American Journal of Plant Sciences, 2016, 7, 1662-1672
Published Online August 2016 in SciRes. http://www.scirp.org/journal/ajps
http://dx.doi.org/10.4236/ajps.2016.712157

Peoples' Perception and Conservation of *Dactylorhiza hatagirea* (D. Don) Soó in Manaslu Conservation Area, Central Nepal

Bikram Pandey[1*], Arbindra Timilsina[2,3], Binita Pandey[4], Chhabi Lal Thapa[1], Kamal Bahadur Nepali[5], Pradeep Neupane[1], Resham Thapa[1], Sunil Kumar Gaire[1], Mohan Siwakoti[1]

[1]Central Department of Botany, Tribhuvan University, Kirtipur, Nepal
[2]Key Laboratory of Agricultural Water Resources, Center for Agricultural Resources Research, Institute of Genetic and Developmental Biology, The Chinese Academy of Sciences, Shijiazhuang, China
[3]University of Chinese Academy of Sciences, Beijing, China
[4]Central Department of Zoology, Tribhuvan University, Kirtipur, Nepal
[5]National Botanical Garden, Godawari, Lalitpur, Nepal
Email: [*]bikram_pandey4@yahoo.com

Received 18 July 2016; accepted 26 August 2016; published 29 August 2016

Abstract

The present study analyzes the information and perception of the local community of Samagaun VDC, Manaslu Conservation Area Project (MCAP) regarding *Dactylorhiza hatagirea* (D. Don) Soó (Orchidaceae). We assessed the local peoples' perception on its population status, its availability, factors causing its decline and management practices of this terrestrial orchids. A pre-designed questionnaire was used to gather information targeting the age group between 25 and 60 years (n = 75, 45 male and 30 female). Most of the informants (76%) believe that the abundance of this orchid is declining. Over grazing of domestic animals, over harvesting and lack of awareness among the local community were determined to be the major causes of decline of *D. hatagirea* in the study area. Protection measures as prescribed by the informants were control grazing, raising awareness among the individuals and sustainable harvestings for the long-term conservation of the species. Systematic management plans that incorporate the participation of local individuals and prioritization of their views will be applicable for the proper conservation of the species.

Keywords

Local Perceptions, Conservation and Management, Orchid, *Dactylorhiza hartagirea*,

[*]Corresponding author.

How to cite this paper: Pandey, B., Timilsina, A., Pandey, B., Thapa, C.L., Nepali, K.B., Neupane, P., Thapa, R., Gaire, S.K. and Siwakoti, M. (2016) Peoples' Perception and Conservation of *Dactylorhiza hatagirea* (D. Don) Soó in Manaslu Conservation Area, Central Nepal. *American Journal of Plant Sciences*, **7**, 1662-1672. http://dx.doi.org/10.4236/ajps.2016.712157

Samagaun VDC, Manaslu Conservation Area

1. Introduction

People living in natural environments are indispensable to wild resources. The indigenous community depends completely on natural resources to maintain their necessities like food, fuel, fodder and medicine [1]-[3]. These people do not have access or have limited access to modern facilities like good hospitals, trained doctors, and medicine so they partly or fully depend on traditional medicinal practices [4] [5]. The incessant use of wild plants and the relay of this knowledge from generation to generation gave people a thorough impression of plant resources in the local environment [1]. All these indigenous communities are therefore a store house of information regarding the valuable species and may have priorities for use and management of the resources [6] [7]. Peoples in the protected areas also depend on the available resources to fulfill their needs. Thus, living near nature reserves often allowed them to use the natural resources from protected areas in a sustainable manner, and it is now widely accepted that local knowledge and priorities should be incorporated into management strategies for nature reserves [1] [6] [8].

Local-knowledge based management strategies ensure a focus on the species and vegetation types that are most valuable to local societies. Perception of the local communities can be utilized for the benefits and costs of protected areas [9]; vegetation change [1]; conservation status of animals and plants [10]; use, trade and conservation of medicinal plants [10] [11] and setting conservation priorities [12]. Furthermore, an incorporation of local priorities gives management strategies a better chance for success, because people are more likely to obey regulations influenced by themselves than those forced on societies from outside [1] [10]. Such research can contribute to an approach by characterizing patterns of plant use and management and investigating how these relate to plant's decline or conservation priorities.

The current study prioritizes the perception of the local people towards the conservation of *Dactylorhiza hatagirea* (D. Don) Soó, *locally* known as *Panchaule*. This plant species is native to Afghanistan, Pakistan, India, Nepal and Tibet distributed from an altitudinal range between 2500 and 5000 m above sea level (asl) in open grassy slope and alpine meadows [13]-[15] characterized by palmately lobed tuber (usually 3 - 5 lobed) and lilac to purplish coloured flower (**Figure 1**).

Figure 1. *Dactylorhiza hatagirea*, in natural habitat.

It has been identified as a threatened species in Nepal and listed in CITES Appendix II [16]. The plant was assessed by Convention Assessment Management Plan (CAMP) workshop in 2001 and has been assigned under vulnerable status [17]. *D. hatagirea* is an important medicinal plant species prioritized by government for research and management. Government of Nepal (GoN) under its Forest act (1993) and Forest Regulation (1995), has banned collection, trade, transport and use of *Dactylorhiza hatagirea* [17]. Although GoN has banned the collection and trading of *D. hatagirea* and recently imposed fine of NRs 1000 for every kg, however these types of ban and restriction have not been effective in the conservation of species and the reduction of the collection amount [17] [18].

