



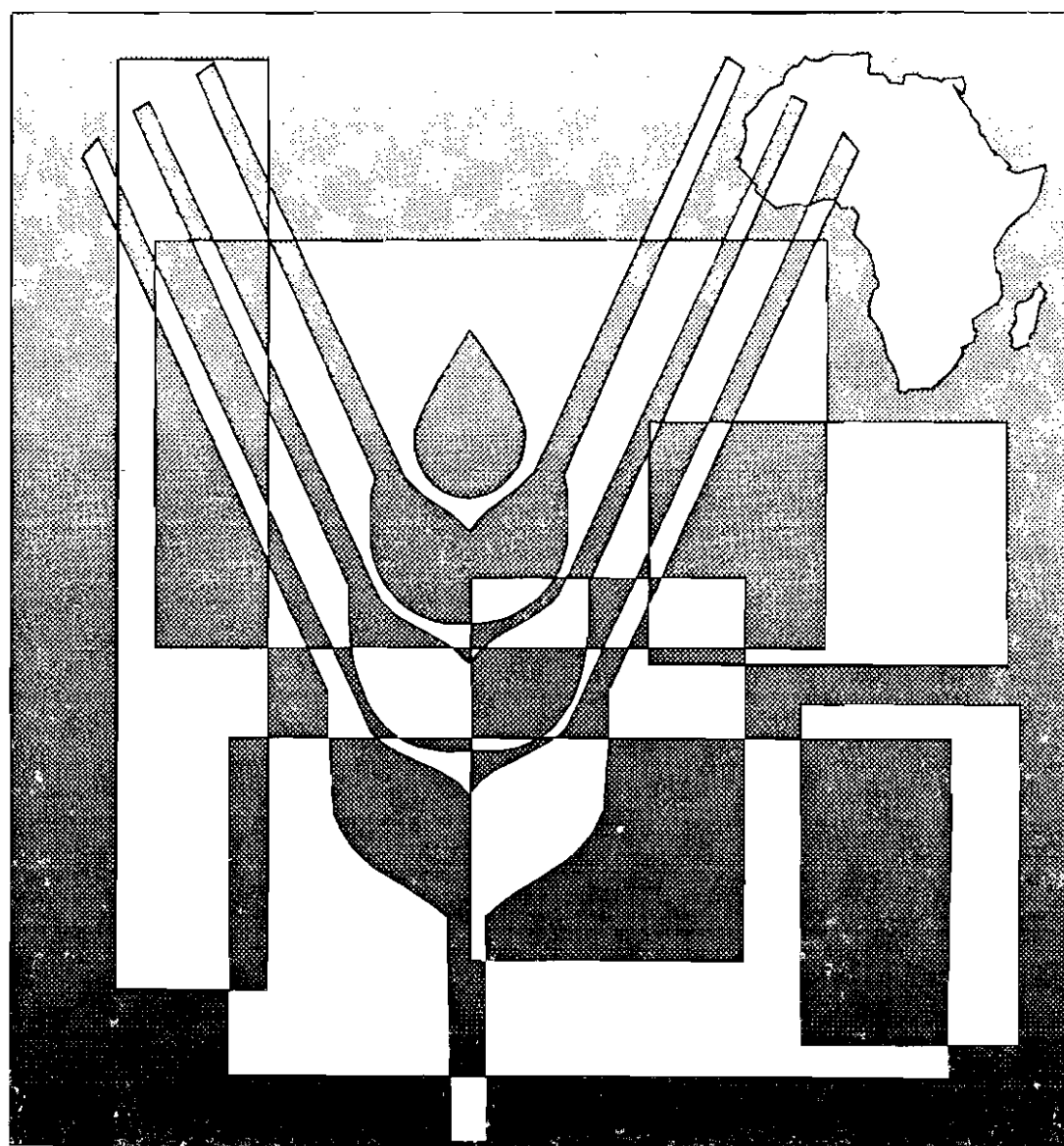
UNITED NATIONS  
Economic Commission  
for Africa



Food and Agriculture  
Organization of  
the United Nations

# LAND AND ENVIRONMENTAL DEGRADATION AND DESERTIFICATION IN AFRICA

*ISSUES AND OPTIONS FOR SUSTAINABLE ECONOMIC  
DEVELOPMENT WITH TRANSFORMATION*



Joint ECA/FAO Agriculture Division

MONOGRAPH

No 10

57273

# **LAND AND ENVIRONMENTAL DEGRADATION AND DESERTIFICATION IN AFRICA**

**ISSUES AND OPTIONS FOR SUSTAINABLE ECONOMIC  
DEVELOPMENT WITH TRANSFORMATION**

by

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The views expressed in this document are those of the author and do not necessarily reflect the views of the United Nations Economic Commission for Africa and/or the Food and Agriculture Organization of the United Nations.

February 1995

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## EXECUTIVE SUMMARY

For more than thirty five years, UNECA has provided support to Africa Regional Economic and Social Cooperation and Integration within which food and agriculture development is of paramount importance. However, methods of formulating and implementing this assistance must now be re-assessed to ensure that: they reflect the comparative advantage of the Secretariat; global, multinational, regional and subregional, and macro-economic analysis continue to be priorities within the changing environment; approaches are coordinated and sustainable at all levels of the chain of the development process; optimal use of the limited resources available is made; and, the partnerships and strategic alliances to be created within the system are indeed established and supported by policies translated into sustainable action.

Also, presently UNECA support to member countries in food and agriculture is financed from three main sources, its own limited resources from the regular budget, the UN system (mainly UNDP) and bilateral trust funds including UNTFAD. The changing financial times require that these traditional sources be re-examined within the context of current thinking and the necessity to satisfy member countries and especially the Low Income and Food Deficit African Countries (LIFDC) emerging needs.

With the present changing international economic and social environment, assistance to member countries must respond more sensitively to emerging new needs of countries. New actors are becoming involved in the partnership for development, necessitating re-assessment of traditional roles. Consequently, the challenge facing African countries, donors, NGOs, and the UN System at large, is to create room for innovative actions to be developed and implemented, to turn around the food and agriculture sector's performance and to build the national human, institutional and infrastructural capacities to that effect, especially in Low Income and Food Deficit African Countries (LIFDC). The ultimate aim being to improve the national economies, ensure equitable distribution of the benefits accrued and, to improve the quality of life of the rural populations.

*Man's present demand for food, grazing, fibre and fuel has increased well beyond the limits that nature can provide unassisted.* Future demands on the resource base for these products will be even greater. The potential of the land to produce is set by soil and climatic conditions and by the level of inputs and management applied to the land. Any over exploitation or "mining" of land beyond these limits results in degradation and declining yields and this is now happening in many parts of Africa.

*Of all the challenges facing African communities, their governments, and the international community, that of ending endemic hunger is the most pressing. Many countries in Africa face exceptional food shortages, and millions of people still face the threat of famine and starvation. Even without famine and starvation, malnutrition is widespread.* According to the World Bank, just under half of the region's population suffers from some level of food deprivation, with serious consequences for health and productivity. Ending this food and agriculture crisis depends critically

on peace, increased agriculture productivity, especially in African Low Income and Food Deficit Countries (LIFDC), self-reliance in food, and redistributive policies aimed at improving the living conditions of the rural poor.

*Nature can be very forgiving - though not indefinitely: persistent abuse usually leads to irreversible degradation.* Unfortunately, the environment has been persistently abused in many parts of Africa for 30 years or more. In these areas, rapidly increasing numbers of people and livestock have taken population densities well past the land's carrying capacity at current levels of input use.

*The rural poor, many of whom live in environmentally fragile areas, are both the main victims and the unwilling architects of soil degradation.* Nomadic herders in the Sahel region, increasingly impoverished as a result of drought and the expansion of arable agriculture, have been forced to graze their herds on fragile grasslands. Similarly, staple-food producers working on marginal soils have little choice but to sacrifice the future for the present, clearing trees and mining soils in an unsustainable manner to provide a livelihood. They are often unable to invest in soil and water conservation. Loss of tree cover contributes to erosion by exposing soils to wind and rain. It also results in women being forced to walk increasingly long distances to collect and carry home bundles of fuel-wood - a process that we have witnessed right across the region. Apart from its implications for their health, this diverts their labour from food production and household activities.

*What the African rural poor are concerned about is a secure food supply at all times, education, employment, shelter, health and full participation in the determination of their future. Improving the welfare of the poor, reducing inequality and reinforcing popular participation would also contribute to improve the social environment and enhance the capacity to further improve the physical environment. Thus the main policy change should be of an institutional nature so as to radically offset the marginalization of a large proportion of the population.*

Mandate has already been given to FAO, vide the Scheme for the Conservation and Rehabilitation of African Lands (ISCRA) adopted by the African Ministers at the 16th FAO Regional Conference for Africa held in June 1990 at Marrakech (the Kingdom of Morocco).

On the basis of the above, the purpose of the present paper is to set up a framework to search for lasting and sustainable solution to the devastating problem of land and environmental degradation and desertification in Africa. Drawing on past actions, emerging countries' needs, current thinking on the role of the UN system in the field of assistance to member countries, the views of other partners involved in the development process and more especially on the past FAO and UNECA experiences in the field, a framework for sustainable, lasting and integrated solution is proposed.

This new strategy is adopting a "programme approach" which requires multi-disciplinary, cross-sectoral linkages which will in turn ensure that a holistic view of the development problem is obtained, and the appropriate solutions identified and supported. *This approach would not only ensure national ownership of both the problems and solutions to development process and to facilitate the ownership of the assistance by beneficiaries, but would also enhance the sustainability of interventions. Taking into account the limited resources available, the proposed framework is formulated around building local communities capacities to participate more effectively in the development process affecting their future.*

Relationships between the different components of development are complex. The linkage between production of goods and conservation requires special emphasis. In many references to these activities it is inferred that the two are separate or even competitive. It should be appreciated that the two are very much interdependent. Production is impossible, over more than a very short period, without attention to conservation. Conservation cannot be successfully practised without a productive return. This relationship should be remembered when developments affecting land and water are planned. Conservation measures must be included in the schedule and budgets of development activities.

*There is no simple formula for reversing Africa's environmental crisis. But experiences offer some lessons. Firstly, the dynamics of environmental degradation are reversible, but only in collaboration with local communities. It is often forgotten by development 'experts' that the best people to speak on behalf of the poor are the poor themselves. Working with the poor requires the establishment of democratic and participative structures at every level, and not just in national institutions. Secondly, to stand any hope of adoption, conservation methods must cost little or nothing in cash, increase yields, and improve household food security by minimising risk. Thirdly, where tree planting and other conservation interventions are involved, they must not conflict with the labour needs of the agricultural cycle, and must produce timber, fuel-wood, or fodder. We hope that these principles have informed the recent negotiations on the Desertification Convention - one of the few potential benefits for Africa to come out of the Rio Earth Summit in 1992.*

The challenges that Africa faces are many, but the most urgent one is that of protecting the future and action must be initiated firmly now. Governments must seriously and critically look at the policies they have constructed in the past and answer the question - who will benefit from the development programmes? Though there is no simple answer to the question of eliminating poverty, its progressive alleviation is a condition for sustainability.

The intricate dynamics of sustainability have still to be adequately investigated and articulated. But already we can see enough of the outline of this new area of science, economics and technology to understand the general direction in which society needs to travel. In this respect, the concept of sustainable economic development is important for three main reasons.



- (i) First, it provides a framework within which broader cultural, socio-political, economic and technological factors can be incorporated into the environmental debate - and vice versa.
- (ii) Second, the phrase is dynamic, implying a transition from unsustainable to sustainable forms of economic development and activity. It thereby potentially opens out the time-horizons within which environmental issues are discussed. The phrase introduces the notion that some problems may be more critical than others in terms of negotiating that transition. The implicit message is that we must set priorities.
- (iii) Third, sustainable development is inclusive. By focusing on the need for "development", it increasingly provides a framework within which the business and development communities can feel comfortable in discussing and addressing environmental priorities. And development, clearly, is an area where business has a distinct edge on most non-governmental organisations (NGOs) - with the result that there are growing numbers of business organizations working in this area.

A major obstacle to promoting policies that foster sustainability to date has been the incomplete measurement of income and investment, particularly the failure to reflect the use or deterioration of natural capital. To correct this failure, the World Bank is promoting improvements in Systems National Income Accounts (SNA). Environmentally adjusted SNA has massive policy implications for most developing countries. Without environmentally adjusted SNA for example, the Bank now postulates, that we cannot judge if an economy is genuinely growing or merely living unsustainably on asset liquidation beyond its true income; whether the balance of payments is in surplus or deficit on current account, or whether the exchange rate needs to be changed.

Politicians, advisors, and ecologically conscious scientists that work for an environment-oriented change in economic policy need a measure of economic production/growth that is deflated by natural resources and environmental costs (degradation) induced by production/growth.

This task is politically (and scientifically, too) so important that we have to accept imperfect solutions. We have to teach the public that the currently prevailing production, income and growth concepts and calculations are only seemingly objective, seemingly valid and seemingly "modern". They profit from the fact that the produced goods and services are valued with market prices which seems to be self-evident. But the market prices of today are determined really without the external environmental costs of production and consumption and are therefore increasingly distant from the economic-ecological "truth".

Part of the problem should consist of pricing the unpriced, which are the scarce environmental goods such as clean air, water, soil, open space and the like. Efforts to calculate these values properly have started some 30 years ago, and have long been in vain. However, there are signals that estimates and methods for this valuation are being accepted by and large.



But perhaps the most fundamental challenge is to break the links between poverty and environmental degradation at source; namely, by enhancing the capacity of the poor to expand their own incomes. This means increasing and improving their access to land, making more capital available, providing infrastructure, and investing in labour-intensive technologies and training for new skills. This is part of the foundation of the programme on Sustainable Agriculture and Environmental Rehabilitation of Tigray (SAERT) and Sustainable Agriculture and Environmental Rehabilitation of the Amhara Region (SAERA), being promoted by UNECA and FAO as part of the Sustainable Regional Agriculture and Environmental Rehabilitation Programmes in Ethiopia.

The programme uses the coordinated approach to development initiatives and greater involvement of beneficiaries in development planning and implementation, all this in a holistic manner to ensure maximum utilisation of scarce resources for maximum benefit. This approach would not only facilitate ownership of the assistance by the beneficiaries but would also enhance the sustainability of interventions. The formulation process of programme development was supported by multi-disciplinary and cross-sectoral collaboration.

All major institutions within the agriculture sector, participated in jointly analyzing issues, establishing targets and identifying interventions necessary to reach those goals. The preparation of priority programmes were undertaken by multi-disciplinary teams of nationals supported by UNECA, FAO and other UN agencies and other donors where it was necessary.

For the case of Tigray, the test of the proposed approach which creates the forum for greater beneficiary participation in the development of the programmes to address the issues identified, was facilitated by the Transitional Government of Ethiopia (TGE) policies on regionalisation, decentralization of authority and community participation.

Based on the design experiences attained in Ethiopia (SAERT and SAERA, etc.), and elsewhere, UNECA and FAO are prepared to discuss the modus operandis for joint technical undertakings with other African development partners to test the proposed approach or to find any other suitable long term and lasting solution to the problem of land and environmental degradation and desertification in Africa.

We seem to be all obviously trapped in a wrong economic, political and mental model. It is our belief that the developing countries in general and more specifically African countries are in need of an economic reformation, a deep analysis of the real roots of this predicament, a reformation which will loosen the ties with current economic thought, to replace it with one that is more ethical, doing justice to the poor, the earth and the future. We seem to have little time to fulfil that task.

# INTRODUCTION

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## THE ISSUE

*Man's present demand for food, grazing, fibre and fuel has increased well beyond the limits that nature can provide unassisted.* Future demands on the resource base for these products will be even greater. The potential of the land to produce is set by soil and climatic conditions and by the level of inputs and management applied to the land. Any over exploitation or "mining" of land beyond these limits results in degradation and declining yields and this is now happening in many parts of Africa.

*Of all the challenges facing African communities, their governments, and the international community, that of ending endemic hunger is the most pressing. Many countries in Africa face exceptional food shortages, and millions of people still face the threat of famine and starvation. Even without famine and starvation, malnutrition is widespread.* According to the World Bank, just under half of the region's population suffers from some level of food deprivation, with serious consequences for health and productivity. Ending this food and agriculture crisis depends critically on peace, increased agriculture productivity, especially in African Low Income and Food Deficit Countries (LIFDC) as stated by FAO, self-reliance in food, and redistributive policies aimed at improving the living conditions of the rural poor.

*Chronic localised food shortages caused by war and drought are the most visible aspects of Africa's food and agricultural crisis. But the greatest long-term source of food insecurity has been and remains poor agricultural performance.* In contrast to other developing regions, food production in Africa has not kept pace with population growth. As a result, food self-sufficiency has fallen, and dependence on commercial food imports and food aid has increased. These now account for about 17 per cent of overall food availability, and considerably more in parts of West Africa. Future prospects are not encouraging. *FAO projections suggest that sub-Saharan Africa's food imports will more than double by 2010 - and several other estimates suggest that they may double before the end of the decade.*

*Nature can be very forgiving - though not indefinitely: persistent abuse usually leads to irreversible degradation.* Unfortunately, the environment has been persistently abused in many parts of Africa for 30 years or more. In these areas, rapidly increasing numbers of people and livestock have taken population densities well past the land's carrying capacity at current levels of input use.

*There is virtually no inhabited areas of Africa that is not prone to soil and environmental degradation of one sort or another.* Most regions of the continent suffer from several forms of environmental degradation, leading to desertification and with its detrimental impact on food and agricultural productivity and production. The process is often not obvious because it is usually gradual and unnoticeable. It is, therefore, a grave mistake to see areas of presently unused land as an inexhaustible reserve. Only 16 per cent of the total arable land has no serious fertility limitations and 47 per cent of it is too dry for productive rain-fed agriculture. The United Nations Environment Programme (UNEP) has estimated that the area which is prone to desertification worldwide is approximately 38 million km<sup>2</sup> of which 6.9 million km<sup>2</sup> (23 per cent) are in sub-saharan Africa. Africa's soil resources are thus mostly fragile and sensitive to unwise use. Sub-Saharan Africa's fuelwood consumption is running 30 to 200 per cent ahead of the average increase in the stock of trees. Africa loses an estimated 5 million hectares of tropical forest area per year. Land degradation is estimated to affect about 230 million hectares annually.

*Like conflict, drought desertification and environmental degradation have a debilitating effect on the poorest communities.* During 1992, we witnessed at first hand the devastating impact of southern Africa's worst drought in living memory. In eastern Zambia, some of the villages saw their entire crop destroyed, leaving them without seeds for planting, and forcing farmers to leave their land in a desperate bid to earn income elsewhere. Draught animals needed for ploughing fields were also wiped out in many areas. Aid agencies responded by providing seeds and supporting incomes through 'food for work' programmes. Under these programmes, food aid was provided as payment to villagers working on projects - such as building feeder roads and digging wells - identified by the local community. However, despite good rains in 1993, the depletion of resources caused by the drought was such that agricultural production did not recover to pre-drought levels.

*The rural poor, many of whom live in environmentally fragile areas, are both the main victims and the unwilling architects of soil degradation.* Nomadic herders in the Sahel region, increasingly impoverished as a result of drought and the expansion of arable agriculture, have been forced to graze their herds on fragile grasslands. *Similarly, staple-food producers working on marginal soils have little choice but to sacrifice the future for the present, clearing trees and mining soils in an unsustainable manner to provide a livelihood.* They are often unable to invest in soil and water conservation. Loss of tree cover contributes to erosion by exposing soils to wind and rain. It also results in women being forced to walk increasingly long distances to collect and carry home bundles of fuel-wood - a process that we have witnessed right across the region. Apart from its implications for their health, this diverts their labour from food production and household activities.

*With regard to poverty alleviation, it is noteworthy that the concept of development based only on growth is insufficient, as the rate of growth is not the only contributor to life improvement or to sustainable development.* For example, the impressive 5 per cent GDP growth during the 1960s contributed little to alleviating poverty in developing countries, and even less so in African countries.

Four and a half billion people or 85 per cent of world's total population, occupying 72 per cent of the land area of the globe, belong in the category of low and middle income countries of the South with a per capita income ranging from US\$ 80.- (Mozambique) to US\$7,820.- (Saudi Arabia) in 1991. If these countries in their endeavour to raise income per capita are following the same path as the industrialized countries, its impact will be catastrophic to the global environment. It is therefore necessary for the South to follow a different path of development: one that makes possible the eradication of poverty and at the same time does not degrade the environment. This calls for an elaborated pattern of sustainable economic development that meets the interests of the South.

Sustainable economic development as pursued by the South must foremost focus its efforts on meeting the developmental challenges which are the causes of environmental degradation. In this connection the first objective of sustainable development must be to eradicate poverty. Poverty, as defined by the World Development Report 1990 refers to the inability to attain a minimal standard of living. This inability is caused by factors internal to the poor such as no skill, low education,

no shelter, poor health and low capacity to respond to income-earning opportunities. On the other hand it is also caused by factors external to the poor such as no access to land tenure, minerals or other natural resources, no access to credits or other financial resources, no access to markets, no access to technology and no access to productive infrastructure like irrigated water, electricity, transportation, etc.

To overcome this inability, development should be geared to ensure the poor the provision of basic needs such as nutritious food, clothes, shelter, basic education, health facilities and clean water. All this requires a development policy that is focused on engaging the poor in productive employment.

*What the African rural poor are concerned about is a secure food supply at all times, education, employment, shelter, health and full participation in the determination of their future. Improving the welfare of the poor, reducing inequality and reinforcing popular participation would also contribute to improve the social environment and enhance the capacity to further improve the physical environment. Thus the main policy change should be of an institutional nature so as to radically offset the marginalization of a large proportion of the population.*

Another target is to achieve food self-sufficiency and ecological reclamation, especially in areas of the continent that are severely affected by recurrent drought. In resource allocation, countries should respond to the needs of the population and not to the demands of developed countries. As stated by the UNECA in the "African Alternative Framework to Structural Adjustment Programme for Socio-Economic Recovery and Transformation": "Unless there is an immediate amelioration in the condition of the vast majority of the African population, there is a real danger of a systematic breakdown in the socio-economic fabric and the supporting natural environment". The UNECA further stresses that "the critical focus of the framework for adjustment with transformation is that of a more human centered development process in which productive forces are given a prominent role, and resources are used so as to bring about the transformation of the African economy from a primarily exchange economy to a production economy". This is what FAO is advocating in its "Sustainable Development Policy".

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science, economics and technology to understand the general direction in which society needs to travel. In this respect, the concept of sustainable economic development is important for three main reasons.

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A major obstacle to promoting policies that foster sustainability to date has been the incomplete measurement of income and investment, particularly the failure to reflect the use or deterioration of natural capital. To correct this failure, the World Bank is promoting improvements in Systems National Income Accounts (SNA). Environmentally adjusted SNA has massive policy implications for most developing countries<sup>1</sup>. Without environmentally adjusted SNA for example, the Bank now postulates, that we cannot judge if an economy is genuinely growing or merely living unsustainably on asset liquidation beyond its true income; whether the balance of

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<sup>1</sup> Economics Nobel Laureate Robert Solow has recently retreated from his 1973 position that natural capital is unimportant: "The world can, in effect, get along well without natural resources" (Solow 1974, p.11). In 1992, he concluded that the US GDP may change only 1-2 per cent if environmentally adjusted (Solow 1992). Perhaps this seems a small concession, but during the discussion period of his 1992 RFF lecture he recognized that developing countries rely to a vastly greater extent on natural capital than does the US.

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payments is in surplus or deficit on current account, or whether the exchange rate needs to be changed.

*Real and lasting food security in Africa will depend on a sustainable and productive agricultural resource base. Yet that base is being undermined by accelerating environmental degradation.* Soil erosion affects more than three-quarters of cultivable land, drastically reducing its productive potential; and tropical forests, vital to the maintenance of fragile eco-systems, are being cleared at the rate of 5 million hectares annually. As the Brundtland Commission observed in 1987, poverty is both a cause and effect of this loss of environmental resources. 'No other region', it wrote, 'more tragically suffers the vicious cycle of poverty leading to environmental degradation, which leads in turn to even greater poverty.' Unless that cycle is reversed, the number of people suffering from poverty, hunger, and malnutrition will grow and the deteriorating effects of natural resources and environmental degradation will continue.

