their own share of the developing world's poor. In some low potential areas the degree of poverty and the percentage of the poor is higher than in high potential areas.

Secondly, high input technology which is widely prevalent in high potential areas is not always appropriate in fragile and low potential areas. Heavy use of chemical inputs, i.e., fertilizers, pesticides, or a heavy reliance on mechanical equipment may not be suitable for the structure and composition of soil in the low potential areas. They, therefore, often need low input technology. Appropriate yield increasing technology suitable for low potential areas is urgently required. The alternative of out migration from low-potential areas is not without serious socio-political constraints; it involves large costs of settlement including development of infrastructure and related facilities. At the same time, an appropriate combination of income generating activities, both farm and non-farm, through a diversification of cropping pattern, livestock, forestry and non-farm activities, etc. needs to be developed.

On the issue of environmental degradation, one needs to distinguish between the depletion or degradation of resources which can be reversed or repaired in the long run and those which cannot be so reversed. If degradation is reversible, for the sake of growth and poverty alleviation degradation may be sustained in the short run with a view to recouping this as resources expand and technologies develop in the future. In this way, conflict between the short and the long run objectives can partially be mitigated.

Among the policy reforms which are frequently mentioned as conducive to environmental preservation or enhancement are the appropriate pricing of natural resources. Market failures and government policies together or singly often contrive to under value natural resources such as forests or foodcrops as well as inputs such as chemical, mechanical, etc. which if overused lead to environmental degradation. There are two issues worth considering in this context. One, is the question of

divergence between market prices and socially optimum prices for natural resources owing to externalities and market failures. This can be corrected by taxes and subsidies. Second, private prices/costs are kept below market prices through subsidies of various kinds or through government intervention or regulation. This relates to the need for the removal of policy distortions used by the government action.

The policy induced distortions and subsidised prices which lead to overuse or excessive use of chemical inputs, for example, can be corrected through elimination or the reduction of subsidies on chemical inputs as has been done recently in many countries. This may lead to a temporary slowdown in the excessive use of such inputs, but would lead to their more efficient use if appropriate extension, training, education is devised and marketing and distribution systems are improved. In this category are policies relating to forestry, which, for example, include the concession rights, logging prices, tax concessions and credits governing logging of tropical forests, etc. These policies have important implications for the rate and pattern of deforestation. Appropriate management of agricultural inputs, including water and chemical inputs, provided at market prices, reflecting opportunity costs, assumes high priority in an environment friendly agricultural strategy. A high level of education and training of farmers is essential for an environmentally sound management of land and water.

To solve the second problem, i.e., the divergence between market prices and socially optimum prices, it is necessary to face the more difficult problem of quantifying the externalities imposed by intensive use of natural resources and internalising such external costs for those who impose such costs on society. This will require pricing of fertilizer above the market price to include the contaminating effect it has on water and soil; it would include higher pesticide prices to take into account adverse effects on health and food contamination which may result from inappropriate use of pesticides. Similarly, it will include pricing of irrigation water to include the additional cost of designing projects which will prevent water logging and salinity.

Technology and policy changes can be fully effective only in an appropriate framework of institutions. These institutions vary between different geographical regions, socio-cultural groups as well as agrieological zones. One institution which has been talked about a great deal in the context of environmental degradation is that of property rights. A system of secure and long-term property rights is essential for enabling internalisation of externalities. It will also enable the resource user to take a long-run view so that they do not over exploit them at present. The establishment of secure property rights may require changes in land tenure system and in the pattern of landownership.

In this context, the role of rate of discount used in evaluating future costs and returns of development projects is no less relevant. It has been mentioned that with-

in the acceptable range of discount rates the present value of future net returns after ten years becomes very small; but this does not, however, resolve the problem of dealing with intergeneration equity, i.e., how far the present generation is willing to sacrifice and preserve resources for the future. If costs are incurred today and returns accrue in the future over a period of time, the longer time investment needs necessarily discouraged. The lending agencies require 10 percent to 15 percent rate of return on projects; this is much higher than the long-term real rate of interest of 4 percent or so. This is done to take into account the unanticipated inflation and other costs associated with project development and implementation. This discourages projects with longer term time horizon. Whether the rate of interest should be reduced in order to encourage investment in environmental preservation, raises the question as to whether rate of interest can be decided solely on environmental considerations. It leads us to a wider and more complex issue.

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