CONCLUSION

The study provides first hand information on the ethnobotanical knowledge, population structure, local harvesting practices and assessment of conservation priority of Medicinal and aromatic Plants (MAPs) in the Dhauladhar mountain range of district Kangra in the state of Himachal Pradesh. A total 29 villages were selected for the documentation of ethnobotanical knowledge on MAPs in the Dhauladhar mountain range. A total of 174 MAPs belonging to 76 families were recorded during the study period from 2013 to 2016. Apart from medicinal uses, these plants were used for some other purposes, like, 35 species as fodder, 30 species as fuel wood, 23 species as food, 15 species used for construction, 14 species in religious ceremony, 13 species for making agricultural tools, 12 species as timber and 24 species used for making ropes, fishing net, dyeing, pesticide etc.

The herbal medicines were consumed in different forms. Most of them were consumed orally, either with water (warm or cold), milk (warm or cold) or honey. Some medicines were applied onto the skin, and others were taken through nasal. The common methods identified for preparing herbal formulations were decoction (concentrated solution resulting from boiling, 30% spp.), concoction (mixture of various elements or ingredients, 17% of medicinal plant spp.), crushing (deforming, 15% spp.) and powdering (reduce to small particles by crushing or drying, 9% spp.).

About 30 categories of human and one category of animal diseases prevalent in the study area and cured by using MAPs were identified during the present study. The common diseases in the study area along the altitudinal gradient were cold and cough, fever and headache, muscular-skeletal problems (arthritis, rheumatism, joint pains, paralysis, osteoporosis, gout, fracture and sprain, muscular strength), birth and menstruation (leucorrhoea, menorrhagia, abortion, excessive menstruation, menopause, pregnancy), gastro-intestinal
problems (diarrhea, dysentery, gastric problem, constipation, indigestion, stomachache, vomiting), skin infection, and respiratory disorders. The maximum number of species (n=25-30) were used to cure gastrointestinal disorders, muscular-skeletal problems and birth and menstruation disorders.

Among the practitioners of traditional herbal medicine, most of the practitioners belonged to the higher age classes (>41 yrs old). Both male and female members of the society practiced herbal medicinal system, of which 46.91% were female healers and the rest were males. There was a significant difference ($\alpha= 0.05)$ between male and female practitioners of different age classes in the study area. Along the altitudinal gradient maximum population of traditional healers were found in the high altitudinal zone, followed by middle altitudinal and low altitudinal zones. A household at high altitudinal zone was familiar with high number of MAPs (about 42) in comparison to the household at middle (about 32 MAPs) and low (about 20 MAPs) altitudinal zones. In most of the cases, practitioners preferred whole plant to prepare medicine instead of individual plant part as they considered that the medicinal properties of plants distribute in all parts and hence increase the efficacy and potency of herbal formulation against the particular disease. The generalized linear model reflected that distance from the district headquarters and elevations were important indicators for the occupancy of traditional knowledge by local people in the study area.

To enumerate species density, Importance Value Index, species diversity and MAPs relationship with the environment variables, quadrats at equal intervals were laid across the Dhauladhar mountain range. Of the total 184 species sampled during the present study by using quadrats, 42 were tree species, 29 shrubs, 91 herbs, 7 ferns and 15 comprised of climbers, epiphytes, mosses and grasses. The distribution of plants varied across various forest types, of which highest number of plants (n=116) were found in temperate region, followed by 68 species in subtropical region and 51 in sub alpine region. In terms of density, the chir pine ($Pinus roxburghii$) was the most dominant species in sub-tropical forest,
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*Rhododendron arboreum* in temperate forest and *Abies pindrow* in sub alpine forest.

About 13 tree species were distributed in two different forest types i.e. *Abies pindrow*, *Betula utilis*, *Lyonia ovalifolia*, *Myrica nagi*, *Picea smithiana*, *Pinus roxburghii*, *Prunus cerasoides*, *Pyrus pashia*, *Quercus leucotrichophora*, *Quercus semecarpifolia*, *Sapium sebiferum*, *Taxus wallichiana* and *Ulmus wallichiana*. *Berberis lycium*, *Cotoneaster acuminatus*, *Indigofera heterantha*, and *Rosa macrophylla* were common shrubs found in temperate as well as subalpine regions. Four species, namely *Cirsium verutum*, *Digitaria setigera*, *Morina longifolia* and *Cyperus rotundus* were found across the altitudinal zones whereas 65 species are common across two altitudinal zones, indicating their wide adaptability.