Deteriorating effects are also occurring regarding public services. The welfare state was built up in the period since 1955: first social security, then education, culture, social services and housing. Since 1970, the costs have sharply risen, and have become a public problem, causing among others increasing national financing deficits. Despite the great importance of collective services for the creation of the welfare state, they are now being cut back. Public health budgets are being reduced; government insurance policies are being adjusted; there are plans to unlink old age pensions and unemployment insurances from the minimum wage, as it is stated that these services are becoming too expensive. These parts of the Western welfare state are being sacrificed, particularly at the expense of the less fortunate groups in society, while on the other hand money is being allocated for enormous investments in airports, roads, tunnels, and other infrastructural projects. The idea is still that one day this boosting will make the return of welfare possible. However, for developing countries in general and for African countries in particular, the welfare state is dead and for ever!.

The statistics tell us that welfare has not increased in Africa since 1970, despite the fact that the economy on the whole has prospered: production growth (GDP) has increased globally between 1970 and 1990. While consumption is steadily increasing on the one hand, we observe a loss of welfare on the other hand. Until 1970, this



process was not really noticeable. Since then, however, it has risen in importance, it has become more structural, and less curable with the usual prescriptions.

The reason why our societies cannot interpret the data of decline properly is threefold. First, the main information flow on a nation's state of affairs is in the statistics of the national accounts or the (gross) national or domestic product (GNP, GDP). Second, natural resources are still widely considered free goods, to be consumed and depleted freely. Thirdly, the relationship between environmental losses and general welfare loss is not understood.

To begin with GDP: It is widely believed that the GDP is a reflection of the economic state of a nation, that is of its wealth, welfare, richness, health, prosperity and the like. The economics keep repeating this story - that a healthy nation has a high GDP, and that more of this GDP therefore means even more of this health. The real statistics of the GDP, however, tell a more limited story: they only refer to the amount of goods and services rendered in the economy, excluding important so-called non-productive services such as justice, education, and government, to name a few. Critics of the GDP have observed the anomalies of the accounts which add as income such negatives as waste production and handling, car repair, and even the production of weapons and warfare. If a factory produces noise and wastes to disturb people's health and waste to pollute a river, then the GDP goes up.

In order to correct this misleading GDP information, the UN System of National Accounts has to be changed, in that it stops accounting damage and depletion as income. The number of hectic - debates on this subject is so high, and the outlook on a consensus so limited.

Part of the problem should consist of pricing the unpriced, which are the scarce environmental goods such as land, clean air, water, soil, open space and the like. Putting it differently, the National Accounting System must take into account the natural resources and environmental degradation caused by economic activities. Efforts to calculate these values properly have started some 30 years ago, and have long been in vain. However, there are signals that estimates and methods for this valuation are being accepted by and large.

Africa is a continent of contrasts and extremes, ranging from the desert to the evergreen equatorial forest. *Land resources are the base on which the African economies largely depend. A proper appreciation of constraints and qualities is therefore an essential prerequisite to their optimum use.* While environmental problems abound, a considerable agricultural potential exists over large areas of the continent. When land resources are used in accordance with their suitability, and are appropriately managed, land degradation can be prevented and increases in productivity and production can be obtained.

While recognizing the great variety of land degradation problems, a number of basic principles have been established which provide guidelines for action. They are outlined in the World Soil Charter (FAO, 1982), and ought to be the basis for the control and reversal of land degradation. In short, the World Soil Charter recommends:

- developing a policy for wise land use according to land suitability for different types of utilization and needs of the country;
- incorporating the principles of rational land use into appropriate resource legislation;
- developing an institutional framework for monitoring, supervising and coordinating the conservation of the country's land resources;
- assessing all lands of their suitability for different purposes and the likely hazards of degradation;
- implementing education, training and extension programmes at all levels in soil management and conservation;
- disseminating as widely as possible knowledge on the subject of soil degradation and its prevention;
- establishing links between administrators and land users for the implementation of soils policies;

- striving to create socio-economic and institutional conditions favourable to rational land resource management and conservation;
- conducting research programmes which will provide practical solutions to soil degradation problems but give due consideration to prevailing socio-economic conditions.

*In the process of shifting the bias, the key element is participation and the strategy must be holistic by nature and should be based on the effective and enthusiastic participation of populations, taking into account social and cultural traditions.* Based on these guidelines, the following main, broad fronts of immediate action to be taken by African governments are suggested.

- (a) Conservation should be seen as an integral part of the farming system and the general extension worker should be the one to provide the necessary technical advice. But for this to succeed, the extension worker needs adequate training to recognize problems requiring expert assistance and specialists should be available to provide such assistance when needed. The lack of professional experts has often led to the failure of many schemes.
- (b) Africa will continue to need the valuable technical and financial assistance of both bilateral and multilateral donors. However, the flow of aid has only partly reached African populations and has thus contributed little to significant improvements in their productive capacities.
- (c) The development of conservation programmes should be considered a long-term activity. Donor agencies have sometimes provided short-term support for specific projects which have not been closely linked to an ongoing national programme. Knowledge and experience gained have not always been handed on and the long-term impact has been minimal. The problem is further complicated where there are several donor agencies acting independently each with its own agenda and time frame.
- (d) Where there are many donors involved, it is important that there be a strong team of nationals with the necessary professional qualifications and leadership abilities

to ensure that the work is properly directed and co-ordinated in the best interests of the country and of the beneficiaries.

Mandate has already been given to FAO, vide the Scheme for the Conservation and Rehabilitation of African Lands (ISCRAL) adopted by the African Ministers at the 16th FAO Regional Conference for Africa held in June 1990 at Marrakech (the Kingdom of Morocco).

This scheme seeks to promote joint undertakings at national, subregional, regional and international levels to improve land use and land degradation. At national level, the scheme essentially implies identifying the causes of land degradation, determining appropriate corrective solutions, stimulating the full participation from the population concerned while in the meantime strengthening the national capacities building (human, institutional and infrastructural), paying special attention to feasibility, efficiency, acceptability, environmental conservation and profitability (see the case of Tigray Region in Ethiopia).

As a leit motif, the African region, especially the Horn of Africa and many countries in the Sahel are recurrently affected by drought. The Food situation in the Africa region as a whole will be worsened during the current year principally because of widespread drought in the continent and secondarily because of armed civil and political unrest taking place in many countries in the Africa region. Despite the restoration of peace in Ethiopia, Eritrea, Mozambique and a few other cases of isolated civil unrests, there are still many hot beds of serious civil unrests and armed conflicts in many parts of Africa: Angola, Burundi, Liberia, Rwanda, Somalia, the Sudan, etc. to mention but a few.

These conflicts continue to affect vast food producing populations. These twin elements - drought and civil unrests are inseparable elements of major syndromes affecting African Agriculture and, sustainable and lasting solutions have to be found to these elements if African economies are to be established on solid foundations.

It was in consideration of these major deterrents of African economies that the United Nations Economic Commission for Africa, in cooperation with the Food and Agriculture Organization of the United Nations, embarked on a special programme of rehabilitation, recovery, reconstruction and development for countries affected either

by drought or civil war and armed conflicts or both. The objective of this special programme is to assist these countries in formulating coherent national and rural development programmes within the four continuums: (a) rehabilitation, recovery, reconstruction and development with transformation, or linking the short, the medium and the long term; (b) the necessity to maintain a continuum from national to sub-regional and regional framework in the development process within the spirit of the Abuja Treaty establishing the Panafrikan Economic Community; (c) the necessity to achieve a decentralization of the economic development process from national level to regional and provincial with the aim of involving the whole population especially at the grassroots level; and finally (d) the necessity to develop an institutional capacity capable of translating medium and long term visions into immediate actions, to support on-going relief efforts, and to provide a local permanent technical expertise for follow-up and coordination. In these regard, UN inter-agency missions have been undertaken in Somalia, Ethiopia, Eritrea, Burundi, Rwanda, Mozambique, Namibia. These missions worked very closely with national experts of these countries and have arrived at a series of integrated programmes which will assist these countries to recover from their respective national calamities and to base this recovery on sustained rural and national development.

Quite apart from the inter-agency missions indicated above, UNECA and FAO have embarked on a more serious mission of assisting Ethiopia in developing the institutional and technical capacity to withstand the devastating effects of recurring droughts. The Northern regions of Ethiopia have been particularly the victims of these recurring droughts although the drought situation has now spread to the southern regions of the country. In accordance with its activities and following a request received from the Transitional Government of Ethiopia, the UNECA in collaboration with FAO and UNDP has now embarked on developing for eight drought-prone regions of Ethiopia strategic plans and programmes which will help ensure that this country will not any more suffer from the menacing effects of droughts. Already a complete strategy and programme has been developed for Ethiopia's Tigray region under an umbrella programme called, "Sustainable Agriculture and Environmental Rehabilitation in Tigray (SAERT)" is only one of eight such Regional Programmes being elaborated by UNECA, UNDP, FAO, the Transitional Government of Ethiopia (TGE) and the respective Regional Governments under the umbrella programme called: Sustainable Agriculture and Environmental Rehabilitation, Reconstruction and Development Programmes (SAERRDP). This effort has succeeded in designing the SAERT

programme using local expertise in Tigray and other parts of Ethiopia. Having completed the design of the SAERT programme a similar exercise has started in another region of Ethiopia - the Amhara Region. UNECA-FAO now, are of the views that the Ethiopian experience can serve as basis to elaborate similar programmes for other drought, desertification and environmentally degraded prone regions of the continent.

The present document clearly states what current thinking on the subject should be. It provides a very rich basis for project/programme development within existing international conventions and agreements on desertification and for addressing the emerging environmental issues of biodiversity conservation and the management of water resources.

With the small dam projects foreseen, one sees the evolution of micro-ecosystems which will be the centre of attraction not only for agricultural and desertification reserving purposes but also for a variety of species (flora and fauna) that are related to wetlands. The Tigray is also an important watershed that sets the basis for discussions on multi-country management of the water resources under financing arrangements provided by international agreements. The document provides sound arguments for projects under GEF and the recently adopted International Convention to Combat Desertification in those countries seriously affected by desertification and/or drought, particularly in Africa.

# **THE MAGNITUDE OF THE PROBLEM**

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*Little reliable data is available on the extent of land degradation in Africa. However, anyone who has travelled through the continent has observed that land degradation is widespread and serious.* The presence of gullies and sand dunes, of degraded forests and grazing lands are obvious, although the effects of sheet erosion and declining soil fertility are less noticeable.

*The wealth of Africa depends on her ability to conserve and manage her land resources.* It is a well known fact that soil degradation not only results in decreased food production but also in droughts, ecological imbalance and consequent degradation of the quality of life. In Africa, the most conspicuous symptoms of the negative impact of land degradation on food production are stagnating and declining yields and increasing levels of poverty.

Throughout the continent, regardless of the climatic zone, meteorological records show that unpredictability of rains is a common feature. In the Sahel, variations in total annual rainfall can be up to 30 or 40 per cent. Even, the humid and sub-humid zones are subject to rainfall fluctuations of 15 to 20 per cent. In most cases, the rainfall is rarely gentle and even. It usually comes as torrential downpours, which are destructive to soils and harmful to plants.

The continent can be divided into four major climatic zones:

- The humid zone with an annual rainfall exceeding 1,500 mm and covering 14 per cent of the land area;
- The sub-humid zone with annual rainfall between 600 and 1,200 mm and covering 31 per cent of the land area;
- The semi-arid zone with an average rainfall equalling or less than 600 mm, which covers 8 per cent of the total land area; and



- The arid and desert zone with an erratic rainfall of between 0 and 100 mm and having the greatest share (47 per cent) of the total land area.

*Africa also suffers from geologically induced and inherently low soil fertility as the bedrock consists of mostly granites and gneiss. African rocks are among the oldest in the world. The relationship between the parent soils and the soil forming factors are very complex because the land surface has undergone a series of shifts in vegetation and climate.* Nearly one-third of the central plateau of Africa is of Pre-Cambrian age (over 600 million years old). The rest of the surface is covered with sand and alluvial deposits of Pleistocene age (less than 2 million years old). A recent volcanic activity occurred mainly in the eastern and southern parts of the continent, principally between Ethiopia and Lake Victoria. For this reason, most of the soils in Africa are characterized by a low proportion of clay, making them easy to work, but also easy to lose.

*Not only is Africa geologically old and afflicted with a harsh climate, but also large parts of the continent have been occupied by human beings much longer than in other continents.* Human activities in obtaining food, fibre, fuel and shelter have, therefore, significantly altered the soil.

Though degradation is largely man-made, and hence its pace is governed primarily by the speed at which population pressure mounts, irregular natural events, such as droughts, exacerbate the situation. The 1982/85 drought, for example, had a dramatic effect on the speed of land degradation and desertification. Essential though food aid is in such emergencies, it clearly does nothing to alleviate environmental damage.

*Many African countries have already lost a significant quantity of their soils to various forms of degradation. Many areas in the continent are said to be losing over 50 tones of soil per hectare per year. This is roughly equivalent to a loss of about 20 billion tones of Nitrogen, 2 billion tones of Phosphorus and 41 billion tones of potassium per year.* Serious erosion areas in the continent can be found in Sierra Leone, Liberia, Guinea, Ghana, Nigeria, Zaire, Central African Republic, Ethiopia, Senegal, Mauritania, Niger, the Sudan and Somalia.

Nomadic herders, grazing animals on arid and semi-arid lands, are particularly vulnerable to drought, since it depletes their most precious assets: their livestock herds. In northern and eastern Kenya, we saw the drought of 1992 decimate the livestock herds of pastoral communities, forcing herders to sell cheaply to local traders. At the same time, shortages of cereals forced up prices of food staples. The result has been widespread malnutrition, with an estimated 1.7 million people left dependent on relief assistance. In Somalia, drought in 1991 and 1992 forced the nomadic pastoralists of the central region to sell off their herds at a time of escalating food prices caused by ethnic and tribal armed conflicts and civil wars, exposing them to severe hunger.

Desertification is a serious problem in the continent. It has been estimated that 319 million hectares of Africa are vulnerable to desertification hazards due to sand movement. An FAO/UNEP assessment of land degradation in Africa suggests that large areas of countries north of the equator suffer from serious desertification problems. *For example, the desert is said to be moving at an annual rate of 5 km in the semi-arid areas of West Africa.*

*Desertification, of course, did not begin with the recent drought. Archaeological records suggest that Africa's arid areas have been getting progressively drier over the past 5 000 years. What is new is the coincidence of drought with the increasing pressures put on fragile arid and semi-arid lands by mounting numbers of people and livestock.* This is basically what is accelerating land degradation throughout much of Africa. In the wetter areas, however, there is a better chance that degradation can be halted and the land restored.

Soil degradation caused by deforestation is also a serious threat in Africa. Deforestation exposes the soil to high temperatures which break down the organic matter, increase evaporation and make the soils vulnerable to erosion. Thirty-seven million hectares of forest and wood lands in Africa are said to be disappearing each year (FAO, 1986). More serious still is the gradual removal of trees in farms and pastures, which are crucial for protecting productive land from erosion.

*To summarize, available evidence leaves no doubt that soil degradation caused by erosion, desertification, deforestation, and poor agricultural practices is undermining the very resources on which African farmers and their families depend for their very*

*survival.* In many areas of Africa, the manifestations of this calamity include the creation of deep gullies, of crusts that water cannot penetrate, rock-hard layers, laterite that hand-tools and plant roots cannot pierce, and shifting sand dunes that swamp villages and fields. UNEP has estimated that more than a quarter of the African continent is at present in the process of becoming useless for cultivation due to degradation.

In the drier parts of Africa, millions of hectares of grazing land and rangeland are also threatened with degradation - in the arid north, the semi-arid south, the Sudano-Sahelian countries and in the drier parts of Cameroon, Ethiopia, Kenya and Nigeria. The 1983-85 and recent droughts killed huge numbers of livestock there, with the result that good breeding stock was lost and the structural balance of herds distorted. Nevertheless, the herds are now recovering, but within five or ten years the trend of increasing overgrazing could be re-established - until the next drought reduces livestock numbers again.

The rangeland itself has been changed for the worse, with many of the perennial grasses being replaced by nutritionally poorer annual grasses. This has permanently impaired the rangeland's potential for recovery and decreased its carrying capacity. As the vegetation has been removed or reduced, the wind has also winnowed out the small amount of silt that the soil contains, reducing its ability to retain moisture. When it does rain, the chances of the range recovering are correspondingly reduced.

Africa's forests and woodlands are also being depleted, threatening one of the continent's most important resources. In Africa, trees play an important role in protecting the environment. They are the principal source of rural energy, and provide countless medicinal and industrial products used in both the home and in small-scale industry. They often supply food and feed, are the main source of building materials in the countryside and, directly and indirectly, are a source of employment and income for many rural Africans.

*Nearly 4 million hectares of this resource are now being deforested or degraded annually, largely in humid and sub-humid West Africa. The rate of destruction is alarmingly high in the Cameroon, in Côte d'Ivoire and in Nigeria. The cause of deforestation is mainly clearing for agriculture but uncontrolled logging, gathering for fuelwood, fire and overgrazing are also taking their toll. In most parts of Africa, the*

current trend cannot be continued indefinitely: in some places, deforestation rates exceed planting rates by a factor of 30:1.

*Despite the great potential in Africa for irrigation estimated by FAO to be about 27 million hectares, only one-sixth has so far been developed.* As most of Africa has little tradition of irrigation, it is likely that its rapid expansion will not happen soon and certainly not under conditions in which the practice is fully managed by the farmers themselves. Consequently, rainfed cultivation accounts, and will continue to account, for any increase in food production in Africa.

*One of the causes of degradations is that population pressure is forcing farmers to cultivate increasingly marginal land.* In Malawi, for instance, escarpment land that has a slope of more than 12 per cent - and that should therefore be forested - is being cultivated, causing erosion, the flooding of fertile crop land below, and the siltation of stream beds and irrigation canals. Thus erosion is threatening the future of one of the few countries in Africa that is successfully feeding itself.

FAO's 1985 study of the carrying capacity of land in developing countries compared Africa's projected future population with its food production potential. *According to the study, the number of countries that will be unable to feed themselves from home production using the present low level of inputs will rise from 22 out of 49 in 1975 to 32 by the end of the century and to 35 by the year 2025.* Indeed, even as early as the year 2000, 16 countries will have a critical food shortage even if they use intermediate inputs. They include the five North African countries together with Mauritania, Niger, Somalia, Rwanda, Burundi, Kenya, Lesotho, Namibia and the Indian Ocean islands of Mauritius, Reunion and the Comoros. Nigeria and Ethiopia would be close to being in a critical state. These predictions are based on the assumption of using every scrap of suitable and marginal land to grow nothing but crops. If we consider only production from land that is likely to be actually cultivated, and deduct one third for non-food crops and unequal food distribution, the results are very alarming. *By 2000 A.D. Africa would be able to feed only 55 per cent of its population with low inputs. By 2025, it would be able to feed only 40 per cent of its population.*

Most countries of the Sahel and mountainous East Africa will face severe problems. *Ethiopia's 1983 population of 36 million will more than treble to 112*

*million in 2025, forty-four million more than it can feed with intermediate inputs. Nigeria's population in 2025 is projected to reach 338 million, 123 million in excess of its carrying capacity with intermediate inputs. Even with high inputs, Kenya's lands can support only 51 million people a total that will be passed by 2010. By 2025 there maybe 83 million Kenyans, with as many as 111 million before the population reaches its plateau.*

*Central Africa will face no land shortage even if it is still using low inputs. With intermediate inputs, Zaire alone can feed 1,280 million people, 95 per cent of the projected total for the whole of sub-Saharan Africa in the year 2025. But this enormous surplus capacity is based on clearing most of the rain forest for agriculture. Even if this were to be done, it would not solve the food problems of the Sahel or East Africa any more than North America's present surplus could. The only way this huge potential can alleviate population pressure elsewhere is the occurrence of massive migrations into Central Africa from the surrounding areas, a solution which is fraught with political and environmental problems.*

The belt of land running through the West African Sahel region and the Sudan to north-east Ethiopia and Kenya is particularly vulnerable. Around 90 percent of rangelands and 80 per cent of rain-fed farmlands in the area are affected by degradation - including soil erosion, deforestation, and loss of woody vegetation - which makes them less able to bear crops and pasture.

These grim prospects are all based on the assumption that past trends continue. They are entirely realistic and they point towards disaster. Africa is the world's nightmare, a continent of recurrent drought, famine and bloody tribal, ethnic conflicts and civil warfare, perpetually dependent on food aid handouts with spreading deserts and shrinking forests.

The facile response to these prospects is to point out that many developed countries are not self-sufficient in food or energy and that they pay for their imports with exports of manufactured goods or services. Could not Africa's food-deficit countries do the same? The problem here is that the prospects of industrialization in Africa are dimmer than those in any other region of the world. The developed countries are price-takers and competitors among themselves in protected markets for their exported agricultural products. Apart from the oil-rich countries and a few city-

states deluged with foreign investment, no country has industrialized without a reasonably healthy agricultural base. *Africa seems to be caught in a trap; industrialization could solve her food problems, but with agriculture stagnant, the chances of industrialization are slim. In addition, with the level of income of the 80 % of population living in the rural sector very low, chances of having a market for industrialization are further very slim.*

In countries with limited cultivable land and high population-growth rates - such as Kenya, Ethiopia, Malawi, Burundi, and Rwanda - fallow periods are no longer sufficient to allow soil fertility to be restored, so that crop yields have fallen. In response, farmers have been forced either to bring increasingly marginal lands into cultivation, or to migrate into tropical forest areas, exacerbating problems of land degradation and deforestation.

*Nowhere is the lethal interaction of poverty and environmental degradation more evident than in Ethiopia. About half of the country's highland area is significantly eroded, reducing yields by between 2 per cent and 3 per cent a year. According to a 1986 study by the UN Food and Agricultural Organization, over 1,900 million tons of soil are lost from the highlands annually. If the trend continues, some 38,000 square kilometres will be eroded down to bare rock by the year 2010, and a further 60,000 square kilometres will have a soil depth of 10 centimetres, below which the soil would be too shallow to support cropping. About 2 million hectares of farmland are already estimated to be beyond recovery.*

*As stated by FAO, raising agricultural productivity to achieve greater self-reliance in food especially in Low Income and Food Deficit Countries (LIFDC), will require major changes in the policy priorities of African governments especially regarding the conservation of the natural resource base. In the past, there has also been an anti-poor bias in agricultural policy across much of the region, notably through over-taxation of crops; inadequate spending on market infrastructure for smallholder producers; insufficient investment in research on local food staples; and an undue concentration on rainfed, rather than irrigated agriculture.*

These trends are worrying, because agriculture is the backbone of most African economies, accounting on average for more than a third of GDP and more than three-quarters of employment. It follows that agricultural performance has a critical bearing

on both national and household incomes. In addition, food imports now constitute a major strain on Africa's balance of payments, accounting for about 15 per cent of total imports.

Future prospects must be assessed against this background of diversity. For many countries, a simple extrapolation of current trends in per caput consumption to derive estimates of future food availability would be highly inappropriate. Trends that either continued a downward spiral or a rapid improvement in diet are unlikely to be sustained for long. The threat or existence of mass starvation, for example, would provoke corrective action at the national or international level, or both. This analysis, therefore assumes that, except in emergencies, per caput food supplies are not allowed to fall below 1,750 calories a day, or below what is the internationally recommended requirement.

*However, large increases in per caput consumption will not be maintained either partly because there are physiological limits to how much people need to eat and partly because the economic outlook is much less favourable than it was.* Subject to these reservations, a continuation of the trends in demand would mean a small increase in per caput food availability in North Africa, and continued stagnation for sub-Saharan Africa. Measured from the more normal levels of 1979/81, per caput food supplies in sub-Saharan Africa would actually decline.

Even this outcome is probably optimistic, particularly for the low-income countries of sub-Saharan Africa: their food deficits would soon become so great that no plausible combination of commercial food imports and food aid could meet them. In 1982/84, the food imports of sub-Saharan Africa amounted to US\$5.2 thousand million and accounted for two-thirds of all agricultural export earnings. *Projecting current trends implies that by 2010 food imports would cost US\$28.5 thousand million at constant prices, compared to agricultural export earnings of at most US\$12 thousand million. The cereals gap alone would grow to 100 million tonnes, of which 58 million tonnes would be in sub-Saharan Africa.*

It is difficult to see how these food gaps could be bridged. Except for some of the more industrialized countries of North Africa, present and potential oil exporters, some mineral producers and a few net agricultural exporters, it is unlikely that foreign



exchange earnings would be sufficient to pay for substantial imports, particularly in the low-income countries that account for half the projected deficit.

