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**INVESTING IN SCIENCE AND TECHNOLOGY TO ENSURE  
SUSTAINABLE DEVELOPMENT AND AVERT MAN-MADE  
CATASTROPHES IN NORTH AFRICA**

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## **1. Introduction**

North Africa, with seven countries, covers 31 percent of land surface in Africa, and has over 22.5 percent of the total population. The subregion commands vast sea, land and mineral resources, and has immense potential for development provided adequate efforts are made to invest in science and technology that can raise the quality and the standard of living of the peoples. With its proximity to Europe, the opportunities for development are all the more accessible, and cooperation in science and technology can expedite this process. Investing in capacity building and utilisation of science and technology can ensure sustainable development and avert man-made catastrophes. For the subregion is subject to endemic droughts, population pressure, food shortages, falling commodity prices, high unemployment, and strife in some countries. The full potential of science and technology has to be exploited in the search for solutions to these problems, for investing in science and technology can ensure a sustainable development.

The spread of desertification, increased pollution of the sea and inland water resources, and other environmental problems, are closely linked with the nexus of population, agriculture and environment, and the inadequate as well as inappropriate exploitation of science and technology in the subregion.

## **2. Science and technology as the pillars of sustainability**

When it comes to sustainable development, the role of science and technology is paramount. Principle 9 of the Rio Declaration says: 'States should cooperate to strengthen endogenous capacity building for sustainable development by improving scientific understanding through exchanges of scientific and technological knowledge, and by enhancing the development, adaptation, diffusion and transfer of technologies, including new and innovative technologies.'<sup>1</sup> The development and dissemination of environmentally sound technologies, or **ecotechnologies** can be very effective in ensuring sustainable development. Since prevention is always better than cure, timely application of ecotechnologies can prevent a host of interrelated social and environmental calamities. Problems of ethnic conflict, population migrations and encroachment, refugee concentrations, are all often linked to environmental issues, themselves linked to inadequate and untimely application of science and technology.

Amongst social problems there are regular rural-urban migrations in search of food, employment and better living conditions including health facilities, transport and communications, education, market access, etc. While some of these problems can be tackled at little cost with timely intervention through science and technology, others like ethnic conflicts and civil wars which ensue when action is not taken at the right time, due to deterioration of the situation, require massive investment for their containment. Few people realise that an inappropriate and untimely application or lack of application of science and technology causes such calamities or catastrophes.

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<sup>1</sup> Rio Declaration and Forest Principles, UN Conference on Environment and Development- Rio de Janeiro, Brazil, 3-14 June 1992

### **3. Availability of technologies**

Environmentally sound or ecotechnologies for countries that are not highly industrialised are readily available off the shelf, for they are not governed by industrial property rights, but are either in the public domain, or have never been patented. Such technologies are available for better practices in agriculture, animal husbandry, food processing, drainage and irrigation, health and sanitation, transport and communication, housing and urban development, water purification and supply, energy and small-scale industries, etc. When one talks about ecotechnologies, one often forgets the multiple so-called appropriate technologies that are available at low costs. On the other hand one refers to sophisticated and patented technologies that are valid mainly for industrial production, and north-south transfer of technology issues often clouds the debate. It must be remembered that if only developing countries give more importance to the production and utilisation of appropriate ecotechnologies, most of their problems could be solved. Discussions in international fora have centred on the transfer of sophisticated technologies that are not in the public domain, and that require purchase at high prices by producers and consumers of the south. Those industries that are polluting the environment need to upgrade their technologies, and profit motives prevent the manufacturers from doing so.

