Tribal Dominated Tracts are the "Hot Spots" of Agrobiodiversity - Priorities and Concerns for PGR Management

Anjula Pandey, Soyimchiten and **S. Niveditha**
Division of Plant Exploration and Germplasm Collection, ICAR-NBPGR, New Delhi

Introduction

Agricultural biodiversity, agri- or agro-biodiversity (a subset of biodiversity) is defined as 'all crops and livestocks, their wild relatives, and all interacting species of pollinators, symbionts, pests, parasites, predators and competitors' (Qualset *et al*. 1995). Plant genetic resources (PGR) are one of the most crucial components of agri-biodiversity and constitute the genetic material of plants having value as a resource for present and future generations of human beings (IPGRI, 1993). Full spectrum of the PGR broadly includes landraces, modern varieties, wild and weedy relatives of cultivated plants, and potential domesticates (wild species used or having potential value).

During the process of crop evolution crops originated in its centre of origin have changed from the wild progenitors in morphological, physiological and agronomic traits to newer types through selection for desired traits (Pandey and Arora 2004). In this whole process, agriculture (broadly the process of rearing plants and animals, wild or tamed), cultivation (physical activities which are relevant to and associated with agriculture) and domestication (process of genetic shift in domesticated population to adapt them to better/changed or artificial environment, created by cultivation conditions) have shapened them for appropriate PGR. Selection for characteristic(s) may be unintentional or unconscious (Harlan, 1975).

Over centuries, tribal or traditional farming communities have continuously adapted and shapened the dimensions of rich genetic material available with them. These resources or traditional varieties or landrace populations often bear specific traits- early or late maturing, adaptability to a particular soil type, uses and usually have local names (Brush *et al.*, 1981, Dennis, 1987) which has enabled them to survive so long under various biotic and abiotic stresses in the centres of diversity along with wild progenitors of crop plants, wild and weedy relatives. Besides these resources, potential domesticates (also can be called wild economic species) are involved in the PGR spectrum; they are those wild species, which are not yet domesticated but are extensively used. Some of them grow widely, though genetically and culturally in a near wild state. With richness of plant genetic resources, the tribal regions have therefore been identified as "Hot Spots" of agri-biodiversty. However, they are different from the biodiversity hot-spots (as per definition of Myer s et al. 2000) which include all entire endemic biodiversity as a priority for defining hot-spots of a region.

The North East Hill region of India is inhabited by over 100 different tribal communities that intimately dependent on forest resources for their sustenance (Saha and Sundriyal 2010). Native medicinal plants of India- *Dioscorea deltoidea* (an important source of diosgenin, a precursor for the synthesis of cortisone and of steroidal sex hormone) and *Rauvolfia serpentina* (the roots of which contain many alkaloids, notably reserpine, an anti-hypertensive drug) and wild species, pasture and rangelands are some examples.

PGR Management: Prioritization

Effective and efficient management practices of PGR demand a rationale approach towards prioritization. Prioritization of a crop based on level of genetic erosion (if declared so) or where areas under crop cultivation is drastically reduced in short period (vulnerable to erosion and replacement by

newly introduced type) remains at the top; areas with rich diversity in terms of landraces and wild relatives growing simultaneously and no extensive farming is practiced come at medium priority.

The national priority for collection and conservation of targeted crops/ crop-group(s) are set as per guidelines for germplasm collection based on status of: (i) loss of genetic diversity, (ii) economic importance, (iii) nutritional value, and (iv) level of research. Data recorded during previous collection missions, the feedback from consumers, users, grower communities, information on onset of disease, recurrence of flood/ drought, etc. occurred in the past are helpful in deciding priority. Areas of concentration of diversity (where cultivated and wild types are simultaneously growing, crossable to produce introgressed forms) are likely to carry useful genes. Areas of distribution representing the extreme limits of occurrence may contain some useful and rare alleles that might have escaped during the process of domestication. Similarly germplasm collected from an areas showing promising trait if found stable on evaluation, needs to be further surveyed through fine grid sampling for desirable genotypes (to capture continuous population/ large population sampling).

Among the diversity rich areas of a country, the tribal dominating areas are difficult, many times unsurveyed or least surveyed, and have primitive cultivars/ locally adapted types. Many native crops such as brinjal, pointed gourd, Indian round melon, bitter gourd, ridge and smooth gourd, snake gourd, cucumbers and leafy amaranths and leafy crops that have long history of cultivation in tribal tracts of India.

