approached Dasholi Gram Swaraj Mandal (DGSM), an NGO based in Gopeshwar which has been working on environmental conservation in mountain areas since 1964, under the guidance of environmentalist, Chandi Prasad Bhatt. DGSM and Bhatt suggested to the villagers to look into the revenue records, who found that the disputed unclassified forest land was the property of Kunkuli village. Thereafter, the villagers of Kunkuli were motivated by DGSM to protect the *Q. leucotrichophora* forest. Since then, approximately 6.0 ha area has been conserved and lopping or felling of green trees is prohibited. DGSM assisted the villagers to fence the area with a stone wall, which also helped in minimizing incidental grazing. The wall separating the village and the protected area has also helped the villagers overcome the damage caused by wild animals to their crops.

Figure 1. Bird's eye view of protected and lush-green *Quercus leucotrichophora* (Banj oak) forest in Kunkuli village, Chamoli (Western Himalaya).

At present, around 20 households inhabit Kunkuli village and own nearly 60–70 livestock, including cows, buffaloes, sheep and goats. They continue to practice agro-pastoral activities. It is interesting to note that because of conservation practices, now trees such as *Myrica esculenta* (Kaphal), *Pyrush pashia* (Mehal) and *Rhododendron arboreum* (Burans) are also flourishing in this area. In order to protect this oak forest, the villagers prefer to walk 8–10 km in far forest for collecting fodder and fuel wood. The villagers used to collect dried leaves only for animals cushion and dried wood as fuel wood from this area, but now they collect wild edible fruits and flowers as well.

In 2010, the Forest Department started an experimental plantation of *Arundinaria falcata* (wild species of bamboo called as 'Ringal' used for rough weaving in hill areas) under oak trees. It has been observed that the plantation under the oak trees has also reduced the expansion of an invasive weed like *Eupatorium* sp. The villagers of Kunkuli feel that the area has developed and serves as a habitat for wild animals like barking deer, Himalayan black bear, wild boar, wildfowl and porcupine.

The village has set a unique example of defensive and constructive participatory approach that has turned the village-level conflicts to embrace conservation (Figure 1). The village has therefore attracted several NGOs, and trainees of the Indian Administrative Service, and Indian Forest Service. Similar initiatives are required to restore the mountain ecosystem and conserve species that are vulnerable to climate change[3,4].

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Siddhwari sacred grove in Upper Ganga Ramsar site of Uttar Pradesh

According to the contemporary definition a sacred grove is 'a physically diverse patch of natural, primary forested enclosure of sacred trees and connected life-forms, revered by the endogamous clan for their supernatural association with religious or ominous attribute, or some alarming mythological anecdote, ascribed to a deity, devil or a demon, who is strongly bond with the woods conserved informally over generations to uphold these beliefs'[1]. Existence of sacred groves is of immense advantage in conservation of natural plant wealth through defence of the forest patch from anthropogenic pressures, with access restrictions based on traditional beliefs of the local clan that worships these plants/trees. Hence these segments of the forests become auto-conserved, virgin forests endowed with climax vegetation and rich biodiversity, besides serving as a repository of many medicinal, palaeo-endemic and threatened taxa.

Known to exist since 1897 (ref. 2), the floristic and ethnobotanical studies of sacred groves were made from various regions in India mainly from Maharashtra[3], Meghalaya[4], Manipur[5] and several parts of the Himalaya[6]; however, their existence in any of the 25 Ramsar Sites of India was never revealed, although these internationally recognized wetlands hold highly rich mineral nutrients in their soil beds with availability of ample photosynthetic raw materials round the year. The favourable environmental conditions coupled with least anthropogenic intrusion makes them congenial for plant growth and sustenance of diverse vegetation. The Upper Ganga Ramsar Site is the only Ramsar Site of Uttar Pradesh covering a stretch of 85 km on the banks of the River Ganga from Brijghat (Ghaziabad district) to Narora (Bulandshahr district). Connected with various religious attributes, the inhabitants of this region uphold immense devotion and firm belief in ancestral deity worships. Therefore, the entire region is infiltrated with many ancient shrines and monuments of the Vedic era surrounded by diverse floristic components often of primary origin and sometimes venerated over generations on the belief of their connection to various sacred life-forms[7].