*Developed countries could produce enough surplus to meet the deficits, but food aid would have to be increased many times by the year 2010, and even more in drought years. This would be beyond the existing, and probably the foreseeable, transport and distribution facilities of many African countries.* The most likely result is that food availability would therefore tend to decline even further. The word 'trend' is used here because this report does not include speculation over what might happen if per caput food supplies were to fall to levels normally associated with famines.

*A continuation of current trends would place many countries on the edge of survival, even if they were provided with substantial international support.* Some countries, however, most of which depend for their incomes on sectors other than agriculture, should be able to preserve and even improve their nutritional standards.

This outcome is not a sustainable one either, in at least two major ways. From what has been said, it is clear that the food shortages that would prevail in Africa if current trends were allowed to continue would produce perilous and unpredictable consequences that would affect not only Africa but most other regions as well. *In addition, it is also clear that the land would not be able to sustain the pressures on it arising from the growing human and livestock populations and inappropriate land use systems. Severe degradation is already occurring, with rates of soil loss reaching at least ten times the natural rate of soil formation. Unchecked, this would result, by the year 2010, in an African landscape that had a greatly reduced potential for agricultural production. Irreversible damage would have occurred over huge areas, and it is doubtful whether reclamation would ever be possible on an economic basis.*

The most serious soil degradation problems in Africa are summarized in Table 1. If the present trend of stagnating or declining productivity found over much of Africa is to be reversed, land degradation will have to be halted. The problems, as well as their underlying causes, vary greatly from country to country and even within individual countries. Consequently, the approaches used, techniques applied and methods adopted will have to be adapted to the specific needs of different environments.

Drought and conflict have left many countries in sub-Saharan Africa critically dependent on food and emergency aid. The provision of that aid is vital to the region's food security, and for local efforts at post-drought and post-conflict reconstruction. Unfortunately, for several countries, gaps between local needs and donors' pledges remain. This is why Northern governments should be pressed to respond more favourably to UN appeals. *At different levels, a myriad of responses have been offered and/or tested to solve the problem of land and environmental degradation and diversification in Africa. Unfortunately the results have not been up to expectations and the situation continue to worsen.* The recent Paris Conference on Desertification brought no consolation.

The belief of the World Commission on Environment that economic development need not be environmentally degrading and that growth should in fact create the capacity to solve environmental problems should be shared by all.

In short, the heart of the problem is that the natural resource base of Africa is being degraded and destroyed at a rate which will soon make food and agricultural production un-sustainable. Poverty, coupled with increasing population pressure, is the biggest single cause of this degradation. *The rural poor, the overwhelming majority of Africa's citizens, destroy their own environment, not out of ignorance, but simply to survive.* Peasant farmers preoccupied with survival over-crop marginal and because there is no alternative employment and no better technologies they can afford. Pastoralists overstock to improve their chances of surviving the next drought. Rural dwellers strip trees and shrubs for fuelwood because they need fuel. *In the context of the short-term basic needs of an individual, each decision is rational; in the long-run, the effects are disastrous.*

<p><b>Table 1</b>  <b>Summary of most serious degradation problems by region</b></p>			
Region	Arable Land	Grazing Land	Forest Land
Mediterranean and and North Africa	<ul style="list-style-type: none"> <li>- Declining soil fertility</li> <li>- Wind and water erosion</li> <li>- Salinization on irrigated lands</li> </ul>	<ul style="list-style-type: none"> <li>- General degradation of Vegetation both in quality and quantity</li> <li>- Wind and water erosion</li> </ul>	<ul style="list-style-type: none"> <li>- Degradation of vegetation as the deficit in fuelwood and timber increases</li> <li>- Water erosion on degraded forest lands</li> </ul>
Sudano-Sahelian Africa	<ul style="list-style-type: none"> <li>- Decline in nutrient levels in the soils</li> <li>- Decline in soil physical properties</li> <li>- Wind and water erosion</li> </ul>	<ul style="list-style-type: none"> <li>- General degradation of vegetation both in quality and quantity</li> <li>- Wind erosion in sub-humid</li> </ul>	<ul style="list-style-type: none"> <li>- Degradation of vegetation</li> </ul>
Humid and sub-humid West Africa	<ul style="list-style-type: none"> <li>- Decline in nutrient levels in the soil</li> <li>- Decline in soil physical properties</li> <li>- Water erosion</li> </ul>	<ul style="list-style-type: none"> <li>- Degradation of vegetation</li> <li>- Wind erosion in sub-humid areas</li> </ul>	<ul style="list-style-type: none"> <li>- Degradation of vegetation</li> </ul>
Humid Central Africa	<ul style="list-style-type: none"> <li>- Degraded soil physical properties</li> <li>- Degraded soil chemical properties</li> </ul>		
Sub-humid and mountain East Africa	<ul style="list-style-type: none"> <li>- Water erosion</li> <li>- Degradation of soil physical properties</li> <li>- Degradation of soil chemical properties</li> </ul>	<ul style="list-style-type: none"> <li>- Degradation in quality and quantity of vegetation</li> <li>- Water erosion</li> </ul>	<ul style="list-style-type: none"> <li>- Degradation of vegetation</li> <li>- Water erosion</li> </ul>
Sub-humid and semi- arid Southern Africa	<ul style="list-style-type: none"> <li>- Water erosion</li> <li>- Degradation of soil physical properties</li> <li>- Degradation of soil chemical properties</li> </ul>	<ul style="list-style-type: none"> <li>- Degradation in quality and quantity of vegetation</li> <li>- Wind erosion</li> <li>- Water erosion</li> </ul>	<ul style="list-style-type: none"> <li>- Degradation of vegetation</li> <li>- Erosion</li> </ul>

Source: FAO: African agriculture: the next 25 years, 1986.

# RESPONSES TO THE IMPACTS OF LAND AND ENVIRONMENTAL DEGRADATION AND DESERTIFICATION

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*The future need not echo the past. Most African countries have a number of options that, if applied wisely, could boost agricultural production and slow down land and environmental degradation. It would be both physically and technically possible to apply these options over the next 35 years, just less than a generation. It is, however, an important assumption that technical changes of this type cannot and will not be implemented unless far-reaching policy changes are introduced by African governments themselves, especially through a genuine democratization process.*

The main technical options open to African governments are:

- (i) Land and optimal irrigation development or water policy in general;
- (ii) Increasing land and labour productivity with available technology;
- (iii) Developing additional technology to overcome production constraints that currently have no technical solutions; and
- (iv) Institutional framework including land tenure policy, desertification of rural communities income.

These options are closely related. For example, in most agro-climatic zones soil productivity has already been lowered by erosion or degradation. However, existing technology, and closer integration of crop, forestry and livestock production, could be used to increase productivity, conserve land and water resources, and open up new areas for cultivation in a sustainable manner. But these options must be put into their proper perspective since misleading claims have been made for them. *In fact there are four myths about how these options can solve Africa's agricultural crisis. They assume that Africa has huge areas of surplus land, plenty of agricultural labour is available, there is a vast potential for irrigation, and that these can be married with the use of agricultural technologies that have been successful in Asia* (see Table 2).

**Table 2**

**Four Myths about African Agriculture**

**The land surplus myth**

Although Africa is underpopulated in terms of average densities, neither populations nor natural resources suitable for food production are evenly distributed. About one-third of the continent's 2.9 billion ha (excluding South Africa) is too dry for rainfed agriculture. Of the remaining rainfed land with a potential for cultivation, half is of marginal quality and vulnerable to degradation unless appropriate management techniques are applied.

There is limited scope for expansion of rain-fed cultivation in most sub-regions. North Africa has no unused land left to bring into cultivation. In fact, some land is already been cultivated that should be reserved for perennial crops and grazing. In the Sudano-Sahelian region, only the Sudan has appreciable reserves. West and East Africa have limited reserves relative to population growth. When grazing and forest land requirements are taken into account, the situation is even more critical. The other two regions have substantial reserves, particularly Central Africa, but development will be restricted by low population densities, weak infrastructure, human and animal diseases, and the fragility of its soils.

**The labour surplus myth**

High population growth rates apparent underemployment and massive rural-urban migration can be taken to indicate the existence of labour surpluses in rural areas. Nonetheless, rural labour shortages are a significant constraint. The labour shortage has arisen for several reasons. First, the predominance of manual techniques for land clearance, tillage, sowing, weeding and harvesting tends to generate seasonal peaks in labour demand, particularly in regions with relatively short rainy seasons. Secondly, low labour productivity in agriculture, and poor producer prices, result in low rural incomes. Thirdly, artificially high urban incomes have often led to large rural-urban wage differentials, and massive rural-urban migration involving disproportionate numbers of able-bodied males. Fourthly, the spread of education has reduced the attractiveness of agriculture as an occupation, even in areas where it can provide year-round employment. Fifthly, the division of labour between the sexes has added to the problem. In many areas, women are largely responsible for a number of key food production tasks, such as weeding and harvesting, which cannot be delayed. However, population

pressure and poor infrastructural development is causing them to spend increasing proportions of their time on collecting water and fuel, thereby reducing the time available for crop husbandry.

**The irrigation myth**

Africa has substantial water resources but most of them are not in, or economically accessible to, areas where aridity limits production. There is sufficient water to irrigate more than 40 million ha, but almost half of this is in areas with ample rainfall. Thus the feasible potential is possibly of the order to 20 to 25 million ha, and this only in the long term. In contrast, India already has some 40 million ha of irrigated land, serving about 25 per cent of the arable area. Africa, with a similar area of arable land, has just over 9 million ha currently under irrigation - that is, less than 5 per cent of the arable area - and almost half of this is in North Africa.

Even where there exists both a need and a potential for irrigation, it may not be financially viable. Modern irrigation development in Africa, with full water control, tends to cost two or three times as much as in India. With such costs it is not possible to irrigate staple foodcrops and earn a satisfactory return on capital. Consequently, future irrigation development will have to be much more selective than in the past, exploiting wherever possible the potential for low-cost, small-or medium-scale schemes at the farm or village level in areas with good access to urban markets.

**The Asian technology myth**

It has been proposed that Asia's "green revolution" technology can be transferred to Africa. This is not generally correct. The new varieties of rice and wheat that formed the basis of the green revolution in Asia yield well only when irrigation or reliable rainfall provide sufficient moisture. This precondition cannot be met in much of Africa. Irrigation is too limited in extent and generally too costly for staple food production, and some 40 percent of the currently cultivated area suffers from unreliable rainfall. Past attempts to transfer improved varieties of rainfed crops, such as sorghum and millet, from Asia to Africa have met with little success. They have generally inferior yields and cooking qualities compared with the best local African varieties.

**Source:** FAO: African Agriculture: the next 25 years, 1986.

Africa has about 600 million hectares of land that could be developed for crop production, although some is only suitable for tree crops and most is already in use for forestry or grazing. About 75 per cent of these reserves are located in three sub-regions: Central Africa (255 million hectares), where development will be held back by low population densities, and limited road and rail access; and East and Southern Africa, where two-thirds of the reserve have marginal soils and/or unreliable rainfall and are located mainly in four countries - Angola, Mozambique, Tanzania and Zambia.

In most other countries, reserves are small relative to current population growth rates. Even so, they are still large enough for most countries to be able to double their rates of arable land expansion over the next 25 years, providing that producer incentives are increased, governments are committed to the expansion, and donors are prepared to assist.

The physical potential for irrigation is large and, with the exception of North Africa - where irrigation has already been introduced in about 70 per cent of the potentially irrigable areas - physical resources exceed likely needs over the next 25 years. The main constraints are likely to be economic and institutional, notably the high construction and operation costs prevailing in Africa, and the shortages of trained manpower. Consequently the grassroot technology approach appears as the most appropriate solution to irrigation problem.

*Rehabilitation and development could expand Africa's total irrigated area from 9.5 to about 14.5 million hectares by 2010.* Rehabilitation could provide about 25 000 ha/year. Small-scale and traditional irrigation could be expanded by about 150 000 hectares or some 3 per cent a year, but financial and other constraints would limit the growth of modern, fully-controlled irrigation to about 1 per cent a year. Collectively, these developments could have a marked effect on agricultural production in arid and semi-arid areas.

The traditional responses to soil degradation vary from one ecological zone to another. In the humid zone traditional, agricultural practices ensure that soil degradation is kept to a minimum. The mixed crop canopy protects the soil from physical destruction and keeps organic matter up. These traditional farming systems maintain a vegetation with properties similar to the native forest and thus effectively protect the environment. The systems are maintained by:

forest or bush fallowing techniques which can allow forest regeneration;

clearing of limited spaces leaving root stumps and big trees;

retaining useful trees (such as those with medicinal properties, hare wood, etc.);

inter-cropping;

maintaining ground cover most of the year by including crops with trailing systems;

use of household refuse as fertilizer for selected crops in the farm or garden.

It should, however, be pointed out that not all traditional practices have had favourable impact on the soil situation in the continent. A number of traditional practices have, on the contrary, encouraged soil degradation. These include the creation of bush fires, the use of trees for fuelwood, overgrazing and destruction of pasture lands.

Besides over-grazing of the available pastures, branches of evergreen trees are often lopped off to provide fodder for livestock during the dry season journeys. This practice results in further degeneration of the already scanty vegetation of the zone.

The dominant farming system throughout much of the continent is shifting cultivation, which is essentially a zero-input form of agriculture because it makes maximum use of the resources available within the system. During cultivation, the soil is usually covered by a mixture of crops which utilize soil nutrients from different depths and provide a varied canopy to shelter the soil surface. At the end of the cropping cycle, the natural system of resting the land restores the nutrients removed by the crops and the opportunistic pests and diseases are driven out. So long as the fallow period is long enough, the system is stable and sustainable.

The impact of droughts in Africa is to be seen in a proper global context. The overall observation is that most semi-arid lands tend to be naturally, alternatively plagued by prolonged droughts, followed by periods of plentiful rainfall, thereby



presenting agricultural planners with a challenge. The real issue then is how the people who live in these areas perceive the climatic element in their environment, and what appropriate arrangements they make to "manage" the "climate resource".

The farming systems of Africa and the techniques used are very varied, having evolved to meet the needs of the people in a wide range of environments.

## **1. At the Technical Level**

*Most African governments have seen irrigation as a solution towards food self-sufficiency, for import substitution or as a source of foreign exchange earnings from export crops.* Tenants or small farmers on major schemes have been therefore usually required to concentrate on commercial production of the crops given priority by the government and to sell them to the state. Due to the novelty of modern irrigation in most cases, and the remoteness of many sites, governments have often had to supplement already costly irrigation works with extensive production, marketing and social support services. High yields and double cropping are needed to pay for these high investments. By contrast, traditional irrigation is more often used to provide subsistence food. It is normally less costly, and often integrated with rainfed and livestock farming as a means of spreading climatic risks.

*The current strong interest in irrigation in Africa arises from the growing incapacity of much of the continent to feed itself.* Food production, predominantly under rainfed conditions, has risen at a rate of only 1.4 % p.a. in the period 1970 to 1990, less than half the rate of population growth which is estimated at 3.0 % p.a. Recurrent droughts have accelerated the rising trend of cereal imports which amounted to 28 million tons in 1984 and 31 million tons in 1992. Irrigation through intensification and stabilization of production has appeared to many to offer a good solution. *However, any successful irrigation scheme must involve the beneficiaries and must be managed by them for the interest of the communities.*

Africa has an estimated 9.5 million ha of irrigation, of which 6.1 million ha of modern irrigation, mostly under major government schemes and 3.4 million ha of small-scale and traditional flood, swamp, surface and low-lift irrigation developed without government support by individuals or local groups. Egypt, the Maghreb

countries and the Sudan account for 82 % of modern irrigation. Other countries with important irrigated areas are Nigeria and Madagascar, with the bulk of irrigation, however, in the traditional sectors of both countries.

For eight countries (Botswana, Burkina Faso, Kenya, Mali, Mauritania, Niger, Senegal and Somalia), containing some 11 % of Africa's population, lack of rainfed potential and/or rising demographic pressure on rainfed land are likely to make irrigation an essential element of future food strategies in the short and medium term. Eventually, some large-scale schemes may be justified in these countries but there is need to take advantage first of the scope for cheap rehabilitation wherever possible, and in some cases expansion of existing schemes. Simple improvements to traditional swamp and flood irrigation, although giving smaller yield gains, could in aggregate also make an appreciable contribution to food supply.

Another 14 countries in Sub-Saharan Africa have some of their territory in drought-risk zones where small-scale irrigation based mainly on small dams, direct pumping from rivers and groundwater could do much to reduce rural hardship and the need for costly disaster relief.

For the remaining countries in Sub-Saharan African, first priority is more likely to be given to rainfed development, which is usually simpler to organize, cheaper and can give quicker benefits. Nevertheless, few of these countries can afford to discard any existing schemes where rehabilitation is feasible, and in most there is scope for improvement and possibly expansion of traditional and small-scale irrigation.

In North Africa there is limited potential for expansion, and irrigation efforts will need to be directed towards completion of irrigation projects where major works have already been constructed, a continuation of rehabilitation of modern schemes and of renovation of traditional irrigation. However, the major effort would be in further intensification and more efficient water management in existing areas.

There are at present many constraints to these developments. Social, institutional and economic factors appear more important than technical limitations. *To improve the future performance of irrigation in the region, governments would have to make difficult policy and institutional changes.* Planners must recognize that, to become established, modern irrigation requires long periods of social change and adaptation,

in a consistently favourable policy and budgetary environment. Financial returns from irrigation need to be raised to improve the commitment of irrigators, and to encourage the emergence of private sector agricultural services. Government irrigation agencies need to shed excess staff, and abandon unprofitable activities and wasteful methods. Manpower development is needed at all levels, especially for managers. This will only be possible with substantial international support to governments through policy discussion, loans, grants and technical assistance programmes. *The most profitable irrigation scheme must be at the community level with the full participation of the beneficiaries, involving technologies they can easily absorb and manage on a sustainable basis. Participation of small arable farmers and pastoralists in resources conservation and development etc. will require intensive promotional effort.*

Looking towards the Year 2010 and assuming reasonable success in making such changes and adequate external support, the pace of construction of new, modern schemes could average some 70,000 ha/year, while the rehabilitation of existing schemes might reach 35,000 ha/year and expansion of traditional and small-scale irrigation could amount to 180,000 ha/year.

Combined with yield increases, this could allow irrigated cereal production in Africa in the Year 2010 to reach twice the present figure. But due to population growth and increased demand, the contribution of irrigation to cereal demand would remain broadly at the same level. The total for the continent hides divergent trends between North and Sub-Saharan Africa. In the former, irrigation's contribution to cereal demand would decline in relative terms from 45 % of food demand and 33 % of total cereal utilization to 34 % and 20 % respectively. In Sub-Saharan Africa, the relative contribution of irrigated cereal production would rise from 11 % of food demand and 9 % of total cereal utilization to 13 % of food demand and 11 % of total utilization. Cereal output from irrigation in Sub-Saharan Africa would be more than triple from 4.6 to 15 million tons.

Government support for small-case schemes has suffered many of the problems of larger schemes, unless based on simpler approaches closer to those of the traditional irrigator, and with an obvious appeal to the beneficiaries. The future is more in the direction of small case schemes, entailing popular participation and mainly managed by beneficiaries.

## 2. At the Farmer Level

*Over the centuries African farmers and graziers developed farming systems which were compatible with their environment. These systems permitted a steady, if rather low, level of production which did not entail land degradation.* The dominant forms of land use were shifting cultivation in the humid tropics and nomadic grazing in the semi-arid areas.

Yields with these systems were generally low so that relatively large areas were needed to support a small population. Problems began to arise in recent times as populations increased rapidly. More pressure was placed on the resources to produce more food, fibre and fuel while, for the most part, the old systems of land use were maintained. For example, shifting cultivation was still practised but the fallow periods were reduced. Nomadic grazing was maintained but with a higher human and animal population density. For the most part, the land has not been able to bear these sudden, increased pressures and the result has been "mining" of the resource base and the spread of land degradation.

*African farmers do not need to be considered the ideal husbandmen and women for one to realize that they have always been conscious of the fact that their survival depends on the land. Through a system of empirical trial and error they have worked out how to balance their demands on the natural resources around them and the ability of these resources to satisfy their basic needs.*

Prolonged and devastating droughts, such as those which struck southern Africa in 1992 and the Sahel region in the mid-1980s, coupled with poor soils and erratic and precipitate rainfall, makes much of sub-Saharan Africa a difficult environment for agriculture. Traditionally, peasant farmers have coped with Africa's fragile ecology by leaving soils fallow for long periods, and developing complex inter-cropping systems, designed to minimise risk and maximise sustainability. Today, these systems are breaking down in the face of a range of mutually reinforcing local, regional, and international pressures.

In the savannah, one of the best ways of maintaining soil organic matter is by fallowing. First a variety of short-lived herbs appear. These early colonizers tolerate the daily extremes in temperature and water stress and provide the conditions for the

establishment of other plants including legumes. Once legumes appear in the system, both nitrogen and organic matter increase. Left alone, the sequence of plant appearances would continue until a stable climax vegetation is established.

*The savannah farmer, according to Allan (1967), has a complete knowledge of his environment. He can relate the fertility status of the land and its suitability for one or another crop to the vegetation which covers it and the physical characteristics of the soil. He can also assess the staying power of the soil i.e. the number of seasons for which it must be rested before good crops yields can be obtained again. It is mainly population pressure that has caused this system to break down, resulting in devastating soil degradation given the terrifying name of desertification.*

The tropical highlands, as in Ethiopia, Lesotho and Cameroon, have rainfed agricultural systems based on small-seed cereals, pulses and oil crops often. Animal power is often used for land preparation. Soil degradation is a major problem for these mountainous environments. Traditionally this is tackled by a combination of crop rotation involving legumes, the application of animal manure and allowing animals to graze harvested fields, as well as fallowing usually for one or two years.

To compensate for the falling yields caused by soil erosion, farmers in the highlands have cleared forests on steeper slopes, accelerating land degradation in the process. With population growing at around 3 per cent a year, and the population density in some of the most vulnerable rural areas increasing even faster, the dangers posed by this cycle of increasing poverty, deforestation, and accelerating land degradation are readily apparent.

River valleys and swamps depend on regular soils renewal to keep their high fertility. These systems are mostly used for continuous cereal cultivation. In Egypt, for example, the silt of the Nile laden with rich organic matter replenished the soil and makes continuous cultivation possible. Similar systems exist today in the Niger delta in Mali and along the Nile in the Sudan.

In the semi-arid zone, a sizeable proportion of the population are full-time herdsman, who have a strong tradition of regarding livestock, particularly cattle, as a form of savings rather than a productive unit. Thus the rate of off-take from cattle herds is very low. Moreover, there has been an increase in the animal population in

this zone resulting in critical ratios of biomass to animals and consequently to overgrazing. During periods of drought, livestock have to be herded for long distances in search of water and suitable pasture, resulting in serious trampling due to the increased traffic by animals. As a result, there is seasonal migration of nomadic communities. These migrations are associated with soil deterioration, particularly around water holes.

The inhabitants of the semi-arid and arid zones of Africa depend largely on firewood as fuel for cooking and heating of homes during the cold harmattan nights as well as for the construction of houses. There is, therefore, an intensive exploitation of the scanty vegetation to meet the ever-increasing demand for firewood. Even roots of plants are dug in search of fuel and grasses and crop residues, which should be returned to the soil, are used for roofing, heating, fencing and feeding animals. In the highlands, women and children scour the fields at dusk for dry animal droppings, mix these with straw and mould them into fat pancakes for burning. The slow rate of tree growth in the semi-arid zone makes it impossible for the regeneration of forest vegetation to cope with the rate and intensity of exploitation. This leads to an increase in the deterioration of environmental conditions.

Nomadic herdsmen regularly and intentionally set fires to promote the growth of new shoots of fodder for their starved livestock. Hunters also use fire frequently to drive wild game into the open while farmers sometimes use fires to clear land for preparation before planting. Fires may even be started from sheer habit or wantonness. These fires, which are uncontrolled, burn the grass down to ground level and trees lose their remaining leaves resulting in wind erosion.

### **3. At the National Level**

The central theme of both the Lagos Plan of Action (LPA) and the United Nations Programme of Action for African Economic Recovery and Development (UN-PAAERD), replaced by the United Nations New Agenda for the Development of Africa in the 1990s (UN-NADAF), must be strongly reiterated: the primary responsibility of reversing the actual trend of Africa's socio-economic decline is that of African governments. Thus, African governments must effectively put into practice their proclaimed commitments. It is obvious that the most important factors which impede

the sustained development of the agricultural sector in Africa are rural poverty and land degradation. *Though population pressure has tended to compound the adverse effects of these factors, population growth should only be seen as a dependent factor which will only be controlled through an equitable socio-economic development. The response to the threat should thus include poverty alleviation and a practical commitment to environmental conservation and rehabilitation.*

Individual African countries have also established institutions for environmental management, which have yielded some good results. The following examples do not constitute an exhaustive list of success stories, but are meant to illustrate what has been done using local resources.