D. hatagirea is one of the highly valued medicinal orchids extensively used in Ayurveda. The tubers of this species yield high quality "Salep" which is extensively used for its aphrodisiac properties and sexual stimulant in traditional medicines in different parts of Himalayas [19]-[21]. Apart from this, the tuber is used as farinaceous food and nerve tonic [22] [23]. The paste is also considered nutritive and is used in treating weaknesses in children and women [2] [21]. Root powder is also applied on cuts and wounds to stop bleeding [19] [22]-[24]. Thus high medicinal value of *D. hatagirea* has resulted into illegal trading practice. The threats on the plants not only resulted due to its medicinal properties but various natural forces exaggerate to its decline.

The natural factors that mainly cause the decline of *D. hatagirea* comprises of small population size (0.17 - 4.2 individuals/m^2) [2] [13] [25] [26], strong geographical isolation and harsh environmental conditions [27]. The population of *D. hatagirea* is in declining [2] [13] [25] that not only resulted due to anthropogenic activities [2] but also because they are naturally very rare [28] and shows high habitat specificity [29] [30].

In this paper the results are prepared from a study aimed at examining the conservational priorities for *Dactylorhiza hatagirea*. Single plant species is chosen because identification of the most valuable and threatened species (or types of species) and vegetation types can provide a focus for future management strategies that will allow a more sustainable use of plant resources and a better conservation of ecosystems.

2. Methods and Methodology

2.1. Study Area

This study was conducted in Samagaun Village Development Committee (VDC) of Manaslu Conservation Area (MCA). MCA is one of the remote conservation areas in Nepal which lies in Gorkha district of Central Nepal. MCA is bordered by Dhading district in the east, Bhimtang VDC of Manang district in the west, Tibet Autonomous Region (TAR) of the Peoples' Republic of China in the north and Kerouja, Uhiya, Laprak, Barpak VDCs part of Gorkha district in the south [31]-[33]. It lies between the latitude 28˚21' - 28˚45' N, and longitude 84˚30' - 85˚21'E. The area was declared as Conservation Area in 1998 by the then His Majesty's Government of Nepal and is managed by National Trust for Nature Conservation (NTNC) known previously as King Mahendra Trust for Nature Conservation [32].

The total area of the MCA is 1663 sq·km [32] ranging from 1400 m (Jagat) to 8163 m (Mt. Manaslu) above the sea level. This conservation area comprises of seven Village Development Committees (VDCs): Sirdibas, Bihi, Prok, Lho, Samagaun, Chumchet and Chhekampar [31]-[33].

Altitudinal and abundance of different types of habitats and microclimatic condition in MCA represents a unique and ideal site for the availability of varied types of flora and vegetation within short distances. An estimated 2500 species of flora were recorded in the area including 587 vascular plants: 10 gymnosperms, 491 dicots (218 plants species included in medicinal plants) and 86 monocots [27] [31]. MCA is mainly dominated by the east Himalayan species like *Larix himalaica*, *Schima wallichii* and *Castanopsis indica* whereas *Picea smithiana* is the western Himalayan species. The availability of the species of *Rhododendron* (*R. arboreum*, *R. anthopogon*, *R. barbatum* and *R. campanulatum*) is mainly in high altitude of MCA. Large numbers of medicinal plants are also found in MCA along with *Dactylorhiza hatagirea*, which are very important and highly valuable like *Aconitum* spp. *Nardostachys grandiflora* (Jattamansi), *Valeriana jatamansi* (Sugandawal) etc. Samagaun alone consists of more than 54 species of herbs that are of medical and religious values [2] [27]. The presence of 19 types of forests and other forms of dominant vegetation have been recorded from the area [27] [31] [33]. There are different diversity patterns of people's livelihood in MCA. Due to the unfavorable climate and limited arable land, crop farming is very limited in the northern region of MCA than in the southern region [33].

Based on the study of the herbarium samples of *Dactylorhiza hatagirea* stored in National Herbarium and Plant Laboratories (KATH) and Tribhuvan University Central Herbarium (TUCH), we carried our research in Samagaun VDC (**Figure 2**).

