INTRODUCTION

Nepal is a settlement in the Himalayan lap that has a rich biodiversity. The rough terrains have given rise to some hardy tribes with interesting ways of life. Nature can still exist in a somewhat conserved state, making it a tourist destination for both humans and various species of birds. Nepal is a biodiversity rich country with 1600-1900 plant species commonly used in traditional practices from ancient times [1-3]. High altitude rangelands are highly rich in herbal and aromatic plants, and they are the rich sources of medicines and value products [4]. Cultural healing through traditional knowledge of herbal medicine, including complementary and alternative medicine provides the basis for problem-solving strategies for economically marginalized communities in any nation. Moreover, the remote areas of Nepal are particularly rich in ethno-medical knowledge and practices and are the major collectors and exporters of crude forms. Although many studies have been conducted to document medicinal plants of Nepal [5-13], only three studies have been made to document the medicinal plants in this area [4,8,14], but the ethno-botanical knowledge of yak herders has not been documented until date.

The rugged topography, aridity, and poor soils in the Mustang district make it unfavorable for agriculture; thus, nomadic pastoralism is critically important for the economy of the Mustang District. These nomadic communities are underprivileged communities in the nation and are dependent on ethno-medicine for both humans and animals. Almost every nomad who lives in alpine areas away from villages with yak and chauri rely solely on herbal and traditional practices as medicine. The reason behind this is the lack of reliable and sufficient health facilities in these areas. Over time, generations of these families in Mustang district have generated an immense amount of ethno-botanical knowledge to facilitate in curing diseases. The rich knowledge of herbal medicine in this community is totally oral, and little of it has been documented; however, it has been passed down from generation to generation [15]. Their knowledge regarding the use of plants and plants parts such as leaves, fruits, rhizomes, or bark, and also the method of processing for medicinal purposes needs to be well-documented and preserved, this is not only for the effective and cheap sources of medicine but also for the conservation of indigenous ethno-botanical knowledge and sustainable use of this knowledge. The lack of proper documentation, uncontrolled exploitation, and

Ethnomedicinal plants used by yak herders for management of health disorders

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ABSTRACT

Aim: The aim of the study was to document the indigenous ethno-botanical knowledge of the transhumant nomads of Mustang, Nepal, a representative settlement in the Himalayan highland. Methodology: A study was carried out during a direct field visit to collect plants, consisting of a semi-structured questionnaire and personal interviews. Both fresh and dried herbs, plants parts, and fungus were collected as far as possible. Results: The present study identified 51 medicinal plants and 2 funguses that were used for 47 different ailments in the medicinal practices of the nomadic tribes of Lower Mustang, Nepal. Most of the medicines were prepared as juice (22.64%) or powder (49.05%) and administered orally. Roots (23%) and leaves (28%) were the most frequently used parts of the plants while prayer-laced ties were commonly applied in sheds and housing areas. Conclusion: This study has shown that the transhumant pastoralist nomadic communities have their own traditional ethno-botanical medicines that remain cost effective and the method of choice for management of health disorders and is passed down through oral traditions under the guidance of an herbal practitioner. There is a need for such practices to be scientifically validated, with respect and inclusion into sustainable veterinary medicine to support these remotely located communities.

KEY WORDS: Animal husbandry, ethno-medicine, ethno-veterinary practices, Himalayan highland
also the shortage of effective conservation efforts have caused many medicinal plants to become either extinct or replaced by chemotherapeutic agents [16]. Thus, there is an urgent need to document the indigenous ethno-botanical knowledge, especially in times when natural tragedies such as earthquakes, floods, landslides, glacial lake bursts, and droughts threaten survival in the high mountainous terrains. Thus, the documentation, conservation, and sustainable use of these resources based on indigenous technological knowledge is a present need within the country.