#### **(a) Burkina Faso**

An OXFAM project in Burkina Faso worked with villagers to improve on the local technique of building small dams called digguettes. It was found that if the stones are aligned properly along the contour, the dams hold rain water back and make a pool stretching from four to fifteen meters uphill, giving the water plenty of time to infiltrate into soil. The lines of digguettes are easy to make. A trench 5-10 cm deep is dug to provide a foundation, and the earth piled uphill. Then medium-sized stones 15 cm in diameter are heaped up to a height of 15-21 cm in a band 20-30 cm wide. The lower part of the wall on the uphill side is plastered with the excavated earth to prevent run-off water from seeping underneath the stones and under-cutting the wall.

#### **(b) Egypt**

In Egypt, where the coastal dunes form a narrow strip along the Mediterranean sea, the top layer is usually very dry during the summer. This acts as an insulator which protects the sand in the lower layers from desiccation. The temperature is very uniform, preventing evaporation and retaining water underneath the surface. Mechanical fixation of the dunes is followed by afforestation. The main activity is to establish shelter belts to protect the newly reclaimed sandy soils on the fringe of the western desert.

### **(c) Ethiopia**

In Ethiopia, the amount of human labour that has been mobilized for soil conservation practices is unrivalled in Africa. Soil conservation programmes in Ethiopia started through food aid from the World Food Programme in 1973 in the northern regions of Eritrea, Tigray and Wello. In 1980 it was expanded to cover 44 densely populated catchment areas seriously affected by drought, land degradation and food shortage. The programme combines forestry, soil conservation and water resource development. Land with slopes above 35 per cent is stone-terraced and planted with eucalyptus. Harerghe was also one of the first regions where such large scale soil conservation was undertaken.

### **(d) Kenya**

Kenya has a Presidential Commission on soil conservation and afforestation which was set up in 1981. It co-ordinates the many government agencies, donors and voluntary groups involved. It also reviews performances, policies and legislation and recommends new measures and projects. Soil and water conservation and afforestation committees have also been created at every level of government from district to locality with similar roles of co-ordinating and selecting priority activities.

Kenya leads Africa in tree planting. In 1983, four out of five households had planted trees in the preceding 12 months and two out of five had their own tree nurseries. In 1971, the rural afforestation scheme was launched by the Kenya Forestry Department. The scheme aimed at providing one extension worker for each district to supervise community and government nurseries. It also recommended the planting of trees along terraces. This was followed by the creation of a Ministry of Energy in 1979. Furthermore, presidential directives in the early eighties directed all local government offices to be planted and terraced. Schools must have a tree nursery and an agroforestry plot; and in 1985, the presidential tree fund was set up to encourage tree planting. There have also been many examples of successful soil conservation and reclamation projects in the country. In one village, checkdams were built to slow the water flow in a 9 Acacia cyanophylla, a creeping leguminous tree that flourishes on degraded soils, was planted in the bed. The banks were protected by lines of eucalyptus. A small earth dam that now irrigates about 60 hectares of



land was also built to collect the run-off from the hill. By 1988 about 1,000,000 ha of land had been reinforced or terraced with about 20,000 ha of forest re-planted annually and 200,000 km of earth or stone terraces constructed.

#### **(e) Niger**

In the Niger Republic, CARE, with the help of the inhabitants, fixed 22 dunes with 45,000 trees and 50 km of palisades was constructed from millet stalks. In 1978, CARE, with the assistance of the local forestry department, set up tree nurseries growing seedlings of eucalyptus. Long palisades of millet stalks one and a half meters tall were erected with their bases buried 30-40 cm into the sand to act as windbreaks to protect the young trees. The seedlings were planted at the beginning of the rains so they would need no watering to get established. The villagers provided labour for fencing and digging the holes for the seedlings. The palisades were spaced ten meters apart. For every hectare of fixed dune, one kilometer of millet windbreak was used. The Guesselbodi experiment is another example of soil conservation using small-scale, low-cost rehabilitation measures which could provide immediate results. According to Harrison (1987), some of the methods involved were as follows:

- (i) A water-harvesting techniques pioneered in the Sahel by OXFAM;
- (ii) Earth and stone banks aligned along the contour to slow down the flow of sheeting rain-water and dam it back up the slope for slow infiltration in the gullies;
- (iii) Checkdams of large rocks and interception dams to divert the water of flash floods along gently sloping dikes into the slopes in between the banks of dammed gullies;
- (iv) A patchwork of micro-catchments, using small banks to collect water and direct it to a lower point. The raised banks also collect fine soil particles, twigs, leaves and seeds. Local species of trees, grasses and herbs whose seeds had been in the soil grow spontaneously because of the moisture trapped by the bank;
- (v) The use of a mulch of twigs and small branches scattered on the surface of a bare, deforested patch with a few limbs pressed in to hold the rest in place so

that the brushwood accumulates soil, sand, organic materials and seeds, lowers the temperature of the soil beneath and protects it against battering raindrops. It also attracts termites. The method helps regenerate degraded land more cheaply than other methods.

#### (f) Nigeria

Organized tree planting campaigns and annual tree-planting dates go back to the early 1940s in the Katsina province of northern Nigeria. This spreads to Kano and Sokoto provinces (now States) so that by 1972 the number of seedlings distributed free of charge by the Forestry Service to the local population exceeded one million annually. The tree species planted are Azadirachta indica (neem), eucalyptus and other such economically useful species such as Parkia clappertoniana, Adansonia digitata (baobab), Butyrospermum parkii (shea butter tree) and Ceiba pentandra (kapok). Several other species, including Acacia nilotica, Zizyphus spp., Prosopis chilensis (mesquite) and Anacardium occidentale (cashew) have also been reported, but results have shown that only neem and sometimes Acacia nilotica are sufficiently drought-resistant for the environment. Acacia albida is also commonly planted as a valuable fodder during the dry season.

#### (g) Tunisia

Forests which have produced 58 m<sup>3</sup> of wood/ha have been planted for coastal dune stabilization. Acacia is usually planted first followed by pine after 20 years. About 30,000 ha of productive forest have been established on the sand dunes in this manner. The government has plans to treat a further 7,000 ha of sand dunes in a similar fashion.

Groups of countries affected by a common drought problem have organized themselves to fight the threat. For example, the Permanent Inter-State Committee on Drought Control in the Sahel (CILSS) was established following the severe drought which affected the Sahel in 1970/1973. The countries of Eastern Africa have, in a similar manner, responded to the drought in the sub-region by creating a coordinating office (IGADD) based in Djibouti. The South African Development Co-ordination

Conference (SADCC) which has now become the Southern African Development Community (SADC), and is being transformed into the Common Market for Eastern and Southern Africa (COMESA), has also adopted three broad strategies for resource management including conservation, utilization and environment monitoring.

#### **4. At the International Level**

Co-operation at a broader, international front has also taken place. The United Nations General Assembly, by resolution 38/161, has established the World Commission on Environment and Development (WCED). The Food and Agriculture Organisation of the United Nations (FAO) has long warned its member States and the international community of the necessity of making developmental projects more environmentally sustainable. In 1979, the Economic Commission for Africa organized a regional seminar on "Alternative patterns of development and life style" whose recommendations were considered in chapter IX of the Lagos Plan of Action. As a follow up, UNECA prepared a document on the importance of environmental degradation in the African crisis. This document was approved by the UNECA Conference of Ministers in 1984. These actions in promoting environmental protection and rehabilitation led to the formal constitution of the African Ministerial Conference on the Environment (AMCEN) in Cairo (Egypt) in 1985. The first conference adopted a Programme of Action and gave priority to halting the degradation of Africa's resource base and its rehabilitation with the fundamental view of achieving self-sufficiency in food and energy by mobilizing Africa's human and technological resources.

The FAO's catalytic action has been strongly supported by other United Nations' agencies, particularly the UNEP and UNECA. UNEP, being an Africa-based worldwide institution, focuses its efforts on Africa and supports AMCEN as well as the African NGO Environment Network (ANGEN). The organization has also established a Senior Women's Advisory Group on Sustainable Development (SWAG). UNEP's Global Environment Monitoring System (GEMS) has been operational for more than 10 years. Besides its leading role in the development of food and agriculture in developing countries within the United Nations System, FAO has recently compiled and published a monograph on "The Conservation and Rehabilitation of African Lands - an International Scheme". The framework for action proposed by FAO is very

comprehensive and takes into account the preoccupation of the above-mentioned organizations and that of African governments. It proposes actions at three levels:

● **At the national level:**

- improving land use;
- encouraging participation;
- developing national institutions.

● **At the regional level:**

- catalyzing regional programmes.

● **At the international level:**

- co-ordinating international action.

Besides this framework for action aimed at conserving and rehabilitating African lands, FAO has launched a comprehensive project for preserving the tropical forests which, by its nature, will also significantly contribute to land conservation. The ECA endorses the FAO framework of action as it conforms with some of the recommendations of the Lagos Plan of Action and AMCEN.

Besides the United Nations System, a great number of aid agencies and voluntary organizations (NGOs) have contributed to a better knowledge of the physical and socio-economic environments of Africa and have provided valuable services and financial support to African member States.

It should, however, be noted that the overall funding of the land conservation and anti-desertification programmes in Africa is far from encouraging. UNEP has estimated that anti-desertification programmes in developing countries require a minimum of US\$ 4.5 billion a year for a period of 20 years to make a significant impact. In 1990,

UNEP found that the maximum funds which could be realized each year for such programmes amounted to only US\$600 million, far less than required.

In many cases efforts to combat soil erosion have failed, because aid donors and governments do not recognise that soil conservation requires an investment of labour and capital. Apart from the fact that these are typically in short supply, the potential benefits, in terms of increased soil potential benefits, in terms of increased soil productivity, are not realised for several years. These were among the important early lessons which we learned from discussions with farmers in the Hararghe area of Ethiopia's Eastern Highlands - a site of particularly severe soils erosion. Another important factor which has been neglected in the economic, natural resources and environment sustainability, is the accounting for natural resources and environmental degradation due to economic activities, natural and/or man made calamities. We will succinctly approach this important issue in the next section.

# **SUSTAINABILITY, ACCOUNTING FOR NATURAL RESOURCES AND ENVIRONMENTAL DEGRADATION**

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## **1. What is it?**

On first hearing, "sustainable development" sounds difficult - and certainly achieving sustainability looks to be one of the toughest challenges our species has ever faced. But the significance of these terms is simple to sum up: they indicate a switch in environmental thinking from a necessary early obsession with emerging problems to a growing interest in environmental solutions which will be economically, socially and politically viable. They also potentially permit a much wider range of interests (environmental, social, political, economic, commercial) to make common cause. However, there are very different views on what the end-point of this process should be, what it will involve, who is responsible for initiating and guiding it, and how fast it should go.

The 1992 UN Conference on Environment and Development (UNCED), or Earth Summit, called for a shift from "talk" to "action". Two main categories of problem are seen as targets.

The first category is the broad range of environmental degradation which has been so thoroughly catalogued in such publications as the Worldwatch Institute's "State of the World" series<sup>2</sup>.

The second category embraces a range of socio-economic problems, including poverty, lack of shelter, poor health condition, lack of appropriate education, malnutrition and famine.

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<sup>2</sup> See *State of the World 1994*, A Worldwatch Institute Report on Progress Towards a Sustainable Society, W.W. Northon, New York, 1994.

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It is often argued that the first category of problems is aggravated by population and economic growth, while the second can only be alleviated by economic growth. Sustainable development aims to square the circle by proposing a new model of development which is simultaneously sustainable in environmental, economic and social terms. But the fundamental collision between proponents of growth-based solutions and no-growth or almost-no-growth-based solutions remains at the heart of the sustainability debate.

The generally used concept of "growth", as it adheres to misleading information on economic activities which also deplete and destroy, is not suitable for any sustainable solution. "Sustainable development" is definitely meant as an alternative to growth, not as a semantic replacement.

Sustainability in economic terms can be described as the "maintenance of capital", sometimes phrased as "non-declining capital". Historically, at least as early as the Middle Ages, the merchant traders used the word "capital" to refer to human-made capital. The merchants wanted to know how much of their trading ships cargo sales receipts could be consumed by their families without depleting their capital. Of the forms of capital environmental sustainability refers to natural capital. So defining environmental sustainability includes at least two further terms, namely "natural capital" and "maintenance" or at least "non-declining".

The most commonly accepted definition of sustainable economic development is that first proposed in "Our Common Future": development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Fine, as far as it goes, but it can hardly be described as a blueprint. The World Commission on Environment and Development (WCED) Secretary-General MacNeill was a bit more specific: "An essential condition for sustainable development is that a community's and a nation's basic stock of natural capital should not decrease over time. A constant or increasing stock of natural capital is needed not only to meet the needs of present generations, but also to ensure a minimum degree of fairness and equity with future generations"<sup>3</sup>

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<sup>3</sup> "Meeting the Growth Imperative for the 21st Century", Jim MacNeill, pp 191-205 in *Sustaining Earth: Response to the Environmental Threats*, edited by David J.R. Angelle et al, Macmillan, London, 1990.

The concept has variously been described as a compass point, a banner, a rallying cry. The implication is that its power to attract and direct is one of its fundamental values. "Sustainable economic development has become the new rallying cry of the environment/development movement," as Timberlake noted in 1988<sup>4</sup>. "Like most such cries ("Liberty!", "Popular Participation!", "Power to the People!"), its meaning is not absolutely clear." By the time Pezzey settled down to review the literature in 1989, he identified around 60 separate definitions of "sustainability"<sup>5</sup>. In fact, there are those who see its very vagueness as part of its power to attract new recruits.

The intricate dynamics of sustainability have still to be adequately investigated and articulated. But already we can see enough of the outline of this new area of science, economics and technology to understand the general direction in which society needs to travel. In this respect, the concept of sustainable economic development is important for three main reasons.

- (i) First, it provides a framework within which broader cultural, socio-political, economic and technological factors can be incorporated into the environmental debate - and vice versa.
- (ii) Second, the phrase is dynamic, implying a transition from unsustainable to sustainable forms of economic development and activity. It thereby potentially opens out the time-horizons within which environmental issues are discussed. The phrase introduces the notion that some problems may be more critical than others in terms of negotiating that transition. The implicit message is that we must set priorities.
- (iii) Third, sustainable development is inclusive. By focusing on the need for "development", it increasingly provides a framework within which the business and development communities can feel comfortable in discussing and addressing environmental priorities. And development, clearly, is an area where business has

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<sup>4</sup> "What is Sustainability", Lloyd Timberlake, pp 50-51 in *Green Pages: The Business of Saving the World*, edited by John Elkington, Julia Hailes and Tome Burke, Routledge, London, 1988.

<sup>5</sup> *Definitions of Sustainability*, John Pezzey, CEED Discussion Paper No. 9, The UK Centre for Economic and Environmental Development, Cambridge, 1989.



a distinct edge on most non-governmental organisations (NGOs) - with the result that there are growing numbers of business organizations working in this area.

Sustainable economic development is a process which necessarily involves all sectors of society, including those not yet born. The early phase - when key actors in this process felt they faced "no win" (where no-one could win) or "zero sum" (where only one side could win) outcomes - has been replaced by a phase in which key actors - including NGOs - have been looking for "win-win" outcomes, where both sides can benefit. The central challenge for the future is to work out how to achieve "win-win-win" outcomes, where both sides and the environment benefit. This by no means implies that conflict should be avoided, on the contrary: conflict is a function of the great choices ahead.

Natural capital is basically our natural environment, and is defined as the stock of environmentally provided assets (such as soil, atmosphere, forests, water, wetlands), which provide a flow of useful goods or services. The flow of useful goods and services from natural capital can be renewable or non-renewable, and marketed or non-marketed. Sustainability means maintaining environmental assets, or at least not depleting them. "Income" is sustainable by the generally accepted Hicksian definition. Any consumption that is based on the depletion of natural capital should not be counted as income. Prevailing models of economic analysis tend to treat consumption of natural capital as income, and therefore tend to promote patterns of economic activity that are unsustainable. Consumption of natural capital is liquidation, the opposite of capital accumulation.

Natural capital is distinguished from other forms of capital, namely human capital or social capital (people, their capacity levels, institutions, cultural cohesion, education, information, knowledge),<sup>6</sup> and man-made capital (houses, roads, factories, ships). From the mercantilists until very recently capital referred to the form of capital in the shortest supply, namely man-made capital. Investments were made in the

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<sup>6</sup> Human capital formation, by convention is left out of the national accounts for various reasons one of which is that, if it is truly productive, it will eventually be reflected, through enhanced productivity, in a higher GDP. Realization of the values of education and administration, for example, are lagged, and are conventionally assumed to be equal to their costs. The loss of natural capital, if not recorded, as largely is the case today, may take some time before it will reflect itself in income and productivity measurements.

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limiting factor, such as sawmills and fishing boats, because their natural capital complements - forests and fish - were abundant. That idyllic era has ended.

Now that the environment is so heavily used, the limiting factor for much economic development has become natural capital as much as man-made capital. In some cases, like marine fishing, it has become the limiting factor. Fish have become limiting, rather than fishing boats. Timber is limited by remaining forests, not by saw mills; petroleum is limited by geological deposits and atmospheric capacity to absorb CO<sub>2</sub>, not by refining capacity. As natural forests and fish populations become limiting we begin to invest in plantation forests and fish ponds. This introduces a hybrid category that combines natural and human-made capital - a category one may call "cultivated natural capital".<sup>7</sup> This category is vital to human well-being, accounting for most of the food we eat, and a good deal of the wood and fibers we use. The fact that humanity has the capacity to "cultivate" natural capital dramatically expands the capacity of natural capital to deliver services, but does not avoid entirely the limiting role of such capital.

In an era in which natural capital was considered infinite relative to the scale of human use, it was reasonable not to deduct natural capital consumption from gross receipts in calculating income. That era is now past. The goal of environmental sustainability is thus the conservative effort to maintain the traditional meaning and measure of income in an era in which natural capital is no longer a free good, but is more and more the limiting factor in development. The difficulties in applying the concept arise mainly from operational problems of measurement and valuation of natural capital, as emphasized elsewhere in this report, and by Ahmad et al. (1989), and El Serafy (1991).

Sustainability has several levels - weak, sensible, strong and absurdly strong - depending on how strictly one elects to hew to the concept of maintenance or non-declining capital. One recognizes that there are at least four kinds of capital: Man-made (the one usually considered in financial and economic accounts), natural capital (as defined previously, and leaving for the moment the case of cultivated natural

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<sup>7</sup> The subcategory of marketed natural capital, intermediate between human capital and natural capital, is "cultivated natural capital" such as agriculture products, pond-bred fish, cattle herds, and plantation forests.

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capital), human (investments in education, health and nutrition of individuals), and social (the institutional and cultural basis for a society to function).

- (a) Weak sustainability is maintaining total capital intact without regard to the composition of that capital between the different kinds of capital (natural, man-made, social or human). This would imply that the different kinds of capital are perfect substitutes, at least within the boundaries of current levels of economic activity and resource endowment.
- (b) Sensible sustainability would require that in addition to maintaining the total level of capital intact, some concern should be given to the composition of that capital between natural, human-made, human and social). Thus oil may be depleted as long as the receipts are invested in other capital (e.g.: human capital development) elsewhere, but that, in addition, efforts should be made to define critical levels of each type of capital, beyond which concerns about substitutability could arise and these should be monitored to ensure that the patterns of development do not promote a total decimation of one kind of capital no matter what is being accumulated in the other forms of capital. This assumes that while human-made and natural capital are substitutable over a sometimes significant but limited margin, they are complementary beyond that limited margin. The full functioning of the system requires at least a mix of the different kinds of capital. Since one does not know exactly where the boundaries of these critical limits for each type of capital lie, it behooves the sensible person to err on the side of caution in depleting resources (especially natural capital) at too fast a rate.
- (c) Strong sustainability requires maintaining different kinds of capital intact separately. Thus for natural capital, receipts from depleting oil should be invested in ensuring that energy will be available to future generations at least as plentifully as enjoyed by the beneficiaries of today's oil consumption. This assumes that natural and man-made capital are not really substitutes but complements in most production functions. A saw-mill (human-made capital) is worthless without the complementary natural capital of a forest. The same logic would argue that if there are to be reductions in one kind of educational investments they should be offset by other kinds of education, not by investments in roads.

- (d) Absurdly strong sustainability would never deplete anything. Non-renewable resources - absurdly - could not be used at all; for renewables, only net annual growth rates could be harvested, in the form of the overmature portions of the stock.

This schematic presentation highlights the general direction to be taken for this immediate discussion, which can usefully be limited for the time being to the perceived tradeoffs between human-made capital and natural capital, fully recognizing that the issues are more complex than will be exposed here.

The implications of implementing environmental sustainability are immense. One must learn how to manage the renewable resources for the long term; one has to reduce waste and pollution; one must learn how to use energy and materials with scrupulous efficiency; one must learn how to use solar energy in all its forms; and one must invest in repairing the damage, as much as possible, done to the earth in the past few decades by unthinking industrialization in many parts of the globe.

Environmental sustainability needs enabling conditions which are not integral parts of environmental sustainability: not only economic and social sustainability but democracy, human resources development, empowerment of women, genuine decentralization, and much more investment in human capital than common today (i.e. increased literacy, especially ecoliteracy, Orr, 1992).

The sooner one starts to approach environmental sustainability the easier it will become. For example, the demographic transition took a century in Europe, but only a decade in Taiwan: technology and education make big differences. But the longer one delays, the worse the eventual quality of life (e.g., fewer choices, fewer species, more risk), especially for the poor who do not have the means to insulate themselves from the negative effects of environmental degradation.

Many writers have expressed concern that the world is hurtling away from environmental sustainability at present, although consensus has not yet been reached. But what is not contestable is that the current modes of production prevailing in most parts of the global economy are causing the exhaustion and dispersion of a one-time inheritance of natural capital, such as topsoil, groundwater, tropical forests, fisheries, and biodiversity.

It is obvious that if pollution and environmental degradation were to grow at the same rate as economic activity, or even population growth, the damage to ecological and human health would be appalling, and the growth itself would be undermined and even self-defeating. However, a transition to sustainability is possible, although it will require changes in policies and the way humans value things. The key to the improvement of the well-being of millions of people lies in the increase of the added value of output after properly netting out all the environmental costs and benefits and after differentiating between the stock and flow aspects of the use of natural resources. Without this needed adjustment in thinking and measurement, the pursuit of economic growth that does not account for natural capital and counts depletion of natural capital as an income stream will not lead to a sustainable development path. The global ecosystem, which is the source of all the resources needed for the economic subsystem, is finite and has now reached a stage where its regenerative and assimilative capacities have become very strained (see the case of some regions in Ethiopia). It looks inevitable that the next century will witness a doubling of the number of people in the human economy, depleting sources and filling sinks with their increasing wastes. If we emphasize the latter, it is because human experience seems to indicate that we have tended to overestimate the environment's capacity to cope with our wastes, even more than we overestimates the "limitless" bounty of such resources as the fish in the sea.

A single measure - population times per capita consumption of natural capital - encapsulates an essential dimension of the relationship between economic activity and environmental sustainability. This scale of the growing human economic subsystem is judged, whether large or small, relative to the finite global ecosystem on which it so totally depends, and of which it is a part. The global ecosystem is the source of all material inputs feeding the economic subsystem, and is the sink for all its wastes. Population times per capita consumption of natural capital is the total flow - throughput - of resources from the global ecosystem to the economic subsystem, then back to the global ecosystem as waste. In the long gone "empty world" case, the scale of the human economic subsystem is small, relative to the large, but non-growing global ecosystem. In the "full world" case, the scale of the human economic subsystem is large and still growing, relative to the finite global ecosystem. In the full world case, the economic subsystem has already started to interfere with global ecosystematic processes, such as altering the composition of the atmosphere, or the now nearly global damage to the ozone shield.

## 2. Sustainability and Population Factor

Carrying capacity as we have said elsewhere is a measure of the amount of renewable resources in the environment in units of the number of organisms these resources can support. It is thus a function of the area and the organism: a given area could support more lizards than birds with the same body mass. Carrying capacity is difficult to estimate for humans because of major differences in affluence, behaviour, and technology. An undesirable "factory-farm" approach could support a large human population at the lowest standards of living: certainly the maximum number of people is not the optimum. The higher the throughput of matter and energy, or the higher the consumption of environmental sources and sinks, the fewer the number of people that can enjoy it.

