



# Conserving crop wild relatives of North-East India for sustainable agriculture

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## ABSTRACT

Crop wild relatives (CWRs) offer valuable genetic resources for breeding better crop varieties, making agriculture more sustainable and resilient to meet global challenges like climate change. India occupies a significant position in the global conservation landscape due to its exceptional biodiversity. The Northeast region, located within the Indo-Burma Hotspot, contributes significantly to this diversity. CWRs in this region hold untapped potential for improving crop diversity, yet there remains a huge number of CWRs that are poorly documented and conserved. Consequently, the identification, documentation, and conservation of these wild resources are vital for agriculture. The Northeast region's tribal communities, constituting around 12% of India's tribal population, possess traditional knowledge about plant utilization and conservation. Their involvement is pivotal in preserving CWRs and their habitats. Effective CWR conservation calls for collaboration among research institutions, non-governmental organizations and local communities to preserve the genetic diversity inherent in Northeast India. Notable CWRs in Northeast India include wild rice, citrus relatives, wild bananas, brassicas, legumes, turmeric-ginger species and many more. The conservation of CWRs is not only crucial for biodiversity preservation but also for the future of agriculture. Raising awareness among the public, policymakers and agricultural communities is essential to ensure the conservation and utilization of CWRs.

**Key words:** Conservation, crop wild relatives, North-East India, traditional knowledge

## INTRODUCTION

Crop wild relatives (CWRs), also known as wild progenitors or wild relatives of crops, are plant species that are closely related to cultivated crops. These are found in their natural habitats as wild plants. They often share common ancestors with cultivated crops and, therefore, these wild plants may be genetically similar to the domesticated crops. Maxted et al. (2006) defined CWR as “a wild plant taxon that has an indirect use derived from its relatively close genetic relationship to a crop”. Conservation and utilization of crop wild relatives are essential for sustainable food production as they provide valuable genetic resources to the breeders

to develop novel crop varieties with improved crop yield, quality etc. to face global challenges of climate change. In other words, CWRs are the hidden treasures of valuable genes in the world of plants.

McNeely (1990) designated India as one of the twelve mega-diversity countries in the world and that research findings played a major role in placing India prominently on the global conservation landscape. Earlier, Myers (1988, 2000) delineated 'hotspots' of global biodiversity, identifying regions with both exceptional biological diversity and high endemism, yet facing significant anthropogenic threats. Northeast India, which lies between 21°

50' and 29° 34' N latitude and 85° 34' and 97° 50' E longitude, is considered as one of the most biologically diverse places in India. The Northeast India forms a distinctive part of the Indo-Burma Hotspot which ranks 6<sup>th</sup> among the 25 biodiversity hotspots of the world (Tandon et al., 2009). The diverse landscape and bio-geographical features of this region contribute to creating an ecologically rich environment. Pradheep et al. (2017) stated that the richness in biodiversity is commonly attributed to the diverse topography and extensive forest coverage present in this region. Approximately 45% of the country's total plant species are found in this region, showcasing a remarkable biodiversity of both flora and fauna. Moreover, this area serves as a vital genetic treasure trove for a wide range of agricultural and horticultural crops. It is home to several important CWRs that are closely related to cultivated crops many of which are yet to be properly documented and studied. Wild relatives of crops provide a vast resource of genetic diversity for breeding new, higher yielding, climate resilient crop varieties, but unfortunately there are a lot of species that are still under-conserved in NE India. Therefore, identification, documentation and conservation of the plants, particularly crop wild relatives in North East India, is of great importance in agriculture.

#### **KEY ASPECTS OF CWR CONSERVATION IN NORTH-EAST INDIA**

India is known for its indigenous plants that are used to cure various diseases (Gogoi and Bhoutekar, 2017). However, the decline in biodiversity has become a worldwide concern these days. Crop wild relatives are also confronting threats in their natural habitats due to various human activities. Pradhan and Nayak (2017) stated that many of the species are in the verge of extinction due to habitat loss. In the North Eastern region of India, which encompasses a significant portion of the country's forest cover, is losing its forest cover consistently to the extent of 765 square km (0.45%) in all the states except Assam and Tripura (Anonymous, 2019).

The wild relatives of crop plants of NE India can be conserved using two broader strategies, viz., *in situ* and *ex situ* conservation.

