

Traditional agriculture systems*

The United Nations Proclamation of 2014 as the International Year of Family Farming (2014 IYFF) provides an opportunity to promote family farming or smallholder farming since it contributes significantly to end hunger, improve livelihood, manage natural resources and also to the well-being of the rural people. 2014 IYFF should act to revitalize the emphasis placed by researchers, policy makers and development planners on the importance of family farms and highlight the need to integrate family farming/small farming at the centre of social, environmental and economic policies so as to promote equitable and sustainable agendas^{1,2}. The farming system in the Central Himalayan region represents a true concept and model of family farming since generations. Here the farmers make their own decisions, choices and live on the farm and likely feel a deep, personal sense of connectedness to the farm³.

In this region about 70% of the population depends on farming-based activities. Environmental, biological, socio-cultural and economic variations in the region have led to the evolution of diverse and unique traditional agro-ecosystems, crop species and livestock, which help the small farm communities to sustain themselves. The traditional farming systems in this region are complex and have close linkages and interdependencies with animal husbandry and forest ecosystems. The land holdings are small and fragmented; the per capita land holding is 0.2 ha. Majority of the farm families are smallholders and contribute significantly to the food and nutritional security, livelihood, social protection and well-being of the farming community. The use of bullocks for draught power, humans for labour and nutrients, water, energy and organic matter derived from the surrounding forests is considered

as an important input in the farming system.

Terraced slopes, covering 85% of the total agricultural land of the Central Himalaya are largely rainfed, whereas the valleys, covering 15% of area, are irrigated. Mixed cropping is common in rainfed agro-ecosystem. The cropping patterns are built around two major cropping seasons, viz. *kharif* (April–October) and *rabi* (October–April) generally up to 1800 m asl and, at some locations, up to 2000 m asl. At higher altitudes (>2000 m asl), only summer season crops (April–October) are raised. Over 40 crop species and numerous farmer-selected landraces comprising cereals, millets, pseudo-cereals, pulses, oil seeds, tubers, bulbs and spices are cultivated across an elevation gradient. The huge diversity has been maintained through a variety of crop compositions, cropping patterns and crop rotations. A wide range of variation in edaphic, topographic and climatic conditions and selection pressures over centuries of cultivation has resulted in immense crop genetic diversity.

The studies carried out so far in the Central Himalaya indicate that farming systems, particularly farm families with small holding in the region, are in transition. People and institutions are faced with a situation of deteriorating conditions in subsistence farming, in which the family farm economy, ecological environment and agro-biodiversity components are adversely affected. Recently, a variety of changes in traditional farming systems have emerged, in response to population pressure, ineffective technological innovation, climate variability/climate change impact, market forces, land tenure policies, economic growth, inappropriate social welfare and environmental conservation policies. Negative trends in the farming systems such as declining crop yields, expansion of agriculture on marginal land, declining carrying capacity of the forests and rangelands, weed infestation, loss of crop diversity, soil erosion, hydrological imbalances and social disintegration dominate the debate on sustainability of the smallholder farm families and communities in the hills/mountains.