Ehrlich and Holdren (1974) encapsulate the basic elements of this concept in a simple and forceful, though static, presentation: The impact (I) of any population or nation upon environmental sources and sinks is a product of its population (P), its level of affluence (A), and the damage done by the particular technologies (T) that support that affluence.<sup>8</sup>

There are a number of ways of reducing environmental impacts of human activities upon the environment. These include changing the structure of production and demand (i.e. more high-value, low-throughput production and service industries) and investing in environmental protection (e.g. for the amenity value, if for nothing else). But for the simplicity, we will first proceed with the static analysis of the Ehrlich and Holdren formulation before we move to adding a more dynamic understanding of sustainability issues. As a start, we will look at reducing environmental impacts of human activities upon the environment through the three variables in the equation, namely: limiting population growth; limiting affluence; and improving technology, thereby reducing throughput intensity of production. There is much to be done to limit the impact of human activities upon the environment,

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<sup>8</sup>  $[I = P \times A \times T]$  or  
 $[I = P \times Y/P \times I/Y]$

Population (P) refers to human numbers.

Affluence (Y/P) is output (Y) per capita.

Technology (I/Y) refers to environmental impact per unit of output, i.e. a dollar's worth of solar heating stresses the environment less than a dollar's worth of heat from a lignite-fired thermal power plant.

although so far many of the measures have proven politically unpopular and difficult to achieve. The changes in variables - population, affluence, technology - through which the impact can be limited, are each examined in more detail below.

Population control and stability are fundamental to environmental sustainability. Today's 5.5 billion people are increasing by nearly 100 million a year. Just the basic maintenance of 100 million extra people per year needs an irreducible minimum of throughput in the form of clothing, housing, food, and fuel. There is so much momentum in population growth that even under the United Nations most optimistic scenario, the world's population may level off at 11.6 billion in 2150! Since under current inequitable patterns of production, consumption and distribution, we have not provided adequately for one-fifth of humanity at today's relatively low population, the prospects for being either able or willing to provide better for double that number of people look grim indeed, unless major changes in attitudes and practices were to happen. We do not want to cast a political problem (willingness to share) as a biophysical problem (encountering limits to total product). We urge much greater sharing. However, we do not want to make the opposite error of suggesting that more equitable sharing will permit us completely to avoid the issue of biophysical limits to total production in the face of mounting population pressure. Responsible stewardship of the earth requires that we redouble efforts to slow down population growth, especially in the poorest and most vulnerable countries in Africa, where population is currently growing fastest and people are suffering most.

The Production-Population relation is one which must be monitored carefully if we want to maintain and increase sustainably the level of "Human Individual Well Being (HIWB)". In fact, in the equation:

$$\frac{\text{Production (Pro)}}{\text{Population (Pop)}} = \text{HIWB}$$

- (a) Population (Pop): if not controlled, can be increased indefinitely.
- (b) Production (Prod): is limited by available quantity of natural resources as it totally depends on the finite global ecosystem and safe and sustainable technology.

Consequently, while we strive to increase production (the numerator) sustainably, without sacrificing future generations, we should endeavour to control Population (the denominator) if we want HIWB to increase or to remain at least constant in a sustainable manner.

The human population is totally dependent on energy from the sun, fixed by green plants, for all food, practically all fiber (cotton, wool, paper), most building materials (wood), and most of the cooking and heating fuels in many developing countries (fuelwood). The human economic subsystem now appropriates 40 per cent of all that energy, according to Vitousek et al. Yet the sun provides enough energy to cover 6,500 times the total commercial energy consumption of the world. Instead of harnessing this massive source of clean and renewable energy, the bulk of energy research funds are still going to nuclear energy. This speaks poorly of the priorities of energy research worldwide and is a measure of how far we still have to go to get the concept of sustainability thoroughly incorporated into the priorities of those allocating the energy research money.

Whether the issue will be joined over the energy fixed by photosynthesis or not, there are reasons to be concerned. Several factors are all working in the same direction to reduce irreversibly the energy available globally through plants. Greenhouse warming, damage to the ozone shield, and unstable climates seem inescapable and may have started. Depending on the models used, these will reduce agricultural, forest, fisheries, rangeland and other yields. The increases in ultra violet b light reaching the earth through the damaged ozone shield may decrease the carbon-fixing rates of marine plankton, one of the biggest current carbon sinks. In addition, ultra violet b light may damage young or germinating crops. According to some reports, tiny temperature elevations have already begun to increase the decomposition rates of the vast global deposits of peats, soil organic matter, and muskeg, thus releasing stored carbon. Only in mid-1992 did the circumboreal muskeg and tundra become net global carbon sources (instead of being net C-sinks). Some claim that at least an immediate 50 per cent reduction in global fossil fuel use is necessary to stabilize atmospheric composition. Whether one accepts this estimate or not, it dramatizes the gravity of the situation. There really is no ground for complacency.

Overconsumption by the OECD countries contributes more to some forms of global unsustainability than does population growth in low income countries. If



energy consumption is used as a crude surrogate for environmental impact on the earth's life support systems, (crude since the type of energy used is not taken into account), then "A baby born in the United States represents twice the impact on the Earth as one born in Sweden, three times one born in Italy, 13 times one born in Brazil, 35 times one in India, 140 times one born in Bangladesh or Kenya, and 280 times one born in Chad, Rwanda, Haiti or Nepal". Although Switzerland, Japan and Scandinavia, for example, have recently made great progress in reducing the energy intensity of production, the key question is: can humans lower their per-capita impact (mainly in OECD countries) at a rate sufficiently high to counterbalance their explosive increases in population (mainly in low income countries)? The affluent are reluctant to acknowledge the concept of sufficiency - to begin emphasizing quality and non-material satisfactions. Redistribution from rich to poor on any significant scale is, at present, felt to be politically impossible. But the questions of increasing equity in sharing the earth's resources and its bounty must be forcefully put on the table.

### **3. Sustainability and Technological Factor**

Increased affluence, especially of the poor, thus need not inevitably hurt the environment. Indeed, used wisely, economic growth can provide the resources needed to protect and enhance the environment in the poorest developing countries where environmental damage is caused as much by the lack of resources as it is by rapid industrialization. Indeed if Africa is to have any hope of protecting its forests and soils, accelerated economic and human development is imperative. African farmers destroy their environment just for sheer survival for like of options and opportunities to earn a decent living and an employment.

Thus, there is a nexus of problems linking poverty, environmental degradation, and rapid population growth. Breaking this nexus of problems is essential if the poor are not to continue to be the victims, as well as the unwitting cause, of environmental degradation.

Technology continues to play a vital role in driving a wedge between economic activity and environmental damage. Illustrations of this occur in virtually every field of human activity. In energy, for example, the introduction of mechanical and electrical devices in power generation over the past four decades has reduced

particulate emissions per unit of energy generated by up to 99 per cent and newer technologies, such as flue gas desulphurisation and fluidized bed combustion are dramatically reducing emissions of sulphur and nitrogen oxides. But it will be the transition to non-fossil based sources that will make the permanent difference. Here, the technological progress has been remarkable - with costs of solar generation of electricity (where Africa has tremendous potential) falling by 95 per cent in the past two decades - but not yet enough. Renewable energy continues to receive much too small a share of public research funds.

Technological innovation and application has also done much to make agriculture more sustainable. New technologies have enabled a doubling of food production in the world in just 25 years, with more than 90 per cent of this growth deriving from yield increases and less than 10 per cent from area expansion. More recently, the dissemination of Integrated Pest Management approaches has enabled pesticide application to be cut dramatically with no less of productivity. Biotechnology is in the verge of adding substantially to this improvement.

Despite such remarkable progress, it may be a mistake to place too much optimism in technological change. New technology is often adopted in order to improve labour productivity, which in turn can raise material standards of living, but without adequate attention to the environmental impacts of the manner in which the improvements are reached. The impact of a particular technology depends on the nature of the technology, the size of the population deploying it, and the population's level of affluence. The World Bank, along with others, is increasing investments in more sustainable technologies, such as on wind and solar energy, which have limited or benign impacts on the relations of humanity to the ecosystem that supports us all.

#### **4. Sustainability and Affluence Factor**

But the level of affluence currently enjoyed by the citizens of the OECD countries, for example, cannot be generalized to the rest of the world's current population, much less the massively larger population of the developing countries (especially in Africa) 40 years from now, no matter what the improvements in technology are likely to be.

Experts in development are well aware that bringing the low income countries up to the affluence levels in OECD countries, in 40 or even 100 years, is an unrealistic goal. One may well accuse us of attacking a straw man - who ever claimed that global equality at current OECD levels was possible? We acknowledge the force of that objection, but would suggest that most politicians and most citizens have not yet accepted the unrealistic nature of this goal. Most people would accept that it is desirable for low income countries to be as rich as the North - and then leap to the false conclusion that it must therefore be possible! They are encouraged in this non sequitur by the realization that if greater equality cannot be attained by growth alone, then sharing and population control will be necessary. Politicians find it easier to revert to wishful thinking than to face those two issues. Once we wake up to reality, however, there is no further reason for dwelling on the impossible, and every reason to focus on what is possible. One can make a persuasive case that achieving per capita income levels in low income countries of \$1,500 to \$2,000 (rather than \$21,000) is quite possible. Moreover, that level of income may provide 80 per cent of the basic welfare provided by a \$20,000 income - as measured by life expectancy, nutrition, education, and other measures of social welfare. But to accomplish the possible, we must stop idolizing the impossible.

The foregoing discussion of Population, Technology and Affluence is based on the static formulation of the Ehrlich and Holdren identity, presented some 20 years ago. More recent work brings nuance and shading to this generalization. Particularly important are the inter-relationships among the three factors, and their links with shifts in the structure of the economy.

Three questions need to be asked as we seek to monitor progress towards sustainability:

- (i) First, given the political unreality of a voluntary decline in the overall affluence of industrial countries, how is the "pattern" of this affluence shifting? Specifically, is the economic structure of the economy shifting away from environmentally damaging activities (e.g. heavy and toxic industries) and towards less "natural capital-depleting" sectors (e.g. services). Recent research shows that structural shifts can have powerful impacts on natural resources consumption.

- (ii) Second, what is the trend in the consumption of natural resources per unit of output? Two mechanisms need to be monitored here: improvements in economic efficiency (inputs per unit of output), and the degree of substitution away from environmentally critical inputs. Policy instruments, including taxes and user charges, can help promote such transitions, especially when the environment costs are not captured in the marketplace.
- (iii) Third, to what extent is the pollution impact per unit of economic activity declining? Here it is important to distinguish between the innovation of new technologies, and their dissemination and application. Many of the most profound forms of environmental damage in today's world (soil erosion, lack of clean water, deforestation, municipal waste, etc.) do not require new technologies, but simply the application of existing ones. This in turn requires (a) that decision-makers are persuaded that the benefits of using such technologies exceed the costs, and (b) that resources are available for putting them in place. Public policies can be targeted towards meeting both conditions.

Interactions among the driving factors - scale, structure, efficiency, technology and investment in environmental protection - together with the key feedback loops between economic activity and human behaviour - such as the powerful impact of income on fertility - explain why in some situations, economic growth and technological progress will cause increased environmental damage and sometimes less. The now-famous "humps" in the relationship between certain forms of pollution and income illustrate this point. For effective policy making, it is essential that these various paths be disentangled so that policies may be targeted in a manner that induces changed behaviour away from environmentally damaging inequitable growth and towards accelerated sustainable poverty reduction.

## **5. Sustainability and Economic Measurement**

A major obstacle to promoting policies that foster sustainability to date has been the incomplete measurement of income and investment, particularly the failure to reflect the use or deterioration of natural capital. To correct this failure, the World Bank is promoting improvements in Systems National Income Accounts (SNA). Environmentally adjusted SNA has massive policy implications for most developing

countries<sup>9</sup>. Without environmentally adjusted SNA for example, the Bank now postulates, that we cannot judge if an economy is genuinely growing or merely living unsustainably on asset liquidation beyond its true income; whether the balance of payments is in surplus or deficit on current account, or whether the exchange rate needs to be changed.

The sustainable economic development credo is not that appeals to all - or perhaps even most - NGOs. One of the key architects of the Brundtland Commission formulation of sustainability, Secretary General Jim MacNeill, has said that: "The maxim for sustainable economic development is not 'limits to growth'; it is the 'growth of limits'"<sup>10</sup>. This definition, based on stretching environmental limits to accommodate expanding human needs, will certainly not appeal to those who argue for a "steady-state economy", let alone to supporters of the "deep ecology" worldview<sup>11</sup>. But the mainstream sustainable economic development community recognises that we are faced with some fairly inexorable population trends. Faced with this challenge, the argument runs, the imaginative use of emerging technologies can help relax "natural" limits by boosting our resource efficiency - helping us do more with less. In the end, however, limits will be definite, and the steady state unavoidable.

Although the liable and legalistic part of the *international business community* is embarking on the Sustainability trend, at the very same time, critics of industry can point to exactly opposite movements. Critics of the North American Free Trade Agreement (NAFTA) note that hundreds of US companies have been joining the rush to capitalise on Mexico's cheap labour and lax environmental laws by locating along the 1,250-mile border between Mexico and the United States. More than 2,000 such companies, or "maquilas", now represent Mexico's second largest source of foreign

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<sup>9</sup> Economics Nobel Laureate Robert Solow has recently retreated from his 1973 position that natural capital is unimportant: "The world can, in effect, get along well without natural resources" (Solow 1974, p.11). In 1992, he concluded that the US GDP may change only 1-2 per cent if environmentally adjusted (Solow 1992). Perhaps this seems a small concession, but during the discussion period of his 1992 RFF lecture he recognized that developing countries rely to a vastly greater extent on natural capital than does the US.

<sup>10</sup> "Meeting the Growth Imperative for the 21st Century", Jim MacNeill, pp 191-205 in *Sustaining Earth: Response to the Environmental Threats*, edited by David J.R. Angell et al., Macmillan, London, 1990.

<sup>11</sup> See "Deep Ecology", pp 242-247 in *The Green Reader*, edited by Andrew Dobson, Andre Deutsch, London, 1991.

exchange after oil and are helping to create environmental legacies which will haunt Mexico for decades to come.

But the concept of sustainable economic development is rarely now seen as evidence of an imperialist or neo-colonialist conspiracy. Growing number of newly industrialised and developing countries recognise that this has to be the way forward - the real issue is how fast to move and who pays. It will be well worth watching countries like India over the next decade: the Confederation of Indian Industry (CII) is working hard to disseminate the thinking of organisations like the Business Council for Sustainable Development to Indian companies<sup>12</sup>.

More fundamentally still, the sustainability implication which few - if any - companies have yet considered relates to the issue of "need". Markets grow by inventing new needs, new wants, new desires. At some point, the sustainable economic development vector will intersect with this aspect of the market economy, with the result that business will increasingly find that it is no longer enough simply to consider the environmental performance of a product from cradle to grave - but, even more fundamentally, we will have to ask whether the likely impacts are balanced by the meeting of real needs.

Ultimately, sustainable development has to be sold to the *citizens* of every country in Africa, whether they are acting as industry's neighbours, as employees, voters, parents, or consumers. Despite public opinion polls showing surprisingly high levels of environmental awareness, concern and action in a wide range of countries<sup>13</sup>, the public's support cannot be taken for granted. These are the people who will ultimately have to pay and to sacrifice other possible rewards to ensure that future generations inherit a world worth living in. We need to see more advertising and media campaigns which carry aspects of the sustainability message through to the general public in their everyday lives - standing waiting for buses or trains.

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<sup>12</sup> *Changing Course: Towards Sustainable Development - An Indian Industry Perspective*, Confederation of Indian Industry / United Nations Development Programme / Business Council for Sustainable Development, New Delhi, India, 1992.

<sup>13</sup> *The Health of the Planet Survey: A Preliminary Report on Attitudes to the Environment and Economic Growth Measured by Surveys of Citizens in 22 Nations*, Riley E. Dunlap, George H. Gallup and Alec M. Gallup, The George H. Gallup International Institute, Princeton, New Jersey, USA, May 1992.

The critical role of ordinary citizens is recognised in the European Commission's Fifth Environmental Action Programme - and the European Union may well be worth watching as it struggles with the task of communicating sustainability to an increasingly diverse range of nationalities. This, in microcosm, will represent a useful model of the challenge facing the world as a whole.

Sustainable economic development principles are beginning to be adopted - or at least experimented with - by some international government agencies, by some national governments and by some corporations and business organisations. Unfortunately, however, the early involvement of the business community (and particularly of the marketing profession) has spurred the process whereby the words "sustainable" and "sustainability" - like "green" or "environment-friendly" before them - are strapped onto other words. So one sees phrases like "sustainable use" (of natural resources), "sustainable society" (or economy), "design for sustainability", "sustainable manufacturing", "sustainable mobility", "sustainable tourism", "sustainable futures" and even "sustainable growth". This process seems to simply give a green light for further consumption, further production, further growth, which is a falsification. But, from another perspective, this can be seen as an important first stage in the selling of the idea of sustainability to the citizens - and to voters; who will need to understand why real sacrifices may be needed to ensure a genuinely sustainable future.

If there is one thing more long-standing proponents of sustainable economic development would agree upon it is this: to arrive at a sustainable state, our industrialised societies will have to re-invent themselves, just as agricultural societies reinvented themselves during the Industrial Revolution. As a result, Meadows et al. have spoken in terms of the "Sustainability Revolution"<sup>14</sup>. But sustainable economic development will only move from the realm of talk to the world of action if it is seen to offer real-world solutions to recognised problems.

Anyone searching for a visionary account of what all of this could mean in terms of everyday realities for governments, corporations and citizens, should read: "The

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<sup>14</sup> *Beyond the Limits: Confronting Global Collapse, Envisioning a Sustainable Future*, Donella Meadows et al., Earthscan, 1992.

Ecology of Commerce”<sup>15</sup>. In talking of the need to make the transition to a “restorative economy”, Hawken, the author sketches the extraordinary scale of the challenge now facing us. Reassuringly, he also shows that the transition is still likely to be manageable and could well turn out to be one of the most exciting historical stages which our species has yet gone through. At long last we seem to be approaching the point where the list of possible solutions is beginning to catch up with the still growing list of problems.

## 6. Sustainable Development and Developing Countries

Four and a half billion people or 85 per cent of world’s total population, occupying 72 per cent of the land area of the globe, belong in the category of low and middle income countries of the South with a per capita income ranging from US\$ 80.- (Mozambique) to US\$7,820.- (Saudi Arabia) in 1991<sup>16</sup>. If these countries in their endeavour to raise income per capita are following the same path as the industrialized countries, its impact will be catastrophic to the global environment. It is therefore necessary for the South to follow a different path of development: one that makes possible the eradication of poverty and at the same time does not degrade the environment. This calls for an elaborated pattern of sustainable economic development that meets the interests of the South.

Sustainable economic development as pursued by the South must foremost focus its efforts on meeting the developmental challenges which are the causes of environmental degradation. In this connection the first objective of sustainable development must be to eradicate poverty. Poverty, as defined by the World Development Report 1990 refers to the inability to attain a minimal standard of living<sup>17</sup>. This inability is caused by factors internal to the poor such as no skill, low education, no shelter, poor health and low capacity to respond to income-earning opportunities. On the other hand it is also caused by factors external to the poor such

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<sup>15</sup> *The Ecology of Commerce: A Declaration of Sustainability*, Paul Hawken, Harper Collins, New York, 1993.

<sup>16</sup> The International Bank for Reconstruction and Development (1993), *World Development Report 1993, Investing in Health*, Oxford University Press, page 238-239.

<sup>17</sup> The International Bank for Reconstruction and Development (1990), *World Development Report 1990, Poverty*, Oxford University Press, page 2.



as no access to land tenure, minerals or other natural resources, no access to credits or other financial resources, no access to markets, no access to technology and no access to productive infrastructure like irrigated water, electricity, transportation, etc.

To overcome this inability, development should be geared to ensure the poor the provision of basic needs such as nutritious food, clothes, shelter, basic education, health facilities and clean water. All this requires a development policy that is focused on engaging the poor in productive employment.

Productive employment can be created by diversifying the primary sector based economy into a secondary and tertiary sector based economy. The experiences of the six economies of Indonesia, Japan, Korea, Malaysia, Thailand, Taiwan and China have shown that average annual growth rate of agricultural income has drastically increased during 1965-1988, although the agriculture's share of output and employment has declined sharply during the same period. The various factors that contributed to the success of agriculture in these economies are land reform, agricultural extension services, genuine decentralization, popular participation, reasonably good infrastructure and heavy investments in rural areas<sup>18</sup>. High productivity in agriculture strengthened the competitive position of these economies, and allowed them to raise their market share in the commodity market in spite of declining commodity prices. The share of agriculture in gross domestic output did not decline not because of reduced output, but because of the increased share of other non-agricultural output. It is important to note that it is possible to move from an unbalanced primary sector based economy towards a self-reliant growth economy with diversification and higher value added.

## **7. Accounting for natural resources and environmental degradation**

Natural resources have been considered priceless, they were and are being sacrificed, and not conserved, as the example of transport shows. Since the oil crisis, the price of oil has not followed the price index, on the contrary. Had it done so, then a barrel of oil would not cost some 170 US dollars. Other resources and commodities

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<sup>18</sup> The International Bank for Reconstruction and Development (1993), *The East Asia Miracle*, Oxford University Press, page 32.

have been dropping in price continuously since 1973 as well, making the resources delivering Third World ever poorer (the total debt now being 1650 billion US dollars), and sacrificing this world to an ever increasing exploitation.

According to UN Secretariat data, the US dollar combined price index of non-fuel primary commodities exported by developing countries has fallen from 171 in 1980 to 100 in the index's base year 1985 to 114 in 1992. In the same three reference years, the price index of manufactures exported by developed market economies had moved from 116 to 100 and then risen to 164. As a result of these movements (the fall in commodity prices and the rise in prices of manufactures), the terms of trade of commodities vis-à-vis manufactures (or the real prices of commodities) had declined very substantially from 147 in 1980 to 100 in 1985 to 80 in 1990 and further to 71 in 1992.

These figures are so alarming that it would be difficult to exaggerate the sharpness of the decline and the seriousness of the losses for the South. Between 1980 and 1992, non-fuel commodity prices had fallen on average by 52 per cent. In other words, on average, whilst in 1980, 100 units of a Southern country commodity export could buy 100 units of manufactured product imported from the North, the same 100 units of commodity export could only pay for 48 units of the same imported manufactured product in 1992. There is thus a loss of real income amounting to 52 units of imports for every 100 units of exports, so a great loss of real economic resources for the South.

The UNCED's Agenda 21 agrees to slow down resource depletion and to do so by global economic instruments coupled with lower consumption in the rich North. However, the Western economy is becoming ever more wasteful. The amount of energy and environmental volume per unit food in the North is doubling every nine years, a dangerous development no-one seems to care about. The protagonists of the free market should explain what kind of sustainable income is to be derived from a trade which brings Uganda coffee to Côte d'Ivoire and Ivorian coffee to Uganda, or what the benefit is of transporting dairy milk from Europe to African countries specialized in livestock, from Côte d'Ivoire to Mali, from Sudan to Ethiopia, why Cameroon alumina should be transformed into aluminium in Guinea - the price of all this being unemployed citizens, thousands of deserted villages in the less "endowed"

part of African countries, dying forests, drought, desertification, inundations, destroyed infrastructure, cracking buildings, and in the end, climate change.

The causes of this non-system are the idea that exports are, by definition, good, the conviction that the GDP economy is a goal in itself, the fact that transport is too cheap, because energy is priced too low, and that the destroyed goods, including the environment, have no price at all, and - in the end - that political decisions stretching over more than a few years are rare because of the "carpediem" behaviour of politicians.

What has emerged from this, as the driving force, is a new trend, which can be called "profitonomics", instead of "economics": money flowing to the margins of the globe, where the quick buck is.