**METHODOLOGY**

**Study Area**

The Mustang district covers 3,639 km² and is located in the trans-Himalayan Arid Zone [17] in the Midwestern Development region of north-central Nepal, which is bounded by Myagdi to the South, by Dolpa to the West, by Manang to the East, and by the Tibetan Autonomous region of the People’s Republic of China to the North [4].

The study area is comprised of the alpine pastures and temperate forests of Lete, Kowang, Marpha, and the Tukuche VDCs of Lower Mustang, Nepal. All the areas are located above 1500 meter altitude, and extend up to 6800 meter altitude. The major ethnic inhabitants of the area are Thakali, Gurung, Bishwakarma, and Sherpa. They have roots with Tibeto-Burmese and Indo-Aryan cultures speaking Thakali, Nepali, and Tibetian Dialects. Their economy relies on livestock farming, agriculture, and tourism. Owing to the low productivity of the soil, they are engaged in the collection and trade of medicinal plants and livestock farming [Figure 1].

**Ethno-botanical Survey**

All the 32 yak herders of lower Mustang, including the Local healers known as Aamchi, were surveyed with a set of pre-tested semi-structured questionnaires. The age of informants ranged between 24 and 56 years. Prior informed consent was obtained verbally before they were interviewed and all agreed to be involved in this survey. Two interview methods were followed, and walks were taken around the grazing land and forest for plant collection and information gathering during February-June 2014. The data were compiled and interpreted in the form of Table 1.

**Total Key Informants**

During the survey, we discussed with 32 yak herders including local healers called “Aamchi.” Among these all of the informants were male (100%), this is because females are confined to the household works and males are only involved in transhuman animal husbandry. The age of informants ranged between 24 and 56 years only two informants were below 30 years of age and rest above 30. The obtained informations were subjected to the other informants to check their precise knowledge of ethno-medicines.

**Data Analysis**

The obtained informations were put in a Microsoft office excel 2007 and analyzed using descriptive statistics.

**RESULTS**

**Plants Used**

The total of 51 plants and 2 fungal species belonging to 32 families and 44 genera were found to be commonly used in treating 47 ailments in the communities studied. The largest number of plant species were recorded from families **Compositae** (4 species), **Gentianaceae** (4 species) followed by **Asparagaceae** (3 species), and **Rutaceae** (3 species). Three families **Pinaceae**, **Rosaceae**, and **Ericaceae** represent 2 plant species each and rest of the families represented 1 species each.

Although Bhattarai et al. [4] reported 121 species belonging to 49 vascular plant and 2 fungal families and 92 genera, 8 plant species namely **Acorus calamus**, **Prunus armeniaca**, **Artemisia vulgaris**, **Chlorophytum nepalense**, **Swertia multicaulis**, **Rhodiola rosea**, **Pedicularis siphonantha**, **Taraxacum officinale** were added by the present research. When compared to ancient Tibetian literature, 1 plant species (R. rosea) was recorded, and medicinal plants such as **Rhododendron lepidotum**, **Rumex nepalensis**, **P. armeniaca**, **Daetlyorrhiza hatagirea** were reported with same ethno-medicinal values.

**Parts of Plants Used and Modes of Preparation**

Various parts of plants were used in the preparation of remedies. The most frequently used were leaves (28%), followed by roots/ rhizomes (23%), and fruits/flowers (18%) [Figure 2].

Several types of medicinal plants were used; the most common were climbers and the least common were trees [Figure 3].

The largest numbers of medicinal plants (19 species) were used for respiratory tract infections (cold, cough, headache,
Table 1: Traditional herbal medicine for treatment of disease and ailments by yak herders of Mustang district in Nepal

