***GSV Technical Brief*: 006**
***Date of Release*: 02 MAY 2019**

Ecosystem Functions, Services and Biodiversity-III[1]

In ***Part I*** of this brief, we tried to explain what the term ecosystem means, and elaborated briefly on ecosystems services and functions. We also introduced biodiversity and the need for the conservation of diversity in the biological world. In ***Part II***, we described briefly the relationship between ecosystems functions and biodiversity. Here in ***Part III*,** we describe the components of biodiversity, the current thinking of GRSV on why we should be concerned about biodiversity at different levels, how conservation and use of biodiversity, focusing on agricultural biodiversity and how such efforts can be balanced with developmental efforts.

Components of Biodiversity: The Need for Concern for its Conservation

We briefly recapitulate here what we said on this in Parts I and II. Different forms of life - plant, animal, and microbial species - living within an ecosystem community are the different components of biodiversity. We have noted that critical processes at the ecosystem level influence almost all the ecosystem services - plant productivity, soil fertility, water quality, atmosphere, etc., which ultimately affects human well-being. In turn, the ecosystem functions and services are controlled by both the diversity and identity of the plant, animal, and microbial species that inhabit an ecosystem and their frequency. Substantial changes have already occurred, especially in terms of the loss or erosion of biodiversity at both local and global levels. We already noted the following:

- There has been dramatic loss in biodiversity at all levels - from genes and species to entire ecosystems;
- Loss at the local level has been more dramatic than loss at the global level;
- Such a loss has affected many functions and services.

All this loss can significantly impact, mostly negatively, human well-being. It can take the following forms:

- Decline in production of various goods;

---

[1] **Ramanatha Rao V**, former Senior Scientist, Bioversity International, Regional Office for Asia, the Pacific and Oceania, Kuala Lumpur, Malaysia and Honorary Research Fellow, Bioversity International, Rome;
V Parthasarathy, formerly Director and Emeritus Scientist, Indian Institute of Spices Research, Calicut; formerly National Project Coordinator, COGENT (IPGRI) at CPCRI and formerly National Project Coordinator, Tropical Fruit Genetic Resources, Bioversity International based at IIHR, presently Adjunct Faculty in Horticulture by IARI and President of National Academy of Biological Sciences, Chennai;
Toby Hodgkin, former Principal Scientist, Bioversity International, Rome, Italy and presently Coordinator of Platform for Agrobiodiversity Research and Honorary Research Fellow with Bioversity International, Rome.

- Decline in soil structure and nutrition; or
- Polluted water, etc.

We believe that there is really no indication that these negative effects will stop in the future; indeed, they may further increase in changing climatic conditions. Hence, it is imperative that conservation of local and global biodiversity be given high priority. These efforts should not only be a national priority but should also be a part of social movements.

Agricultural biodiversity

Although there is no formal definition of agricultural biodiversity, generally it is agreed by the parties to the Convention on Biological Diversity (CBD)(https://www.cbd.int/agro/whatis.shtml) that it is a broad term that includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agricultural ecosystems, also named agro-ecosystems: the variety and variability of animals, plants and micro-organisms, at the genetic, species, and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem, its structure and processes. Agricultural biodiversity is a vital component of human well-being, as the services it provides include all the agricultural products needed by us in everyday life – for food, feed, fodder, fibre, health, habitation, etc. Hence, there is no need to highlight the importance of the role played by agricultural biodiversity in our lives, and it becomes imperative that we be concerned about its status and that it continues to contribute to the present and future needs of all humans.

Value of agricultural biodiversity

Policy makers in most countries have responded to concerns over declining levels of biodiversity in general, and agricultural biodiversity , and this has led to the introduction of a range of policy measures at national levels and conventions (or agreements) at the international level. There has been some questioning of costs involved in conservation measures to be taken. Estimating the costs for measures that promote conservation is relatively easy; however, it is much more difficult to estimate the benefits. Econometrics can help guide the design of biodiversity policy by eliciting public preferences on different attributes of biodiversity. However, this is complicated by the generally low level of awareness and understanding of what biodiversity means on the part of the general public. Since many of the estimates will be/are based on highly theoretical concepts, assumptions, and perceptions, it is important to treat them as guidelines and not standards. One might even question the need for valuation of such life-sustaining natural resources purely in economic terms, which runs the risk of undervaluing the immense social and cultural benefits provided by agricultural biodiversity.