In order to understand the paradoxes of growth and trade, and to correct the GDP for environmental losses and related decline, economists Herman Daly and John Cobb developed the Index of Sustainable Economic Welfare (ISEW, 1989), now favourably called the Genuine Progress Indicator (GPI). They followed earlier efforts of among others Nordhaus and Tobin (1972) who researched the relationship between added (production) value and the creation of wealth and welfare. In the ISEW, this creation is central to the economy. The indicators of Daly and Cobb are household labour, government spending such as education, services from household and government capital, loss of leisure time, costs of underemployment, costs of commuting, costs of car accidents, costs of air, water and noise pollution, loss of wetlands, farmland and forest, depletion of non-renewable resources, long term environmental damage, cost of ozone depletion, net capital investment, net foreign lending or borrowing. They are being weighted against their potential contribution to income generation or loss of income. Consumption, employment, disposable income, leisure, all add to welfare obviously, but involuntary leisure does not, and neither does an increase in unequal income distribution or a decrease in environmental quality or health. Totalling the various indicators and their behaviour, an ISEW on an economy's achievement can be made up. In spite of the methodological weaknesses inherently belonging to such science development, the Index is giving illuminating and shocking new insights and could be adapted to the case of any African country or subregion.

First ISEWs have been made for the US, the UK, Germany, Denmark, the Netherlands and Austria. They all point at a similar pattern: indeed, production growth has created a parallel increase in wealth and welfare between 1950 and 1975, but thereafter, the relationship lines begin either to level off or to decline. In some cases this divergence is a function of growing differences in income distribution, coupled with rising unemployment and environmental deterioration. In other cases, the phenomenon is due to other emphasis, such as drawbacks in education, social care, coupled with unemployment and environmental collapse. The overall conclusion is dramatic: since the mid-seventies, in these countries, *things are getting worse*. The old economic model is no longer working. We have perhaps assumed it, but the statistics of growth, such as the GDP, did not tell us the right story. The Delors Whitebook in its Chapter 10 is therefore asking the right question.

National income measurements straddle the disciplines of economics and accounting. In the current critical phase of reviewing the methods used for national income accounting, experts are bringing to the discussion the perspectives of their differing specializations, and there is much confusion in what is being written about the subject. In time, such confusion is bound to recede in the light of debate and informed discussion. It is worth stressing, however, that accountants and economists normally have different perspectives, with economists tending to be forward looking, and inclined to view resources as a medium for optimization of decisions. They concern themselves with such aspects as pricing, market forms, as well as with ideal rates of resource depletion. Accountants, on the other hand, hardly ever look forward. They are in effect economic historians, seeking to describe, in accounting language, what had taken place in a period that has already ended. Keeping capital intact has remained a pillar of accounting methods since the profession was born. Capital and its depreciation are not easily measured, and have presented the accountants with problems of estimation no less formidable than those that have confronted the economists. This is because the life of capital, by definition, extends well beyond one accounting period, and the accountant is forced to look forward to ascertain how long a piece of capital will last. More so than the economist who, with the help of assumptions, is able to build airtight compartments within which relevant analyses can be conducted, the accountant has to produce rough and ready answers that must serve the practical purpose of guarding against capital consumption. Capital, after all, is needed for the sustainability of future income, and where there is doubt, the accountant would rather err on the side of caution, under-estimating

income rather than exaggerating it. In doing this, the accountant plays an invaluable role as a guardian of sustainability.

Politicians, advisors, and ecologically conscious scientists that work for an environment-oriented change in economic policy need a measure of economic production/growth that is deflated by natural resources and environmental costs (degradation) induced by production/growth.

This task is politically (and scientifically, too) so important that we have to accept imperfect solutions. We have to teach the public that the currently prevailing production, income and growth concepts and calculations are only seemingly objective, seemingly valid and seemingly "modern". They profit from the fact that the produced goods and services are valued with market prices which seems to be self-evident. But the market prices of today are determined really without the external environmental costs of production and consumption and are therefore increasingly distant from the economic-ecological "truth".

The assumptions behind the calculation of an economic production/growth figure are "conventions". Their character as conventions will be more evident in the future because a calculation of an environmentally adjusted national product figure lacks the self-evidence of the current accounting systems based on market prices. But this change corresponds with the increase of complexity in the economic discourse in the era of environmental scarcity. The collective/public value of economic (private/micro-economic/firm) activities depends from the environmental requirements and environmental effects of that activities. The societal uncertainties implied with this new phenomenon cannot be overcome by monetarizing the environmental losses by a seemingly correct valuation method.

An environmentally adjusted national income (net national product) means that it will be adjusted by environmental costs of production and income spending which are not being counted for till now. The criterion for calculating annual net national income "Keep Capital Intact" has to be enlarged by an additional capital dimension "scarce environmental potentials/assets". This enlarged cost accounting of the annual production/income returns is an important step to a timely welfare interpretation of the current environmentally deteriorating production/consumption style. But its

construction is not intended as *the* comprehensive economic welfare measure in the tradition of the "Net National Welfare" - line of thought.

The *revision of the System of National Accounts* (SNA, United Nations, 1994) afforded a unique opportunity to examine how the various concepts, definitions, classifications and tabulations of environmental and natural resource accounting can be linked to the SNA. Such linkage was originally proposed in a framework for a SNA satellite system of integrated environmental and economic accounting. Considering the knowledge currently available on environmental accounting and the divergent views on a number of conceptual and practical issues, it was not possible to reach an international consensus at that time for a fundamental change in the SNA. Nevertheless, there was agreement that the SNA should address the issue of its links to *environmental concerns*. Therefore, the 1993 SNA devotes a separate section (Chapter XXI, section D) to integrated environmental-economic satellite accounts and introduces refinements into the cost, capital and valuation concepts of the central framework that deal with natural assets. This will also facilitate using the SNA at a point of departure in the development of environmental accounts.

The satellite approach to environmental accounting expands the analytical capacity of national accounts without overburdening the central framework of the SNA. The Statistical Commission, as indicated in its report on its twenty-sixth session (United Nations, 1991), endorsed the *satellite approach* and requested that the concepts and methods of integrated economic and environmental accounting be developed by means of satellite accounts. This approach was confirmed by the United Nations Conference on Environment and Development (UNCED), which recommended in Agenda 21 that systems of integrated environmental accounting, to be established in all member States at the earliest date, should be seen as a complement to, rather than a substitute for, traditional national accounting practices for the foreseeable future (United Nations, 1992, resolution 1, annex II, para. 8.42).

As a conceptual basis for implementing an SNA (satellite) System for integrated Environmental and Economic Accounting (SEEA), a *handbook* of national accounting was published by the United Nations (United Nations, 1993). The Handbook states that:

*"It is not the aim of this handbook to present just another approach to environmental accounting; rather, it reflects as far as possible the different concepts and methodologies that have been discussed and applied in the past few years. The main task of the handbook is to effect a synthesis of the approaches of the different schools of thought in the fields of natural resource and environmental accounting. A thorough analysis of those approaches indicates that they are often complementary rather than mutually exclusive. This is true not only with regard to physical and monetary accounting but also with respect to valuing the economic use of the natural environment. Different analytical aims imply different valuating methods. The absence of a general approach seems to be due more to missing linkages among the different approaches than to the existence of contradictory concepts. The handbook therefore does not intend to replace existing data systems like the natural resource accounts for the System of National Accounts (SNA), but rather to incorporate their elements as far as possible in order to establish a comprehensive data system."*

There has already been a long and partly hot debate on how national accounting should be extended towards environmental accounting.

Recently, the UN Handbook on Integrated Economic and Environmental Accounting has been published, which provides guidelines for a general framework for environmental accounting for national statistical offices.

In recent years, many national statistical offices have also gained experience with environmental accounting, mainly regarding the systematic recording and linking of physical data on the stocks and flows of natural resources and emissions to air, water and soil to monetary data of economic activity on a sectoral and national level as recorded in the System of National Accounts. Environmental accounting in physical units provides important information on the use of natural resources and the pressure on and the state of the environment.

However, physical environmental accounting as such does not enable policy makers to make a trade off between economic and environmental gains and losses and obviously does not solve the fundamental flaws in the calculation of GDP. The UN Handbook on Integrated Economic and Environmental Accounting acknowledges

this. As a consequence, it states that physical data are needed to describe the state of the environment and to provide a solid basis for any attempt to value the changes of natural assets in monetary units. The central question is: How to value the observed and recorded changes?

A lot of work has been done in order to develop methodologies to value natural resources and the environment in monetary terms. Most academic textbooks on environmental economics contain a description of well-known valuation methodologies like the Contingent Valuation Method, hedonic pricing and the travel-cost method.

These valuation methods provide insights which can be used for environmental decision making, but mainly in rather specific situations. Case studies are carried out to estimate the recreational value of lakes, forests or the property value of houses, building and land. The described methods are object-, project- or micro-oriented. Another important feature is the focus on the revealed preferences of people. This can be an advantage in the sense that it is a more or less democratic approach. The direct involvement of people can also be a disadvantage for reasons like the ones mentioned earlier (limited knowledge and the introduction of bias).

From the above it is easy to understand that these valuation methodologies can hardly be applied in the context of the environmental adjustment of GDP and the system of National Accounts (SNA), which is sectoral and macro-oriented. The estimation of value changes in the quality and quantity of natural assets requires another, meso- and macro-oriented type of valuation methodology.

Different ways of valuing the natural resources and environmental degradation costs of economic activities have been suggested. There are *two approaches* which differ fundamentally:

1. Should the analysis focus on the state of the environment and its effects on the population in a specific country and a specific time-period irrespective of the question which economic activities have caused environmental deterioration and when.

In this case, the imputed environmental *costs borne* by enterprises, the government and households are estimated and deducted from the net value added



of the economic units *affected* by environmental deterioration. Only the deterioration of the *domestic* natural environment is taken into account.

2. Should the analysis focus on the immediate environmental impacts of the economic activities of a specific country in a specific time-period irrespective of the question at what time and in which country those impacts will cause environmental deterioration.

In this second case, the imputed environmental *costs caused* by economic activities are deducted from the net value added of the economic units *responsible*. The impacts on nature *abroad* are also recorded as far as they are caused by domestic economic activities. Thus, valuation refers only to domestic *welfare* in the first case, whereas, in the second case, the leading valuation principle is oriented towards *responsibility* for all countries.

The concept of environmental costs caused is based on the principle of *responsibility* for the long-term development of our continent. This attitude recognizes the same rights for all African living beings irrespective of whether they live in their countries or abroad, and is based on the ethical postulate that we should act in a way that does not adversely affect other African living beings now and in the future. This principle represents a *strong sustainability concept*: Our economic activities should be limited to those which will not entail a decrease in the natural capital. This concept allows the substitution of a type of natural capital for another but no replacing of natural by man-made capital.

It seems to be more and more difficult to *link* the two types of environmental costs. Only if economic activities cause environmental deterioration in the same country as well as in the same time-period are such linkages possible at all. It is typical of most of the environmental impacts of economic activities that they cause long-term and international problems. The traditional *cost-benefit analysis* which refers to such linkages is nowadays increasingly restricted to specific regional environmental problems (e.g. noise, changes of land use). In the SEEA, no attempt is made to link the approaches of environmental costs borne and environmental costs caused. The optimistic attempt to compare benefits and costs of economic activities in a specific country and specific time-period seems to have been abandoned after

observing the long-term and global problems of environmental deterioration caused by economic activities.

It seems to be very important that the environmental impacts of *international trade* are also taken into account in calculating the eco domestic products of the importing and exporting countries. It is said that the importing country has to bear responsibility for the environmental deterioration caused by the production of the imported goods in the delivering (exporting) country. A rich country could "export" its environmental problems by importing all goods whose production causes environmental problems. In a similar way, a rich country could export its dangerous wastes in order to store them in poorer countries.

One could also state with confidence that, for the North-South poverty gap, a related conclusion can be drawn. The concept of development by following the Northern model is probably a wrong one. It may well be true that most of the developing countries do not develop, but follow a path of decline altogether. Presently, the Southern debt of 1650 billion US dollars cannot be reimbursed, only there is an effort to pay interest over interest rates, generally by the export of low priced commodities and natural resources. Even the Asian Tigers, the so-called successful economies of Indonesia, Malaysia, Singapore, Thailand and Taiwan, South Korea, Hong Kong, would probably score badly in an Index of Sustainable Economic Welfare (ISEW) effort. World trade with footloose industries, absent social contracts and failing international treaties is a cruel game. One has to put hope on the recent Uruguay Round Agreement and the newly established World Trade Organization (WTO).

As already stated, the concept of environmental costs caused by economic activities is based on the principle of strong sustainability. Our economic activities should be limited to those which will not entail a decrease in the natural capital. The suitable valuation concept for such an attitude is the avoidance (prevention) cost approach. We measure the decrease in the level of economic activities by the additional cost necessary for achieving sustainable development and interpret this decrease as the value of the natural environment which reduces the net domestic product.

The strategies to avoid negative environmental impacts of economic activities differ with regard to the *types of economic use of the natural environment*:

- (i) In the case of *depleting non-renewable* natural resources (like subsoil assets), the quantitative decrease in these resources could be diminished by developing more efficient ways of using raw materials. Nevertheless, a decrease in these assets will normally be unavoidable. In this case, replacement by other types of natural capital would be necessary to achieve at least a constant level of natural capital as a whole (Daly 1991). The substitution costs could be used as estimates of the environmental costs.
- (ii) In the case of depleting *renewable cyclical* natural assets, natural growth (biota) or natural inflow (groundwater) should be balanced against the quantities depleted. If depletion exceeds natural increase, the necessary reduction in net value added of the depleting industries can be used as an estimate of environmental costs.
- (iii) In the case of *land use*, sustainability implies a constant qualitative and quantitative level of landscapes and their eco systems, including their biodiversity. If an increase in economic activities results in a decrease in this level, the necessary reduction in economic activities and in their net value added involved will have to be calculated.
- (iv) With regard to *discharging residuals* into nature, numerous possible prevention activities have to be analyzed which comprise the replacement of products (by increasingly more environmentally friendly goods and services), technological changes to produce technologies with low pollution, and a reduction in economic performance, especially lowering the consumption level of the population. To reach specific standards, the strategy based on minimal costs should be chosen, and these prevention costs represent the deterioration of non-produced natural assets caused by pollution etc.

It should be stressed that the necessary prevention costs are only calculated for the impacts of *domestic* economic activities of the *reporting period*. Thus, prevention costs comprise the costs of activities which prevent at least further negative impacts of present activities (in the own country or abroad). It could happen that the

environmental quality would decrease even if no additional negative effects of present activities were added. In this case, the negative development of the natural environment in the reporting period was already recorded in the past by calculating prevention costs for the economic activities of previous periods.

The calculation of avoidance (prevention) costs is only possible on the basis of *modelling*. In the process of thinking about alternative and more sustainable ways of economic performance, the comparison between the actual and the desirable development can only be a hypothetical one. The necessary modelling work can be more micro- or more macro-oriented.

In the first case, each economic activity is studied with regard to its environmental impacts. In a second step, alternatives are developed which avoid possible negative environmental effects of the actual activities. The difference between the net value added of the two types of activities is treated as (imputed) environmental costs. By adding the differences of all economic activities studied we obtain the total of environmental costs which is subtracted from the net domestic product. The main problem of this approach consists in the dependencies between the economic activities and their impacts on the natural environment which allow only a restricted additivity of the environmental costs calculated at the micro-level.

An alternative way of calculating avoidance costs is to introduce limits (standards) of environmental effects of economic activities first and to calculate in a macro-economic model a sustainable level of economic activities (especially of final consumption of products). The difference between the actual net domestic product and the hypothetical net domestic product could be interpreted as the necessary environmental costs. In this case, the eco domestic product would be the net domestic product of the hypothetical economy without negative impacts on the natural environment.

A crucial point of all estimates of avoidance (prevention) costs is the determination of the level of economic activities whose effects on the natural environment could be assimilated by the nature without long-term negative impacts. This determination is especially difficult because we have to take into account effects which could be both long-term and widespread. If knowledge about these effects is limited a risk-averse attitude should be applied. Furthermore, setting *sustainability*

*standards* also means solving distribution problems. If, for example, global limits for producing carbon dioxide have been set, it will have to be decided which proportion of the globally allowed pollution of carbon dioxide is accepted for the individual countries. Theoretically, the principle that pollution per head should be equal worldwide, seems to be acceptable. If especially developing countries accept a lower level of pollution they should receive a compensation from the (normally richer) countries whose pollution per head exceeds the average.

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- (iv) With regard to *discharging residuals* into nature, numerous possible prevention activities have to be analyzed which comprise the replacement of products (by increasingly more environmentally friendly goods and services), technological changes to produce technologies with low pollution, and a reduction in economic performance, especially lowering the consumption level of the population. To

reach specific standards, the strategy based on minimal costs should be chosen, and these prevention costs represent the deterioration of non-produced natural assets caused by pollution, etc.

Modelling connected with the avoidance cost approach implies a variety of assumptions which do not fit into the traditional national accounting system. It exceeds the traditional scope of work of statistical offices. This fact should not be interpreted as a disadvantage of this method. Urgent environmental problems necessitate a close cooperation between statisticians and model builders. Improved knowledge in environmental analyses can only be achieved if specialization is given up and interfaces of different disciplines are defined.

The different types of economic use of the environment can be specified in terms of environmental problems. Based on these specific environmental problems a so-called elimination cost curve can be constructed. All these aspects are only summarized here to show the importance of accounting for natural resources and environmental degradation in building National Accounting.

## SUCSESSES AND FAILURES

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Over the last forty years various conservation programmes and projects have been initiated in a number of different African countries. The results of these have been mixed, ranging from near failure to partial success. Whether successful or not, these experiences have all contributed to our knowledge to the point where we can now identify at least some of the factors which have led to the successes or failures.

*The first and general conclusion that can be drawn from a review of conservation programmes in Africa is that there is no single factor which can be singled out as the key to successful and failed conservation programmes.* Success can generally be attributed to a combination of factors which have led farmers to adopt, and continue to use, conservation practices. Furthermore, whether farmers do accept conservation practices appears to depend at least as much on socio-economic factors as on the physical effectiveness of the practices advocated. The opposite to these factors have contributed to the failures in conservation programmes.

Secondly, many conservation schemes have appeared to be very successful while a particular project has been in progress but farmers have not maintained conservation structures or continued to use conservation practices once the project had finished. Very quickly conditions have reverted to their original state. These and other experiences have pointed to the need to consider the following points when conservation programmes are planned:

- (i) farmers and other land users need to be involved right from the start of schemes. This involvement must be a genuine one which includes full explanations of what is possible, consultations and the obtaining of agreements - not the perfunctory contacts which are often described as farmer participation. Care must be taken that conservation schemes are not just imposed on farmers as there is ample evidence that schemes which have been imposed have met with very limited success.
- (ii) farmers will only adopt, and then continue to practise conservation methods only if they are directly involved, if they are responding to genuine needs assessment and if they can see some direct benefit to themselves and their families in the

short term. These benefits are usually in the form of increased or more assured yields, higher incomes or the reduced need of an input such as labour. Appeals to land users to adopt conservation programmes for such reasons as the national interest, the protection of downstream dams or the need to save soil for future generations, seldom have lasting effects.

- (iii) the adoption of conservation practices sometimes appears to happen almost by chance. Frequently this is because the farmer may perceive a particular practice not just as a way of conserving soil but of achieving some other objective such as increasing yields or reducing labour requirements. Farmers in the Kitui area of Kenya are now terracing their fields at their own expense. The terraces very effectively prevent soil erosion, but it has been shown that in this area they also lead to yield increases in the order of forty to ninety per cent, and it is probably for this reason that they are being installed. Planners of conservation schemes therefore need to look not only at methods which will prevent or cure degradation, but also at practices which will lead to increased productivity.
- (iv) land tenure systems have an important bearing on which conservation practices land users will accept. Farmers can see little point in carrying out conservation work on land to which they have no assured long-term use. It is not coincidental that many farmers in the Machako district of Kenya have been building terraces on their fields in recent years, at the same time as they are being granted legal titles to the land. On the other hand, it is quite understandable that farmers may show little interest in leaving protective crop residues on their fields when they know that anyone can bring animals to graze on them once the grain has been harvested. Similarly, it is very difficult to persuade farmers to construct and then maintain conservation works on communal land.
- (v) conservation practices and techniques must be practical and appropriate for the local conditions. Most of the conservation practices used in Africa have been developed in to other continents with vastly different ecological and socio-economic conditions. In most cases the practices and techniques require modification and adaption before they can be applied to local conditions. The conservation practices advocated should be within the technical capabilities of field staff and farmers to apply. Thus, systems which require complex engineering designs and layouts are not practical in circumstances where large



areas must be treated, field staff are few and their training limited. This problem has been faced in Ethiopia where the solution being tried is the wide-scale implementation of a limited number of relatively simple practices which are within the reach of extension workers and farmers. While this approach does have its problems, it has allowed large areas to be covered quickly.

- (vi) implementing conservation can be expensive in time and labour and in most countries it has been found that a combination of incentives, subsidies and disincentives are required to induce land users to take up soil conservation. In recent years, the use of food aid schemes has proved very successful in encouraging farmers to install physical erosion control structures in a number of countries including Ethiopia and Lesotho. However, the use of incentives and subsidies of this nature must be very carefully thought out, planned and implemented since farmers can very easily become dependent on subsidies or expect payment for carrying out conservation work.

*Fortunately, recent conservation projects show that in most instances land degradation can be prevented or remedied.* The reversal of soil erosion in Ethiopia and in Kenya, wind erosion in Somalia and sheet erosion in Burkina Faso and Mali are notable cases. Problems of overgrazing and range degradation have been successfully tackled in parts of Malawi and Senegal, with cattle in the former country being integrated into the farming system. Finally, the serious problem of forest and woodland degradation, although widespread, is being tackled. A promising start has been made in Lesotho and Senegal. In Zambia the example of industrial forestry development provides a solution to the problem of urban fuelwood supply.

*Experience in Africa and elsewhere has shown that conservation can only be achieved if governments are committed to seeing through long-term programmes.* Short-term project approaches to the conservation of land resources have inevitably proved ineffective. *It has only been long-term programmes, supported by the necessary legislation, staff, finance and facilities, participation of beneficiaries, that have attained worthwhile achievements.*

*People, mainly farmers, herders woodcutters and fishermen, make the changes in the face of the land. Regardless of how soundly plans and techniques are rooted in an understanding of the land resource, the people make the required actions on the*

*ground. The key to successful implementation is people participation and commitment and cooperation among all participants in development.* The more farmers, governments and donors work with each other toward one goal, the greater the hope of progress in improved resource use. Farmers and graziers are the most important part of this trio because they are in direct contact with the land and are the very people who must actually use and conserve the croplands, forests and rangelands. Any land use strategy must be farmer, grazer and forester oriented, that is from the "bottom up", not a "top down" approach.

*Measures, however well conceived and diligently implemented by authorities, will not succeed if they are not understood and supported by the local community.* Ideally, the local community should be so convinced of their necessity that the initiative for their introduction comes from them. Campaigns to develop farmers' or graziers' commitment to sound land husbandry should be a priority. The objective must be to work with and through the local community, and it is vital to establish a collaborative approach from the start. Such collaborative approaches require a sound knowledge of the local farming or grazing systems on which to base the activities. If this entails further investigation, the reasons for the failure of earlier schemes should be included in the enquiry. If nothing is learned from past mistakes, they will inevitably be repeated.

Successful land husbandry dictates that conservation is an integral part of all measures to improve the efficiency of land utilization. *In the short run, conservation practices may require relatively large initial investments of time and money. A farmer needs an incentive to undertake the additional work involved in conservation; if he cannot see an immediate benefit he is unlikely to commit money or labour.* In Kenya farmers have been encouraged to build terraces by the prospect of being able to grow cash crops such as coffee and pyrethrum. Currently Burkina Faso farmers are adopting tied ridges because they have seen that this action results in millet yield increases. In Ethiopia the great surge of conservation is directly related to the Food for Work Programme. Frequently the benefit from conservation will be seen by the farmer as being too small to be worth the extra work. *The fact that conservation will benefit future generations, and thus the country itself, is not really an incentive in the short term. In these circumstances, the long-term interests of the country require that soil conservation should be financially supported by the government and people's participation.*

# **HARVESTING WATER AND ENVIRONMENTAL SUSTAINABILITY: THE LONG TERM AND LASTING SOLUTION TO LAND DEGRADATION - THE CASE OF TIGRAY**

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## **1. THE OPTION**

Considerable parts of Africa have the potential to be highly productive and yields can be substantially raised from present levels with correct land use and good management especially of Africa's water resources. However the opposite is also true: inappropriate land use, poor management and the lack of inputs can quickly lead to decline of productivity and land degradation, a situation which prevails in many parts of Africa.