| Scientific name          | Family          | Vernacular name | Parts used | Conditions          | Method of application                                                                 | References |
|--------------------------|-----------------|-----------------|------------|---------------------|----------------------------------------------------------------------------------------|------------|
| *Abies spectabilis* D. Don | Pinaceae        | Kye (Gurung) Talispatra, Gobre salla (Nepali) | Fresh leaves and cones | Bone fracture | About 20 g of pulverized fresh leaves and cones drunk two times a day until recovery. Paste of pulverized roots and cones are applied around the site of fracture | 32         |
| Aconitum naviculare (Bruhl) Stapf | Ranunculaceae | Bhalaponar (Gurung) Nirmasi (Gurung) | Whole plant | Fever, jaundice | About 15 g of decoction is mixed with 5-10 g is taken with a cup of Luke warm water BID-TID until recovery | 28         |
| Aconitum orochryseum Stapf | Ranunculaceae   |                | Roots      | Altitude sickness, diarrhea, dysentery, cough, fever | 30         |
| Acorus calamus L. | Acoraceae       | Bojho (Nepali)  | Rhizome    | Cold, anthelminthics, fever | About spoonful powder of rhizome is taken with hot water for worms. A piece of rhizome is chewed to tear fever and cold. | 32         |
| *Allium fasciculatum* Rendle | Amaryllidaceae  | Jimmu (Nepali) Nosyante (Gurung) | Whole plant | Plant poisoning, gastritis, purification of blood | 10 g of the whole plant is pounded and boiled with 2 cups of water, and half cup of decoction is drunk twice a day | 32         |
| *Artemisia gmelinii* Weber ex Stechm. | Compositae | Titepati (Nepali) Bajha (Gurung) | Leaves     | Gastritis, scabies, indigestion | About 10-15 g of plant parts is boiled with 2 cups of water and taken BID-TID to cure | 32         |
| *Artemisia vulgaris* L. | Compositae      | Titepati (Nepali) | Leaves     | Fever, Indigestion | 5-10 g is taken with a cup of hot water BID until recovery. About 1-2 spoonful of leaves extract is given for three alternate days to kill roundworms | 28         |
| *Asparagus filicinus* Buch.-Ham. ex D. Don | Asparagaceae | Kurilo (Nepali) Nirshing (Gurung) | Roots      | Mastitis, Menstrual disorders | 10 g of root powder is taken with a cup of hot water once a day after having meal. | 32         |
| *Asparagus racemosus* Willd. | Asparagaceae    | Kurilo (Nepali) | Root, tuber, fruit, stem | Tonic Kidney and liver problem | Root paste applied topically 2-3 spoonful of root powder is taken with a cup of milk BID until recovery. Paste of roots is applied topically in treatment of mastitis | 32         |
| *Betula utilis* D. Don | Betulaceae      | Bhojpatra (Nepali) Buspath (Gurung, Thakali) | Bark, Leaves | Fever, dysentery, skin troubles | About 10 teaspoonful of juice of fruit is used BID as an antidote of alcohol poisoning | 32         |
| *Cannabis sativa* L. | Cannabaceae     | Bhang (Nepali) Kantsya (Gurung, Thakali) | Leaves     | Diarrhea and Dysentery Clairvoyance, Psychoactive Gout | 5-10 g of leaves powder is taken once a day with hot water until recovery. Powder of leaves smoked with tobacco | 32         |
| *Chlorophyllum nepalense* Lindley | Asparagaceae | Ban pyaj (Nepali) | Root      | Fever | Root is crushed on stone slab and paste is made. Root paste is mixed with mustard oil and applied topically to care gout 1 cup of water decoction is taken BID orally until cure | 32         |
| Clematis barbella Edgew. | Ranunculaceae  | Laharejarh (Nepali) Kramay (Gurung, Thakali) | Leaves, stem, flowers | Jaundice | 1-2 spoonful of powder of bark is taken with Tea or hot water BID-TID until recovery | 25         |
| Cinnaromum zeylanicum Garcin ex Blume | Lauraceae | Dalchini (Nepali) | Barks | Colic, diarrhea, indigestion | 1-2 spoonful of powder of bark is taken with Tea or hot water BID-TID until recovery | 32         |
| Cordyceps sinensis (Berk.) Sacc | Clavicipitaceae | Jibanbuti, Yartsagumba (Nepali, Gurung, Thakali) | Whole part | Tonic | Green leaves chewed to cure throat allergy | 32         |
| *Dactylorhiza hatagirea* D. Don | Orchidaceae    | Panch aumle (Nepali), Soo (Gurung) | Roots      | Snake bite, scorpion stings, cuts, wounds, boils | Paste of root is usually applied around the site of snake bite, scorpion stings, cuts, wounds, boils once a day until recovery | 32         |
| Scientific name                          | Family             | Vernacular name         | Parts used | Conditions                       | Method of application                                                                 | References |
|-----------------------------------------|--------------------|-------------------------|------------|----------------------------------|----------------------------------------------------------------------------------------|------------|
