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The Ecosystem Approach and Agricultural Biodiversity

The focus of agricultural biodiversity has led to the realization of the importance of the components of agricultural biodiversity at the ecosystem level. These are important in supporting agricultural production, and in providing a wider range of "ecosystem services."

> As defined in Article 2 of the Convention on Biological Diversity, an ecosystem consists of a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.

Preliminary categorization of the multiple goods and services provided by agricultural biodiversity in ecosystems.

Goods and Services	Examples	Nature of Value	Contibutions to Livelihoods and Benefits to other Stakeholders	Major Challenge for Sustainability of Use
Goods				
1. Products derived directly from biological resources hunted or gathered from managed systems through agriculture	Crop and livestock production, timber from plantation forestry, and fish from aquaculture	Direct use values (consumptive, some not traded in markets)	Basis of food industry and sustainable food production and livelihood systems, especially for traditional farmers	To ensure sustainability of the managed ecosystem itself; to avoid negative externalities on other ecosystems
2. Products derived directly from biological resources hunted or gathered from natural or seminatural systems	Most fish, wildlife, gathered wild foods and medicinal plants, etc. Pharmaceutical derivatives and new plant varieties	Direct use values (consumptive, much not traded in markets)	Significant contribution of nutrition and other livelihood needs of rural and peri-urban vulnerable groups, and of traditional healers	To avoid over-exploitation of resources and damage to ecosystem integrity
3. Products derived indirectly from the information content of collected genetic resources	Nutrient cycling, pest and disease control, pollination	Direct use value (current use) Option value (known material, not used currently) Exploration value (undiscovered sources)	Raw materials for plant breeding and pharmaceutical production. Values largely appropriated by breeding and pharmaceutical companies, and by farmers in 'industrial' areas that use improved varieties	To ensure continued provision of genetic resources by incentives and fair and equitable sharing of benefits derived

Goods and Services	Examples	Nature of Value	Contibutions to Livelihoods and Benefits to other Stakeholders	Major Challenge for Sustainability of Use
Services				
4. Essential processes to ensure continued functioning, resilience and productivity of ecosystems which provide the goods 1,2 and 3	Watershed protection, carbon sequestration, habitat protection, climate stabilization	Indirect use values	Essential support to sustainable food production and livelihood systems for all types of farmers. Benefits largely appropriated at the local level	To maintain ecosystem integrity; and to prevent pollution
5. Wider ecosystem functions	Varieties valued for culinary properties; scenic and culturally important landscapes; sacred sites, etc.	Indirect use values	Benefits of services appropriated at various levels, from local to global	To maintain ecosystem integrity; to prevent pollution and habitat conversion; and to internalize externalities
6. Spiritual, cultural, and aesthetic functions	Use of multiple species, breeds and varieties	Direct use value (recreation), Indirect use value Existence (non-use) value	Benefits of services appropriated at various levels, from local to global	To prevent damage from excessive and/or inappropriate tourism; and prevention of habitat
7. Insurance against risk and uncertainty		Porfolio value Option and exploration values	Portfolio value appropriated at various levels from local to global	

One feature of the ecosystem approach being developed under the Convention on Biological Diversity is the attention it gives to the full range of goods and services provided by biological diversity (see table on previous page). The application of the ecosystem approach implies:

- intersectoral cooperation;
- decentralization of management to the lowest level appropriate;
- equitable distribution of benefits; and
- use of adaptive management policies that can deal with uncertainties and are modified in the light of experience and changing conditions.

Farmers as Ecosystem Managers

There is an opportunity for farmers to be engaged in the management of agricultural ecosystems. They can help reduce negative externalities and increase productivity. This management is usually practiced by: individual fishers, farmers, or forest harvesters (through communities, non-governmental organizations, district governments, nations, private corporations, large eco-regions, and global organizations).