The various systems of land tenure currently in operation are frequently a major disincentive to the adoption of sound land husbandry. Communal and allocated lands are frequently abused because neither farmers nor graziers feel any responsibility for their conservation. To the farmer there is little to be gained from constructing conservation ditches if they are to be trampled by another's cattle when farms are open to communal grazing after harvest. In some rangeland areas it often pays the herder to over-use the forage; if he does not, someone else will and he will be the loser. Conservation work becomes practically impossible where holdings are fragmented. For these reasons, campaigns to survey, consolidate and register land are required to establish individual, (including women) collective or corporate ownership. Some 4,200 billion m<sup>3</sup> of fresh water flows out of Africa into the ocean every year; 10 % of it would increase Africa's food production by 10 %!

*Public participation in conservation-based land husbandry requires access to information, physical resources, and financial and social services. Information needs may be met through extension programmes and various forms of communication media, e.g. newspapers, radio and signboards.* Physical resources, other than land, that must be available include fertilizer, improved seed, tree cuttings and improved implements. The land user needs access to financial resources such as credit, grants, long-term loans and marketing assistance. Environmentally sound improvements in land husbandry require the support of social agencies that are too often confined to

the cities. The key to many of these is access, i.e. an improved transportation system: roads, bridges, public transport. Good transportation facilities also make an array of communication, marketing and employment opportunities available and plans for improved use should consider inclusion of such measures.

*Whilst considering the opportunities presented by the potential of the land resource base and the problem of land degradation in Africa, it must continually be borne in mind that issues of sustainable production and productivity especially in Low Income Food Deficit Countries (LIFDC), are closely linked to both economic and environmental factors.* Without greater investment in infrastructure, proper incentives to farmers, adequate supplies of production inputs, effective marketing and credit facilities, land reserves will be left unutilized and production from land at present cultivated, will remain below its potential. Using the land beyond its inherent suitability and at low levels of inputs will lead to further abuse and degradation.

Education is perhaps the main component of long-term solutions to the many land husbandry problems in Africa. Whether it is protecting crops from pests, cultivating crops for soil improvement, constructing water control structures, or the multitude of other land-related practices, the extension worker is undoubtedly a key participant. His or her preparation and support must receive high priority in any land improvement and development strategy. Successful extension techniques need to be identified and disseminated; follow-up and evaluation of extension activities will provide a guide for improvement. Basic education of people is an important corner stone in improved resource use. *Teaching a land ethic and the national objectives of a convenient for land husbandry, particularly conservation, begin early in public education.* Technical and vocational training help build understanding and acceptance of environmentally sound land use practices. Education's greatest contribution to improve land husbandry is probably achieved through its attack on illiteracy. The village school teachers may well play a key role in solving Africa's land use problems.

Education must be something more than equipping a person with technical information. Knowledge is merely esoteric if it cannot contribute to turning potential resources into real wealth for the benefit of people.

Training and education must be aimed not only at technicians, but also at farmers and administrators. Past experience has shown that well educated African technicians

backed by foreign experts have contributed little to conservation. Though Africa will still need to formally train technicians in environment related disciplines, the key element for success is going to be working with farmers. Since the farmer manages the land, he will ask specific, environmental questions and the expert or technician will try to answer them. Knowledge that has not incorporated local information and wisdom cannot possibly provide appropriate answers for such questions.

*In Africa, research services have given little or no support to conservation activities.* This may be due to the fact that conservation requires a multidisciplinary approach. It needs inputs from many different disciplines such as ecology, soil science, hydrology, soil and water engineering, agronomy, forestry, range science, farming systems, economics and sociology. Some work has been done on the nature of erosion problems. The problem, however, is that soil conservation is usually treated differently from water conservation. They should be handled together as soil and water conservation. In effect, they should be related to farming systems in a systems' research approach. The application of knowledge to soil and water conservation will lead to research on conservation farming. The components of such a research programme are land degradation studies, conservation methods research, soil fertility/productivity research with emphasis on the effect of soil degradation on productivity, soil survey and land evaluation, economics of soil degradation, and socio-economic analysis of costs and benefits and the integration of the cost of natural resources degradation into National Accounting.

Basic to this challenge is the fundamental need to recognize that Africa has an extremely wide range of land values and conditions. As described previously, lands range from deserts with stony, shallow soils and meagre life-sustaining capabilities to humid forest lands with old, deeply weathered soils which recycle great quantities of biomass. Through years of misuse and over exploitation, some lands are severely degraded. Though these degraded lands have understandably received much attention, it must be realized that in considerable areas of the continent, the lands are still in good condition and that opportunities for producing food and cash crops, forage and trees are great. *This complex pattern of resources and land conditions is the framework for African development, but one fact is overwhelmingly clear, namely that the lands of Africa can no longer meet demand unaided. Overexploitation and misuse must stop and the optimization of land husbandry must be actively pursued.* To this end, it is recommended that national authorities draw up the suggested land balance

sheets, comparing demands with land potentials and quantifying the inputs necessary to meet the demands on a sound and degradation-free basis.

*There are no easy solutions and no panaceas to the "land degradation" problem. Each country will have to develop its own package of land and water husbandry measures, with due emphasis on the central importance of land conservation, the capacity building in human, institution and infrastructure fields, equity, people's participation and accountability. Without attention to these factors, no plan or technical solution stands much chance of success.* The necessity of "knowing what one is dealing with" is perhaps the most important conclusion policy makers could draw from this analysis of Africa's land degradation issue.

For more than thirty five years, UNECA has provided support to Africa Regional Economic and Social Cooperation and Integration within which food and agriculture development is of paramount importance. However, methods of formulating and implementing this assistance must now be re-assessed to ensure that: they reflect the comparative advantage of the Secretariat; global, multinational, regional and subregional, and macro-economic analysis continue to be priorities within the changing environment; approaches are coordinated and sustainable at all levels of the chain of the development process; optimal and sustainable use of the limited resources available is made; and, the partnerships and strategic alliances to be created within the system are indeed established and supported by policies translated into sustainable action with accountability including the integration of natural resources and environmental degradation in the National Accounting process.

UNECA and FAO's mandates respectively include among others, the support to Government's efforts to reduce hunger and poverty through improving agricultural productivity, especially in LIFDC.

Also, presently UNECA support to member countries in food and agriculture is financed from three main sources, the limited resources from the regular budget, the UN system (mainly UNDP) and bilateral trust funds including UNTFAD. The changing financial times require that these traditional sources be re-examined within the context of current thinking and the necessity to satisfy African countries', especially LIFDC's emerging needs.

Assisting governments to eliminate the hunger and poverty affecting the millions of people in developing countries, is one of the major concern of FAO and UNECA. Governments, particularly those of the LIFDC, cannot overcome these problems on their own. Some lack of resources and expertise, and most feel the need for cooperation in addressing these critical issues. FAO uses four main avenues to assist governments in tackling these issues: a) Undertaking programmes of technical advice and assistance for the agricultural community on behalf of governments and development funding agencies; b) Collection, analysis and dissemination of information; c) Provision of advice to governments on policy and planning; d) creation of a forum for governments to meet and to discuss food and agricultural problems and for finding lasting solutions.

With the present changing international economic and social environment, assistance to member countries must respond more sensitively to emerging new needs of countries. New actors are becoming involved in the partnership for development, necessitating re-assessment of traditional roles. Consequently, the challenge facing African countries, donors, NGOs, and the UN System at large, is to create room for innovative actions to be developed and implemented, to turn around the food and agriculture sector's performance and to build the national human, institutional and infrastructural capacities to that effect, especially in Low Income and Food Deficit African Countries (LIFDC). The ultimate aim being to improve the national economies, ensure equitable distribution of the benefits accrued and, to improve the quality of life of the rural populations.

## **2. THE NEW APPROACH**

One of the major consequences of natural and man-made disasters in Africa has been the massive increase of refugees and displaced persons. Although the status of refugees is well defined by the UN and UNHCR, the Department of Humanitarian Affairs and UNICEF which are rendering the required assistance, there are no comparable structures for assisting the continuously growing number of displaced persons. There is therefore an urgent need for additional legal and humanitarian safeguards to be put in place to assist and protect internally displaced populations. Such safeguards should be part of long term and sustainable solutions, especially in the objective of ensuring food security and a sustainable poverty alleviation.

Furthermore, post conflict rehabilitation, reconstruction and economic and social development also pose immense and daunting challenges, as impoverished refugees and displaced people return home to rebuild their lives with few - if any - resources. Nevertheless, where the destruction of the countries wealth is very often not caused by foreign "injunctions" or natural calamities, the bulk of reconstruction, social and economic development must remain the responsibility of nationals themselves and the international community can play only a catalytic role.

However, merely coping with emergency situations is not enough. Only a genuine development policy can, in the final analysis, make Africa a partner in the international scheme of things. Immediate assistance for long-term reconstruction, also requires security and political stability.

*The Rehabilitation, Reconstruction, Development and Cooperation and integration at the sub-regional and regional context, are unavoidable stages, and form a logical sequel to humanitarian assistance to member countries, leading to the three continuum strategy: (1) continuum from rehabilitation to reconstruction and development or from short to medium to long term; (2) continuum from national to subregional and regional level or regional cooperation and integration; (3) continuum from national to regional, provincial and communities level or genuine decentralization.* It was from this medium- and long-term perspective and in conformity with its mandate that the Economic Commission for Africa decided to advocate the adoption of the continuum approach based on a close linkage between rehabilitation,



reconstruction and development; and between the short, the medium and the long term.

Within the framework of its "Agenda on Emergency, Humanitarian, Rehabilitation and Reconstruction Affairs", and more specifically in consonance with its objective in Poverty Alleviation through Sustainable Development, UNECA, at the request of the Transitional Government of Ethiopia (TGE) has launched a major undertaking called "Sustainable Agriculture and Environmental, Rehabilitation in Tigray (SAERT), which is only the first of 8 Programmes being elaborated in cooperation with UNDP and FAO within the framework of what is known as "Sustainable Agriculture and Environmental Rehabilitation, Reconstruction and Development (SAERRD) for Ethiopia".

The UNECA has therefore articulated, at a conceptual level, the need to organize the various processes involved in post-conflict situations, all contained within a continuum processes of moving from conflict to rehabilitation, reconstruction and development, and from national to subregional and regional within the Abuja Treaty establishing the Panafrican Economic Community.

Within the Greater Horn of Africa, Ethiopia is a country where UNECA has concretely and seriously addressed, at a programme level, issues of rehabilitation, reconstruction and sustainable development, within the framework of a genuine decentralization and popular participation. In very close consultations with the highest authorities of Ethiopia and in cooperation with UNDP and FAO, a programme called, "Sustainable Agriculture and Environmental Rehabilitation, Reconstruction and Development Programme (SAERP)" has been developed to address not only the issue of food security in Ethiopia but the whole area of sustainable development in agriculture and natural resources. In view of the fact that this is a programme where we have concrete field experience, it is important to state the objectives of this programme. This important programme is being executed on a region-by-region basis with the regional governments in Ethiopia at the forefront of this exercise. It is important to note that UNECA has now completed the design processes of SAERP in one of Ethiopia's food deficit regions, Tigray. It may be recalled that Tigray, as part of Ethiopia's northern highlands has witnessed, within a matter of only two decades, major disasters in famines, as a result of which several hundred thousand people have perished or fled their region. The objectives of SAERP are described hereunder:

The first objective is capacity building. The conception of SAERP presupposes the use of local expertise in designing the SAER Programme. Accordingly, with the assistance of UNECA Secretariat, the design process was successfully conducted by Ethiopian professionals. In order to achieve this objective, the Commission organized intensive training programmes as well as consultation workshops to ensure grassroots planning and to carry this planning process at minimum cost. Such process not only contributed to strengthening local capacity in design processes, but also succeeded in ensuring that practically all of the design components are undertaken by local institutions and expertise.

The second objective, very much in line with the first one, relates to using participatory methods in addressing issues of design elements. The SAER Programme in Tigray was designed with the active participation of the beneficiaries of the Region. Like all the forthcoming SAER Programmes in Ethiopia, the Programme in Tigray has evolved into a farmer-managed programme involving decision-making processes by beneficiaries. The design process has also resulted in the creation of major institutions at all levels of the regional government, which institutions operate directly under the organization, management and supervision of beneficiaries. These institutions have built-in mechanisms for grassroots planning and monitoring and evaluation, all operating under the direct guidance of the beneficiaries.

The third objective of SAERP is to increase production as quickly as possible using extensive water harvesting systems for irrigation. The design process for the Tigray region anticipates the building of 500 irrigation schemes, principally using micro-dams within a period of ten years. This undertaking, ambitious as it may appear, has been carefully targeted taking into consideration the experiences of the region in irrigation as well as in participatory labour processes. The undertaking of the proposed schemes will involve extensive watershed management as well as adequate preparatory measures in organizing the agronomy components of irrigation schemes to an extent that the region can be self-sufficient in food resources and export food to other Ethiopian regions and to other countries in the Horn of Africa (such as the neighbouring Eritrea) within a matter of ten years.

The fourth objective involves, through measures outlined above, the massive rehabilitation of the environment. The watershed management programme will involve, by the end of the tenth year, a capacity to rehabilitate and reconstruct no less than 200,000 hectares of watershed areas in a single year. The massive accumulation of water in strategic locations will also radically alter the state of the environment. Two major effects are most likely to occur. The first one involves a change in the environment, meaning the water levels of the region will be higher, the fauna of the region will change as it has already occurred in the areas where a few micro dams exist, the land-population optimal factors will also improve since higher levels of yield and output will be achieved on limited plots of land because of irrigation. While these are the positive elements that are already emerging affecting the environment, unless extreme care is taken from the beginning, there can also be negative consequences: a rise in the incidence of malaria and bilharzia and other water-born diseases. Consultations have already been undertaken with WHO and are taking the appropriate measures to ensure that the irrigation schemes are free from health hazards. One of such measures being taken is designing the irrigation canals appropriately so that the water flow in these canals discourages the breeding of malaria, bilharzia and other water-borne diseases.

The SAER Programme is one of the unique programmes that the Commission is organizing to break the cycle of agrarian crisis in Ethiopia. This programme has received the full endorsement of the Government of Ethiopia and is now moving from region to region. The Commission is elaborating a programme similar to that of Tigray for the Amhara Region in Ethiopia which is the second out of eight Programmes to be elaborated for eight Ethiopian Regions as per the Transitional Government of Ethiopia (TGE) request.

The UNECA's new approach in providing sustainable assistance to countries affected by land and environmental degradation and desertification (partially as consequences of droughts, armed conflicts and civil wars) as a major disaster area for intervention is different from those used up to now. In fact the approach used up to present has been based on extensive coverage of services; it is a batching and peacemeal approach. This approach usually addresses short term issues because there will not be enough resources to cover large communities. The present approach as judged by the design processes of the Sustainable Agriculture and Environmental

Rehabilitation, Reconstruction and Development in Ethiopia (SAERRD), are based on targeted intensive operations starting in few drought/crisis areas, make these areas environmentally, economically and socially sustainable in agricultural production and then move further, in a similar fashion, to cover other areas. This may take time but in the end it is the most productive and rewarding approach if serious sustainable system for preventing the menacing effects of droughts on human and animal populations is to be prevented. What is important is to recognize that the battle against the four continuums cannot start in several communities. It has to start in a few communities from where design/implementation processes can be learned and adjusted, covers a region, then extends to other regions of the country and then move the experience in other African countries facing similar problems.

The new approach introduced emphasizes adaptability, government or beneficiaries commitment, capacity building and effective monitoring. The new approach centers on the borrowers and the beneficiaries and not on the requirements of the assistance agencies; it incorporates the development of capacities at national and local levels and participation and listening to the beneficiaries right from the start; it provides explicitly, reduction, proper assessment, and prudent management of risks; it prepares the ground to reduce elapsed time and resources spent before initiating action on the ground with the donors contributions; it facilitates and strengthen coordination at the programme level; it ensures the sustainability (environmentally and through time) of the actions undertaken through a continuous learning process by all participants; it ensures less formalistic and more continuous contact with beneficiaries and the involvement of NGOs.

The traditional programme/project cycle which covers: identification, preparation, appraisal, negotiation, implementation & supervision, and evaluation; is no longer adapted to the participatory approach advocated by UNECA, to the risky, complex, uncertain environment, and very volatile framework within which the development with transformation is taking place today.

Experience thus far in Project/Programme Design Approach which advocates, multidisciplinary, sub-regional and regional dimension, sustainability and participation, is encouraging and one is convinced that things are moving in the right direction! The new approach will definitely achieve a lasting impact on the country's policies, practices, technologies and skills. It would be important and appropriate to also build

on the work of other organizations, and to build strategic alliances with other interested agencies including NGOs and bilateral agencies.

The main focus of the regional programmes is to ensure national ownership of both the problems and solutions to sector development. Therefore, top priority has been accorded to development of national capacities at all levels, especially at the community level, to further elaborate the framework developed; manage programme implementation; as well as to undertake monitoring and evaluation functions. In these specific cases, national execution of proposed interventions therefore appears to be the appropriate modality to reach these goals thus creating a better environment for sustained impact. Under those circumstances, UNDP, UNECA and FAO will be partners providing advisory services, jointly testing approaches and undertaking training activities at all levels in all aspects of sustainable food and agricultural development (policy identification, formulation and development of regulation on sectoral issues, information, collection analysis/dissemination network, planning and implementation capacities, verification and use of indigenous technical knowledge, participation technique and community ownership programmes to enhance sustainability, extension, research, marketing, credit, environment, food security, small-scale irrigation, conservation based food production, on- and off-farm employment, etc. with focus on the community and their perceived needs). The required innovative approaches are likely to vary between Regions.

The new and comprehensive approach introduced by UNECA and FAO is based on integrated water harvesting. The participatory rural development programme design for Tigray is based on a comprehensive water-harvesting cum soil conservation scheme, embodying watershed management measures and the provision of well designed macro-dam integrated systems for storing and ultimate utilization of the seasonal surface run-off water for irrigation, human and livestock use. The case of Tigray described in the next section present the archetype framework to be adapted for each country taking into account its specificities.

### 3. SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL REHABILITATION IN TIGRAY REGION

#### (a) Background

##### *Resume*

*Level of subsistence production declined radically.*

*High density per arable land has resulted in steady decline in soil and labour productivities.*

*A choice of two scenarios: continue on the road of serious ecological decline or meet the timely opportunity of creating a strong, stable and self-reliant Tigray.*

*The volume of annual run-off is estimated at 9 billion cubic metres. 50% of this volume can irrigate 450,000 hectares of land or 44% of total cultivated area of Tigray.*

*Government requests ECA to design a comprehensive rural development programme.*

*Government's proposal for integrated design includes 500 micro-dams and allied technology, services and infrastructures.*

*FAO-ECA responds positively to Government's request to design programme of SAERT.*

*SAERT has been designed through joint financing of FAO, ECA, UNDP and Regional Government of Tigray.*

*SAERT fulfils fully 5 of the 6 conditionalities for donor funding.*

*Design process undertaken with overwhelming input of 27 Eihioptian professionals. A 13-volume study produced.*

*SAERT exhibits process attributes of projects and programmes. It is a project because it is area specific; programme because it is comprehensive.*

*SAERT ultimately integrates agriculture, natural resources and the environment.*

Tigray's agriculture is based on ox-plough cultivation of predominantly cereal crops. This technology has prevailed without modification for thousands of years, harvesting the same land over and over again. The level of subsistence, except for periods of good rains, has declined radically during the past decades, with almost everything produced being consumed at the farm household level. Quite apart from the erratic nature of rain water on which Tigray's agricultural production depends almost entirely, Tigray's agrarian system has, within it superimposed, a fast accelerating population growth, resulting in high density per arable land, causing, over time, the steady decline in soil and labour productivities. With such deterioration has come about the deterioration of the terms of trade of agriculture affecting all areas of economic management. The Tigray's characteristics is general for all countries in the Horn of Africa and appropriately reflect the prevailing situation in the Sahel as well as in other African countries suffering from drought desertification land and

environmental degradation, sometimes compounded by armed ethnic, tribal and civil conflicts.

More than at any time of its history, Tigray finds itself in the threshold of two possible scenarios: for lack of timely response the region may either continue on the present direction of emerging serious environmental and ecological dangers of unheard proportions, or given the present favourable political stability and democratization process unknown to its peoples in modern times, it may decide to harness the enormous opportunities now widely open and, within a reasonable period of time, create a socio-economic base that is strong, stable and self-reliant. The possible achievement of this opportunity is based especially on realistic assessment of the region's potential in agrarian and water resources, considering the fact that the volume of annual run-off that could be obtained from the basins draining Tigray is estimated to be 9 billion cubic metres. Almost all of this estimated volume of water is lost annually. If 50% of this volume of water is harvested, it would have been sufficient to irrigate more than 450,000 hectares of land or roughly 44 per cent of the present total cultivated areas of Tigray. In here lies the unlimited opportunities for transforming Tigray's backward agrarian system and production.

It is in consideration of these potentials, that the Transitional Government of Ethiopia requested the Economic Commission for Africa (UNECA) and the Food and Agriculture Organization of the United Nations (FAO) to design a participatory rural development programme based on a comprehensive water-harvesting cum soil conservation scheme, embodying watershed management measures and the provision of well designed micro-dam integrated systems for the storage and ultimate utilization of the seasonal surface run-off water for irrigation and for human and livestock use. The development packages proposed for study and integration into an Action Plan include the consideration of a well thought out institution building process that would enable Tigray to evolve real and self-reliant development. The supplementary package proposed also include the construction of 500 micro-dams supported by appropriate irrigation infrastructures; a modern soil laboratory; appropriate labour power enhancing technologies, functioning at all levels of development; an efficient development support extension communication system; the evolvement of a capacity to terrace 200,000 hectares of land every year and the provision of several million seedlings of forestry and agronomy, supported by 81 newly established seedling nurseries.

Considering the magnitude and seriousness of the programme, ECA and FAO has formulated a project document whose objective is to design a project proposal incorporating all the programme elements. After the formulation of the project document, ECA and FAO sought the collaboration of the UNDP for funding the design process of a programme called, "Sustainable Agriculture and Environmental Rehabilitation in Tigray (SAERT)". The SAERT project's design process is now being funded jointly by the UNDP, ECA and FAO, with the Regional Government of Tigray sharing project financing in kind. SAERT fully satisfies 5 of the 6 conditions prescribed by the Transitional Government of Ethiopia for donor funding. In a remarkably short period of time, thanks to the enthusiasm of Ethiopian and ECA-FAO professionals who designed the project, a 13-volume study was produced. The fact that the project has been designed by Ethiopian professionals not only demonstrates the dynamism of Ethiopia's trained manpower, but it also demonstrates ECA-FAO's current effort to enhancing national capacity building in the designing implementation, monitoring and evaluation of African economies.

SAERT's unique design incorporates process attributes of projects and programmes. It is a project in a sense that the services are delivered on a phase by phase area specificity. It is a programme because SAERT has comprehensive coverage which touch base with almost all 'weredas' in Tigray. The SAERT project will ultimately integrate into one coherent entity activities relating to agriculture, natural resources and the environment.



## (b) Basic Proposals Emerging from Design Process

### (i) Production Benefits

*Resume*

*Original programme approach revised and a decision made to go through a 3 year preparatory phase.*

*During preparatory period only 60 micro dams to be built.*

*Remaining 440 micro dams to be built in seven years given the accumulation of human and tech. resources during preparatory period.*

*Survey conducted by SAERT confirmed the great importance of supplementary irrigation to household income.*

*12,000 households benefit directly during preparatory programme.*

*In total 500,000 people benefit as owner producer in the whole programme.*

*Supplementary irrigation would enable production of 4.5, 4.2, and 16 tons of wheat, maize and potato per ha. respectively.*

*800,000 tons of potato can be produced from irrigation of 500 micro dams providing calorie requirements to 3 million people<sup>19</sup>.*

*By end of year 10 grain/potato produced can support calorie needs of 4 million people.*

The intensive technical discussions undertaken with beneficiaries' full participation led to one fundamental fact: that the design process could not be undertaken in a manner applicable for know-how rich full scale projects or programmes. The experience in Tigray in extensive micro-dams' construction was not only very limited, but the technical means for doing so, including the readiness of the human resources and technological base, as well as the supporting services were almost absent. Accordingly, the prevailing wisdom was to embark on the challenge, at least initially, with a slow but relevant pace of confidence building, accumulating experience, technical and institutional know-how. It was therefore important to first design a three year preparatory project which will help prepare the region for a more ambitious transformation process in future years. During the preparatory project, only 60 micro-dams will be built, but that during this period, not only the relevant experience will be obtained but that the material and human resources needed for building the remaining 440 micro-dams and their accessories will be constituted, enabling post-preparatory

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<sup>19</sup> Conversion rates: 100 grams of grain = 356 kcal; 100 grams potato = 87 kcal.

implementation phase to be undertaken at a faster rate and with minimum extra cost, *which cost is expected to be borne by the beneficiaries themselves*. The remaining 440 micro-dams will be built in seven years, roughly at 62 micro-dams per year. This means the 500 micro-dams proposed by the Government will be built in ten years using the human/technical base established for the preparatory period. In here lies the uniqueness of the forward planning exercise of SAERT.