The authors prefer the following four criteria keeping in view the mandate and priorities of PGR ICAR-NBPGR as well as practical utilitarian considerations. Prioritization of crops needs to be done based on the following criterion: Level of genetic erosion; Areas not explored for collection of germplasm of major/ minor vegetables; Areas explored but germplasm holdings do not represent full spectrum of diversity across regions; Areas fully explored, germplasm represented in the genebank holdings but material is not enough for medium term storage/ supply; and Areas fully explored, but crop not yet collected for specific traits (on demand by the breeders, R&D basis) Further, within each category, assessment of the level of priority (high, medium and low) has been considered keeping in view the collection/conservation gaps and research thrust in India.

PGR Management in Tribal Areas

Farming communities and tribals usually have multiple interests or concerns and are confronted with numerous challenges of sustenance. On-farm conservation of PGR involves continued cultivation and management of a diverse set of crop populations in the agro-systems where the crop has evolved or in secondary centres of diversity (Bellon et al., 1997). Particularly in the marginal areas, they depend largely on the availability of genetic diversity because of food security and self-sufficiency. In diversity rich areas farmers/tribals often cultivate several crop varieties in one season, and adaptive complex of crop genetic diversity enables them to adopt crops suited to their ecological niches and cultural crop production practices. For conserving the diversity they generally follow their local methods of preservation/ conservation. Among the communities there is reciprocal and sometimes free exchange of material for their mutual benefits.

In course of development in PGR management practices, over the years India has developed sound scientific management regimes for *ex situ* conservation and access to its genetic resources. Groups of institutions, scientific societies, non-governmental organisations are addressing the task of protecting the genetic resources while deriving benefit from them through the Indian National Plant Genetic Resources System. The System operates in a network mode with ICAR-NBPGR, New Delhi as the nodal agency for its coordination wherein material from these areas is systematically identified, collected , conserved and use for research and development in agri-system.

Even while practising *in situ* conservation, there is always a threat of a species becoming extinct or its population declining due to genetic drift and inbreeding, demographic and environmental variations, habitat loss, competition from exotic species, disease or over-exploitation and human disturbances. The ex situ conservation - seed genebanks, field genebanks, *in vitro* repositories and cryopreservation does not maintain evolutionary processes that created the crop germplasm (Harris, 1989; Hamilton, 1994).

Tribal Areas- One of the Prioritised Sites for PGR Management

Among the global diversity rich regions, Hindustan gene centre (Hotspot- a biogeographic region with a significant reservoir of rich endemic diversity; lost at least 2/3 of primary vegetation) are one of the known region. In this the tribal pockets have range of native/ endemic diversity spectrum of PGR and demonstrate evolutionary process from wild to cultivated crops. They serve as resource for knowledge on collection, methods of conservation, storage practices, documentation of traditional methods for valuation, and neutraceutical use. Therefore they may be designated as experimental sites and working laboratory for PGR study.

The effect of environment in shaping the plant evolutionary path has been studied in details in natural populations and also under domestication. The difference between the two is that human intervention has played an important role in effecting the trends in latter and rates of evolution under domestication is faster. Tribal sites demonstrate the domestication process wherein agri-biodiversity represented as cultivated and associated wild, wild potential, crop relatives/weedy/wild relatives may be seen in human inhabited regions tribal dominated tracts. Such diversity is also seen in haats/market where they harvest and sell the produce; stored in farms. Tribals have their ethnic touch and also the indigenous knowledge.

The tribal areas are identified on the basis of following features:

- PGR diversity evidently available as wild, semi-wild, cultivated as a part of the area; depict the process of plant domestication
- Heavy interdependence on locally available plant material; multi-uses of plant species, uses based on indigenous traditional/environmental knowledge
- Impact of rich ethnic and traditional culture on use of genetic resources; closer linkage with ecology, sociology, demographic, etc.
- Areas restricted/confined; plant diversity is generally unique, least known to have influence from other factors as compared to the other areas
- Knowledge resources related to PGR well preserved and passed on to generations
- Low-input, low-cost option for enhanced nutritional value with limited monitory benefits
- Trait-specific germplasm screened through natural conditions-drought or conflict-driven famine, water stress

In many parts of the globes, tribal communities still gather and consume edible wild plants. Rural communities use these plants to supplement their diets which are based on a narrow range of rain-fed staples particularly vital at times of food shortage because they enhance livelihoods, survival strategies and support household economies. Free and easy accessibility and nutritional richness especially vitamins and micronutrients play a significant role in the livelihoods of rural communities through improved household incomes and food security. Some studies on ethnomedicinal plants have been conducted in many tribal areas- NEH, Chhattisgarh. Information on the nutritional values of most of

the underutilized species is not available. Systematic documentation of indigenous knowledge on identity and use of wild plants used as food by communities is much needed.