*In situ* conservation of CWR populations in their natural habitats allows these plants to evolve and adapt naturally while maintaining ecological balance. Conservation efforts may include the protection of natural habitats of CWRs by designating protected areas, national parks, or community reserves to safeguard the ecosystems in which these wild relatives thrive. For this, the identification of hot spots as well as critical habitats of CWRs for *in situ* conservation is an important thrust area for this NE region. A site or population that has been identified as having rare, threatened, or high levels of genetic diversity is worthy of joining the national, regional, or global networks. Maxted et al. (2015) showed the actual process of a site/population joining the network (Fig. 1).

One of the crucial cornerstones for conserving the CWRs in Northeast India lies in the active involvement and participation of indigenous communities. The Northeast region is primarily inhabited by tribal communities who hold a wealth of traditional knowledge. This area is home to over 200 distinct tribal groups, comprising approximately 12 per cent of India's total tribal population (Ali and Das, 2003; Ganguly, 2016). These tribal communities, residing in biodiverse environments, possess a profound knowledge on conservation and utilization of plants viz., endemic food plants, medicinal plants, CWRs and their habitats. The deep-rooted traditional knowledge of these people about the local ecosystems is invaluable for the preservation of these vital plant resources. Recently, emphasis has been given on greater use of local and traditional or indigenous knowledge alongside conventional scientific knowledge in making decisions about biodiversity and natural resources (Fazey et al., 2006; Raymond et al., 2010). In 2010, parties to the UN Framework Convention on Climate Change adopted a decision on 'enhanced action on adaptation' that identified the need to draw attention on traditional and indigenous knowledge as the best available science.

The United Nations Development Agenda (UN, 2012) also acknowledges their importance, stating “traditional and indigenous knowledge, adaptation and coping strategies can be major assets for local response strategies”. Therefore, *in situ* conservation of wild relatives can be achieved by creating awareness among the local people. Public awareness and community-based programmes should be encouraged for conservation (Sahoo et al., 2016). Further, providing special incentives to local people for growing and maintaining these precious wild resources may also aid in conservation.

Moreover, the fundamental step in CWR conservation is the collection of seeds, plant material, or genetic resources from unique wild relatives, which are endemic to NE India, to be stored in seed banks, gene banks, or living collections to ensure their long-term preservation. It ensures the preservation of genetic diversity for future breeding programmes.

CWRs are valuable genetic resources for crop improvement. Therefore, comprehensive documentation of CWRs is of utmost importance as it helps the breeders to incorporate desirable traits from wild relatives into cultivated crops. Generation of passport data and preparation of inventory on endemic CWRs should be prioritized.

An effective approach to conserve CWRs necessitates collaboration among research institutions, non-governmental organizations (NGOs), and local communities to collectively work towards preserving the invaluable genetic diversity present in Northeast India. For that raising awareness among the local people about the importance of CWRs and their role in sustaining agriculture is of paramount significance to protect the region's CWRs.

Most of the *ex-situ* conservation of germplasm have been done in the National Gene Bank, New Delhi. The Regional Gene Bank Module with medium-term storage at Barapani, Meghalaya, is also associated with *ex situ* conservation in the region. AAU-ARRI, Titabor, Jorhat, Assam has also been maintaining 7000 accessions of different rice cultivars.

## MAJOR IMPLICATIONS OF CROP WILD RELATIVES IN CROP IMPROVEMENT PROGRAMMES

CWRs may play a significant role in crop improvement programmes by offering a wealth of wide genetic diversity. The genetic diversity of CWRs can be used to develop novel crop varieties. By conserving and utilizing CWRs, we ensure the preservation of genetic resources that may be critical for future crop improvement efforts. CWRs often thrive in diverse and challenging environments. These are rich sources of valuable traits like resistance to biotic and abiotic stresses. Further, they are the potential sources of genes for developing climate-resilient crops that can thrive in challenging conditions, such as flood, drought, extreme temperatures, cold etc. CWRs possess natural resistance to pests and diseases and these traits can be transferred to cultivated crops through breeding to reduce the reliance on chemical pesticides.

