spatial scales; (f) in fullfilling the 'communication gap' between scientists and the public[9] and (g) in networking individuals with similar interest across different regions, thus increasing the size of the dataset and participation[7].

Despite the advantages of the SIM, there are several potential caveats as well. Some of these arise not as much due to the technology but due to the amateur nature of the contributors. Thus in many instances, the exact location of the sightings may not be provided or imprecisely provided[7]. Information could carry inaccurate/mis-identification of species. Since the data collection is not planned, information may tend to be non-uniformly spread across the region or country and biased to urban and semi-urban areas. Finally in most of the cases, the less charismatic and common species may be grossly under represented which will have implication while addressing species distribution patterns.

Despite of short comings, SIM can provide useful resources for scientific research, especially in engaging citizen scientists in research. Affordable camera, mobile phone with camera, GPS and Internet connection have opened the floodgate of information documentation and dissemination. Moreover this has a great multiplier effect. The idea proposed here is the first ever initiative in India to map the bio-resources using social network, Internet media and e-mail discussion groups. This is cost effective, efficient and has a far-reaching effect on mapping and conservation of bio-resources of India. SIM allows not only rapid remote taxonomic identification, bio-resources mapping but can also fill the gap in our knowledge on 'Wallacean Shortfall' and conservation education and awareness and also reconnect back to our natural world.

1. Loarie, 2011; http://calendar.tamu.edu/?y=2011&m=10&d=06&eventdatetime_id=8234&
2. Dickinson, *et al*., *Annu. Rev. Ecol. Evol. Syst*., 2010, **41**, 149–172.
3. Silvertown, J., *Int. J. Sci. Edu.*, 2005, **27**, 1099–1121.
4. Roy, *et al.*, Understanding citizen science and environmental monitoring. Final report on behalf of UK-EOF. NERC Centre for Ecology and Hydrology and Natural History Museum, 2011.
5. Bonney, R. *et al*., *Bioscience*, 2009, **59**, 977–984.
6. Mackechnie, *et al.*, *J. Environ. Monit.*, 2011, **13**, 2687–2691.
7. Stafford, *et al.*, *PLoS One*, 2010, **5**, e14381; doi:10.1371/journal.pone.0014381
8. www.sciencedaily.com/releases/2011/05/110513204526.htm
9. http://biofreshblog.com/2010/11/18/citizen-science-and-new-technology/
10. http://news.cos.ucf.edu/?p=2458
11. Sarma, R. R. and Aravind, N. A., *J. Nat. Hist.* (under review).
12. http://www.indianaturewatch.net/display-image.php?id=290752
13. http://ifoundbutterflies.org/54-bhutanitis/bhutanitis-ludlowi

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Sustainable mountain development in Indian Himalayan region is under the shadow of regional instability

Indian Himalayan Region (IHR) is characterized by a complex socio-ecological system, rich cultural and biological diversity[1]. Himalaya forms a continuous chain of mountains from the West to East. However, the diversity in topography, latitudinal variations and rainfall factors in different parts of the Himalaya is incredible[2]. The Himalayan mountains, located in Northern India play a significant role in deriving ecological benefits for mountains and adjacent plains of the country[1]. Snow covered mountains, high altitude lakes and perennial rivers originating from the region are vital sources of drinking water, irrigation and hydroelectric power for nearly 1.5 billion people of eight countries located in IHR[3]. Approximately 207,937 sq. km of forest cover spreading in IHR is pivotal to the ecosystem. The value of Himalayan forests in terms of carbon sequestration has been estimated to be around Rs 943 billion/year[4]. IHR is also bestowed with a variety of medicinal plants[5]. There are nearly 99 wildlife sanctuaries, 28 national parks, 5 biosphere reserves, 4 tiger reserves, 11 elephant reserves and 2 world heritage sites[6]. Owing to the scenic topography, natural resources and sacred mountains (Figure 1), IHR is a leading destination for tourism, pilgrimage, generation of hydroelectric power, medicinal plants and establishment of natural resources-based enterprises.

But several factors are affecting the mountain ecosystem. The mountains are susceptible to frequent earthquakes, melting of glaciers, flash floods, forest fires, land slides and other natural hazards that have led to geophysical instability. Further, developmental activities like (i) quarrying, (ii) deforestation, (iii) road widening and construction of dams, (iv) frequent vehicular movement, (v) construction of multi-storey buildings along riverbanks and in subalpine–alpine–moraine habitats, (v) unregulated tourism and pilgrimage, and (vii) non-biodegradable waste deposits are degrading the mountain ecosystem. Migration is yet another factor that is hampering traditional conservation agricultural and agro-pastoral practices.