Keeping this in mind, the first popular lecture series on ‘Save the Seeds of traditional Agriculture System’ was organized by the Garhwal Unit of G.B. Pant Institute of Himalayan Environment and Development (GBPIHED). It also offered a platform to deliberate on the aims, goals, issues and challenges raised by 2014 IYFF and faced by farm families and smallholder families. Over 150 participants, including local people, senior citizens, academicians, scientists, researchers, progressive farmers and students attended the lectures. Vijay Jadhari (a well-known environmentalist, who significantly contributed towards conservation of traditional seeds) delivered the first popular lecture. Drawing insight from his past experience as a small farmer and his active association and deep involvement with ‘Save the seed campaign’, he mentioned that one could find ways to protect the unique traditional agriculture of the Himalayan mountains. He said, that ‘Save the seed campaign’ is not merely about conserving traditional seeds, but it also involves conservation of local culture, traditions, best practices and traditional knowledge related to farming systems. He highlighted the uniqueness of mixed cropping, cropping pattern and crop rotation with particular reference to the Barahnaja system: one in which 12 or more rainfed crops are cultivated simultaneously on the same piece of land during the *kharif* (March–October) season in ‘synergetic’ combinations; this is an effective mechanism to avert total crop failure and to ensure food security to the farm family and small-holder farming communities in Central Himalaya. *Elusine coracana* is the main crop of this system. *Amaranthus frumentaceus*, *Fagopyrum tataricum*, *Fagopyrum esculentum*, *Perilla frutescens*, *Setaria italica*, *Sesum indica*, *Hibiscus sabdarifa*, *Echinochloa frumentacea*, *Zea maize* and various legumes crops, viz. *Macrotyloma uniflorum*, *Phaeolus vulgaris*, *Vigna mungo*, *Macrotyloma uniflorum*, *Vigna radiata*, *Vigna angularis*, *Vigna unguiculata*, *Pisum arvense* and *Glycine* spp. are sown together. This huge agro-diversity in family farming plays a crucial role in

*A report on the first popular lecture series on ‘Save the Seeds of Traditional Agriculture System’ organized by G.B. Pant Institute of Himalayan Environment and Development, Garhwal Unit, Srinagar (Garhwal), on the occasion of its Annual Day on 10 September 2014.

maintaining the long-term stability of the rainfed farming system in a number of ways: it increases productivity, improves soil fertility when legumes are mixed, reduces the chances of pest, pathogen and weed infestation, conserves soil nutrients, checks soil erosion and produces a rich and balanced nutritional diet. The significance of these traditional crops cannot be assessed from the area under cultivation and the quality of production, but from the kind of contribution they can make to support livelihood of marginal and small farming communities under adverse environmental conditions, Jardhari added. Most of those crops are used in traditional dishes. Besides, many other crops possess medicinal properties and are used for curing various ailments and therefore, there is a need to explore their nutritive and medicinal properties, so that their potential can be harnessed properly. Though the area under cultivation of many of these traditional crops has declined precariously in several parts of the region, there are still a few areas located in remote and far-flung valleys, where these crops are still being cultivated on a smaller scale. However, it is difficult to conserve such resources by merely depositing them in a gene bank. In view of long-term sustainability of the farming system, however, these crops should not be isolated from their traditional uses, culture, folk art and rituals, from where they evolved during the past centuries and have close association and introgression with their weedy and wild relatives, he mentioned.

While the Green Revolution has had a positive impact on food production, its approaches have failed to recognize the value of mixed cropping in risk avoidance and the difficulty of providing the inputs required by HYVs in subsistence farming systems. Therefore, there is a need to revive the farming systems in the Himalaya mountains following the traditional and indigenous practices, Jardhari highlighted. A huge opportunity is arising now in terms of more choices for organic food and increasing demand of coarse cereals and millets in confectionaries and urban market centres, which may improve the economic conditions of the farming communities. Value addition to traditional crops is another viable and appropriate strategy to promote cultivation and conservation of these crops. The region represents a strong network of protected areas (sanctuary, national parks

and biosphere reserves), and many of them are reservoirs of cultivated and wild relatives of diverse traditional crops and could be viable options for their *in situ* conservation. One possibility is to declare some of them as an agro-diversity heritage sites under the Biological Diversity Act, 2002. It is also important to create awareness among the masses through education and communication, for conservation and management of traditional agro-biodiversity and promote traditional items/cuisine/dishes prepared from them at fetes and festivals, so as to make them more familiar to people from other regions. This will also increase their market demand.

