

Biological Diversity of Medicinal Plants and Cereals of North-eastern Mountainous Regions of Pakistan, and their Exploitation for Sustainable Development

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Introduction

The north-eastern regions of Pakistan represent an important area of the Hindu Kush-Himalayan (HKH) region, with a rich diversity of natural biological resources including vegetation, insects, fungi, microbes, domesticated animals, and wildlife. Micro-niches comprise almost all climatic conditions from tropical to alpine zones. The diversity of higher plants, including cultivated crops and fruits, is known to some extent but the diversity of medicinal plants, animals, and microbes in many environments of the area remains unknown.

The under-development of the area has restricted its economic prosperity, but helped to conserve important biological species. Over the centuries, the continuous selection of cultivated crops has robbed these species of many valuable genes. Consequently, the commercial crop varieties have become input-intensive and are not economical for farmers with small landholdings (Gardezi 1993). However, the primitive ancestral genotypes of cultivated crops are still cultivated in restricted patches (Shah and Ahmad, in press), and the precious gene pool extinct elsewhere is still available in this region. The gene pool of unique characteristics may be of worldwide importance, and needs to be conserved in situ. Similarly, the area is abundant in diverse medicinal plants (Amin 1984). However, increasing the area under cultivation and clearing the rich forest land have threatened the diversity of plants.

The importance of preserving the biological diversity of cultivated and wild plant species has increased due to the advent of recombinant DNA technology. The technology has great potential to modify the characteristics of biological organisms like plants by transferring those characteristics from other organisms of any nature. The biological resources of the area need to be classified, characterised, preserved, and registered to ensure future potential economic benefits.

Agriculture in the area is conventional, and the trend is to grow only a few varieties of grains like maize and wheat, some vegetables, and to rear a few cattle and chickens. The livelihoods of farmers tend to be inadequate.

The diversification of agriculture to make it economic and sustainable has led to the introduction of high value cash crops on small land holdings. Precious crops like medicinal plants, flowers, and non-conventional crops may increase earnings and reduce the miseries of the local population. Traditional medicines of plant origin still contribute more than 50% of the total medicinal needs of the local population. The value of medicines of biological origin is increasing with the new environmental trends and awareness of the

hazards of synthetic chemicals. Even today, the world's pharmaceutical industry earns more than US\$100 billion every year from drugs derived from natural compounds of plant origin (Sittenfeld 1996). Locally available medicinal plants could fetch good prices in the market as raw material for pharmaceutical industries. Similarly the development and introduction of cold- and drought-tolerant varieties of forage grasses and legumes in natural pastures could increase production and the development of dairy and meat animals on a commercial scale. The area is also suitable for the commercial cultivation of flowers and spices. Locally available species of flowers and spices are abundant but have never been developed as marketable products. New job opportunities resulting from the above-mentioned activities could reduce urbanisation and help traditional societies and communities to survive.

For many years, the University College of Agriculture, Rawalakot has helped to introduce new farming technology and to conserve biological natural resources for commercial exploitation. Though the pace of progress is slow due to limited resources, the problems have been identified and the line of action set.

Progress to Date

The biological diversity of some cultivated crops including wheat, maize, potato, and tomato from the north-eastern regions of Pakistan has been investigated. Local land races, genotypes, and varieties were collected from various micro-climatic conditions, inventories were prepared, and molecular markers based on seed and plants at a particular stage of development were explored. The results indicated immense variability among the genotypes, land races, and local cultivars, which could be exploited in future breeding programmes. Similarly, local medicinal plants from various environmental conditions including *Ocimum sanctum*, *Racinus communis*, *Adhatoda vasica*, *Mentha*, and *Rumex* (Ahmad et al. in press), seabuckthorn, *Piganum*, *Pimpinella*, and others have been investigated. The investigation showed significant variability in their genetic make-up as observed by their phenotypic characters and molecular/biochemical constituents. Species of flowers and spices with good aesthetic and commercial value were also included and their biological diversity and potential for commercial production in the area investigated.

To develop and introduce drought- and cold-tolerant varieties of forage grasses and legumes, germplasm was collected from all over the world and evaluated under local conditions (Ahmad in press; Hammad and Ahmad 1996). Introduced species and varieties were hybridised and potential varieties for *Lolium parennea*, *Lolium multiflorum*, *Festuca*, *Lathyrus* (Khan et al. 2000), and white and red clovers (Iqbal and Ahmad 1996) were developed.

Natural forage grasses and legumes only provide green herbage during the monsoon season, but the newly developed varieties can produce green herbage from late March to November with maximum production from July to October (Ahmad and Chaudhry 1995). The nitrogen fixation potential and the biological diversity of *Rhizobium* from clovers of mountain origin were also investigated using molecular techniques (Ahmad and Hassan 1998).

Conclusions

The north-eastern mountainous regions of Pakistan are rich in biological natural resources, but their potential has not been properly realised. The local population cannot prosper on a sustainable basis unless and until these resources are exploited and utilised scientifically. The University College of Agriculture Rawalakot has initiated investigations for proper utilisation of the existing biological resources for the betterment of the local communities and the region at large.

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