There is need to restore the lost glory of the mountain ecosystem. The government should (a) promote low-cost erosion control measures that are simple and easy to use, (b) create protected areas to save wild genetic material, (c) develop

early-warning systems and disaster-response teams to minimize the effects of natural hazards occurring in the region and (d) create centers of information on mountain ecosystems. It is inevitable to implement these measures without local participation. The government should incentivize locals to conserve resources using environment-friendly technology. Apart from implementing measures to improve crop productivity, horticulture practices, efforts should be made towards conservation. There is a need to integrate traditional knowledge with modern technology to conserve soil moisture, rare and endangered species and to tackle the adversities caused by natural hazards. A policy should be formulated to effectively manage protected area networks, water resources, forests and strengthen institutes in skill-building and decision making.

Figure 1. Early spring view of Chopta subalpine-timberline area with flowering *Rhododendron* sp. in Rudraprayag, Uttarakhand. This area remains under heavy pressures of tourists, pilgrims and grazing during summer-rainy months (Photo: C. P. Kuniyal).

It is important to involve local people in conservation programmes. To engage the locals in large numbers periodic programmes on sustainable mountain development should be organized to sensitize leaders, decision-makers, media, school children and developmental agencies. In the wake of global climate change, regional instability and lack of education lead to degradation in the mountain ecosystem; sustainable mountain development in IHR will remain a Himalayan tragedy[2].

1. Hajra, P. K. and Rao, R. R., *Proc. Indian Acad. Sci.* (*Plant Sci.*), 1990, **100**, 263–277.
2. Ramakrishnan, P. S., *Curr. Sci.*, 2007, **92**, 308–316.
3. http://www.livescience.com/23119-climate-change-himalayas-water-scarcity.html
4. http://gbpihed.gov.in/WebsiteWED/Forests%-20of%20IHR.doc
5. Samant, S. S., Dhar, U. and Palni, L. M. S., *Medicinal Plants of Indian Himalayas: Diversity Distribution Potential Values*, Gyanodaya Prakashan, Nainital, 1998, p. 435.
6. http://gbpihedenvis.nic.in/PAN%20Net-work.html#bio

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Conservation through cultivation: a promising opportunity for the critically endangered tree *Gymnocladus assamicus*

Extinction of species is considered as one of the greatest threats to humankind. Unfortunately, 99% of the species are threatened due to human activities[1] such as habitat fragmentation, resource exploitation and global climate change. With the alarming increase of species extinction, scientists estimated the rate as high as 1,000–10,000 times higher than the natural extinction rate[2]. If the process continues, we will be loosing as many as 30–50% of all species by mid-century[3]. Therefore, effective conservation and management of the biological diversity is urgently needed to face the challenges of climate change, sustainable development and food security.

Plants are often being extinct due to over harvesting for foods, medicines, timber and similar uses to make other resources. Different approaches have been developed to conserve 'species at risk' in both *in-situ* and *ex-situ* conditions. Conservation through cultivation (CTC) is one of the successful approaches for conservation of endangered plant species which gained more popularity for several species. The CTC programme was developed by Limbe Botanic Garden in Mount Cameroon to conserve the rich and fragile biodiversity through reducing harvesting pressures and providing cultivated material[4]. The story of *Prunus africana* in Limbe Botanic Garden[5] showed the pathway for conservation to similar species at risk. American ginseng, Mahogany and many orchid species have also been recovered from the verge of extinction through cultivation for their economic and aesthetic values.

Another successful and perhaps the most popular CTC is the story of the oldest tree on Earth (*Ginkgo biloba*), popularly known as 'living fossil'. Unchanged for more than 200 million years, the species have been extinct in the wild for centuries. The Ginkgo tree is adored in many parts of the world as a street tree and ornamental tree for its beauty and longevity, other than the medicinal values. In a recent interview, Peter Crane, Yale School of Forestry and Environmental Studies Professor and the author of *Ginkgo* agreed that humans have aided to ensure Ginkgo's survival and CTC is an important toolkit for conserving plant diversity[6].

Gymnocladus assamicus is a critically endangered tree species endemic in Northeast India. Over-harvesting of mature pods for traditional uses and habitat degradation posed serious threat to the remnant populations in West Kameng and Tawang districts of Arunachal Pradesh, India[7]. The CTC could be the most suitable approach for *G. assamicus* for two reasons. First, highly saponaceous pods are used for multiple purposes; for example religious activities, day-to-day cleansing, shampooing and expelling leeches from domestic animals[8]. Mature pods are preserved by the local people and offered as a precious gift. Therefore, cultivation in homegardens is an ideal approach to increase the population locally. Secondly, *G. assamicus* leaves turn into elegant, bright yellow colour during autumn (September to