*Journal of Environmental Sciences (China)*, Vol. 2, No. 2, pp 99–104, 1990 ISSN 1001–0742

# Sustainable development and environmental protection

Cyrus M. McKell[1]

**Abstract**—The focus of this paper is on protecting the environment in resource development and not on economic issues even though many obstacles to sustainability include social, political and economic factors. Many stark examples of past failures in resource development serve as grim reminders for future planning. Most of the options will require an evaluation as to their appropriateness as well as to the economic capability and commitment of developing countries and international development institutions to incorporate them into programs.

**Keywords:** ecosystem; environmental quality; environmental protection.

"Sustainable development employs a strategy that meets the needs of present generations without compromising the ability of future generations to meet their needs". This statement is printed in the foreword to Globescope Pacific (1989) in its program for an Assembly and Public Hearing on Sustainable Development. The public meeting is a project of the World Commission on Environment and Development. Environmental values are now drawing increased support in many countries because of the recognition that application of science and technology to increase production requires the dependable functions of environmental resources for present and future generations. Barber Conable (1989), president of the World Bank introduced a conference on "Sustainability Issues in Agricultural Development", by declaring that, "sustaining the natural resource base is critical at early stages of agricultural development".

The focus of this paper is on protecting the environment in resource development and not on economic issues even though many obstacles to sustainability include social, political and economic factors. Jim MacNeil (1959), secretary of World Commission on Environment and Development, declared that the needs and aspirations of today could be reconciled with those of tomorrow, provided fundamental changes are made in the way nations manage resource development.

Unless countries of the world protect their environmental resources they will not be able to sustain present developments or respond to the technologies of tomorrow. As we look at the condition of resources that have been destroyed or debilitated we can determine some of the mistakes in management that have occurred and what should be done in the future to avoid

[1]School of Natural Sciences, Weber State College, Ogden, Utah, USA.

repeating the process. Many present and past failures in resource development serve as grim reminders for future planning. Land degradation results from many human activities that are unsustainable and as a result the degraded areas are unable to meet the needs of the people living there. One of the most obvious examples of ecosystem resource abuse is the loss of topsoil as a result of overgrazing, excess cropping practices, or deforestation. Three examples are from the highlands of Bolivia (overgrazing), China (excess cropping) and Kenya (deforestation) are given.

## MAJOR PLANNING ISSUES IN ENVIRONMENTAL SUSTAINABILITY

Several major issues must be considered in planning for sustainable development. These issues include:

Protection of environmental functions to maintain base productivity. Among the most critical functions are to protect the interrelations of cycles dealing with water, nutrients, soil, energy and air. Any existing use or proposed project that adversely affects water quality, soil fertility, energy balance, or air quality needs to be modified to meet sustainability criteria.

Determination of the carrying capacity of a system or resource to establish the level of sustainable use that can use be obtained from the available ecosystem capital. This concept has its best expression in rangeland management which requires a manager or grazier to determine the number of livestock that can be pastured in a given area for a specified period of time on a sustained basis. This determination represents the carrying capacity of the specific ecological unit. The carrying capacity concept, as a planning tool, also has a great value. For example, if a land unit produces only so much food under a set of management inputs that unit may be at its capacity to sustain, any increases can only be obtained by making technical inputs modify whatever limiting factors that constrain the system. Excess development demands on the system must not be made at the expense of damaging the basic system resources. Celestial Lake in Tien Shan Mountains illustrates the carrying capacity concept. Only so many people can use the lake shore for habitation and recreation without degrading the quality of the lake water with their effluent and wastes. To significantly increase the number of people using this beautiful area, while still maintaining the functions of the system, would require installation of a sewage system to export the excess waste out of the system.

Development of management plans that respect ecosystem resilience and set levels of use that are within the limits of resilience. Resilience is defined as the ability of a natural ecosystem to restore its structure and function following acute or chronic disturbance (Westman, 1978).

Understanding of the barriers to biological productivity and their use to guide the development and application of suitable technologies that extend productivity.