Poverty that contributes to environmental degradation in most North-African countries, is also the cause of rural-urban migration and acute peri-urban deterioration. Here again technologies required to improve living conditions in these peri-urban environments are simple and fairly well known technologies. Environmental education within the population in a context where public authorities adopt sound policies for the management of the environment is a prerequisite. Thus urban planning involving the community, privatising the collection of garbage, involving the population in the maintenance of the infrastructure, specially drainage channels, encouraging the use of garbage for manure in urban agriculture and as fuel in households, setting standards for the construction of low-cost houses are all issues that do not require the purchase of sophisticated technologies that have proprietary rights! Since the meagre resources available to urban authorities are already over-stretched the population in these areas must themselves be empowered to manage their environment, using available known technologies.

### **4. The Nexus issues in relation to science and technology**

In most countries of the North-Africa subregion where industrialisation does not contribute significantly to economic growth, the main sectors that impact on the environment and sustainable development are agriculture and population, and in some cases mining. The low level of existing industry hardly contributes to serious environmental problems. An ever-growing population making increased demands on the limited natural resources, coupled with an inability to grow adequate food for the people, is the main threat to sustainability. The role of science and technology in a population-agriculture-environment nexus is depicted in the diagram that follows.

As an intersectoral activity, science and technology has impacts on all three sectors in the nexus, as well as in other related sectors like health, transport, energy, mining, etc. Though the diagram does not show all sectors, the basic ideas contained in the three most important sectors shown can be extended to cover other sectors to show how the use of inappropriate technologies can lead to environmental degradation, which then results in major catastrophes.

