# Sustainable Development and Biodiversity: Conflicts and Complementarities

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# Reconversion of Wasteland into Agricultural Land

This workshop brought the perspectives of agricultural developmentalists and conservationists to bear on the issues of wastelands, or degraded lands. Among the participants were agricultural engineers, foresters, ecologists, and sociologists. The field experience of participants represented a wide range of geographical, agro-ecological, and socio-political settings, including South, Central, and North America, Africa, Asia, and Europe. The examples shared at the workshop encompassed all the continents except Australia.

**Wastelands are not necessarily abandoned. Large numbers of the world's poor rely on degraded lands for their livelihood.**

The term "wastelands" has no strict definition, ambiguously conjuring up images of lands that are abandoned, infertile, barren, or devoid of vegetation. Wastelands are not necessarily abandoned. In fact, large numbers of the world's rural poor rely on degraded lands for their livelihood. The issue of soil fertility raises the question of the land's potential to produce biomass, a consideration that figured prominently in attempts to define the term "wastelands." Some lands that support relatively abundant vegetative cover are still seen as wastelands, or "green deserts," for example, areas in the Philippines covered with lush but useless *imperata* grass.

Areas categorized as wastelands have undergone some degradation, primarily caused by human intervention. For the purposes of discussion, and to propose some clear alternatives for rehabilitation, two symptoms of land degradation are important: 1) the production of dry weight biomass (kg/ha/year) on degraded lands is significantly lower than their potential (suboptimal biomass production can be difficult to determine because certain lands may produce low amounts of biomass due to climatic and related agro-ecological constraints); and 2) degraded lands have declining species diversity.

### Can Wastelands be Rehabilitated?

Efforts to rehabilitate degraded lands must be site-specific, related to the prevailing biophysical and socio-political conditions. In some cases, wastelands may be reconverted to agricultural production. In other cases, however, pasture, forestry, or other activities may be more appropriate land uses for reclaimed wasteland. Strategies for rehabilitation require a balance among four inter-related objectives: 1) agricultural productivity, 2) biological diversity, 3) social equity, and 4) sustainability. The productivity of land should not be measured simply in kg/ha/year of biomass, but should be assessed in terms of biological diversity and economic benefits as well. Biodiversity and economic viability are, in some ways, the preconditions of sustainability. Diverse ecosystems are more stable in the long term, while the adverse impacts of human intervention can be mitigated if sustainable land use is economically remunerative. Short-term sustainability must also be considered in order to address distributional inequities. Both intra- and inter-generational equity issues are important.

## The Causes of Degradation Must be Understood Before Attempting Rehabilitation

While there are virtually as many causes as cases of degradation, causes fit into four broad categories: 1) inequitable distribution of access to, and tenure over, resources; 2) commercially-motivated extraction; 3) population pressure; and 4) bad management. Investigation of these causes provides insight into the processes of degradation. For rehabilitative efforts to succeed, they must systematically address the causes and not simply treat the symptoms in band-aid fashion.

Insecure tenure over land and resources often contributes to the severity of degrading activity. Marginalized social groups with no land rights or no legally recognized claim over resources may exploit land as part of a strategy for survival, since they see no security or long-term benefits from conserving practices. This is not to blame the victim, but to understand the effects of inequitable distribution of resource benefits.

Commercial resource extraction, particularly logging and mining, are major causes of degradation, a process which applies to both renewable and non-renewable resources. Sustainable levels of renewable resource harvesting can be determined and adopted. There are also less environmentally destructive techniques that can be used for the extraction of essential non-renewable resources.

Population growth, in the aggregate sense, exerts pressure on land and can result in degradation. However, it is apparent that inequitable access to resources greatly exacerbates degradation. Further, population dynamics often represent a response to degradation. In the Himalayas and the Andes, out-migration from degraded areas has helped to stabilize populations at or below carrying-capacity levels. Population-induced degradation can occur where tenure systems break down as part of overall social change. In fact, unsustainable levels of consumption and production (including polluting by-products) by societies with zero or negative population growth can lead to resource loss. Therefore, population growth *per se* does not result in degradation.

Poor resource management practices are seen as a major contributor to land degradation. Inappropriate land use, for example, converting forest land with fragile soils to pasture or to permanent cropping, can result in declines in both biomass productivity and biodiversity. Large tracts of land have been subjected to poor irrigation management practices, resulting in waterlogging and soil salinization. Preventing degradation resulting from poor management is usually less difficult than rehabilitating such land after the fact.

## All Rehabilitation Includes Several Basic Steps

Efforts to rehabilitate wastelands must be approached from an interdisciplinary perspective, seeking to integrate the conceptual paradigms of ecology, agriculture, forestry, and the social sciences. The first step is the identification and assessment of degraded lands. While several attempts have been made to estimate the global extent of degraded lands, few researchers have addressed the loss of biodiversity in these estimates.

The loss of biodiversity implies reduced ability to reconvert wastelands to productive and sustainable uses. Conservation of species and ecosystems, therefore, must be part of the rehabilitative effort. Removal, as much as possible, of the structural causes behind the symptoms reflecting land degradation is also imperative.

Prioritization of cases amenable to rehabilitation follows the identification of degraded land and the establishment of basic causes. This process is likened to triage, where some cases are simply "too far gone" so that efforts are best concentrated on cases where some beneficial outcome can be expected.

Wherever possible, degraded lands should be taken out of production so that natural regeneration can take place. Some active improvement may be needed to restart biological cycles. It must be recognized that the impoverishment of certain social groups often makes this exceedingly difficult, as they need to keep exploiting the few resources they have access to even if this is biologically unwise.