Research and development activities to tap these assets for economic development and sustainability have also remained at the bottom. Of several diversity regions/ agri-diversiy hot spots like NEH and other tribal rich regions of India, Chhattisgarh is one of them which deserves to be given emphasis on collection, documentation of WEP especially vegetables, fruits, minor species. The authors have contributed actively in this areas and have undertaken exploratory and surveys in past two decades time. Community leaders in collaboration with government should devise strategies and mechanisms of promoting knowledge and awareness on the importance of production and utilization of these indigenous plant resources for food security, nutrition and income generation. Some studies in India indicated that many rural people are endowed with deep knowledge on how to use plant resources. This is particularly true with regard to the use of medicinal plants and wild edible plants that are consumed at times of famine and other hardships e.g. Soh-phlong, coix, fagopyrum.

The ethnic and cultural diversity of a country has contributed to richness of plant genetic diversity. There are over 427 tribal communities which is 9.74 per cent of the total population, of 227 ethnic groups, spread over 5,000 forest villages (Singh and Lal, 1998). These tribal communities and ethnic tribes use 1,532 wild edible plant species, including 145 of roots and tubers, 521 leafy green vegetables, 101 of bulbs and flowers, 647 fruits and 118 seeds and nut (Arora and Pandey, 1996; Gautam 1998). The diversity in genetic resources of direct or indirect use and their wild relatives is distributed in different agro-ecological regions of the country. The number of species in these regions are: 125 in warm humid tropical/sub-tropical western Himalayas, 132 in North-eastern region, 82 in eastern Himalayas, 66 in Gangetic plains, 45 in western/Sutlej plains, 145 in western peninsular region/Malabar and 91 in eastern peninsular region/Deccan plateau. The species strength of wild relatives and related types in Indian gene centre, is estimated to be about 320, of which about 60 are endemic species. In medicinal and aromatic plants, there are about 7,500 species distributed mainly in humid tropical and temperate forests of the Indian sub-continent. These are still largely used in traditional indigenous systems of medicine and are gathered from the wild.

Traditionally various communities have been conserving economic and ecological keystone species (a species that is crucial in determining the nature and structure of the entire ecosystem in which it lives) for spiritual/medicinal value, in sacred grooves which range from few plants to several acres. The important regions for grooves are Khasi and Jaintia Hills, Western Ghats, Aravalli Hills and Sarguja, Chand and Bastar area in Central India. Ethnically diverse areas in Northeast hills of India, a global hotspot are dependent for livelihood. Tribal mountain communities and other communities are involved in forest management without destroying the resource and have dependence on the forest resources as an important survival strategy in the Himalaya and northeast India (Sundriyal et al. 2004).

PGR Management- Way Ahead

Keeping in view the experience of authors in germplasm collecting activity in general and in tribals areas in particular, the relevant information has been put together for the benefit of the readers. In the hour of climate change regime and changes in the life style, such areas are vulnerable to changes. Genetic resources in tribal regions -cultivated species especially lesser-known/underutilized types, wild relatives, wild economic species, potential material about which there is hardly any knowledge among users. These areas are poorly documented for the intense knowledge resources.

Efforts need to be made to collect germplasm from diverse sources having resistance to biotic and abiotic stresses, genotypes with desirable yield and quality characters. During germplasm collection,

the traits preferred in the outside/foreign markets should be given due attention. Large genetic variability present in crops needs to be utilized.

- Identifying gaps in germplasm collection
- Collecting from priority areas (under-explored/ inaccessible/ tribal/ diversity-rich pockets)
- Collecting from diversity rich areas (ethnically and culturally) for landraces, primitive cultivars; wild relatives, endangered, endemic and potential species/less-known crops of nutraceutical importance
- Collecting trait-specific germplasm mainly for biotic and quality parameters; studies in indigenous taxa
- Documentation of information on traits of significance, methods of use, recepies, nutritional aspects; inventorying diversity of plant genetic resources in tribal communities extract from the natural areas to supplement their home needs
- Basic research on adaptability study, conservation, multiplication, nutritional aspects for food species etc.
- Methods and perceptions of communities about sustainable development of these resources

Selected References

Arora RK and Nayar ER (1984). Wild Relatives Crop Plants in India. NBPGR Sci. Mag. No. 7 90p.