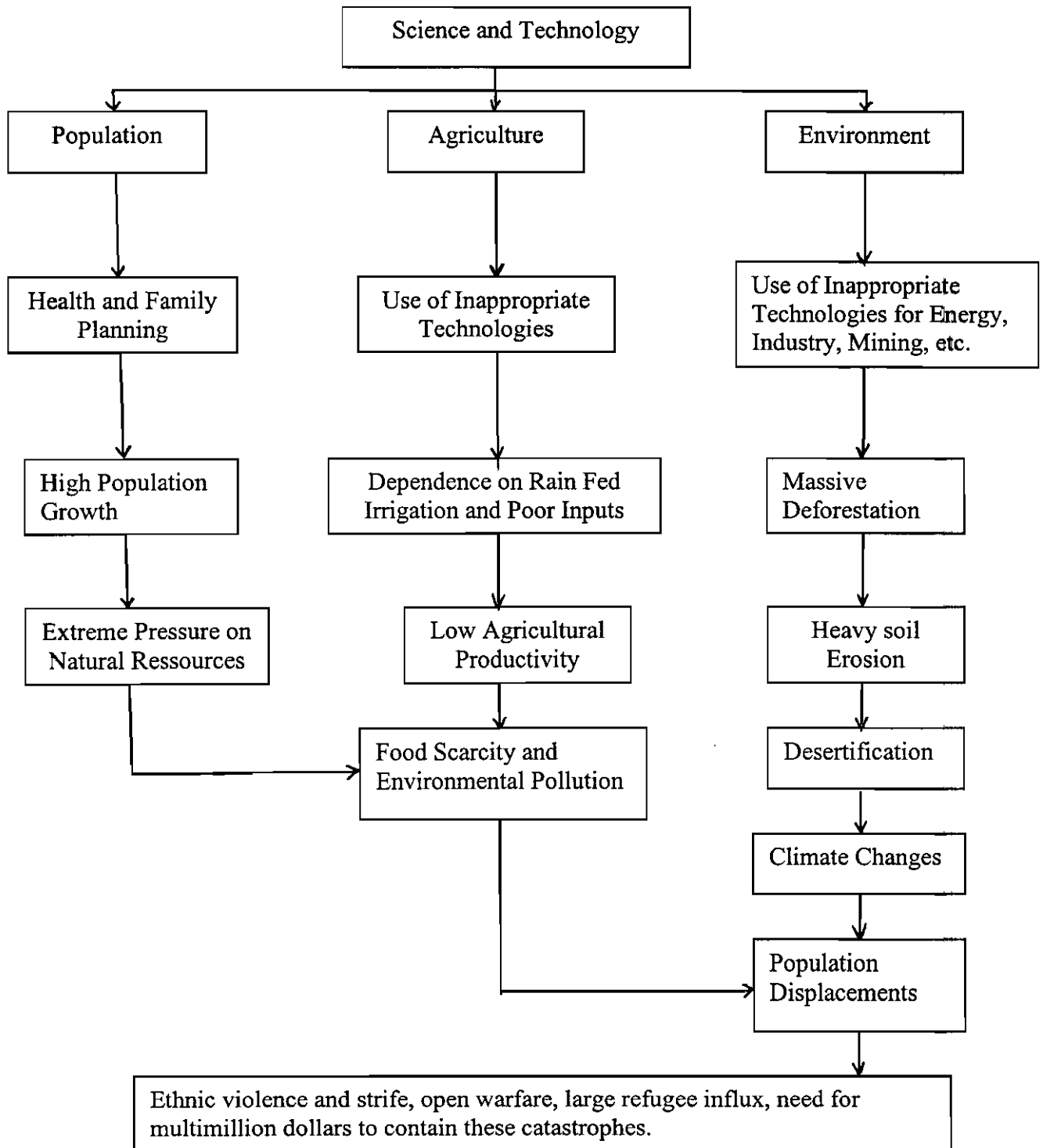


Diagram illustrating contribution of science and technology to the management of man-made catastrophes

## **5. Population and Sustainable Development**

The total population in North Africa has been increasing at a high growth. With a 1997 population estimated at 164 million people, the resources are being exploited beyond limits. Although the rates are declining, past trends have fuelled a tremendous momentum that puts pressure on the resources, environment, etc.

## **6. Appropriate Population Related Technologies**

1. Basic hygiene and Sanitation technologies
2. Primary health care technologies
3. Family health reproductive technologies
4. Human settlement technologies
5. Basic infrastructure technologies

With respect to population, it is well known that enhanced primary health care and use of health technologies have extended the life span of the people. On the other hand a poor application of birth control and family planning technologies have led to high population growths and undue pressure on the limited natural resources available. In the coming decades many North African countries will witness substantial population increase and population movements, including very rapid growth in cities, peri-urban settlements, leading to unbalanced regional distribution of the populations.<sup>2</sup> The development challenge is to meet the needs of the present generations and improve their quality of living without compromising the ability of future generations to meet their own needs.

In terms of primary health technologies, basic hygiene should be taught to schoolchildren, and the children asked to convey the ideas to their parents at home. A simple process of using boiled water during periods of heavy rain can save many lives. Children in their early age have to be inoculated against some diseases, and this, while well-known in urban societies, is not fully understood in rural areas. Here again, through the medium of school children, the message can be passed on to parents in rural areas so that they take the necessary steps. In some countries the absence of latrines in rural homes often leads to the spread of some infectious diseases. Improved pit latrines, as have been developed by the Blair Institute in Zimbabwe, can improve hygienic conditions very much. The technology is simple, and it can be propagated in rural areas easily. So simple health technologies are available and need to be propagated.

In any country with its national frontiers, the limited natural resources suffer the brunt of increased exploitation by this ever-growing population, and cannot last for long. Basic energy resources like wood fuel and biomass get fast depleted. Deforestation increases, and with this there is ensuing soil erosion and loss of huge amounts of topsoil. Food production then decreases, leading to food scarcity and if the situation grows worse, to famine, as has been experienced in parts of Sudan. This forces the population to move to other areas, often to other neighbouring countries.

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<sup>2</sup> United Nations –Report of the International conference on Population and development, A/Conf.171/13, Sept. 1994, Cairo

## **7. Population displacements and strife**

When large population displacements start, these invariably lead to social and ethnic violence and strife in a bid to take hold of the limited natural resources. Encroachment by 'outsiders' is resisted, and violence starts. Refugees are not welcome, and their influx has then to be managed by the international community through the UN High Commission for Refugees and NGO's. Land and specially water resources are the sources of constant disputes. The management of water resources, especially those of international rivers and basins, has become a major issue, and it is often said that in the next century, disputes about the sharing of water resources from rivers can be the cause of open wars.