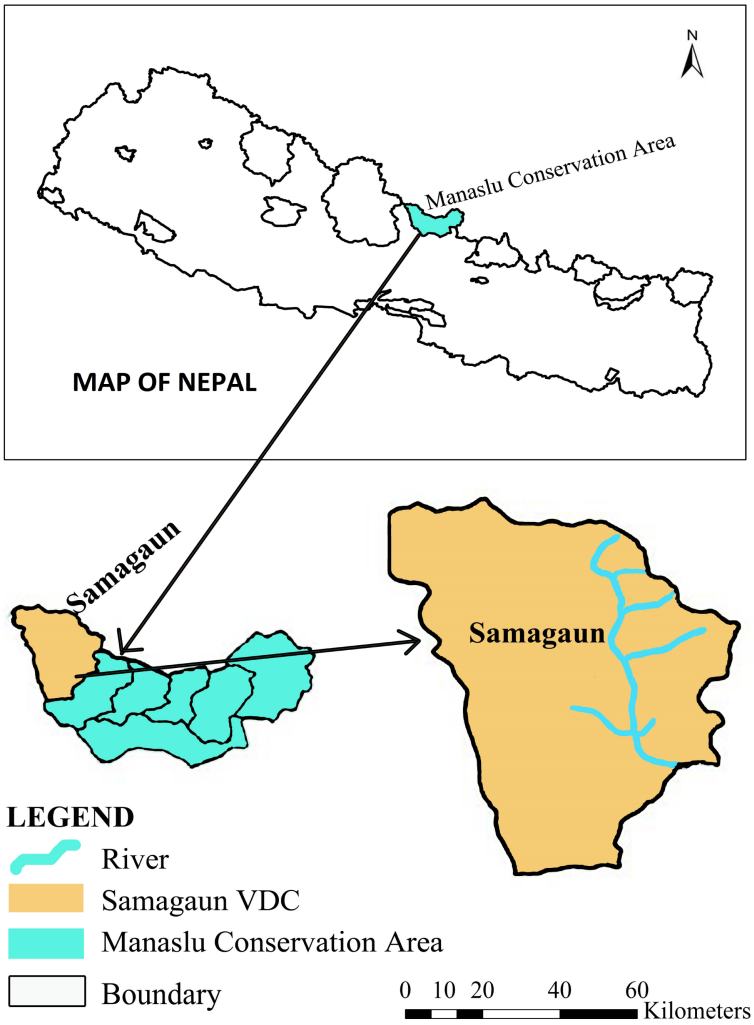

Figure 2. Map of study area (Source Arc GIS 9.0).

2.2. Data Collection and Analysis

Data were collected through key informant interviews, focus-group discussions and formal/informal communications. All interviews were conducted in *Nepali*, the common language of communication in the region.

The survey was carried out during June-July 2012. We administered a questionnaire involving both structured and semi-structured questions. We addressed four specific questions during the study:

- What are the perceptions of the local people about the availability and the use of *Dactylorhiza hatagirea*?
- What are the perceptions of the local people regarding the status of *D. hatagirea* population?
- What factors are perceived by the inhabitants as the drivers of its decline? and,
- What is the conservation status and the management practices for the plant in the area?

We also employed a participatory approach with local people of Samagaun Village to examine the conservation status of *D. hatagirea*. Our discussion then considered the utility of local knowledge and the participation of local people for the plant conservation and we made recommendations for further research.

A pre-designed questionnaire was used to know the local harvesting patterns and peoples' perceptions regarding *D. hatagirea* in the area, targeting the age group between 25 and 60 years. These data were used for further analysis. According to Central Bureau of Statistics, Nepal, there are 197 households in Samagaun VDC of Gorkha District [34]. Total 75 locals inhabitant, 45 males and 30 females, representing different households were taken as the key informants who resided in the area for at least 3 years so that they have idea on area of availability of *Dactylorhiza hatagirea* and to increase precision of data. Thus, 75 household out of 197 were

used in collecting information covering more than 30% of the household in the area. The demographic information of all the respondents were used as variables. These variables includes their age, sex, place of origin, education qualification, practice of transhumance pastoralism and their knowledge regarding the availability and status of *D. hatagirea* (**Table 1**).

We documented local peoples' perceptions on collection patterns, harvesting modes, resource abundance, and sustainability. The availability status was measured based on pre-structured index of 0 - 3 where 0 implies No information, 1—Constant, 2—Declining and 3—Highly declining. Declining and highly declining of the availability of the species depends on how far the inhabitant has to go from their house in order to encounter first species 3 years back and during the time of study. Furthermore, we conducted two focus-group discussions and several informal meetings with local committee leaders. We used focus-group discussions to compare the information we gathered from individuals. The data were analyzed using Microsoft-Excel (2013) and Statistical Package for Social Science (SPSS) 16.0. All the figures are drawn using Microsoft Excel (2013).

3. Results

All the respondents of the study area regarded the surrounding areas as the source of their livelihood needs such as fuel wood, fodder, non-timber forest products (NTFPs), timber and aesthetic values. Besides meeting biomass needs, a sizeable proportion of the respondents also admitted to their economic dependence on surrounding area.

3.1. Peoples' Knowledge Regarding *Dactylorhiza hatagirea* and Its Uses

From the questionnaire it was found that the entire respondents have knowledge regarding *Dactylorhiza hatagirea*. They were also aware about the availability of targeted species in the natural habitat.

According to the respondent, it was found that the germination and sprouting occur between June-July, whereas the plant bear flowers between July-August of the same year, sometimes the flower are noticed until September. Fruiting occurs after September till the onset of autumn. The respondents were however, unaware about the means of propagation.

Around 82.67% of the respondent use the plant for various purpose *i.e.* medicinal, nerve tonic, ornamental, and eaten as vegetable but out of which only 20% respondent mention its religious uses. The paste (Salep) from the tuber is applied on the wounds and cuts. The plant is very useful in treating stomachache, cold and also act as tonic. The powder is also very effective in seminal debility, diarrhea and chronic pain. The flowers been attractive in colour, often use for decorative purpose.

3.2. Perceptions of the Local People on Status of *Dactylorhiza hatagirea*

A majority of the inhabitants (76%) believe that the status of *D. hatagirea*in the area is either declining or highly declining. In contrast, 20% believe that the population of *D. hatagirea* is constant whereas only 4% of respondents have no information regarding its status. Pearson's Chi-square test shows that the availability of this orc-

Table 1. Demographic characteristics of the informant.

