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Research Paper

Medicinal plant dynamics in indigenous medicines in farwest Nepal

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ABSTRACT

Ethnopharmacological relevance: Indigenous medicinal systems have evolved after the shock of original contact of traditional healers with the indigenous traditions because decreasing availability of indigenous medicinal plants and assimilation of new species are increasingly occurred.
Materials and methods: In this study, we appraised the distribution and usage of indigenous and non-indigenous botanicals and their habitats and their uses in indigenous medicines of farwest Nepal following literature and herbarium specimens review, participatory field visits and ethnobotanical surveys.
Results: Because farwest Nepal is least suitable for staple cereal crops, local people have always heavily relied on locally available wild plants. The extensive usage of medicinal plants in farwest Nepal indicates that the plant use is an integral part of culture. Indigenous plants are highly susceptible to overharvesting and their population and distributions have been impacted in response to the introduction of non-indigenous species. Sparse distribution of indigenous species and easy access to non-indigenous species and their habitats, compounded by the need to find for alternatives for species in decline and to treat new diseases, lead to the increment in use of non-indigenous species. Secondary and community forests are gaining importance for the harvest of non-indigenous medicinal plants as they are easily accessible and old-growth forests are overexploited. Besides easy access, ecological versatility and multiple-usefulness of secondary habitats and non-indigenous species also contribute to their increasing use in local pharmacopoeias.
Conclusion: The acceptance of non-indigenous resources is analogous to the cultural evolution and dynamic indigenous knowledge systems, and considered as an adaptive asset.

1. Introduction

At present, 6653 species of flowering plants have been reported from Nepal (Kunwar et al., 2010). About 50% of these can be classified as useful (Kunwar and Bussmann, 2008). Various studies have recorded over 2100 indigenous and 300 non-indigenous plant species as ethnomedicinal (Ghimire, 2008; Rokaya et al., 2010), used by 125 different ethnic groups of the country (Government of Nepal, 2012). The high number of indigenous medicinal plants used, as well as the number of ailments treated, reflects the long history of contact of a community with nature (Prance, 1972; Thomas et al., 2008). Plant use in Nepal Himalaya, recorded in the 6500-year-old text of the *Rigveda*, ranks among the earliest uses of medicinal plants (Malla and Shakya, 1984). Another early account, the *Saushrut Nighantu* written in 878 AD recorded the uses of 278 Nepalese medicinal plants (Subedi and Tiwari, 2000). Later compendia of herbal pharmacopoeias such as *Chandra Nighantu* and *Nepali Nighantu* were published in 19th and 20th century (Ghimire, 2008). The *Nepali Nighantu* is an elaborated corpus with information on the traditional knowledge of 750 medicinal plant species published by the Royal Nepal Academy in 1969 (IUCN, 2004). It is widely reported that medicinal plants are inseparable from Nepal's livelihoods, and have long been collected, consumed, and conserved through indigenous knowledge (Singh et al., 1979). Current estimates suggest that in many developing countries about two third of the population relies heavily on traditional medicines and medicinal plants to meet primary health care (Farnsworth and Soejarto, 1991).

Indigenous knowledge is often hailed for its versatility to recognize and respond to the livelihood changes (Turner and Clifton, 2009) but it has also been transformed by ecological and socio-cultural changes (Pirker et al., 2012). Palmer (2004) and Medeiros (2013) suggest that ethnomedicine has continued to evolve after the shock of original contact, with a decreasing availability of indigenous medicinal plants and the introduction of new species (Albuquerque, 2006;

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Cadena-Gonzalez et al., 2013). Following Webb (1985), we considered medicinal plants which evolve naturally or have long been cultured, but are entirely independent to the human activity as indigenous. On a global scale, whether a species is native or non-native, is generally determined by one (or both) of two concepts: (i) presence in an area before an arbitrary cut-off date imparts native status and (ii) human-mediated movement of individuals results in nonnative status (Trudgen et al., 2012). The term native is synonymous to indigenous and more common in colloquial language (Schwartz, 1997). The present study assesses the patterns of distribution and usage of indigenous and non-indigenous medicinal plants, their habitats, and the status of local traditional healers and healing traditions in farwest Nepal. The dynamics of healing traditions and the species and habitats utilized by them are discussed and the scope of secondary forests and non-indigenous species is analyzed.