Shannon-Weiner Diversity Index ranged from 1.85 to 3.01 in the present study. The highest tree species diversity was found in the mixed forest across the altitudinal range of 1600-2900 m. Trees had maximum dominance in the subtropical forest, whereas shrubs had maximum dominance in temperate forest and herbs had highest dominance across the subalpine region. Most of the tree species, generally, had good to fair regeneration in all three zones. The good regeneration of such tree species along the altitudinal gradient suggests their tolerance to biotic pressures and wider ecological amplitude. However, some tree species such as *Taxus wallichiana*, *Juglans regia*, *Jacaranda mimosifolia* and *Cordia dichotoma* had poor regeneration as a result of human induced activities as well as climatic variations across the region. The application of CANOCO revealed that the distribution of plant species in the study area was influenced by the degree of slope, altitude, soil moisture and soil temperature.

MAPs were harvested from the wild in order to meet the need of domestic as well as commercial demand. The present study revealed that in Dhauladhar mountain range a total of 77 MAPs were harvested from the wild. At the same time 15% MAPs traded in the market were sourced from the farms. There were two
types of collectors i.e., regular and irregular, in the study area. The study further revealed the increase in number of irregular collectors (52%) and participation of younger generation in the collection process. Collection of MAPs was done by both male and female members. Female contributed 39.88% of collection and rests were by the male members. Along the altitudinal gradient, maximum population of collectors were found in the middle altitudinal zone, followed by low altitudinal zone, and high altitudinal zone. In the low altitudinal zone number of regular collector were relatively low than irregular collector, as compared to other altitudinal zone where regular collectors were prominent.

The collection of MAPs from the wild as carried by both the collector type was 81.46%. For domestic purpose, about 45.61% of regular collectors and 10.81% of irregular collectors gathered MAPs from the wild, whereas 54.39% of regular and 89.19% of irregular collectors harvested MAPs for the commercial purpose. About 77% of plant parts were harvested using destructive techniques and rest with non-destructive techniques. The pre seasonal collection of many high valued MAPs was also observed in the study area.

Apart from the traditional trade channels, new channels have been identified during the study period, which involve the direct supply of raw material from collectors, cultivators and local agents to the manufacturing units. *Rhododenron arboreum* supply chain in the study depicted information gaps among MAPs stakeholders, especially in terms of accessibility of market, lack of reliable buyers, discriminatory and unfair pricing.

Based on the density, Use Value Index, Harvesting Risk Index and the current status as per global threatened lists issued by IUCN, Red Data Book, CAMP and literature, the MAPs were classified under different conservation priority categories. As per Conservation Priority Index (CPI) and threatened status, a total 45 MAPs were prioritized, of which 57.77% were herbs, 26.66 % trees, 13.33% shrubs and 2.22% were climber. Among these MAPs, 10 species were common in three threatened list criterion and 9 MAPs were common in two
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different threatened list criterions. Some of these species included *Polygonatum verticillatum*, *Aconitum heterophyllum*, *Podophyllum hexandrum*, *Picrorhiza kurroa*, *Rheum australe*, *Jurinea dolomiae*, *Dioscorea deltoidea*, *Heracleum candicans*, *Bergenia ciliata*, *Valeriana jatamansi*, *Selimum vaginatum*, *Thymus linearis*, *Pinus wallichiana*, *Zanthoxylum armatum* and *Thalictrum foetidum*. Based on the CPI score, a total of 19 MAPs which were assigned as Least Concern (LC) category by the IUCN Red List, were found in category I, II and III of CPI score in the study.

Long term conservation of all prioritized MAPs is required. There is a need to induce community based programmes which may help in protection of highly valuable MAPs utilized for both domestic as well as commercial purpose in the study area. Plantation programme for prioritized MAPs based on availability of their habitats should be organized by involving local village institutions. Besides, preservation and management of traditional knowledge by involving younger generation to behold the traditional knowledge is also the need of hour.

Proper trainings and workshops should be organized for the locals to educate them about the importance and techniques of harvesting MAPs. The study area experienced maximum collection from the wild, which resulted in exploitation of MAPs as well as the environment. Therefore, sustainable harvesting practices and suitable value addition techniques need to be developed and disseminated among various stakeholders of MAPs. The role of SHGs for the protection of MAPs highlighted in the study can help in their management and conservation. The present study identified about 12 Medicinal Plants Conservation Areas based on the rich diversity of MAPs in such sites. Besides, to meet the need of MAPs for domestic as well as commercial consumption Medicinal Plants Development Areas need to be developed in the study area where the MAPs resource can be augmented through their continuous plantation.