Demographic characteristics	Number (%)
Total number of informants	75
Male	45 (60%)
Female	30 (40%)
Origin	
Samagaun VDC	51 (68%)
Others	24 (32%)
Average age of harvesters	37.88 ± 8.43
Academic qualification	
Illiterate	18 (24%)
Literate	42 (56%)
Secondary	11 (14.67%)
Bachelor or higher	4 (5.33%)
Local practicing animal husbandry	28 (37.33%)

hid are not significant with the origin of the informants (**Figure 3**) (χ^2 = 3.8; P = 0.46); sex (χ^2 = 4.1; P = 0.36) (**Figure 4**); age group (χ^2 = 5.7; P = 0.51) (**Figure 5**) and education qualification (χ^2 = 6.1; P = 0.28) of the respondents. Thus it can be said that the response on status of *D. hatagirea* are not related to demographic characteristics. But it was found that majority of the informants (76%) who are educated are aware much about the availability of *D. hatagirea* (**Figure 6**).

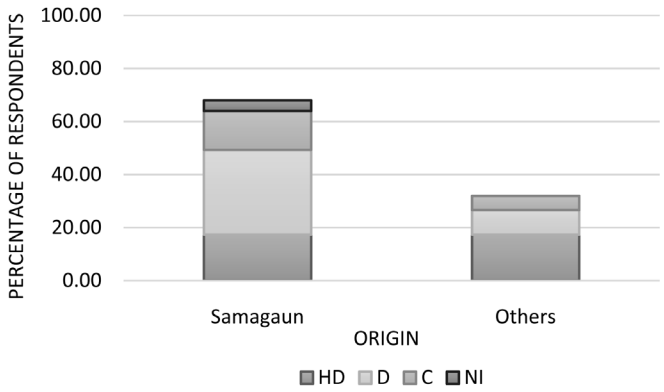

Figure 3. Perceptions of the local inhabitants on status of *Dactylorhiza hatagirea* in the study area based on place of origin. Where, HD—Highly Declining, D—Declining, C—Constant and NI—No Information.

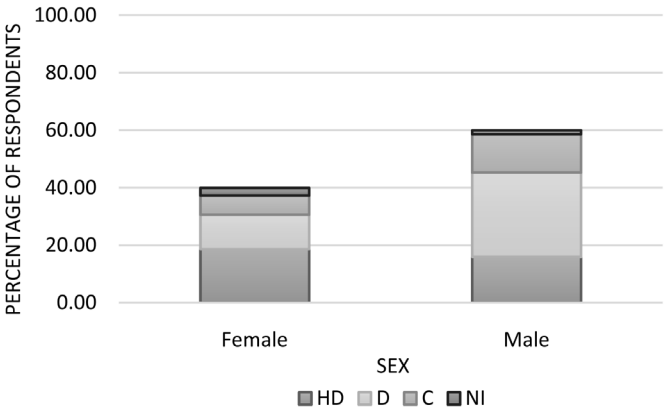

Figure 4. Perceptions of the local inhabitants on status of *Dactylorhiza hatagirea* in the study area based on sex. Where, HD—Highly Declining, D—Declining, C—Constant and NI—No Information.

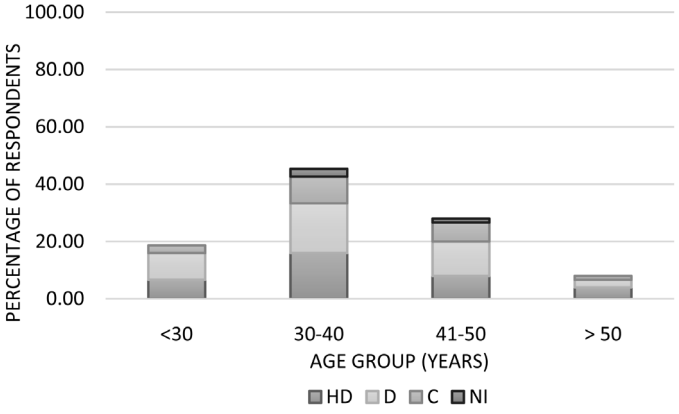

Figure 5. Perceptions of the local inhabitants on status of *Dactylorhiza hatagirea* in the study area based on age group. Where, HD—Highly declining, D—Declining, C—Constant and NI—No Information.

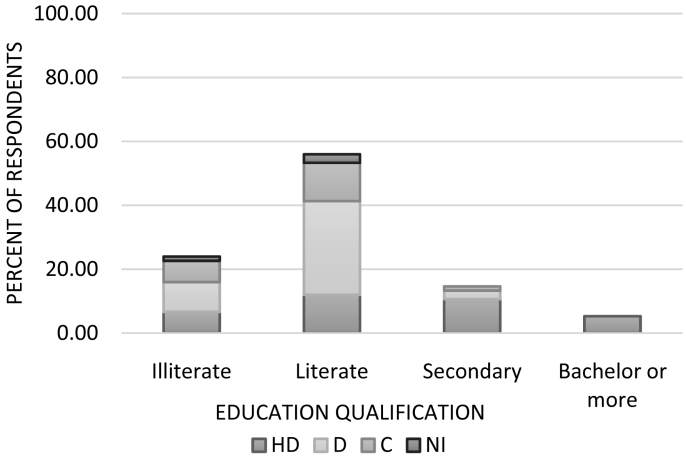

Figure 6. Perceptions of the local inhabitants on status of *Dactylorhiza hatagirea* in the study area based on education qualification of the respondents. Where, HD—Highly Declining, D—Declining, C—Constant and NI—No Information.