Once wars start, massive resources are required to contain them, and to reduce the loss of precious lives. Women, children, and the weaker sections of the society are the ones that suffer most. Even a small fraction of resources required to stop such wars, when invested in preventive measures based on the appropriate development and application of science and technology, can be instrumental in containing such ever-recurring calamities and strife, and in ensuring a sustainable development.

## **8. Appropriate Agricultural technologies**

1. Animal husbandry and cattle breeding technologies
2. Cattle ranching technologies
3. Integrated farming technologies
4. Integrated pest management technologies
5. Fertiliser and chemigation technologies
6. Nitrogen fixation technologies
7. Nutrient recycling technologies
8. Drip, sprinkler and canal irrigation technologies
9. Water storage technologies
10. Land conservation technologies
11. Food processing and storage technologies.

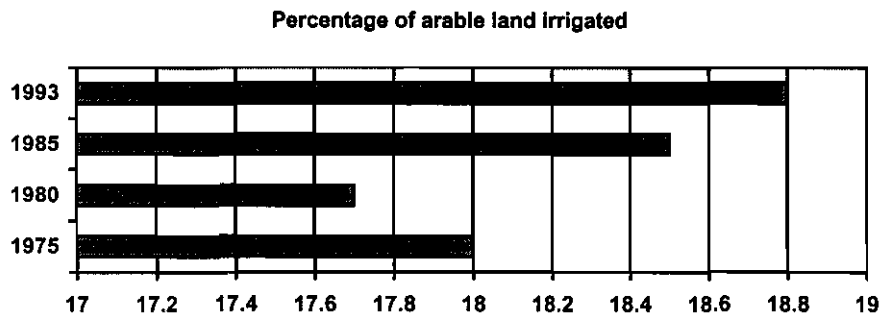
In large areas of the subregion, agriculture is practised as in very old days, and the people earn subsistence living from the scarce cultivable land available. The use of inappropriate and low-level technologies like 'slash and burn' for land clearance before planting, has disastrous effects on the land, especially on the topsoil which gets easily washed away during heavy rains, and thus reduces the fertility of the land. Reliance on rain fed irrigation often leads to low agricultural productivity and to scarcity of food during spells of drought<sup>3</sup>

It can be seen from the graph below that the surface of irrigated land as a percentage of arable land in North Africa is indeed very low, and the trend over the years is hardly reassuring. More than 55 % of the population in Arab countries suffer from serious water shortages, and have less than 1000 cubic metres of water per person per year.<sup>4</sup> This only

<sup>3</sup> UNCED- Agenda 21, Ch.22, Strengthening the role of farmers- A/Conf.151/26, August 1992, Rio de Janeiro.

<sup>4</sup> UNDP report on Human Development, 1997. UNDP New York.

strengthens the case for a rational use of water, and the use of irrigation technologies like drip irrigation that lose little through evaporation.



*Source: SRDC - North Africa*

Technologies for constructing small ponds and reservoirs for water storage have to be propagated. Drip irrigation, sprinkler and simple canal irrigation can improve agricultural productivity by many factors. The blending of proven traditional methods with modern technologies that are environment friendly, can also contribute immensely to enhancing food production. Such technologies like biotechnology, integrated pest management, integrated farming, nitrogen fixation and nutrient recycling are now being practised in developed countries, whereas the subregion suffers from inadequate food production because these technologies are not being popularised and applied on a large scale.

Technologies for small scale and large scale food processing are also known. Solar drying techniques for agricultural products, and even for meat and fish, are well developed, but are hardly popularised. Almost every university in the subregion has carried research in these areas, and the results are lying unexploited. Serious efforts must be made to promote extension services so that the technologies are brought to the users. The role of the universities in community service, and in commercialising research results has to be reviewed. With funding for higher education becoming scarcer, it is time these universities make themselves more relevant to the community for their continued public support.