2. Study methods

2.1. Study area

Bajhang, Baitadi, Dadeldhura and Darchula districts (29°01′N to 30°15′N/80°03′E to 81°34′E) represent the westernmost area of Nepal, with elevation ranges from 257 to 7132 m, and harbor bioclimates from subtropical forests to alpine *Betula-Rhododendron* scrub (Elliott, 2012) within a varied topography (Devkota and Karmacharya, 2003; Pant and Panta, 2004). Dadeldhura and Baitadi districts represent the mid-elevational hills while Darchula and Bajhang are mountainous districts (Lilleso et al., 2005). Most of the area is arid, and access is difficult (Kunwar et al., 2012), resulting in isolation with a few government amenities and frequent food deficiency (UNWFP, 2006). The local development indices are low, with frequent food and nutritional deficiencies, and shortage of supplies for basic needs (Chaudhary et al., 2010). Arable land is scarce (7–21%) and the cultivation of cereal crops is least feasible (Jha et al., 1996). Due to variations in altitude, topography and bio-climate, the diversity of forest types and medicinal plants and knowledge of their utilization varies widely. As mountainous districts, Bajhang and Darchula respectively have only 27% and 25% forests whereas the mid-elevational hill districts Baitadi and Dadeldhura have 47% and 68%, respectively. The studied districts contain six forest ownership and management types (national, protected, community, leasehold, religious, and private) but their extent varies. The largest cover of community forest (69%) is found in Baitadi district, followed by 34% in Darchula, 20% in Dadeldhura and only 12% in Bajhang. Community forests are restored and protected from exploitations since the second-growth vegetation developed and conserved by local forest users (Kunwar and Sharma, 2004). Community forests and their users of Sigas, Rameswor, Madhu, Bhumiraj and Trishuli of Baitadi district; Shivsundari, Trishuli, Parshuram, and Siddhanath of Dadeldhura district; Dumling, Namjung, Tham and Brahmalek of Darchula district; and Hemantabada, Binayak and Lahare of Bajhang district were consulted. National forests were assessed at Jogbudha and Deurali (Dadeldhura), Pancheswor and Melauli (Baitadi), Gokuleswor and Khar (Darchula) and Lataun and Deulekh (Bajhang). Local markets at Amargadhi and Bagarkot of Dadeldhura, Khalanga and Dumling of Darchula, Khodpe and Patan of Baitadi and Chainpur and Deura of Bajhang were assessed.

Upper Darchula district has much in common with Amaranth (Balick and Cox, 1996) and relict hemp cultures (Clarke, 2007) in other regions of Asia. A few remote villages of Dadeldhura district are occupied by the *Raute* tribal group, who lives in and travels between the Siwalik hills in the south and mountainous highlands in the north and maintain livelihood by nomadic hunting and plant gathering (Manandhar, 1998; Fortier 2009). The major ethnic groups of study area are Kshetri (> 50%), Brahmin (20%), Thakuri (7%), Kami (10%) and Sarki (8%). The first two groups are relatively privileged (Bennet, 2005), while the latter two are categorized as *Dalits* in the socio-cultural class system of Nepal (Folmar, 2007). This allows *Dalits* a special access to opportunities provided by the government (Daniel et al., 2012). Animal husbandry, seasonal crop production, collection and trade of medicinal plants and transhumance are the major livelihood strategies of these communities (Bhandari, 2013). Collection, usage and trade of medicinal plants and their products are most important (Burlakoti and Kunwar, 2008); however, medicinal plant collection is mostly carried out by *Dalits,* which are also artisans (Cameron, 2009). The privileged groups engage in agriculture, animal husbandry and medicinal and aromatic plant cultivation and production.

2.2. Sampling, data collection and analysis

Before start of the fieldwork prior informed consent was obtained at district, village, community and individual level, and plant collection permits were obtained from the respective authorities. After establishing consent with the participating entities, participant observations, discussions, walk-in-the-woods, interviews and informal meetings were conducted during consecutive annual field visits from May 2006 through June 2014. Sacred grooves (*Devisthans*) were sparsely accessed. The field visits from 2011 to 2014 focused especially on the dynamics of indigenous medicines, use of indigenous and non-indigenous species, and the application of secondary habitats. Altogether 32 sites ranging from 600 m (lowland) to an elevation of 3400 m were visited (Fig. 1) and 312 respondents were interviewed with the help of local assistants, using Nepali language questionnaires. The respondents represented medicinal plant collectors, cultivators, traders, traditional healers and the oldest persons of the villages.

After obtaining oral prior informed consent from the participants, discussions were begun based on the checklists/inventory method (Mutchnick and McCarthy, 1997) employing visual cues (Alcorn, 1984). All species encountered during walk-in-the-woods were free-listed (Quinlan et al., 2002), and the vouchers of medicinal plant species collected during the day were displayed in the evenings as discussion prompts. Informal meetings were held during the evening while staying with local communities, and at tea vendors in the morning for information about ethnomedicinal plant species in decline or recently introduced in local pharmacopoeias. Plant species were collected, and the material was identified in the National Herbarium and Plant Laboratories (KATH), Godawari, Lalitpur, Nepal as well as using voucher materials from Missouri Botanical garden (MO). Some of the material was lost while being returned to KATH. For the material stored in KATH the original voucher numbers are given in Supplementary Table 1. For all other species the numbers of the MO vouchers used for identification are given. The plant species were collected following Cunningham (2001), and identified using ethnotaxonomic information and secondary literature (Stainton and Polunin, 1984; Stainton, 1988). Local vernacular names were recorded (Singh, 2008). The housed herbarium specimens of 17 important medicinal plants (Kunwar et al., 2013, 2014) were reviewed to assess the distribution of species over time.

nowball sampling was employed for selecting healers, and village census data and village secretaries were consulted to identify the five oldest people (Voeks, 2007) in the 12 villages for semi-structured interviews for cross-checking. The age range of the interviewee was 70–85 years. The average Nepalese life expectancy is 65.8 years (WHO, 2010). Collaborators were asked about indigenous and non-indigenous botanicals, species decline, and species role in local pharmacopoeias. The use-value (*UV*) index was used to calculate the citation of plants during interviews as proposed by Phillips and