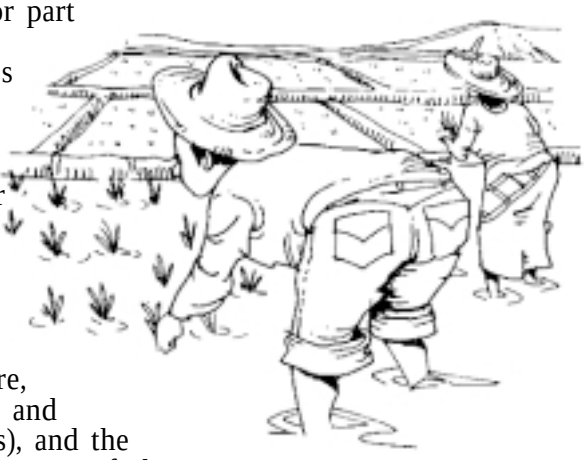
Farmer field schools facilitate application of an ecological approach to agricultural intensification. It uses an adaptive management that requires the main responsibility of ecosystem management be returned to the farmer and the community.

Likewise, farmers in agricultural systems choose and maintain a major part of the biota (i.e., crops and livestock), which are often from exotic species. Furthermore, the farmers influence the composition and activities of the associated biota (i.e., herbivore, predator, symbiont, and decomposer groups), and the structure and function of the landscape within which agricultural production systems are situated.

Ecosystems Approach and Ecosystem Services

Agricultural ecosystems are designed to produce certain goods (e.g., food, feed and fiber). Increasingly, it is being recognized that agricultural ecosystems also provide other services, such as recreational areas and clean water.

In agricultural ecosystems, a major part of the biota (i.e., usually exotic crops and livestock) is chosen and maintained by the farmer. The farmer also influences the composition and activities of the associated biota (including herbivore, predator, symbiont and decomposer groups), and the structure and functioning of the landscape within which agricultural production systems are situated.



Agriculture often represents a simplification of the ecosystem as compared to the one that it displaces. Nonetheless, there are usually substantial levels of biological diversity in agricultural ecosystems. In addition to the "planned components" (i.e., crops and livestock), many "associated components" of biological diversity in agro-ecosystems are essential for agricultural production itself. These components include:

- soil-nutrient cycling;
- pest and disease modulation; and
- pollination of many crops.

Agricultural ecosystems constitute major parts of watersheds. These are often the main landscapes for recreation and tourism, and they harbor important biodiversity in their own right. In fact, in some regions, it is only now that some elements of biodiversity exist in areas dominated by agriculture. Management of biodiversity in such areas, is therefore, an essential component of an overall approach to its conservation. There is a wide range of agricultural ecosystems, and in some of them, biodiversity is comparable to levels in natural ecosystems.

The ecosystem approach to the management of agricultural biodiversity combines food production and the provision of other goods and services derived from biodiversity in agriculture.

Principles of the Ecosystem Approach

The following 12 principles are complementary and interlinked:

Principle 1: The objectives of management of land, water and living resources are a matter of societal choice.

Rationale:

Different sectors of society view ecosystems in terms of their own economic, cultural and societal needs. Indigenous peoples and other local communities living on the land are important stakeholders and their rights and interests should be recognized. Both cultural and biological diversity are central components of the ecosystem approach, and management should take this into account. Societal choices should be expressed as clearly as possible. Ecosystems should be managed for their intrinsic values and for the tangible or intangible benefits for humans, in a fair and equitable way.

Principle 2: Management should be decentralized to the lowest appropriate level.

Rationale:
Decentralized systems may lead to greater efficiency, effectiveness and equity. Management should involve all stakeholders and balance local interests with the wider public interest. The closer management is to the ecosystem, the greater the responsibility, ownership, accountability, participation, and use of local knowledge.

Principle 3: Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.

Rationale:
Management interventions in ecosystems often have unknown or unpredictable effects on other ecosystems; therefore, possible impacts need careful consideration and analysis. This may require new arrangements or ways of organization for institutions involved in decision-making to make, if necessary, appropriate compromises.

Principle 4: Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context.

Any such ecosystem-management programme should:

a. Reduce those market distortions that adversely affect biological diversity;
b. Align incentives to promote biodiversity conservation and sustainable use; and
c. Internalize costs and benefits in the given ecosystem to the extent feasible.

Rationale:
The greatest threat to biological diversity lies in its replacement by alternative systems of land use. This often arises through market distortions, which undervalue natural systems and populations and provide perverse incentives and subsidies to favor the conversion of land to less diverse systems.