3.3. Response on Causes of Decline

Despite disparity in viewpoints concerning the level of threat to *D. hatagirea*, local indigenous people agreed the potential threats are over-harvesting, over-grazing by livestock and lack of awareness among the local. Although there is no illegal harvesting or involvement of the people in poaching, the threats of harvesting is mainly because the plant is often used by the local inhabitants as medicine. Over grazing by the livestock (36% respondents) was the major cause of decline of this threatened orchid where as 20% of the respondents agreed that overharvesting was the cause that leads to dwindling of the species. Likewise, lack of awareness (20% respondents) among the individuals was also identified that cause the species to decline (**Figure 7**).

3.4. Perception on Conservation Status and Management Practice

In an open ended question regarding the perception of local people on conservation status and management practice, people listed a total of 5 different measures (**Figure 8**). Majority of the handlers (25.33%) believe to raise awareness among the individual regarding the conservation of *D. hatagirea*. Sustainable harvesting implementation was second highest (24%) response. People are aware about overgrazing by the livestock in the area as major threats that lead to destruction of the species in the area so they mainly suggest to control grazing of livestock. Apart from this, respondents recommended to undertake research and implement knowledge about this threatened plant species.

4. Discussion

The result from current study shows that all the informants perceive knowledge regarding the availability and use of *D. hatagirea* in the study area. Quoting peoples' knowledge, popular press has reported the presence of *D. hatagirea* in Manaslu Conservation Area [2] and its uses as aphrodisiac and medicine [19] [23] [24]. The present study has attempted to highlight the use of *D. hatagirea* being practiced for many generations by the local people and the unfortunate failure of management authorities to capitalize on such tradition to achieve conservation goals in MCAP. It has often been recorded that such a situation arises mainly due to ignorance of the human needs and aspirations in the initial planning of protected areas, often leading to the conflicts between indigenous people and managers which is common in majority of protected areas in third world countries [35].

Although lack of significance in Chi-square tests between demographic variables and responses indicates that results are uniform among local people irrespective of origin, age, sex and education level, but it was found that male the key informant in understanding the availability of orchids in the area. Citing the perception of the respondents, the abundance of *D. hatagirea* in Nepal [2] [27] and various protected areas of India is declining [13] [25] [28] [30]. The local inhabitant of Samagaun has more idea regarding the abundance of this threatened orchid in the natural habitat. This result was supported by [36] and [37] which state that local inhabitant have more

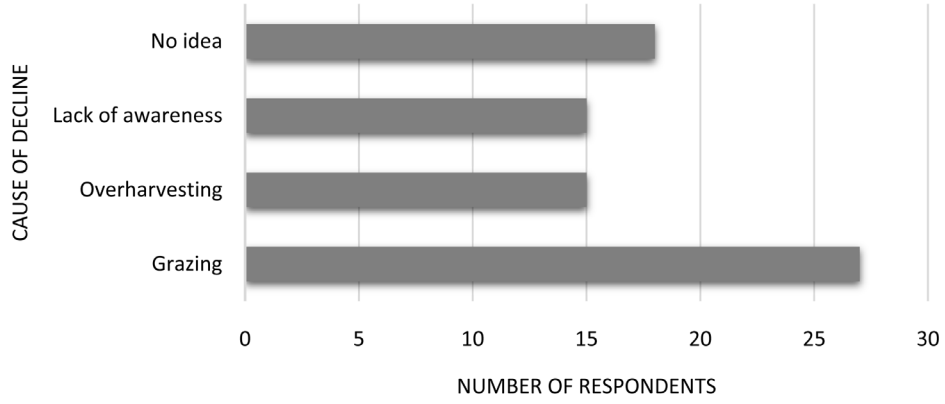

Figure 7. Local perception on cause of decline in abundance of *D. hatagirea*.

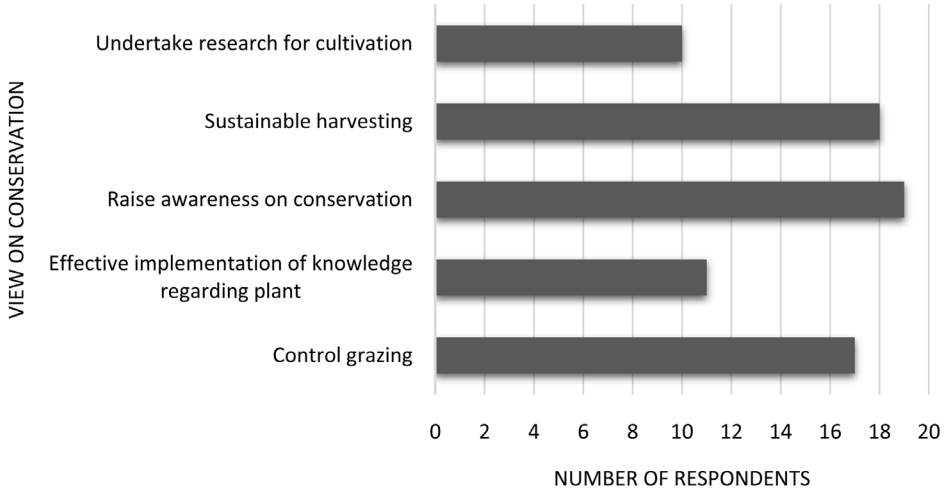

Figure 8. Local perception regarding conservation measures and management practices.