Conservation measures

The available methods for conserving agricultural biodiversity can generally be grouped as *in situ* and *ex situ*.

In situ*/on-farm conservation*: According to the Convention on Biological Diversity CBD, in situ conservation involves the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties, i.e., farmsteads. *In situ* or on-farm conservation, along with home gardens agricultural biodiversity is important to most species and varieties or breeds, supporting farmer livelihoods and allowing for continuing evolution. In general, wild species and crop wild relatives (especially tree and perennial plant species) can be considered as main candidates for conservation *in situ* in the wild, and the involvement of foresters becomes essential. Successful conservation of crop genetic resources on-farm is only possible with the full involvement of farmers and communities, and it can only take place when it is internalized with farmers' production activities directed to improve their livelihood ("conservation through use"). This means that on-farm conservation efforts must be carried out within the framework of farmers' livelihood needs. Institutions and researchers need to learn and appreciate how to work more closely with farmers and communities, as well as recognize that the exchange of knowledge is a two-way process. The success of on-farm conservation of crop diversity demands not only providing incentives for conservation but also empowering farmers in making self-directed decisions, with the assistance of local organizations.

Ex situ *Conservation*: *Ex situ* conservation is a set of conservation methods that focus on the transfer of a target species/genotype/landrace away from its normal native habitat. The main objectives of *ex situ* conservation are the rescue and preservation of threatened genetic material and use of the material for various purposes. These methods include the following: maintaining whole plants in the field (field genebank); well-dried orthodox seeds in cold stores (seed genebank); clonally propagated plants as tissue/organ/cell cultures under slow growth (in vitro genebank) conditions; non-orthodox seed and vegetatively propagated plants, pollen and DNA in liquid nitrogen under cryopreservation (Cryo genebank). Standards for conservation of orthodox seeds, non-orthodox seeds, and vegetatively propagated materials are available, and these are useful to genebank managers and researchers for their establishment and management, and to decision makers to determine the financial support required.

Conservation and Use

The main driving force for the conservation of agricultural biodiversity is their value for the present and future. Thus, either now or in the future, all plant conservation efforts that we make and the methods and approaches that we use should ultimately focus on promoting the use of conserved resources, be it from genebanks, experimental fields, laboratories, farmers' fields, or plantations. During the last four decades, global as well as national efforts on conservation and use of plant genetic resources have made significant progress.

At the national level, or for that matter at the global level, agriculture continues to face five major challenges: ensuring food and nutrition security; livelihood security; achieving sustainable production and productivity of food and

commodity crops; combating diminishing non-renewable resources, including land and water; meeting the demands placed by global changes such as migration, urbanization and climate change and their impact of agriculture on environment. It is our belief that increasing work on making agricultural biodiversity easily accessible and refocussing on integrating traditional knowledge with modern knowledge and methods can help us to continue to make progress in using agricultural biodiversity in facing those challenges. Such a refocus will be useful in making conservation compatible with a developmental agenda.

Suggested Reading

Bakarr, M and K. Pixley 2017. Crop biodiversity: The key to ending hunger. http://www.aljazeera.com/indepth/opinion/2017/05/neglecting-major-ally-hunger-170521103802043.html?%20Accessed%20on%2023052017 Accessed on 23/05/2017.

CBD (Secretariat of the Convention on Biological Diversity) 2005 Handbook of the Convention on Biological Diversity Including its Cartagena Protocol on Biosafety, 3rd edition, (Montreal, Canada).

Gruber K. 2017. Agrobiodiversity: The living library. Nature 544: S8–S10 (27 April 2017) doi:10.1038/544S8a

Cernansky, R. 2017. The biodiversity revolution.Nature 546, June 2017: 22-24.

Rajeswari S Raina, Debanjana Dey. 2017. The Valuation Conundrum. Economic and Pollical Weekly LI(47):70-78.