Often, those who benefit from conservation do not pay costs associated with conservation and, similarly, those who generate environmental costs (e.g., pollution) escape responsibility. Alignment of incentives allows those who control the resource to benefit and ensures that those who generate environmental costs will pay.

Principle 5: Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.

Rationale:
Ecosystem functioning and resilience depends on a dynamic relationship within species, among species and between species and their abiotic environment, as well as the physical and chemical interactions within the environment. The conservation and, where appropriate, restoration of these interactions and processess are of greater significance for the long-term maintenance of biological diversity than simply protection of species.

Principle 6: Ecosystems must be managed within the limits of their functioning.

Rationale:
In considering the likelihood or ease of attaining the management objectives, attention should be given to the environmental conditions that limit natural productivity, ecosystem structure, functioning and diversity. The limits of ecosystem functioning may be affected to different degrees

by temporary, unpredictable or artificially maintained conditions and, accordingly, management should be appropriately cautious.

Principle 7: The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.

Rationale:
The approach should be bounded by spatial and temporal scales that are appropriate to the objectives. Boundaries for management will be defined operationally by users, managers, scientists and indigenous and local peoples. Connectivity between areas should be promoted where necessary. The ecosystem approach is based upon the hierarchical nature of biological diversity characterized by the interaction and integration of genes, species and ecosystems.

Principle 8: Recognizing the varying temporal scales and lag-effects that characterize ecosystem processess, objectives for ecosystem management should be set for the long term.

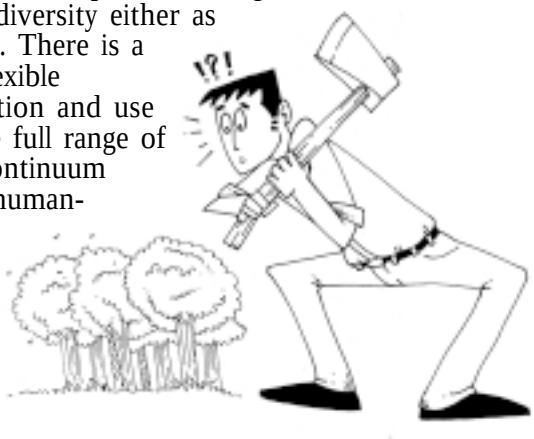
Rationale:
Ecosystem processes are characterized by varying temporal scales and lag-effects. This inherently conflicts with the tendency of humans to favor short-term gains and immediate benefits over future ones.

Principle 9: Management must recognize that change is inevitable.

Rationale:
Ecosystem change, including species composition and population abundance, hence, management should adapt to the changes. Apart from their inherent dynamics of change, ecosystems are beset by a complex of uncertainties and potential "surprises" in the human, biological and environmental realms. Traditional disturbance regimes may be important for ecosystem structure and functioning, and may need to be maintained or restored. The ecosystem approach must utilize adaptive management in order to anticipate and cater for such changes and events and should be cautious in making any decision that may foreclose options, but, at the same time, consider mitigating actions to cope with long-term changes such as climate change.

Principle 10: The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.

Rationale:
Biological diversity is critical both for its intrinsic value and because of the key role it plays in providing the ecosystem and other services upon which we all ultimately depend. There has been a tendency in the past to manage components of biological diversity either as protected or non-protected. There is a need for a shift to more flexible situations, where conservation and use are seen in context and the full range of measures is applied in a continuum from strictly protected to human-made ecosystems.



Principle 11: The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.

Rationale:
Information from all sources is critical to arriving at effective ecosystem management strategies. A much better knowledge of ecosystem functions and the impact of human use is desirable. All relevant information from any concerned area should be shared with all stakeholders and actors, taking into account, inter alia, any decision to be taken under Article 8 (j) of the Convention on Biological Diversity. Assumptions behind proposed management decisions should be made explicit and checked against available knowledge and views of stakeholders.

Principle 12: The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

Rationale:
Most problems of biological diversity management are complex, with many interactions, side-effects and implications, and therefore should involve the necessary expertise and stakeholders at the local, national, regional and international level, as appropriate.

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For more information, see:
UNEP/CBD/COP/5/Inf.11. Information paper prepared for the fifth meeting of the Conference of the Parties of the Convention on Biological Diversity, Nairobi. 2000.

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