Arora RK and Pandey A (1996). Wild Edible Plants of India – Diversity, Conservation and Uses. ICAR, NBPGR.

Arora RK (1991) Plant Diversity in the Indian Gene centre. In: Paroda RS & Arora RK (eds) Plant Genetic Resources - Conservation and Management. Intern. Board for Plant Genetic Resources, Regional Office for South Asia and South East Asia, NBPGR Campus, New Delhi, pp. 25-54.

Bellon MR, Pham LJ and Jackson MT (1997). Genetic conservation- a role for rice farmers in Martel N, Ford-Lloyd BV & Hawkes JG (eds.). Plant Conservation: The In situ Approach. Chapman & Hall, London. pp-263-289.

Brush SB, Carney HJ and Huaman Z (1981). Dynamics of Andean potato cultivars. Eco. Bot. 35: 75-88.

Debabrata Saha and R.C. Sundriyal (2013) Perspectives of tribal communities on NTFP Resource use in a global hotspot: implications for adaptive management. J Nat Sci Res 3 (4):125-169.

Ekka NS and Ekka A (2016) Wild Edible plants Used by Tribals of North-east Chhattisgarh (Part-I), India Research Journal of Recent Sciences 5(ISC-2015): 127-131.

FAO, 1995 Conservation and sustainable utilisation of plant genetic resources in South Asia sub-regional synthesis report, FAO, Rome 28pp

Gupta AK (1995). Compensating Local Communities for Conserving Biodiversity: How Much, Who Will, How and When, 1995, and published as rewarding Local Communities for conserving Biodiversity: The Case of the Honey Bee in Protection of Global Biodiversity: Converging Strategies (ed. Lakshman D. Guruswamy and Jeffrey A McNeely) Durhan and London: Duke University Press, pp. 180-189, 1998, IIMA WP No.99-10-14, October 1999.

Hamilton MB (1994). Ex situ conservation of wild plant species time to reassess the genetic assumption and implications of seed banks Conserv. Biol. 8: 39-40.

Harlan JR (1992). Crops and Men. American Society of Agronomy, Madison.

Harris DR (1989). An evolutionary continuum of plant - people interaction. In: Harris DR & Hillman GC (eds) Foraging and farming: the evolution of plant exploration. Unwin –Hyman, London.

Hawkes JG (1983). The Diversity of Crop Plant. Harvard Univ. Press. Cambridge. 184.

Hawkes JG, Maxted N & Ford Lloyd BV (eds.) (1992). The Ex Situ Conservation of Plant Genetic Resources. Kluwer Acad. Pub, Dordrecht. 32-39.

Myers N, RA Mittermeier, CG Mittermeier, Gustavo AB da Fonseca and J Kent (2000) Biodiversity

hotspots for conservation priorities. Nature 403:853-858
Pal BP (1937) The search of new genes. Agric. Livestocks 7: 372-378.
Qualset CO, McGuire PE and Warbuton ML (1995). Agrobiodiversity - Key to Agricultural Productivity. California Agriculture 49: 45-49.
Saha D and Sundriyal RC (2010) Prioritization of Non-timber forest produces for income generation: a participatory approach. Journal of Non-timber Forest Products, 17(4), 387-394.
Saxena S and PL Gautam (1999). Conservation of biodiversity: present and future strategies in Agriculture and rural changes, the next decade. Ind. Assoc. Soc. Sci. Instit. 17:34-51.
Singh HK and Lal Banwari (1998). Ethno-ecological concept of forest management vis-à-vis protection and exploitation by tribals in India. In: PC Kotwal & Benerjee MK (eds.) Biodiversity Conservation Merged Forest and Protected Areas. Agro Botanica. Bikaner. P. 217-224.
Sundriyal M, Sundriyal RC and Sharma E (2004) Dietary use of wild plant resources in the Sikkim Himalaya, India. Econ Bot 58(4): 626-638.
UNEP/CBD (1992). Global Biodiversity strategy: Guidelines for action to save study and use Earth's Biotic Wealth Sustainabily and Equitably. World Resource institute, Washington DC current views on needed policy changes, with a long list of key people in the field.
Vavilov NI (1926). Studies on the origin and cultivated plants. Inst. Appl. Bot. Plant Breed. Leningrad.
Wilson EO (1989) Threats to biodiversity. Scientific American 261:108-116
Zeven SC and Zhukovsky PM (1975). Dictionary of cultivated plants and then centres of diversity centre for Agric. Pub. & Document. Wageningen, 219