Vikram Singh Negi (Garhwal Unit, GBPIHED) highlighted the celebration of 2014 as the International Year of Family Farming, while explaining the role of family farming in sustainable agriculture production in the Himalaya region. He said that 2014 IYFF can provide and contribute significantly to food security, increased livelihood, social protection and well-being of Himalayan farming communities. Family farming in the Himalaya region contributes immensely to food security – 30–40% of the food requirement of small and marginal farmers. The family farms, however, need technological and knowledge empowerment, as well as policy support at ground level in the Indian Himalayan region.

In most of the farm families of this region, the care of seeds has been traditionally in the hands of women, who develop and maintain a broad spectrum of well-adapted crop varieties. Saving and selecting seeds for storage and future use have been a vital part of women's cultural heritage and are based on farm field observations, from seed germination to the entire growing period. It requires a sharp eye, sensitive hand and a lot of patience to select better quality seeds following traditional knowledge. Many enthusiastic women of this region still practice and promote the transmission of seed selection skills to their children right in the farm fields. Often, women also exchange and barter seeds among themselves. Because of such and other seed exchange practices, the varieties may not evolve as isolated farm lines, but as community germplasm exchange. There is also the practice of offering a portion of the best selected seeds as gifts to the kith and kin on several important occasions.

M. S. M. Rawat (former Vice-Chancellor, HNB Garhwal University) mentioned that 2014 IYFF is an opportunity for subsistence farming communities to look at the contribution that the family farms make within the Central Himalayan region, to prepare for future opportunities and develop strategies to overcome the problems for realization of these opportunities. He further stressed that the Central Himalayan region is home to the largest number of small-scale farmers; however, their contribution towards mitigating hunger and malnutrition is rarely recognized. This has resulted in slow growth in the production of food grains leading to the weakening of the food and nutritional security situation and the economic base of hill family farming communities, especially those inhabiting the higher and middle altitude regions. The farming systems in the region are challenged by political marginalization, limited access to markets, insufficient infrastructure and technological interventions, and poor quality of social services. All these factors combine to limit the options available to the farming communities, driving them further into poverty, which leads to migration of the male members to the plains to seek off-farm jobs. Breaking this vicious cycle of poverty requires robust institutions, fair policies, larger incentives, pragmatic multidisciplinary research approach, a renewed focus on science, appropriate technology and innovations. A strong political commitment is required to address the complex issues affecting the farming system in the region and its evolving needs.

The social, economic, environmental and policy factors significantly influence the farming systems. The social sustainability of the farming system can be addressed by generating employment opportunities, capacity and skill development in simple, hill-specific agrotechnologies, increased access to resources and opportunities for women, attracting youth to farming by creating jobs and rewarding them economically. There is a huge scope for social safety net programmes and initiatives to empower women to take decisions about traditional farming and improve their control over resources, as well as by building policies and institutions that support social and gender equity. The environmental sustainability of farming system can be addressed by restoring and conserving

the natural resources, which help immensely in carbon sequestration, reduced tillage, improve soil fertility and combat land degradation and promote *in situ* conservation of aboveground and belowground biodiversity. From the economic sustainability perspective, science and technological efforts need to focus on helping poor and smallholder farmers while improving their income by enhancing agricultural and reducing production costs. Producing high-value organic products increases the sustainability of the farming systems on short- and long-term basis, Rawat said.

The policy dimension of the farming system must address the issues such as research and extension relevant to small farms, subsidies on farm inputs and credit policies, land-use policies, wildlife conservation policies, etc. The major focus of policies in the Central Himalayan region largely benefits farmers with large land holdings, as subsidies are provided to them for raising orchards, floriculture, chemical fertilizers, medicinal plant cultivation, chemical fertilizers, farm implements, irrigation, pisciculture, etc. However, farmers with small and fragmented land holding are deprived from this benefit.