In order to establish, scientifically, the benefits of supplementary irrigation to household incomes, a small survey was conducted in two villages just before the design process started. *Both villages had farmers depending totally on rain-fed agriculture and others using supplementary irrigation. The results of survey clearly indicated that farmers depending totally on rain-fed agriculture experienced either total crop failure or had very low yields.* Farmers using supplementary irrigation harvested relatively good crops. In general, average agricultural income differential between the farmers who used supplementary irrigation and those that did not was estimated to be 70% in one of the villages and 220% in the other. This survey established beyond doubt the critical importance of supplementary irrigation to the people of Tigray. This could reflect the reality in many other parts of Africa affected by land and environmental degradation.

During the preparatory three year period, as explained above, a total of 60 micro-dams will be built, each dam with an irrigation capacity of 100 hectares. Assuming an acreage per household of 0.5 hectares, this means, at a minimum, 12,000 families will be direct production beneficiaries of the 60 dams or a total of 60,000 people benefiting, assuming the existence of five persons per household. The remaining 440 micro-dams would entail an irrigation capacity of 44,000 hectares or provide production benefits to 88,000 families or 440,000 people, applying the same assumptions described above. This means, in totality, 500,000 people will be owner producers, whereas the food multiplier effect benefits from such a production base will be much higher as conservatively estimated hereunder.

As also demonstrated by the special survey on supplementary irrigation conducted by SAERT in 1993 and also confirmed by earlier studies (Huntings Technical Team, 1972), supplementary irrigation would enable production of 4.5 tons of wheat or 4.2 tons of maize and an additional 16-18 tons of potato per year from one hectare of irrigated field. Assuming a conservative potential production increase of grains of 4

tons only, and also assuming that the irrigated fields are all under grains (60,000 hectares during the preparatory period), the incremental production would be 24,000 tons. At a much higher supply than currently available of daily calorie supply per capita of 2,100, the incremental production of 24,000 tons would suffice to take care of the food needs of about 120,000 extra people. The proposed 500 micro dams entailing 50,000 hectares of irrigated fields would produce 200,000 tons of staple grains enough to feed an extra 930,000 people who, without the project would surely be depending on food aid. It should be noted here that the incremental production of 200,000 tons is almost twice the amount of food deficit estimated for the Tigray region in the 1992/93 crop year.

The potential production benefits of 50,000 hectares of irrigated fields to the food basket of Tigray would even be significant and one requiring closer policy attention. On the production assumptions explained in above, a total of 800,000 tons of potato would be produced every year, by the end of the tenth year. The aforementioned increment of potato production would satisfy the food energy needs of over 3 million people, by very conservative estimates. The full use of this potential would, of course, require the people of Tigray adjusting their food habits as consumers of non-cereal but vegetable root and fibre products. The total perspective emerging is that the irrigation potential of 500 micro-dams would support the food energy needs of about 4 million people, conservatively stated. Besides these, the project would bring other social and environmental benefits.

## **(ii) Technology/Infrastructure Inputs**

*Resume*  
*18.5 million US\$ required for technology and infrastructure needs.*  
*Technical inputs to be managed on basis of internal cost accounting.*

A careful assessment of the technology/infrastructure needs of SAERT has been made taking into serious consideration the procurement, deployment and maintenance needs and capacities of these inputs as well as the complementarity of these with indigenous inputs, especially with labour.

These inputs include, among several others, the equipment needed for the planning and construction of the proposed dams, the equipping of a soil, plant and water testing laboratory, the establishment and equipping of a technology maintenance/ manufacturing centre, the procurement of motorized transport, office and field equipment, camp facilities, processing equipment for Pear Cactus as well as the construction of SAERT infrastructures and premises at regional, zonal and wereda levels. These technologies will be organized and managed using the principles of internal cost accounting to determine the precise profitable use of individual inputs.

### (iii) Budgetary Provisions

*Resume*  
*From donors 25 million US\$ plus food aid required for SAERT programme.*

The initial budgetary provisions for the implementation of the preparatory phase of SAERT will be obtained from donor agencies and from government budgetary provisions. The structure of the proposed SAERT's budget reflects the need to continue programme activities beyond the preparatory phase with minimum inconvenience. Donor agencies' involvement is limited to the procurement of equipment, advisory services, training, infrastructural facilities as well as very limited food aid.

### (iv) Institutional Arrangements

*Resume*  
*SAERT will be managed by beneficiaries themselves with technical support from trained manpower. Real development through empowerment of beneficiaries is EPRDF's Second Vital Revolution. At regional level SAERT receives Directives from a 20 member Board dominated by beneficiaries. SAERT's Project Management Directorate (PMD) is the executive arm of the Board. PMD has six important divisions and 3 semi-autonomous units. Participation and resource mobilization important criteria in structuring board of directors. Every 2 years beneficiaries at all levels organize congresses to evaluate SAERT.*

The design of SAERT reflects a serious grassroots structure and orientation. Many allegedly participatory rural development programmes have failed for a variety of reasons, two of which deserve mentioning: lack of clarity in design elements and lack of commitment on the part of Governance. These problems have been

considered in designing the institution building processes (see Volume III of the SAERT studies) of SAERT and, unlike other programmes of a similar intent, the SAERT project will be organized, led and managed by the beneficiaries themselves. The task of SAERT's technical and intellectual staff is to support and concretize the new reality of peasant empowerment and decision-making in managing the day to day affairs of SAERT. Given this technical support, there is enough experience attained during the Liberation Struggle which confirm, validate and justify the need to pursue the objective of real empowerment as a historic and necessary task. Such a direction is not only cost effective but is also a vital component of the coming Second Revolution of peoples for self-reliant development. The specific aspects of this direction are explained subsequently.

SAERT is structured from the region all the way to the Kshet Level. At the region level, SAERT receives its policy/technical guidance from a 20 person Board of Directors which meets twice a year. The Board has its own monitoring and evaluation system. The composition of the Board reflects the dominance of representatives of peasant beneficiaries and includes representatives of Peasant Associations (4), Women's Associations (4), Rural Youth Association (4), representatives of labour (1), Chamber of Commerce (1), Government (1), Defence Forces (1), Urban Dwellers' Association (1), Independent Professional (1), representatives of NGOs (2). At region level the Board's directives are implemented by a Project Management Directorate which among other technical units has six major functional divisions; planning and programming, resource mobilization, education and training, monitoring and evaluation, private sector development and development support extension communication. There will be three semi-autonomous units which will provide their services to SAERT at cost and at profit to others. These are: soil laboratory service, a consultancy service, and the service for technology choice and maintenance.

Quite apart from the internal monitoring and evaluation system of project management at all levels, there will also be, every two years, Congresses of beneficiaries at all levels, assessing the performance of their institution - SAERT. This process will ensure the direct participation of beneficiaries in all affairs of SAERT. In this important direction of participatory development, training will play a crucial role.

### (c) Some Highlights on the Technical Components of SAERT

#### *Resume*

*Design of SAERT reflects inter-disciplinary technical integration.  
Treatment of watershed areas requires interdisciplinary integrated approaches.  
Planning process of SAERT operates on a highly decentralized framework.  
780 peasant and technical staff in charge of institution process.  
50% labour/technology mix constitutes planning process in construction.  
Water storage rehabilitates land and increase rate of recharge of underground water.  
Beneficiaries involvement in installation of irrigation infrastructures is vital.  
Radical changes in Tigray's farming systems needed.  
38 million Eth. Birr required for inputs through credit.  
60% of production will be cereals 13, 15, 10% fruits, pulses and vegetables respectively.  
Net annual farm profit estimated at 194 million Eth. Birr.  
Forage production apiculture also part of programme; prickly pear cactus important resource of Tigray; prickly pear cactus has all nutritious values; processing of cactus fruit to be undertaken.  
Strong programmes for women component of SAERT.  
Natural resources' component of SAERT is extensive.  
Extensive revegetation planned as part of watershed management programme.  
Research and training also important components.  
Small food aid programmes also anticipated.  
Social consequence of extensive water harvesting examined and programmes developed.*

The design of SAERT reflects an inter-disciplinary technical integration involving water harvesting, soil conservation, forestry husbandry and hydrology, irrigation agronomy, soil chemistry, fodder production and others supported by specific institutional measures. An understanding of the salient points of the proposed technical measures is in order, hence a cursory review of these salient points.

A detailed proposition has been made regarding institution-building for SAERT. Institutions are difficult terrains of struggle in development work. The treatment of vast watershed areas will involve an interdisciplinary technical approach incorporating forest and agronomic hydrology, soil and water conservation, land use planning etc., ordering these disciplines into consistent logical programming frameworks that take into account, the economic, social and institutional factors. The physical changes involving will require decentralized planning and implementation, facilitated through intensive training programmes of beneficiaries by using institutions of SAERT and intermediate rural organizations. The planning process also needs to be augmented by a parallel process of monitoring and evaluation by beneficiaries. The participatory

technical planning will be organized and managed on a highly decentralized framework, involving decentralized planning, resource control and management. In order to implement the transformation process being spearheaded by SAERT, a total of 780 technical staff and peasant coordinators will be required during the preparatory period. This number does not include personnel required in the other technical disciplines of SAERT.

The microdams so far constructed are flexible earth embankment dam types. These microdams were constructed using the labour of the community. The major limitations of the small dam structures exhibited include overtopping, seepage and inaccessibility. Nearly 75% of the dams constructed prior to 1991 have been overtopped and as a result destroyed. These types of pitfalls will be completely avoided through SAERT. As part of this process of proper planning, two study design teams will be created and established in strategic locations, one at Axum and the other at Mekelle. Each design/study team consists of civil engineer, irrigation engineer, geologist, pedologist, hydrologist, surveyors and socio-economists supported by technical and clerical staff. There will also be construction teams in all the four zones, each team consisting of a construction engineer, construction foreman, surveyors, machine operators, mechanics, truck and vehicle operators and other technical and clerical staff needed.

In the construction operations, all supporting technological and institutional requisites will be readily available. These include the equipment, machinery and material for planning and construction of the micro-dams, a supporting material laboratory which will support the investigation and feasibility studies, the training of all types of staff at all levels, including the training of beneficiaries in construction and maintenance works. In all the construction operations, a 50% mix ratio strategy between labour and machine has been worked out. Prior to the commencement of the construction of a dam, it is compulsory to carry out intensive soil conservation and afforestation activities in the catchment. The beneficiaries will be involved in the planning process from the beginning. On the average, a reservoir dam with a gross storage capacity of 2 million cubic metre would be sufficient to supplement more than 300 hectares of rainfed agriculture and/or 100 hectares of dry season irrigation. This is equivalent to the landholding of two or three villages or 300-400 families. With this much of stored water, prevailing socio-economic problems of the region would be alleviated. There are other positive end results of the water storage process which

could not be expressed in monetary terms. *Degraded lands would be rehabilitated, there will be an increase in the rate of recharge of the ground water resulting from the impoundment of a large body of water on the surface.* Therefore, the yield of springs and wells would increase substantially. *A total of US\$7.8 million and Eth. Birr 3.8 million will be required during the preparatory period.* The technology to be procured and the infrastructure to be established would serve the construction of the proposed 500 microdams.

The proper establishment of **irrigation infrastructures** is one of the fundamental (if not the most fundamental) problems at present in Tigray. This activity will be greatly strengthened through the SAERT programme. Activities to be undertaken during the three year preparatory period include the undertaking of reconnaissance, pre-feasibility and feasibility studies to determine that the size of irrigable land is proportional to the size and capacity of the dam; topographical surveying, pedological and agronomic studies; environmental impact assessment and socio-economic studies will be conducted leading to a detail design, hydrological and irrigation system layout and on-farm structures. In addition to these necessary studies, operation and maintenance guideline will be prepared. In all these activities, the beneficiaries will be involved. These activities prepare the ground for construction of the infrastructures. Training and capacity building also receive important priority.

*During the preparatory phase, a major attempt will be made to introduce radical changes in the **farming systems** around the areas of the 60 micro dams.* There will be an increase in the production of cereals and vegetable crops, newly introduced forage species and fruit species. Modern inputs such as fertilizers, improved seeds, pesticides will be introduced. As in the other components of SAERT, training will receive an important priority. In the 6,000 hectares to be developed during the preparatory periods, cereals would occupy 60% of the area, fruits, pulses and vegetables would occupy 15%, 15% and 10%, respectively. Annual incremental production would be in the order of 130,380 quintals of cereals, 8,550 quintals of pulses and 630,000 quintals of vegetables. Net annual farm profit for the project in three years would be 194 million Birr. Net annual farm incomes from crop production would increase on average from the current level of Eth. Birr 2126/Ha to Eth Birr 10,780/ha. Other complementary programmes of irrigation include forage production, apiculture and the improvement of the genetic potential of the local cattle through cross breeding.



The **prickly pear cactus** is an important resource of Tigray for food security, fodder and conservation, and it will receive programme support. The prickly pear cactus covers an area of 355,242 hectares throughout Tigray, 55% of which is man-planted. Total production of the fruit amounts to 2.7 million annually. Most of this fruit gets consumed at the farm level and only 3.37% of the fruit gets marketed. Higher marketable surplus could be achieved with active market promotion, especially in processed form. It must be emphasized that the fruit plays an important role in food security in the critical three months when food supplies are low (July, August and September) in Tigray. A fresh prickly pear cactus of dry matter contains fat, fibre, protein, calcium carbohydrates, phosphorous and sodium in sufficient quantities for daily requirements. Further studies of the plant will be required and small processing facilities will be established during the preparatory period of SAERT.

Three important services will be organized during the preparatory period. These are: **Development support extension communication** which handles the task of conveying proven knowledge to farmers and sensitizing farmers for the adoption of new knowledge and technologies. The other service will be the task of choosing, procuring, using and maintaining all the **technologies** needed by SAERT. The third service will be a **soil, plant and water testing laboratory** to operate principally from Mekelle. These services will be organized as semi-autonomous institutions providing their services to SAERT at cost, and at profit to other institutions.

**Women** receive explicit programmes support in SAERT. During the preparatory period, programme support will be given to achieve the objectives of reducing women's domestic work burden, increasing their access to and control over resources, assisting them to engage in income generating activities which increase their income etc. In these respects, 24 grain mills will be installed and credit programmes for a variety of income generating activities will be organized. Extensive training programmes will also be provided.

The programme component for **natural resources** within SAERT is extensive. The major objective under this component is to minimize soil erosion and run-off, to protect and enhance the environment of the region using biological and physical measures and to meet the region's requirements for fuelwood, poles, fodder and timber. In this respect 60 nurseries with an annual capacity each of 250,000 seedlings a year will be established; extensive construction of physical structures such

as bands, terraces, micro basins, check dams, etc. will be undertaken. As part of the watershed management measures, extensive revegetation of the physical structures with appropriate species will be undertaken, including the improvement of grazing lands with fodder trees, shrubs and grasses. Extensive tree plantings on private woodlots, communal lands etc.. will also be made. Research trials and training of staff are also important programme components. These activities will be organized using the labour of communities with minimal support from SAERT in a form of food aid. It must be emphasized that food aid has been minimized in the SAERT programme on the assumption that whatever tree the communities plant will belong to them. This form of ownership (individual, group and communities) will be contained within a special policy framework to be developed by SAERT.

The **social dimension** programme of SAERT is an important component and looks at the whole spectrum of poverty reduction in Tigray in general and examines the social consequences of extensive water harvesting in the region. Popular adult education, the prevention of water borne diseases, the generation of productive employment are issues tackled as programme components.

# CONCLUSION

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Africa's food and agricultural underdevelopment has perpetuated the poverty of the rural population and seriously jeopardized the long-term development of the continent. Is it reasonable to continue devoting the best lands of Africa to the growing of cash crops while millions of Africans are starving? Can Africa continue to spend more resources on the military than on the agricultural sector when it depends more and more on food-aid? Unless the right policies and a strong political will are adopted now, Africa will become the continent of famine and other disasters. The threat is enormous, but there is hope that it can be averted.

The sheer scale of sub-Saharan Africa's environmental crisis often leads to pessimism about the region's recovery prospects. That sense of pessimism has been reinforced by the failure of large-scale aid initiatives, designed to enhance environmental sustainability, to yield results. UNECA-FAO's view, based on experiences of working with communities across Africa, is that the crisis can be resolved, but only through co-operation with and support for local community initiatives. The issue at stake is the sustainable economic and social development of Africa for present and future generations.

Relationships between the different components of development are complex. The linkage between production of goods and conservation requires special emphasis. In many references to these activities it is inferred that the two are separate or even competitive. It should be appreciated that the two are very much interdependent. Production is impossible, over more than a very short period, without attention to conservation. Conservation cannot be successfully practised without a productive return. This relationship should be remembered when developments affecting land and water are planned. Conservation measures must be included in the schedule and budgets of development activities.

Natural resources have been considered priceless, they were and are being sacrificed, and not conserved, as the example of transport shows. Since the oil crisis, the price of oil has not followed the price index, on the contrary. Had it done so, then a barrel of oil would not cost some 170 US dollars. Other resources and commodities

have been dropping in price continuously since 1973 as well, making the resources delivering Third World ever poorer (the total debt now being 1650 billion US dollars), and sacrificing this world to an ever increasing exploitation.

The statistics tell us that welfare has not increased in Africa since 1970, despite the fact that the economy on the whole has prospered: production growth (GDP) has increased globally between 1970 and 1990. While consumption is steadily increasing on the one hand, we observe a loss of welfare on the other hand. Until 1970, this process was not really noticeable. Since then, however, it has risen in importance, it has become more structural, and less curable with the usual prescriptions.

The reason why our societies cannot interpret the data of decline properly is threefold. First, the main information flow on a nation's state of affairs is in the statistics of the national accounts or the (gross) national or domestic product (GNP, GDP). Second, natural resources are still widely considered free goods, to be consumed and depleted freely. Thirdly, the relationship between environmental losses and general welfare loss is not understood.

To begin with GDP: It is widely believed that the GDP is a reflection of the economic state of a nation, that is of its wealth, welfare, richness, health, prosperity and the like. The economics keep repeating this story - that a healthy nation has a high GDP, and that more of this GDP therefore means even more of this health. The real statistics of the GDP, however, tell a more limited story: they only refer to the amount of goods and services rendered in the economy, excluding important so-called non-productive services such as justice, education, and government, to name a few. Critics of the GDP have observed the anomalies of the accounts which add as income such negatives as waste production and handling, car repair, and even the production of weapons and warfare. If a factory produces noise and wastes to disturb people's health and waste to pollute a river, then the GDP goes up.

In order to correct this misleading GDP information, the UN System of National Accounts has to be changed, in that it stops accounting damage and depletion as income. The number of - hectic - debates on this subject is so high, and the outlook on a consensus so limited.

Part of the problem should consist of pricing the unpriced, which are the scarce environmental goods such as land, clean air, water, soil, open space and the like. Putting it differently, the National Accounting System must take into account the natural resources and environmental degradation caused by economic activities. Efforts to calculate these values properly have started some 30 years ago, and have long been in vain. However, there are signals that estimates and methods for this valuation are being accepted by and large.

The Northern model of growth is not working. The story the ISEW tells is, however, not only one of physical limits but more of the social limits. The possible interpretation is twofold.

First, there are environmental losses. Also, the factor unemployment is worsening the effect of the total Index, as technological developments keep outpacing labour, with no feasible market expansion to compensate for it. These irreversible effects have a dominant effect in the Index of Sustainable Economic Welfare (ISEW) score.

Second, it may well be that before reaching the limits to growth, we are now observing the "limits to competition". If capital is free to flow around the globe at the speed of light, then there is hardly a possibility to control its use or allocation. All economic successes of the past have been a function of some protective rule, writes Paul Bairoch. There is not a single proof underlying the general belief that economic success can be achieved through a totally free market. The behaviour of the economies tested in the Index of Sustainable Economic Welfare (ISEW) studies, points at a process of capital accumulation at the cost of the common good, but also that the costs of growing complexities are not understood (and even accounted for as income). Waste, damage, urban stress, crime, the lawyers' society (not Law and order which are a must), conflict, legalisations, bureaucracies, but even transport and energy, should all be interpreted as costs of complexity (and so as a negative economy). The price of it is not only the environment but also the welfare state itself, as societies account themselves richer than they are.

We seem to be all obviously trapped in a wrong economic, political and mental model. It is our belief that the developing countries in general and more specifically

African countries are in need of an economic reformation, a deep analysis of the real roots of this predicament, a reformation which will loosen the ties with current economic thought, to replace it with one that is more ethical, doing justice to the poor, the earth and the future. We seem to have little time to fulfil that task.

On the basis of the above, the purpose of the present paper is to set up a framework to search for lasting and sustainable solution to the devastating problem of land and environmental degradation and desertification in Africa. Drawing on past actions, emerging countries' needs, current thinking on the role of the UN system in the field of assistance to member countries, the views of other partners involved in the development process and as well as on the past FAO and UNECA experiences in the field, a framework for sustainable, lasting and integrated solution is proposed.

This new strategy is adopting a "programme approach" which requires multi-disciplinary, cross-sectoral linkages which will in turn ensure that a holistic view of the development problem is obtained, and the appropriate solutions identified and supported. *This approach would not only ensure national ownership of both the problems and solutions to development process and to facilitate the ownership of the assistance by beneficiaries, but would also enhance the sustainability of interventions. Taking into account the limited resources available, the proposed framework is formulated around building local communities capacities to participate more effectively in the development process affecting their future.*

*There is no simple formula for reversing Africa's environmental crisis. But experiences offer some lessons. Firstly, the dynamics of environmental degradation are reversible, but only in collaboration with local communities. It is often forgotten by development 'experts' that the best people to speak on behalf of the poor are the poor themselves. Working with the poor requires the establishment of democratic and participative structures at every level, and not just in national institutions. Secondly, to stand any hope of adoption, conservation methods must cost little or nothing in cash, increase yields, and improve household food security by minimising risk. Thirdly, where tree planting and other conservation interventions are involved, they must not conflict with the labour needs of the agricultural cycle, and must produce timber, fuel-wood, or fodder, we hope that these principles have informed the negotiations on the Desertification Convention - one of the few potential benefits for sub-Saharan Africa to come out of the Rio Earth Summit in 1992.*

The challenges that Africa faces are many, but the most urgent one is that of protecting the future and action must be initiated firmly now. Governments must seriously and critically look at the policies they have constructed in the past and answer the question - who will benefit from the development programmes? Though there is no simple answer to the question of eliminating poverty, its progressive alleviation is a condition for sustainability.

Politicians, advisors, and ecologically conscious scientists that work for an environment-oriented change in economic policy need a measure of economic production/growth that is deflated by natural resources and environmental costs (degradation) induced by production/growth.

This task is politically (and scientifically, too) so important that we have to accept imperfect solutions. We have to teach the public that the currently prevailing production, income and growth concepts and calculations are only seemingly objective, seemingly valid and seemingly "modern". They profit from the fact that the produced goods and services are valued with market prices which seems to be self-evident. But the market prices of today are determined really without the external environmental costs of production and consumption and are therefore increasingly distant from the economic-ecological "truth".

But perhaps the most fundamental challenge is to break the links between poverty and environmental degradation at source; namely, by enhancing the capacity of the poor to expand their own incomes. This means increasing and improving their access to land, making more capital available, providing infrastructure, and investing in labour-intensive technologies and training for new skills. This is part of the foundation of Sustainable Agriculture and Environmental, Rehabilitation for Tigray (SAERT) being promoted by FAO and UNECA.

For the case of Tigray, the test of the proposed approach which creates the forum for greater beneficiary participation in the development of the programmes to address the issues identified, was facilitated by the TGE policies on regionalisation, decentralization of authority and community participation.

Based on the design experiences attained in Ethiopia and elsewhere, the UNECA-FAO is prepared to discuss the modus operandis for joint technical undertakings with

other African development partners to find suitable long term and lasting solution to the problem of land and environment degradation and desertification in Africa. There is little doubt that, regional and sub-regional programmes elaborated within the framework presented in this document to face the challenges of Land and Environmental Degradation and Desertification in Africa, would benefit from financing by GEF and the recently adopted International Convention to Combat Desertification.



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