| *Ephedra gerardiana* Wall. ex Stapf     | Ephedraceae        | Somlata, (Gurung) Chaya (Aamchi) | Chest pain, wounds, gastritis, Respiratory disease, nasal bleeding | Root paste is applied in cuts and wound twice a day until recovery. One spoonful root powder is taken once a day for the cure of asthma, cold, cough, altitude sickness, and dysuria until recovery | 32         |
| Girardinia diversifolia (Link) Frils    | Urticaceae         | Chanle sisno (Nepali) Ghyo (Thakali, Gurung) | Leaves and roots | Headache, Joint ache | Leaves are crushed on the stone slab and juice of leaves is applied topically to treat a headache and joint ache | 30         |
| Indigofera bracteata Baker              | Fabaceae           | Sakhino (Nepali)        | Leaves | Leprosy                           | About 5 teaspoonful of juice of leaves is taken BID until recovery. Paste of leaves is used to relieve muscular swellings | 19         |
| Juniperus communis L.                   | Cupressaceae       | Phar, Chuksar (Gurung) Thakali (Gurung) | Fruits and leaves | Kidney diseases | 2 spoonful of paste of leaves and flowers is taken with hot water or milk TID orally until cure | 32         |
| *Lyonia ovalifolia* (Wall)             | Ericaceae          | Angeri (Nepali)         | Leaves | Ticks, Lice                       | About 15-20 g of leaves is pounded on a stone slab and squeezed through a muslin cloth, and liquid is applied on the body OD until recovery | 32         |
| Maharanga bicolor A. DC                | Boraginaceae       | Maharangi (Nepali)      | Root     | Ear pain                         | Liquid from pounded root extract is taken with 2 spoonful of boiled mustard oil. 1-5 drops of pounded root extract is put in ear BID-TID until recovery | 30         |
| Mentha longifolia (L.)                 | Lamiaceae          | Patina (Nepali)         | Leaves   | Tonsilitis, headache, cold cough  | 10 g of leaves is boiled with 2 cups of water, and a half cup of decoction is drunk in the morning | 29         |
| *Mirabilis himalaica* (Edgew.) Heimerl | Nyctaginaceae      | Nighgbilugo, Khemba (Gurung) | Leaves and flowers | Fracture                          | 25 g of leaves and flowers are crushed on the stone slab and paste is applied around fractured part once a day until recovery | 30         |
| Morchella esculenta (L.) Pers.         | Morchellaceae      | Guchichaue (Gurung, Thakali) | Whole plant | Heart disease | 3 spoonful of dried powder taken with hot water SID until recovery. Taken as vegetables | 32         |
| *Nardostachys grandiflora*             | Caprifoliaceae     | Jatamasi (Nepali) Pangphohoe (Gurung). | Roots | Diarrhea                          | ⅓ spoon of root powder + ⅓ Aconitum naviculare plus Betula utilis + 3 spoonful of Chauri ghee BID until recovery for diarrhea. A spoonful is poured on red coal fire and fragrance at night before sleeping until recovery. | 32         |
| Neolitsea pallens D. Don               | Lauraceae          | Pya pya (Nepali)        | Fruit, seed | Eczema                           | Juice obtained from fruit is applied to treat scabies and eczema. Seeds are crushed and oil obtained is used 2 spoonful BID as an antidote of alcohol poisoning | 32         |
| Neopicrorhiza scrophulariiflora Hong.   | Plantaginaceae     | Kutki (Gurung, Thakali) | Roots | Diarrhea, Paralysis, Indigestion Scorpion and snake bite Scabies, Ringworm | 10 g of root powder is boiled in a cup of water and 30-40 ml of filtered decoction is taken with a cup of milk BID-TID until recovery. Half spoonful of powder is mixed with two to three spoonful of Chauri ghee BID-TID until recovery. Paste of roots | 32         |
| *Notochaete hamosa Benth*               | Lamiaceae          | Kuro (Nepali)           | Leaves   | Snakebite                        | About 5 teaspoonful of juice of leaves taken BID as an antidote to cure until recovery | 32         |
| *Paris polyphylla Sm.*                  | Melanthiaceae      | Satuwa (Gurung)         | Leaves, Flowers, Roots | Indigestion, Diarrhea             | About 5 g of stems, leaves and flowers is taken with lake warm water once a day until recovery. About 5 teaspoonful of juice of rhizome is given twice a day in the treatment of Gastritis and menstrual pain | 32         |
| *Pedicularis siphonantha D. Don*       | Orobanchaceae      | Hahale (Nepali)         | Roots | Plant poisoning                   | A spoonful of pulverized powder of is drunk with a cup of hot water BID until recovery | 32         |
| Piper nigrum L.                         | Piperaceae         | Marich (Nepali)         | Seeds    | Indigestion, poisoning, mastitis | A spoonful of pulverized powder of is drunk with a cup of hot water BID until recovery | 32         |