R. K. Maikhuri (Garhwal Unit, GBPIHED) highlighted the issues and challenges with regard to conservation of traditional agrobiodiversity. He mentioned that many valley areas in the Central Himalayan highlands provide a unique opportunity for *in situ* (on-farm) management of agrobiodiversity because of the preponderance of locally developed traditional crop varieties (and associated wild and weedy species) in the farming system, based on traditional

knowledge and skills, high agro-climatic heterogeneity and local socio-cultural integration. Majority of the landrace diversity was maintained by marginal farmers. Farmers' loss of seeds is attributed mainly to crop failure and, in the case of poor farmers, sometimes the consumption needs of the household exceed production. When they lose their seeds, farmers may not be able to procure seeds of their choice for the next planting. Improving seed management and access to crop genetic diversity, could therefore contribute to *in situ* maintenance of materials which are of value to farmers. Maintaining community seed banks and complementing community conservation to *ex situ* institutional conservation of the existing landrace diversity is therefore essential, before more landrace diversity is lost from traditional agro-ecosystems. *In situ* conservation and crop improvement can complement one another in marginal areas. Breeding programmes that evaluate landraces and use them in local improvement efforts are expected to produce material of direct value for marginal agroclimatic zones, as well as achieving significant local conservation. Careful analysis and evaluation of various socio-economic, environmental and scientific challenges is essential, so that farming activities could be reoriented towards better use of local resources and their sustainable management in the Central Himalayan farming systems.

Therefore, efforts to be made to conserve traditional crop diversity-based Himalayan farming system will require creation of new incentives, developing appropriate policies, institutional arrangements, human capacity building and greater involvement of local people in

policy planning; this may help the farming system to be economically, socially and environmentally sustainable. Empowerment of women and gender dimensions of biodiversity conservation and management must also be addressed since they are the main conservationists and custodians of Himalayan agrobiodiversity and farming systems. Tapping the potential of traditional knowledge and wisdom of small farm families/communities will require keeping them in the central focus of research and development efforts and will require appropriate, mountain-specific, cost-effective technological interventions for actions to support equity, fairness and inclusion of small farm communities inhabiting the Western Himalaya in particular and Indian Himalaya in general.

1. Kesavan, P. C. and Swaminathan, M. S., *Curr. Sci.*, 2014, **107**, 1970–1974.
2. FAO, *Deep Roots*, Food and Agriculture Organization of the United Nations, Rome, Italy and Tudor Rose, UK, 2014, p. 256.
3. Sundriyal, R. C., Negi, G. C. S., Maikhuri, R. K., Rawat, D. S., Rawal, R. S. and Dhyani, P. P., In *Deep Roots*, Food and Agriculture Organization of the United Nations, Rome, and Tudor Rose, UK, 2014, pp. 105–108.

R. K. Maikhuri*, **Vikram S. Negi**, **L. S. Rawat** and **A. K. Sahani**, G.B. Pant Institute of Himalayan Environment and Development, Garhwal Unit, Srinagar (Garhwal) 246 174, India; **R. C. Sundriyal** and **P. P. Dhyani**, G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263 643, India.

*e-mail: rkmaikhuri@gbpihed.nic.in

MEETING REPORT

Marine ecosystems*

The second international symposium on marine ecosystems (MECOS-2) consisted of lead talks, keynote addresses, oral and

poster presentations and discussions touching upon different services and goods provided by the marine ecosystems.

The symposium addressed topics like marine fisheries and management, aquaculture production systems, marine biodiversity, climate change and ecosystem assessments, responsible harvest and post-harvest, marine biotechnology, liveli-

hood and economics. The presentations were held in six sessions.

Inaugurating MECOS-2, Trevor Charles Platt (Fellow, Royal Society of London) highlighted the advantageous position of India in generation of remotely sensed data and the need for playing a lead role in data application in the region. Rudolf Hermes (Bay of Bengal

*A report on the second international symposium on 'Marine Ecosystem – Challenges and Opportunities (MECOS-2) organized under the aegis of the Marine Biological Association of India from 2 to 5 December 2014 at Kochi.