## RISKS AND CONSEQUENCES OF UNSUSTAINABLE DEVELOPMENT

In ecological systems as in social systems there are risks in development. The greatest risks are where ecosystem limits or to what degree the systems would be impacted by an unsustainable

level of use are not known. Failure to understand and observe the rules of management and limits of the system resilience will bring consequences. Some of these consequences are of limited seriousness while others are profound and will change the destiny of a nation and ultimately of the planet when the impact of the environmental insult is universal. Excess uses may impact other system functions and produce combined effects. Some of the most obvious risks are:

*Desertification*

Not all examples of the desertification process involve sand encroachment onto farmlands and communities. In the grazing lands of Northern Mexico excess grazing use during a period of time when large land holdings concentrated on maximum yield of animals surface erosion resulted to the degree that the caliche (calcium carbonate) layer was exposed, thus rendering the land unproductive for vegetation wherever the topsoil was inadequate even for the growth of shrubs (McKell, 1989). In the grazing lands of Inner Mongolia north of Huhehot the most productive forage plants have been grazed out leaving a low value shrub and exposed topsoil.

*Soil erosion and siltation of reservoirs and wetlands*

Permanent loss of the productive soil through erosion and topographic change leaves an area which once was a fertile alluvial valley almost unsuitable for plant growth, especially for crops.

*Loss of biodiversity*

Many forests in Brazil, which have supported a large number of species, have given way to row cropping and in the process have lost species diversity. Wholesale burning and cutting of forested areas have destroyed the habitats and their unique species and genetic diversity. In Senegal, the mixed-shrub vegetative cover has been destroyed in some coastal areas to provide space for planting of Eucalyptus trees for fuelwood. Because of the allelopathic effects of the litter droppings of the trees very little understory plant diversity exists to retard soil erosion.

*Accumulation of toxic materials in ecological systems*

Although an electric power plant may be critical for economic development, failure to control the emission of toxic wastes into the atmosphere results in acid rain that creates a severe impact on the vegetation in the path of the smoke.

*Energy resource depletion and dependency*

Lacking petroleum resources or funds to purchase them forces people in many developing countries to utilize trees and shrubs for fuelwood. Many African women have to travel several miles each day to collect wood for cooking. More organized is the charcoal industry in Kenya which depletes a substantial amount of trees and shrubs to provide charcoal for urban users.

## TECHNOLOGICAL SOLUTIONS AND MANAGEMENT CAN INCREASE SUSTAINABLE DEVELOPMENT

Through intensification of management and development strategies, productivity can in-

crease but greater concern must be given to the ability of ecosystems to sustain the increased pressure to produce. Professor Ruttan (1989) pointed out, "Before the beginning of this century almost all increases in production occurred as a result of increases in the amount of area cultivated. By the end of this century, there will be few significant areas where agricultural production can be expanded by simply adding more land to production. Agricultural development and output will have to be expanded almost entirely by more intensive development in areas already being used for agricultural production from the existing land." Thus, the means by which this intensification of development will occur is through the adaptation and application of existing technology and the development of new technologies.

Various technological applications may increase the efficiancy of ecological systems and resources such that ecosystem productivty can be increased within the limits of the system, but any such developments must include the goals of maintaining the ecological base and protecting ecosystem functions. Some examples of appropriate technologies are as follows:

Adaptation of available agricultural practices to local ecosystems, such as:

Fertilization to restore nutrients lost in the export of products from the system. An increment of fertilizer can raise yields while at the same time increase the efficiency of water use.

Employment of precision irrigation in semiarid and arid regions such as drip irrigation to make optimal use of water.

Adoption of minimum tillage management. Use of plants to conserve moisture and protect the soil for the crops to follow.

Development of new crops from existing germplasm. Many opportunities are available to select vigorous and adapted genotypes to increase yields in existing agricultural areas. An excellent example is grain amaranth (Amaranthus Hypochrondriachus).

Employment of land use planning based on land capability to protect productive land for long term productivity rather than short–term gain or non–productive uses. The planning process starts with an evaluation of land potential and identification of constraints for certain uses. An important goal is to restrict the unwise extension of urban or village growth onto agricultural land.

Development and application of appropriate waste disposal practices, including recycling and recovery of energy from waste. The problems of waste disposal are worldwide and may restrict development or future productivity. Valuable resources such as metals, energy materials, and minerals can be obtained from wastes which may help pay costs of recovery. Without proper waste recovery systems, land, water, and plant productivity is reduced.