knowledge on the abundance of available plants species in their locality. Anthropological studies suggest that age and gender determine intra-cultural variations in traditional knowledge and perception of plant species. Among the people of the Himalayas [3] [38] and in other part of the world [10] [39] found that older generation possess more detailed knowledge of medicinal plants than the younger ones [40]. Variances in the knowledge and perception between men and women have been partly explained as a consequence of the sexual division of labor in traditional societies [39]. Following insights from previous research showing that in traditional societies, gender is a key factor influencing division of labor [40] [41]. The positive attitude of educated respondents towards the status of the species in the area might generally because of awareness. Education thus, increases the respondent's awareness of conservation matters and many studies have found positive association between education and conservation attitudes [42]. High level of education is likely to raise a respondent's expectation of the management hence more likely to increase negative perception if these expectations are not met.

In addition to stimulating local participation, the involvement of local people in conservation can be a valuable source of knowledge. Here we compared the local perceptions of species declines. Over grazing, over harvesting and lack of awareness is perceived to be the main cause of decline by the inhabitants. Similarly, some other scientific studies revealed that frequent extraction and increase grazing pressure were mainly responsible for decline of *D. hatagirea* in Central Himalaya [2] [13] [21]. One of the most important causes of loss of plant diversity is habitat fragmentation cause by grazing [13] [30] [40]. Transhumance pastoralism and the increase livestock in the Himalaya have negative impact due to grazing [41]. Similar threat has been experienced in the study area it was found that the livestock were graze in area where there is potential of *D. hatagirea* to be present. From the questionnaire survey it was found that the agro-pastoralists in the study area practice tran-

shumance for which during summer, the livestock are grazed in the sub-alpine to alpine area. Moreover, overgrazing and trampling by the livestock results to destroy the aerial parts [28] [40]. Grazing and periodic movement of livestock in the study area has resulted in the destruction of the habitat which further results in decline of population density of *D. hatagirea*. From the conservation point of view, lack of awareness, over grazing of the livestock, transhumance pastoralism collectively accounts for the decrease in availability in the area.

There are various conservation measures proposed by the local people to prevent decline and to promote long term sustainability of the resources. People proposed: i. Control over discriminate grazing, ii. Raise awareness programme among the local inhabitant, iii. Sustainable harvesting and iv. Development of local capacity in understanding the life cycle of the plants.

The control over discriminant grazing as suggested by the local inhabitants would be obligatory in order of long term sustainability of targeted species. Although the protected area of Nepal has prohibited the grazing of livestock in the core area but due to lack of proper implementation, even the core area are highly grazed [2]. Lack of awareness as perceived by the informants as a major cause of decline of *D. hatagirea* in the study area has arises mainly because during the initiation of protected areas, the local were either ignored or their views were not properly responded. Maximizing benefits to local communities often creates an incentive for conservation of species and results in equal benefit of the both [8]. The effort to expand the protected areas has sometimes misguided and sometime dismisses the whole concept of sustainable use [43]. The sustainable harvesting of the species for long term conservation and its proper implementation thus, acts as a major strategy in conservation [2] [27]. Finally, there is an opportunity of local institution for the development of local capacity in proper understanding the plant. Emergence of such institutions is facilitated by the perceived knowledge about the resource and the impacts of harvesting along with socio-cultural incentives for changing peoples' perceptions [44]. Therefore, cooperation between local institutions, state agencies, researchers, and other stakeholders is necessary for the long-term management of *D. hatagirea*.

5. Conclusion

In conclusion, local community was well aware about the declining rate of *D. hatagirea*. For the conservation and protection of this species, various dimensions of study including ecology, biology, social, cultural and economic should be carried out in order to get a promising outcome. Therefore, government policy related to sustainable management of all plant species must be implemented taking into account the need of the communities. It is advised to pay a greater attention in building a strong governance institution, including raising awareness among the local community and further investigating this species for better management practices.

Acknowledgements

We highly acknowledge Mr. Prakash Bhattarai for providing partial financial support through Rufford Small Grants for Nature Conservation (Project ID 11881-1) to carry out this project. The work would not have been accomplished without the generous help from staff of Manaslu Conservation Area Project (MCAP) and local communities who shared their valuable knowledge and information during the field work. Sincere thanks goes to staff and students of Buddha Secondary School, Phillim (Sirdibas) and the members of Samagaun Youth Club. We owe thanks to faculties of Central Department of Botany, Tribhuvan University for the help which we received after the field survey and their valuable guidance are highly appreciated. Our sincere thanks also goes to Santosh Rana for his help to retrieve the map of study area. The encouragement, inspiration and guidance that we received during the work are thankfully acknowledged.