Table 1: (Continued...)
| Scientific name                  | Family         | Vernacular name         | Parts used       | Conditions                       | Method of application                                                                 | References |
|---------------------------------|----------------|-------------------------|------------------|----------------------------------|---------------------------------------------------------------------------------------|------------|
| *Pinus wallichiana* A.B. Jacks. | Pinaceae       | Sallo (Nepali)           | Resins           | Wounds                           | Paste of leaves and resins are applied topically at the site of injury.                | 32         |
|                                  |                | Thansin (Gurung)         |                  | Fracture                         | Bark cut into smaller parts and applied on fractured site until recovery.              |            |
|                                  |                |                         |                  | Tuberculosis                      | Half spoonful of bark powder is drunk BID after meal for 2 years                      |            |
| Prunus armeniaca L.             | Rosaceae       | Khurpani (Nepali)        | Fruit            | Vitamin deficiency               | Seeds are eaten raw 3 times a day until recovery.                                    | 24         |
|                                  |                | Khamba (Thakali, Gurung) |                  | Seeds                            | Juice of leaves when pounded on stone slab is poured on maggoted area                 | 22         |
| *Prunus persica L.*             | Rosaceae       | Aaru (Nepali)            | Leaves           | Maggoted wound                   | Leaves of plants taken as vegetables.                                                | 1          |
| Rhodiola rosea                   | Gentianaceae   | Solo (Gurung, Thakali)   | Whole plant      | Cognitive improvement            | About 20 g of the whole plant is pounded on stone slab, and a spoonful of powder is   | 32         |
|                                  |                | Sanjevani, Jivanbuti (Nepali) |                  | Anti-aging, Altitude sickness    | taken with a cup of hot water OD until recovery.                                     |            |
|                                  |                |                           |                  | High BP                          | Leaves and flowers are ground to make powder, and a half spoonful of powder is       | 26         |
|                                  |                | Palu (Gurung), Sangalin (Amchi) | Leaves and flowers |                   | taken with a cup of hot water or milk BID after meal until recovery                   |            |
| *Valeriana jatamansi* Jones     | Gentianaceae   | Chiraito (Nepali)        | Whole plant      | Fever, indigestion, diarrhea,   | About 2.5-5 g is taken with a cup of hot water until recovery.                        | 29         |
|                                  |                | Tento (Gurung, Thakali)  |                  | scabies                          | A spoonful of powdered plants/roots is taken BID with a cup of hot water or milk     |            |
|                                  |                |                          |                  |                                  | until recovery.                                                                        |            |
| *Swertia chiraytia* Rob. ex Fien | Gentianaceae   | Chiraito (Nepali)        | Whole plant      | Fever, indigestion               | About 10 g of the plant is boiled with 2 cups of water, and a half cup of decoction    | 32         |
|                                  |                |                          |                  |                                  | is drunk 0D-BID until recovery.                                                      |            |
| Swertia angustifolia Buch.-Ham. ex D. Don | Gentianaceae | Bhaile sunpate (Nepali) | Plant paste      | Blood purification               | Whole plant is pounded on stone slab, water extract is made and applied on the       | 22         |