Development and utilization biotechnology products and services to increase sustainable development. Fears have been expressed that the results of biotechnology research and development will not be as available to developing countries as to scientifically advanced nations. These fears may not be justified because of the need for the biotechnology companies and their

affiliates to market their products as widely as possible. The eventual competition among the various companies will serve to keep prices in line with realistic values. However, concern has been expressed (Wolf, 1986) that the market size represented by the developing nations and the low margins on cereal grain crops such as wheat, rice, and sorghum may not provide sufficient incentive to private companies to do research on these crops. Thus, there is a clear need for research on these problems by public institutions and international research institutes. Some of the more promising areas of biotechnology research and development include:

Superior plant genotypes; genetically improved crop species for yield, quality and tolerant to pests and stress; biological pesticides; genetically improved animals for productivity; biological products to enhance environmental productivity and waste degradation.

## NATIONAL AND INTERNATIONAL POLICIES ARE NEEDED TO PROMOTE SUSTAINABLE DEVELOPMENT AND PROTECT ENVIRONMENTAL SYSTEMS

A number of critical policies must be adopted and followed in the future to promote sustainable development. Most of the policies will require an evaluation as to how a country or international development agency will implement the policy as well as the strategy for incorporating the economic cost into development plans. Most important of all is the commitment of countries and development institutions to plan and design sustainable development programs. A statement by Robert Repetto (1987), in the Symposium on Sustainability Issues in Agricultural Development is appropriate: "Natural resources must also be understood as productive capital—not just when they are mined or harvested as a flow of commodities to market but as a working stock that contributes critically to production." For new technologies and products to be effective, environmental resources must be protected so that they will be able to sustain a level of productivity commensurate to the potential of the new materials. Some of the most important issues to be considered in planning for sustained development are as follows:

Incorporation of environmental needs into project budgets and planning. Internalization of costs to protect, clean up, renovate, and rehabilitate. Consideration of national planning strategies to the effect that ecological system functions are assets that sustain economic development.

Recognization of linkages between healthy ecological functions and sustainable development.

Management of ecological functions as a part of development programs within management structure and budget. Encourage the adaptation of existing technologies from worldwide sources and their application to developing country ecosystems within the context of ecological resilience.

Resource development programs must utilize the opportunities new technologies present to solve immediate problems and create new levels of sustainable productivity. If the world is to successfully adapt and apply appropriate technologies to development and to provide the base for utilization of new technologies in the future, the environment must be protected to ensure its ability to sustain the level of intensification that will be required.

## REFERENCES

Brundtland, Gro Harlem, The World Commission on Environment and Development — getting at first causes. Journal, '86, The Annual Report of the World Resources Institute, 1986, 25

Conable, B. B., Opening Remarks, Sustainability Issues in Agricultural Development, in Agric. Sector Symposium, 7th World Bank, Wash. D. C., 1987, 1

Elkington, John, Double Dividends? U. S. Biotechnology and Third World Development, Wash. D. C. World Resources Institute Paper, 1986, 2:50

Globscope Pacific., Our Common Future, Introduction to Assembly and Public Hearing on Sustainable Development, Global Tomorrow Coalition Project, Los Angeles, CA. 1989

MacNeil, Jim., Sci. Amer., 1989, 261 (3): 155

McKell, Cyrus M., Shrub Biology and Utilization, San Diego, CA., Academic Press, 1979, 656

Repetto, Robert, Managing Natural Resources for Sustainability, in Agric. Sector Symposium, 7th Proc. World Bank, Wash. D. C., 1987, 167

Ruttan, Vernon, Institutional Requirements for Sustained Agricultural Development, in Agric. Sector Symposium, 7th, World Bank. Wash. D. C. 1987, 57

Westman, Walter, E., Measuring the Inertia and Resilience of Ecosystems, Bioscience, 1978, 28(11): 705

Wolf, Edward, C. Beyond the Green Revolution: New approaches for Third World Agriculture, World Watch Paper 73, World Watch Institute, Wash. D. C., 1986