References

[1] Lykke, A.M. (2000) Local Perceptions of Vegetation Change and Priorities for Conservation of Woody-Savanna Vegetation in Senegal. *Journal of Environmental Management*, **59**, 107-120. http://dx.doi.org/10.1006/jema.2000.0336

[2] Bhattarai, P., Pandey, B., Gautam, R.K. and Chhetri, R. (2014) Ecology and Conservation Status of Threatened Orchid *Dactylorhiza hatagirea* (D. Don) Soo in Manaslu Conservation Area, Central Nepal. *American Journal of Plant Science*, **5**, 3483-3491. http://dx.doi.org/10.4236/ajps.2014.523364

[3] Ghimire, S., McKey, D. and Aumeeruddy-Thomas, Y. (2004) Heterogeneity in Ethnoecological Knowledge and Management of Medicinal Plants in the Himalayas of Nepal: Implications for Conservation. *Ecology and Society*, **9**, 6.

[4] Manandhar, N.P. (1990) Some of the Medicinal Plants of Nepal. *Ancient Science of Life*, **IX**, 231-233.

[5] Manandhar, N.P. (2002) Plants and People of Nepal. Timber Press, Oregon.

[6] Salasfky, N. and Wollenberg, E. (2000) Linking Livelihoods and Conservation: A Conceptual Framework and Scale for Assessing the Integration of Human Needs and Biodiversity. *World Development*, **28**, 1421-1438. http://dx.doi.org/10.1016/S0305-750X(00)00031-0

[7] Balemie, K. and Kebebew, F. (2006) Ethnobotanical Study of Wild Edible Plants in Derashe and Kucha Districts, South Ethiopia. *Journal of Ethnobiology and Ethnomedicine*, **2**, 53. http://dx.doi.org/10.1186/1746-4269-2-53

[8] Cunningham, A.B. (2001) Applied Ethnobotany: People, Wild Plant Use and Conservation. Earthscan, London and Sterling, VA.

[9] Karanth, K.K. and Nepal, S.K. (2012) Local Residents Perception of Benefits and Losses from Protected Areas in India and Nepal. *Environmental Management*, **49**, 372-386. http://dx.doi.org/10.1007/s00267-011-9778-1

[10] Dalle, S.P. and Potvin, C. (2004) Conservation of Useful Plants: An Evaluation of Local Priorities from Two Indigenous Communities in Eastern Panama. *Economic Botany*, **58**, 38-57. http://dx.doi.org/10.1663/0013-0001(2004)058[0038:COUPAE]2.0.CO;2

[11] Uprety, Y., Poudel, R.C., Asselin, H., Boon, E.K. and Shrestha, K.K. (2011) Stakeholder Perspectives on Use, Trade, and Conservation of Medicinal Plants in the Rasuwa District of Central Nepal. *Journal of Mountain Science*, **8**, 75-86. http://dx.doi.org/10.1007/s11629-011-1035-6

[12] Potvin, C., Revéret, J.P., Patenaude, G. and Hutton, J. (2002) The role of Indigenous Peoples in Conservation Actions: A Case Study of Cultural Differences and Conservation Priorities. In: Prestre, P.L., Ed., *Governing Global Biodiversity*: *The Evolution and Implementation of the Convention of Biological Diversity*, Ashgate Publishing Company, Aldershot, 159-176.

[13] Bhatt, A., Joishi, S.K. and Garola, S. (2005) *Dactylorhiza hatagirea* (D. Don) Soó—A West Himalayan Orchid in Peril. *Current Science*, **89**, 610-612.

[14] Acharya, K.P., Chaudhary, R.P. and Vetaas, O.R. (2009) Medicinal Plants of Nepal: Distribution Pattern along an Elevation Gradient and Effectiveness of Existing Protected Areas for Their Conservation. *Banko Janakari*, **19**, 16-22. http://dx.doi.org/10.3126/banko.v19i1.2178

[15] Warghat, A.R., Bajpai, P.K., Srivastava, R.B., Chaurasia, O.P. and Sood, H. (2013) Population Gennetic Structure and Conservation of Small Fragmented Location of *Dactylorhiza hatagirea* in Ladakh Region of India. *Scientia Horticulturae*, **164**, 448-454. http://dx.doi.org/10.1016/j.scienta.2013.09.044

[16] WWF (2002) CITES Implementation in Nepal. WWF Program, Nepal. (In Nepali)

[17] DPR (2006) Plants of Nepal: Fact Sheet. Government of Nepal, Ministry of Forest and Soil Conservation, Kathmandu.

[18] Phoboo, S., Devkota, A. and Jha, P.K. (2008) Medicinal Plants in Nepal—An Overview. In: Jha, P.K., Karmacharya, S.B., Chhetri, M.K., Thapa, C.B. and Shreshtha, B.B., Eds., *Medicinal Plants in Nepal*: *An Anthology of Contemporary Research*, Ecological Society (ECOS), Nepal, 1-24.

[19] Lama, Y.C., Ghimire, S.K. and Aumeeruddy-Thomas, Y. (2001) Medicinal Plants of Dolpo: Amchis' Knowledge and Conservation. WWF Nepal Program, Kathmandu.

[20] Thakur, M. and Dixit, V.K. (2007) Aphrodisiac Activity of *Dactylorhiza hatagirea* (D. Don) Soó in Male Albino Rats. *Evidence-Based Complementary and Alternative Medicine*, **4**, 29-31. http://dx.doi.org/10.1093/ecam/nem111

[21] Giri, D. and Tamta, S. (2010) A General Account on Traditional Medicinal Uses of *Dactylorhiza hatagirea* (D. Don) Soó. *New York Science Journal*, **3**, 78-79. http://www.dx.doi.org/10.7537/marsnys030210.12

[22] Watanabe, T., Rajbhandari, K.R., Malla, K.J. and Yahara, S. (2005) A Handbook of Medicinal Plants of Nepal. Kobfai Publishing Project, Foundation for Democracy and Development Studies, Bangkok.