|                                  |                | Bhaiunako (Gurung)       | (flower and leaves) |                                  | site of scabies until recovery.                                                      |            |
|                                  |                | Somang (Gurung, Thakali) | Whole plants, roots | Fracture, joint pain, edema      | A spoonful of powdered plants/roots is taken BID with a cup of hot water or milk     |            |
| Swertia racemosa C.B. Clarke     | Gentianaceae   | Chinwa (Nepali)          | Whole plant      | Fever, indigestion, diarrhea,    | until recovery.                                                                        | 32         |
|                                  |                |                          |                  | scabies                          | A spoonful of plant powder is taken with a cup of hot water BID until recovery.       |            |
|                                  |                | Churpani (Nepali)        | Whole plant      | Fever, indigestion               | About 10 g of the plant is boiled with 2 cups of water, and a half cup of decoction   |            |
| Taraxacum officinale agg.       | Compositae     | Tuki phool (Nepali)      | Plant paste      | Fever, indigestion               | is taken BID until recovery.                                                         | 32         |
| Taraxacum tibetanum Hand.-Mazz. | Compositae     | Khurman (Thakali, Gurung) | Leaves, stem, and flowers | Cuts and wounds                  | A half spoonful of powder is taken with a cup of hot water BID until recovery         | 22         |
| *Triticum aestivum* L.          | Poaceae        | Gahun (Nepali)           | Seeds            | Fever, malaria, jaundice, diabetes, cold, cough, headache                        | Plant powder is taken with cup of hot water until recovery.                          | 32         |
|                                  |                |                         |                  | As an emetics and treatment of altitude sickness                               | About 20 g of young leaves powder is taken with hot water BID-TID.                   |            |
|                                  |                |                         |                  | Vertigo, jaundice, gastritis, fever                                               | Paste of plant is applied topically over the skin at site of fracture and immobilized |            |
|                                  |                |                         |                  | Cancer                            | Paste of the roots and leaves is applied on cuts and wounds until recovery.           |            |
| *Valeriana jatamansi* Jones     | Gentianaceae   | Napu, Ghyapo (Thakali, Gurung) | Roots, leaves    | Cuts, wounds, headache, fever     | Paste of the roots and leaves is applied on cuts and wounds until recovery.           | 32         |
| *Zanthoxylum acaenthopodium DC.* | Rutaceae       | Aaankhe timur, Bote timur (Nepali) | Fruit, leaves   | Fever, cold, respiratory distress | ⅓-1 cup of decoction is taken orally BID until recovery for the headache and fever    | 32         |
|                                  |                |                          |                  |                                  | Decoction of leaves used externally to cure abdominal pain.                           |            |
| *Zanthoxylum armatum DC.*       | Rutaceae       | Prumo (Gurung, Thakali)  | Fruits           | Altitude sickness, vertigo, cold, cough, dysentery, diarrhea                      | Paste of leaves is used topically to relieve a toothache                            | 28         |
| *Zanthoxylum oxyphyllum Edgew.*  | Rutaceae       | Siltimur (Nepali)        | Fruits           | Indigestion, poliosing, lumpy     | One-fourth spoonful powder of fruits taken with a cup of water for diarrhea            | 32         |
|                                  |                |                          |                  |                                  | 5-10 g of powder of fruit is taken with water TID-QID until recovery                   |            |