## **9. Pollution from fertilisers and pesticides**

In trying to increase agricultural productivity, some countries make an abuse of pesticides and fertilisers, by not knowing the exact dosage or the right technology. This often leads to environmental pollution, usually in the form of contamination of the water, food and fodder. It is established that pesticides, nitrates, phosphates, organic wastes and chemical effluent contaminate rainfall, surface and ground water, and cause algal growth and eutrophication.<sup>5</sup> Pesticides and nitrates end up in food as residues and are harmful to animals and humans. Ammonia from livestock manures and paddy fields cause acid rain, while nitrous oxide from fertilisers contributes to ozone depletion and global climatic warming. Livestock wastes generate ammonia and hydrogen sulphide, which are harmful to the farm worker. Thus scientific agriculture should aim at reducing the use of pesticides and fertilisers beyond well prescribed margins, and ensuring a healthy environment. E.Dale Threadgill has

<sup>5</sup> H de Haen : 'Sustainable Agriculture' in Sustainability issues in agricultural and rural development policies-Training Materials for Agricultural Planners No.38/1/FAO, Rome, 1995



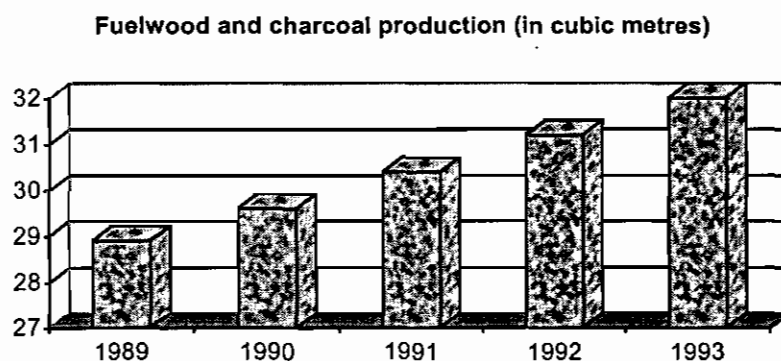
described recent technologies developed to take care of chemigation and the environment in an FAO publication.<sup>6</sup> Here again a proper application of science and technology is a key to proper agricultural productivity and environmental sustainability.

## 10. Energy Production

### Appropriate Energy technologies

1. Solar drying technologies
2. Solar cooking technologies
3. Solar cooling technologies
4. Solar lighting technologies
5. Biogas technologies
6. Biomass conservation technologies
7. Windpower technologies
8. Mini and micro hydropower technologies

Energy requirements keep increasing as the population grows. In North Africa, besides petroleum, many rural areas still have recourse to fuelwood and charcoal. The total production of fuelwood and charcoal in the subregion over a period of five years is shown in the graph below.



*Source: UNECA African Compendium of Environment statistics*

This ever-increasing consumption will have a devastating toll on the environment, unless alternate energy sources are exploited. Efforts have been made to utilise biogas in rural areas with limited success, mainly because of poor government policies to subsidise the initial capital costs in erecting biogas digesters, and in community organisation to sustain such digesters. Other forms of solar energy utilisation are possible, and the technologies have to be popularised. The use of solar cookers, water heaters, solar coolers, solar refrigerators, solar photovoltaic panels, and solar lighting can save the environment from the destruction of scarce forest areas and consequent soil erosion and deforestation.