The need for site-specific solutions should be re-emphasized. Rehabilitative efforts should include an appropriate mix of large and small projects undertaken by local groups, NGOs, national governments, and the international donor community. Successful examples of projects to rehabilitate degraded lands must be documented, evaluated, and given wide dissemination.

## Experiences With Rehabilitation

A number of specific examples of rehabilitation were given from workshop participants' direct experiences from South, Central, and North America, Africa, Asia, and Europe. These represented a diverse set of agro-ecological conditions, raising questions of substantial interest to researchers and practitioners.

Humid, lowland tropical forests of southern Mexico are being converted to pasture. Researchers have found that large canopy trees are often left in cleared pasture land. If not too isolated from the rest of the forest (<150 m), these trees can act as seed dispersal points by birds who perch and even nest in their branches. Each tree creates its own micro-ecosystem and can serve as the basis for natural forest regeneration. Research shows that the spatial configuration of trees as well as the existence of vegetative corridors (some in the form of living fences) are important in maintaining biodiversity.

An interesting point of contrast is Brazil, where trees left on pasture land cleared from the forest may decrease the market value of the land by one half, which gives incentive to remove all trees. Rules of tree tenure, the possibility of forest regeneration starting from these trees, and their serving as pest colonies are possible reasons for such contrasting ways of treating trees.

In the sub-humid Himalayan foothills of India, negotiated conservation agreements between state agencies and local communities in one area have allowed robust regrowth of forest and rangeland with sustained biodiversity. The key activity is promoting irrigation from earthen dams built for rainwater harvesting, which serve the additional function of soil and water conservation. The initial impetus for such investments came from a city downstream that put pressure on the government to control sediment flowing into its recreational lake.

Along with irrigation management, upland village communities set their own regulations and enforce grazing in a process known as "social fencing." With irrigation increased, agriculture has intensified, putting less pressure on forest areas for animal fodder. Additionally, the Forest Department now leases forest produce harvesting rights to local communities, instead of to private contractors. This exercise in joint management of resources appears to be sustainable and raises some interesting questions regarding the techniques and process of rehabilitation. Local communities are given a stake in maintaining biodiversity.

Experience from an agro-forestry project in the humid tropical forest in Brazil indicates that simple techniques can work for testing the viability of local tree species. Designed to meet multiple needs and promote biodiversity through the use of local species, the approach uses tree products to reduce dependence on livestock in the area. Several questions remain, for instance, the ability of various species to find nutrients and water at different depths in the soil profile. In order to endure the five-month dry season with temperatures up to 40° C, many species have roots that are 30m deep or more, as found by well-drilling operators. Understanding land use practices in three dimensions, including the root zone and the canopy, is important for designing rehabilitative efforts.

In the arid savannahs of Botswana, cattle are an important source of livelihood. However, EEC price supports for beef have encouraged overstocking. A diverse mix of large and small stock ensures efficient use of nutrients available on the range. Experience in drier conditions in the Kalahari Desert indicates that establishing trees often requires irrigation by hand at least to get them established. The sequencing of species introduced must address immediate and long-term local needs. Some interesting ecological features of plants in arid areas with low biomass potential include plants' own survival mechanisms (i.e. thorns, taproots, etc.).

Reforestation activities will often be more successful if they use local species. In some cases, the introduction of appropriate exotic species in forestry programs may be justified. One researcher reported from Puerto Rico that exotics may work well as colonizers of degraded land because leaf fall is less susceptible to consumption by local micro-organisms, and hence it improves soil structure. While this indicates that the introduction of exotic species can under some conditions contribute to improving environmental resources, workshop participants felt that most efforts should be directed toward the selection and use of local species.

The critical need to create secure tenure concerning trees and their produce was illustrated by a successful project in the humid tropics in Bangladesh. Villagers had previously burned state-owned forests to cause a growth flush of *Imperata cylindrica* which is used as thatch grass. (It is interesting to note that in the Philippines, land covered by *Imperata* is considered "wasteland.") Once tree tenure was given to individuals (the government still held title to the land), villagers carefully tended the trees, resulting in levels of growth and maintenance that astonished the Forest Department. The Bangladesh case shows how different tenure systems can co-exist for the same land area.

It is instructive to compare two examples of the restoration of mining operations. In both the United States and Spain, restoration is legally required of mine operators. In semi-arid Spain, significant potential exists for converting open pit mines into recreational lakes for swimming and fishing. Reforestation has been successfully used in mine restoration. However, only two species have been planted and the incidence of forest fires has increased. Diversifying the species mix would improve fire resistance and create a more favorable environment for the growth of shrubs and grasses.

Regulations require mine operators in southwestern Virginia to restore the hillside's original grade and to reforest. Bulldozers compact the soil, however, and the establishment of diverse plant species is difficult on poor soils with acidic drainage from the mines. Some potential is seen in developing techniques for bulldozer operators that enable them to leave topsoil on the surface of the restored grade. The sequencing of vegetation is important if full canopy cover is to be restored. Extending the time period for regulatory inspection from three to ten years after mining operations cease might produce better results through legal pressure for continued followup by mine operators.

## Concluding Observations

Sustainable approaches to rehabilitating degraded lands while maintaining biodiversity contain important lessons for researchers and practitioners alike. The workshop called for more site-specific research into complementary aspects of agricultural production and ecological conservation as well as for projects that put the principles presented here into practice. Successful wasteland rehabilitation requires integrating the knowledge and strengths of multiple disciplines with experience gained from field applications.