During field survey and plant collection at the Upper Ganga Ramsar Site, we unearthed a small, unique and entirely secluded forest patch embedded within dense forest which was considered sacred by the local clan of 'Jatas'. This is the Siddhwari sacred grove. Situated on

the bank of the Ganga, Siddhwari sacred grove occupies about 7 ha area with 2 ha core and 5 ha of buffer zone. It is at the highest elevated point of a triangulate forest approximately 190 m amsl, on the northeastern flank of the Ganga at 28°10′38.4″N lat. and 78°12′36″E long. It is at a distance of about 8 km from Narora Atomic Power Station in Bulandshahr district. The River Ganga flows through the southern boundary of the core zone, while all other sides are bordered by the buffer area where a confluence of wetland and terrestrial plants occurs and this serves as a gateway for species migration. It is comprised of an archaic *Ficus benghalensis* L. tree (locally known as 'Siddh Vriksha') with main trunk of *c.* 10 m girth and many prop roots up to 2.5 m in circumference (Figure 1) and associated with diverse floristic elements. The groves stood unexplored in terms of floral wealth and defied transformation due to the stringent religious beliefs of the people with forbidden developmental activities and therefore it thrives as an unscathed, primary forested segment with rich biodiversity supporting climax vegetation and keystone species, the *Ficus religiosa* L. in its virgin state. Presently, this miniature ecosystem stands out as a naturally conserved ecological entity and is unique due to its location within the Upper Ganga wetland precincts.

The Siddhwari sacred grove is endowed with three-tiered vegetation cover. The highest tier comprises lofty trees up to 8–12 m tall with dominant species being *Aegle marmelos* (L.) Correa, *Ailanthus excelsa* Roxb., *Azadirachta indica* A. Juss, *Cassia fistula* L., *Cordia dichotoma* G. Forster, *Dalbergia sissoo* Roxb., *F. benghalensis* L., *F. racemosa* L., *F. religiosa* L., *Holoptelea integrifolia* (Roxb.) Planch, *Manilkara hexandra* (Roxb.) Dubard and *Mimusops elengi* L. The middle tier consists of undershrubs and shrubs, most significant among them being *Adhatoda zeylanica* Medik., *Barleria prionitis* L., *Datura metel* L. and *Lippia javanica* (Burm. f.) Spreng. The lowest tier consists of herbs, including medicinally significant components, viz. *Anagallis arvensis* L., *Centella asiatica* (L.) Urban, *Cleome viscosa* L., *Eclipta prostrata* (L.) L., *Ocimum basilicum* L., *Scoparia dulcis* L., *Tephrosia purpurea* (L.) Pers. and climbers, viz. *Cayratia trifolia* (L.) Domin., *Celastrus paniculatus* Willd., *Diplocyclos palmatus* (L.) Jeffrey, *Mucuna pruriens* (L.) DC. and *Operculina turpethum* (L.) Manso. The purity of the environment is exemplified by the absence of many alien exotics such as *Parthenium hysterophorus* L., *Prosopis juliflora* (Sw.) DC., *Lantana camara* L., *Argemone mexicana* L. etc. The highly valued medicinal and economically important species *C. dichotoma* G. Forster, *M. hexandra* (Roxb.) Dubard and *M. elengi* L. with edible fruits stand out as important components localized within the grove, but are absent in the immediate surroundings. They possibly perished during developmental activities and other anthropogenic interferences in the surrounding areas. Amidst the eroded adjoining forests, the grove exists as an ultimate repository of the diversity-rich climax vegetation and centre of preserved botanical entities serving as an ideal representative of wetland flora of the Upper Gangetic plains.

Figure 1. The Siddhwari sacred grove.

The ancient practice of *in situ* conservation of plants as priceless heritage is maintained in the sacred groves over generations and they subsist as nature's unique reservoirs of biodiversity and wild gene pool with an array of primary forests corralled and sheltered from modernization processes. These multifaceted social institutions help in efficient conservation of nature and often act as the last refuge of relict and extant primary and secondary forests. The wild genetic resources of sacred groves possess immense potential of utility in various breeding programmes for crop improvement, cultivars and development of genotypes and also in the pharmacological industry. In this context, the Siddhwari sacred grove exists as a remarkable heritage of the Ramsar Site and calls for conservation against annihilation during expanding modernization which is gradually eroding the religious beliefs. Further, being an important component of the wetland ecosystem, this sacred grove holds special significance in improving the soil fertility through biomass build-up, efficient nutrient cycling, conserved soil moisture and deeply penetrating root system with soil-binding properties. Additionally, its role in water conservation and thermo-regulation of the micro-environment cannot be ignored in the present scenario of global warming and climate change, and this opens new vistas for future studies.

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