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<sup>6</sup> E.Dale Threadgill, 'Chemigation and the environment' FAO document AGL/MISC/19/91

## 11. Climatic changes.

These problems coupled with the negative environmental impacts of mining in countries where this is an important economic activity, worsen the situation. The over-exploitation of scarce land resources for food, energy and minerals invariably leads to deforestation and desertification. This is usually followed by drought and frequent water shortages, and in due course to unfavourable climatic changes. Climate change is also the result of ozone layer depletion; itself generated by unrestricted use of chlorofluoro-carbons in refrigeration and other utilities. This has led to possible global warming, and the international community has adopted the Montreal Protocol<sup>7</sup> to gradually ban substances that deplete the ozone layer. Of late the El-Nino effect with its highly damaging consequences over vast areas of the globe is also being blamed on such climatic changes. Spells of droughts in North Africa may also be due to the global climatic change.

In the absence of appropriate policies, strategies and practices based on a rational exploitation of science and technology, as is the case in most of the subregion, food scarcity is likely to continue, with dependence on external aid. At the same time the destruction of the environment, leading to desertification will increase. This will cause population displacements from one area to another, and the cycle will continue, unless serious efforts are made to apply environmentally sound science and technology. Hence there is urgent need for a national framework for integrating science and technology within development, bearing in mind the impact of such development on the environment and its sustainability.

## 12. Conclusion

The future of mankind rests on his ability to manage his social and physical environment. Invariably his physical environment conditions the social environment. It is evident that this physical environment can only be managed by an appropriate development and application of science and technology in a society that is aware of the destructive impacts of human greed and consumption patterns. In most developing countries the priority is to meet basic needs of the population without damaging the environment. Extensive flow of information through the new telecommunication channels is most likely to depict the consumption patterns of the North and incite others to follow such consumption patterns. Hence strategies for appropriate science and technology education in the masses have to be implemented as a priority, and investing in science and technology is a dire necessity.

The paper has brought out that timely investment in science and technology by enabling the population to make use of appropriate technologies to manage their lives in a way that conserves the environment can save the international community billions of dollars from spending on the containment of man-made catastrophes.

Unless consumption patterns undergo a visible change, we are likely to witness, in coming decades, an uncontrolled decline in per capita output, energy use and industrial production. Technically it is feasible. What is required is a change of mentality. In the words

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<sup>7</sup> UNEP-Montreal Protocol on substances that deplete the ozone layer- Report of Technology and Economic Assessment Panel-UNEP Ozone secretariat, March 1996, Nairobi.

of Meadows<sup>8</sup>: 'The transition to a sustainable society requires a careful balance between long-term and short-term goals and an emphasis on sufficiency, equity, and quality of life rather than on quantity of output. It requires more than productivity and more than technology; it also requires maturity, compassion and wisdom.' This is where the North-African subregion has to come up with viable strategies backed by public and private sectors to develop and apply science and technology for a sustainable development.

## REFERENCES

1. Dale E. Threadgill, '*Chemigation and the environment*' FAO doc. AGL/MISC/19/91, Rome
2. H de Haen: '*Sustainable Agriculture*' in *Sustainability issues in agricultural and rural development policies*-Training Materials for Agricultural Planners No.38/1/FAO, Rome, 1995
3. Meadows et al- '*Beyond the limits, global collapse or sustainable future*'-Earth Publication, 1992, New York.
4. *Rio Declaration and Forest Principles*, UN Conference on Environment and Development, Rio de Janeiro, Brazil, 3-14 June, 1992
5. UNCED-Agenda 21, Ch.22, *Strengthening the role of the farmers*-A/Conf.151/26, August 1992, Rio de Janeiro
6. *UNDP Report on Human Development, 1997*, UNDP, New York
7. *UNECA African Compendium of Environment Statistics, 1995*, Addis Ababa.
8. *UNEP-Montreal Protocol on substances that deplete the Ozone layer*-Report of Technology and economic Assessment Panel-UNEP Ozone Secretariat. March 1996, Nairobi
9. *United Nations-Report of International conference on Population and Development*, A/Conf.171/13, Sept.1994, Cairo.

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8. Meadows et al- '*Beyond the limits, global collapse or sustainable future*'- Earth Publication, 1992, New York