[23] Baral, S.R. and Kurmi, P.P. (2006) A Compendium of Medicinal Plants in Nepal. Mass Printing Press, Kathmandu.

[24] Pant, B. and Raskoti, B.B. (2013) Medicinal Orchid of Nepal. Himalayan Map House Pvt. Ltd., Kathmandu.

[25] Uniyal, S.K., Awasthi, A. and Rawat, G.S. (2002) Current Status and Distribution of Commercially Exploited Medicinal and Aromatic Plants in Upper Gori Valley, Kumaon Himalaya, Uttaranchal. *Current Science*, **82**, 1246-1252.

[26] Jalal, J.S. and Rawat, G.S. (2009) Habitat Studies for Conservation of Medicinal Orchids of Uttarakhand, Western Himalaya. *African Journal of Plant Science*, **3**, 200-204.

[27] Pandey, B. (2014) Ecological Status and Conservation of *Dactylorhiza hatagirea* (D. Don) Soó in Manaslu Conservation Area, Central Nepal. MSc Thesis, Tribhuvan University, Kathmandu.

[28] Kala, C.P. (2005) Indigenous Uses, Population Density, and Conservation of Threatened Medicinal Plants in Protected Areas of the Indian Himalaya. *Conservation Biology*, **19**, 368-378. http://dx.doi.org/10.1111/j.1523-1739.2005.00602.x

[29] Dhyani, P.P. and Kala, C.P. (2005) Current Research on Medicinal Plants: Five Lesser Known but Valuable Aspects. *Current Science*, **88**, 335-340.

[30] Rinchen, T., Pant, S. and Anwar, M. (2012) Population Census of Critically Endangered *Dactylorhiza hatagirea* (D. Don) Soó in Suru Valley, (Cold Desert Region, Jammu and Kashmir, India). *International Journal of Biodiversity and Conservation*, **4**, 332-335.

[31] KMTNC (1998) Project Proposal for Manaslu Conservation Area. King Mahendra Trust for Nature Conservation, Lalitpur.

[32] NTNC (2009) Profile Layout National Trust for Nature Conservation (NTNC): Project Proposal for Manaslu Conservation Area. National Trust for Nature Conservation, Lalitpur.

[33] DNPWC (2010) Annual Report 2009-10. Government of Nepal, Department of National Parks and Wildlife Conservation (DNPWC), Kathmandu.

[34] Central Bureau of Statistics (2012) National Population and Housing Census 2011 (Village Development Committee/ Municipality). National Planning Commission Secretariat, Kathmandu, 56-57.

[35] Durbin, J.C. and Ralambo, J.A. (1994) The Role of Local People on Successful Maintenance of Protected Areas in Madagascar. *Environmental Conservation*, **21**, 115-120. http://dx.doi.org/10.1017/S037689290002453X

[36] Denslow, J.S. (1995) Disturbance and Diversity in Tropical Rain Forests: The Density Effect. *Ecological Application*, **5**, 962-968. http://dx.doi.org/10.2307/2269347

[37] Primack, R.B. (2006) Essentials of Conservation Biology. Sinauer Associates Inc., Sunderland.

[38] Dhar, U., Rawal, R.S. and Upreti, J. (2000) Setting Priorities for Conservation of Medicinal Plants—A Case Study in the Indian Himalaya. *Biological Conservation*, **95**, 57-65. http://dx.doi.org/10.1016/S0006-3207(00)00010-0

[39] Camou-Guerrero, A., Victoria Reyes-García, V., Martínez-Ramos, M. and Casas, A. (2008) Knowledge and Use Value of Plant Species in a Rarámuri Community: A Gender Perspective for Conservation. *Human Ecology*, **36**, 259-272. http://dx.doi.org/10.1007/s10745-007-9152-3

[40] Shrestha, U.B. and Bawa, K.S. (2014) Harvesters' Perceptions of Population Status and Conservation of Chinese Caterpillar Fungus in the Dolpa Region of Nepal. *Regional Environmental Change*, **15**, 1731-1741. http://dx.doi.org/10.1007/s10113-014-0732-7

[41] Ahmed, M.R. and Laarman, J.G. (2000) Gender Equity in Social Forestry Programs in Bangladesh. *Human Ecology*, **28**, 3433-3450. http://dx.doi.org/10.1023/A:1007009615750

[42] Shrestha, R. and Alavalapati, J. (2006) Linking Conservation and Development: An Analysis of Local People's Attitude towards Koshi Tappu Wildlife Reserve, Nepal. *Environment, Development and Sustainability*, **8**, 69-84. http://dx.doi.org/10.1007/s10668-005-0188-5

[43] Olea, P.P. and Mateo-Tomas, P. (2009) The Role of Traditional Farming Practice in Ecosystem Conservation: The Case of Transhumance and Vulture. *Biological Conservation*, **142**, 1844-1853. http://dx.doi.org/10.1016/j.biocon.2009.03.024

[44] Heywood, V.H. and Irindo, J.M. (2003) Plant Conservation: Old Problems, New Perspectives. *Biological Conservation*, **113**, 321-335. http://dx.doi.org/10.1016/S0006-3207(03)00121-6