## NOTABLE CROP WILD RELATIVES FOUND IN NORTH-EAST INDIA

The Northeastern part of India region is a hotspot for wild rice species. Hore (2005) stated about occurrence of wild relatives of cultivated rice in the NE region. Intermediate forms between cultivated and wild species, viz., *Tulsibaon*, *Bogibaon* and *Kenkuabaon* were also observed. The major wild species found in the region are *Oryza rufipogon*, *O. granulata*, *O. officinalis*, *O. nivara* and *O. meyeriana*. Further, some closely related taxa were also reported namely *Hygrorhiza aristata*, *Leersia hexandra* and *Zizania latifolia* (Hore and Sharma, 1993). Recently, in 2022, Borjuli, Sonitpur District, Assam was notified as a Wild Rice Biodiversity Heritage Site considering the significant populations of *O. rufipogon* in this area. This was done under the initiatives of ICAR-NBPGR.

The region is also recognized as a centre of origin for Citrus (L.) species and is home to several wild and endangered Citrus species, including *Citrus indica*, *Citrus macroptera*, *Citrus latipes*,

*Citrus ichagensis* and *Citrus assamensis*, which thrive in their native and undisturbed habitats (Hynniewta et al., 2013).

**Table 1.** Some of the endemic crop wild relatives of NE region

Name of the plant species	Area
<i>Neoluffa sikkimensis</i>	Sikkim, North-eastern region
<i>Trichosanthes khasiana</i> ; <i>T. ovata</i> , <i>T. bracteata</i> var. <i>tomentosa</i>	Khasi Hills, North-eastern region, southern Western Ghats
<i>Amorphophallus bulbifera</i> , <i>A. campanulatus</i>	Khasi Hills (Meghalaya) and eastern Himalaya (Sikkim) and Deccan Plateau
<i>Dioscorea alata</i>	Western and North-eastern Himalaya
<i>Docynia hookeriana</i>	North-eastern Himalayan region
<i>Mangifera khasiana</i> ; <i>M. sylvatica</i>	Assam, West Bengal and Tripura, Arunachal Pradesh
<i>Musa cheesmanii</i> ; <i>M. flaviflora</i> ( <i>Musa thompsonii</i> )	Assam, Manipur and Meghalaya
<i>Prunus acuminata</i> ; <i>P. jenkinsii</i>	Central and eastern Himalaya, Upper Assam and Arunachal Pradesh
<i>Rubus burkillii</i> ; <i>R. lanatus</i> , <i>R. lineatus</i>	Namdapha Biosphere Reserve (NEH Region), Kumaon to Sikkim Himalaya
<i>Camelia caudata</i> ; <i>C. kissi</i> , <i>C. drupifera</i> , <i>C. lutescens</i>	Namdapha Biosphere Reserve (NEH region), North-eastern India
<i>Eurya runachalensis</i> , <i>Gordonia excelsa</i> , <i>Schima wallichii</i>	North-eastern India
<i>Saccharum sikkimensis</i> , <i>S. benghalensis</i> , <i>S. ravennae</i>	Sikkim Himalaya, NEH region

**Source:** Pandey et al. (2005)

Further, wild *Musa* spp. are largely distributed in North-Eastern States, Western Ghats, Eastern Ghats and Andaman and Nicobar Islands (Joe and Sabu,

2016). In Northeastern India in Khasi, Jaintia, Naga, Patkai and Garo hills, wild *Musa* species may occur also at both lower and higher altitudes. The region hosts wild banana species, like *Musa balbisiana*, which are important for breeding programs. This is one of the hotspots of biodiversity for crop genetic resources and neighbouring to the centre of origin for Brassica, i.e. Indo- Chinese region. The region also houses wild legume species related to cultivated crops like mung beans and kidney beans, which can provide traits for better yields and resistance to pests and diseases.

Further, primitive type of maize had been reported from this region. Ginger, turmeric, chilli, cinnamon and large cardamom have wild relatives in this region. The variability is very high in turmeric, chilli and ginger (Upadhyay and Sundriyal, 1998). Some of the CWRs endemic to the NE region are presented in Table 1. Since the endemic species are region specific, therefore, endemism signifies uniqueness of this region (Chatterjee et al., 2006).

## CONCLUSION

Crop wild relatives and traditional landrace varieties contain a vast array of beneficial traits that are essential to improve the resilience of crops in harsh climates and to sustain global food supplies. Therefore, to conserve crop wild relatives in Northeast India there is the need to raise awareness among the public, policymakers and agricultural communities about the importance of Crop wild relatives and their conservation in the days to come.

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