Figure (Number) indicates the frequency of citation of each species by the informants, *Are also used in Yaks in addition to humans, OD: Once a day, BID: Two times a day, TID: Three times a day.
nasal bleeding, dizziness, altitude sickness, etc.), whereas, gastrointestinal disorders (diarrhea, indigestion, dysentery, gastritis, colic, etc.) treated with 17 species and musculoskeletal disorders (Joint pain, muscular swelling, fracture, etc.) were cured with 8 species. The form of remedies was primarily powder (49.05%), juice (22.64%), or decoction (18.87%), tablets, pills, and infusion were rare [Figure 4].

Tablets, pills, and infusions were usually made only by traditional healers, “Aamchi,” as cited in previous studies [4,8]. Per oral use predominated topical use. Plants were generally prepared using cold or hot water, but occasionally other methods of preparation, such as alcohol, milk, ghee, or oils, were used [Table 1]. Medicinal preparations were found to be administered through various routes-oral was the most predominant route followed by topical, nasal, and other routes. While in animals intended oral formulations were found to be drenched by means of drenching tube from Bambusa indica (Bans). This was followed in only in young and debilitated animals, and adult animals were given medications either mixed with salt or mixed with oat flour.

DISCUSSION

Notably, a mixture of different plant products rather than a single one was used in the treatment of most diseases. Many nomads believed that combination of plant species increased the potency of medicines owing their synergistic actions unlikely that of Paliyar communities of Tamilnadu, India who selectively used single plant for specific ailments [18]. Similar combined formulations were reported from Kani communities in India [19]. Almost all the plant species were collected directly from their wild state during various seasons and thus were in different stages of growth and development. Without a doubt, the future practice of medicine must take into account traditional healing arts while adopting new scientific discoveries [20], that respects, documents and advocates these traditional healing arts. The yak herders are the major collectors of high altitude medicinal plants from the alpine meadow as mentioned by Oli and Nepal [21]. Though, the herders do not have traditional scientific knowledge which advocates sustainable harvesting of medicinal plants as, they are familiar with the nature of plants and their distribution [22,23]. They collect the medicinal plants in fresh and dried form, especially in spring and autumn when the climate is favorable for collection. Transhumant migrating nomads, they partly collect medicinal plants from grassland and forest and partly purchase from the traditional healers “Aamchi.” They follow the rotational grazing system; seasonal and selective harvesting, which is the only management approach and had some contribution to sustainable management of herbal resources of high mountains. North and South trade to India and the Far East through China (now China is in itself a major market) have created huge demands for priced medicinal herbs of Nepalese highland [24]. However, greed is slowly creeping in as highland medicinal plants and materials find premium price leading to over harvesting and social ills which are having an eroding effect in social and ecological harmony.

CONCLUSION

It is concluded that transhumant pastoralist nomadic communities have their own traditional ethno-botanical medicines that remains cost effective. Furthermore, method of choice for management of health disorders is passed down to
next generation usually by oral traditions. These communities have detailed and extensive knowledge regarding medicinal plants and their utility. They have their own way of collecting medicinal plants, method of preparation, dose and application. The lack of modern health facilities, coupled with rugged topography, and a strong belief towards herbal medicines, substantiate the preference for herbal medicines for health care. However, the long-term use of herbal medicinal plants, over-harvesting is risking many valuable medicinal plant species to the extent of becoming extinct. Thus, necessary steps towards conservation of these resources are needed. Continuous training of traditional healers and transfer of this knowledge to the younger generation is necessary. Although their traditional medicine is partially effective for management of ailments, they should be further strengthened by the scientific management of health.

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REFERENCES

1. