Out of seven main and 21 sub-cantonments, 75 percent are located in forested areas and many of them are within high priority environmental sites. An impact study of UNDP at PLA (People's Liberation Army) camps highlighted that PLA energy needs were almost exclusively dependant on firewood extraction that caused deforestation in many areas. An estimated firewood requirement for the combatants residing in the 28 cantonments came to approximately 2,100,000 tons of fuel wood each month. The study report stated, "In the case of the Kailali cantonments, PLA cadres are housed in close proximity to a mere 1.5 kilometres of forest cover that facilitates the migration and genetic dispersal of critically-endangered species like the Royal Bengal Tiger. Without key areas like this, scientists estimate that tigers in Nepal will be genetically extinct in just ten years" (Dinerstein et al 2006).

Conclusions

Mountain biodiversity has been negatively affected and even severely threatened by the decade long armed conflict. Therefore, immediate, short and long term restoration plans are urgently needed. Hence, regular conflict risk assessment has to be one of the fundamental components in any future strategy of protection and conservation of biodiversity in Nepal. Such analysis provides a powerful understanding of conflict impacts on biodiversity in conflict and post-conflict situations and assists in devising appropriate response strategies and options.

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Conservation of Agrobiodiversity through Traditionally Cultivating 'Barahnaja' in the Garhwal Himalaya, India

Vishwambhar Prasad Sati

India's Garhwal Himalaya is an agrobiodiversity hotspot. The traditional system of cultivating 'Barahnaja' (literally, '12 seeds') together in cropped land is a centuries-old practice: a cropping pattern involving 12 or more food crops grown in 'synergetic' combinations (Singh and Tulachan, 2002). This is practiced under a 'Sar system' of crop rotation that characterises the cropping pattern together with a vertical distribution of crops – in valley regions, mid-altitudes and highlands – and supports the maintenance of agrobiodiversity. Three quarters of the people in the region depend on this system for their livelihoods. The traditional agricultural systems are the reservoirs of many crops and cultivars, most of which are still little known to mainstream societies and are better adapted than modern agricultural systems to environmental and social conditions (Altieri, 1995; Ramakrishnan and Saxena, 1996). Recently changes in the cropping pattern have taken place as 'Barahnaja' has decreased, particularly in the mid-slopes and low-lying areas.

The traditional Barahnaja system and agro-biodiversity

'Barahnaja' is an advanced system of traditional rain-fed hill farming with sophisticated intercropping. Mandua (finger millet), ramdana/chua (amaranthus), rajma (common kidney beans), ogal (buckwheat), urad (black gram), moong (green gram), naurangi (mix of pulses), gahath (horse gram), bhat (soybean), lobiya (French beans) kheera (cucumber), bhang (cannabis) and other crops are grown together in a mix which is finely balanced to optimise productivity, maintenance of soil fertility, conservation of crop diversity and is geared towards meeting diverse household requirements. These central Himalayan farmers grow about 100 varieties of paddy (rice), 170 varieties of kidney beans, eight varieties of wheat, four varieties of barley and about a dozen varieties of pulses and oil seeds each year (Zardhari, 2000). Farmers spend almost nothing on inputs, since seeds, organic fertiliser and pest control are virtually free. Whenever they see that conditions are suitable, they start planting. Table 1 shows the ecological sub-regions and agrobiodiversity in the Garhwal region. Crops are grown from 300 to 3,600 metres. Wheat, rice, mandua, and jhangora are the common crops in the three ecological zones, with wheat generally having the highest productivity. Various pulses are grown in the intercropping system during the two harvest seasons: early winter after the rainy season (millet); and midsummer before the hot dry season (barley and wheat). Dry and

Ecological sub-region	Altitude (m)	Agro-biodiversity
Lower Dun, Terai	300-600	Wheat, rice, and sugarcane
Upper Dun,Bhabar, Lower Shivaliks	600-1,200	Wheat, rice, mandua, jhangora, chaulai and maize
Middle Garhwal-Kumaon	1,200-1,800	Wheat, rice mandua, jhangora "cheena" (*Panicum miliaceum*), potato and barley
Upper Garhwal-Kumaon	1,800-2,400	Wheat, barley, potato, chaulai, cheena, phaphra" (*Fagopyum tataricum*)
Cold Zone	2,400-3,600	SUMMER- wheat, barley, potato, phaphra, chaulai, "kauni", "ogal", kodo" (*Fagopyum esculentum*), "uva" (*Hoycleum himalayanse*)

Table 1: Ecological sub-regions and agro-biodiversity. Source: Adapted from Sati (2005)

wet rice, taro, pumpkins, beans, corn, ginger, chili, cucumbers, leafy vegetables and tobacco are also grown. Potatoes have become an important cash crop, grown in areas unsuitable for other plants. 'Barahnaja' remains common in the upland areas (above 1,500 metres), but the mid-slopes and the low-lying river valleys have undergone tremendous changes in cropping patterns, as the cultivation of paddy, wheat and cash crops are recent trends, reducing agrobiodiversity.

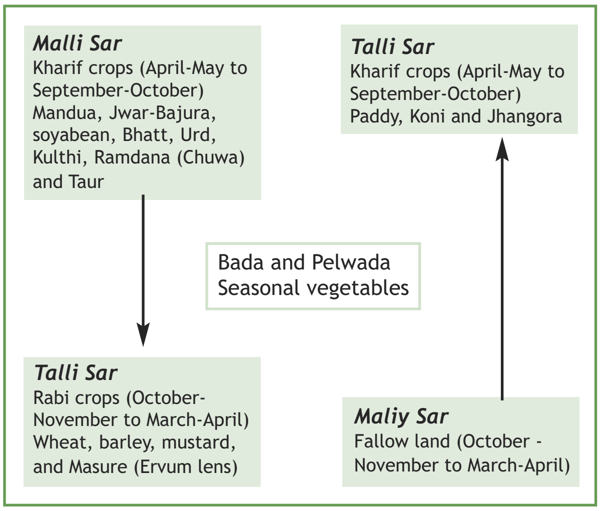

Figure 1: Malli and Talli Sars

Conserving 'Barahnaja' under the 'Sar System'

'Barahnaja' is conserved by the practice of crop rotation in the 'Sar system', in which agricultural land is divided into two parts: Talli and Malli Sar (Figure 1). The cropping pattern in the two sars is reversed every second year. Besides the Talli and Malli Sar, in and around the settlements, vegetables such as cucumber, pumpkin, potato, egg plant, lady's finger (okra), suchas garlic and maize are planted during the rainy season in fields known as Bada and Pelwara.

Sar system

The 'Sar system' gives a good yield and maintains agro-biodiversity. Each year the land is fallow for six months and the Sar is changed from year to year. The pattern of fallow land from October-November until March-April is a systematic method for conserving soil fertility. Figure 2 shows aspects of agrobiodiversity and the 'Sar system'.

While the highlands throughout the Garhwal Himalaya have a high agrobiodiversity, levels are far lower in the mid-altitudes and low-lying areas. The changes in cropping patterns seem more pronounced in these two vertical landscapes. A number of major trends have marginalised 'Barahnaja' and subsequently reduced agrobiodiversity: the low output from 'Barahnaja'; the significant cultivation of wheat, paddy and off-season vegetables; the high rate of population growth and literacy; and large-scale emigration. On the other hand, 'Barahnaja' is suitable in the region's agro-ecological conditions and is sustainable even in adverse climatic conditions such as drought. In 1987, when drought occurred across India, the Garhwal Himalaya enjoyed substantial production of subsistence crops. Keeping agro-ecology and suitability in view, these crops and their traditional farming system need to be conserved, along with cultivating cash crops, to maintain agro-biodiversity and food security in a balanced proportion.

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Figure 2: Agro-biodiversity and Sar-system: [A] Traditional crops 'Barahnaja', [B] Paddy crop with pulses on the edge, [C] Wheat crop, and [D] Fallow land.
Photos: Vishwambhar Prasad Sati.

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Biodiversity Conservation and Crop Improvement in a Fragile Agro-Ecosystem: Insights From Guangxi, China

Yiching Song, Zhang Shihuang with Ronnie Vernooy

Farming communities around the world are facing hardship in nurturing and developing crop and animal biodiversity. Their experimentation and innovation practices are under stress. In light of recent international developments concerning innovation, trade and intellectual property (rights), there is an urgent need to develop new policies and laws that recognise and support the key contributions of rural people in the sustainable use of biodiversity. The government of China acknowledges the importance of the sustainable use of biological resources. China, the most populated country with the lowest amount of arable land per capita in the world, has no choice but to keep food security and the sustainable use of biodiversity high on its agenda. One of the most important policy tasks is to create incentives and rewards that recognise and value promising and successful, collaborative efforts to achieve these goals. Our research in China's south-west mountainous areas confirms that farmers are key players in crop improvement and conservation and that farmer-researcher collaboration can produce added value that farmers or researchers alone could never realise. We illustrate these points with an example from the field.

Figure 1: Maize plot for seed production damaged by strong winds.
Photo: Ronnie Vernooy.

Guangxi: field laboratory for novel practices

The field example concerns a collaborative effort of the Center for Chinese Agricultural Policy (CCAP), national and provincial level plant breeders and local extension agents and farmers to improve maize production through a participatory innovation process. The working assumption of this initiative is that novel forms of collaboration among diverse social actors will lead to the creation of synergies required for the enhancement of sustainable crop development and in-situ/on-farm management of genetic resources (Figure 1). In this process, women and men farmers' research and management capacities to maintain agro-biodiversity in the specific Chinese context will be strengthened (Vernooy and Song 2004, Song and Vernooy, 2009).

The Chinese rural economy has experienced rapid growth since the adoption of a broad programme of rural economic reforms beginning in 1978. China is widely recognised for its achievements in reducing absolute poverty since then. Nevertheless, there are about 30 million people who still live under the absolute poverty line and they comprise the majority of the food insecure population. They mostly live in resource-constrained remote upland areas, which are agro-ecologically diverse, resource poor and risk-prone. Guangxi is one of those risk-prone mountainous regions and with an important ethnic population, the Zhuang. Our study focuses on two contrasting environmental and economic conditions of maize farming in this agro-ecological region that also covers parts of Guizhou and Yunnan provinces.

On steep mountain slopes and between rocks in a very limited number of flat fields, farmers plant maize in minute pockets of soil. Water is a serious problem due to calcareous rocks, while rains easily flood the land and wash away the crops. In these upland areas, there are no good roads and access to the market is reduced. Maize is produced for consumption as a traditional staple crop. There is still some diversity of maize landraces. For instance, waxy maize is considered to have originated from this area. Farmers work an average land size of less than 0.2 hectares. Although the poor have land use rights, in most cases the land itself is of such low quality that it is not possible to achieve subsistence levels of crop production. Some relatively better-off communities can be found in the valleys and flatter areas where maize is used mainly as pig feed. People here tend to be higher educated and their livelihood systems are more integrated in the market economy. Pigs are the main source of income for most villagers. Maize diversity has come under stress here. Since 2000, the planting area for hybrid maize varieties has been enlarged at a high speed and is now out-spacing the area planted with local varieties.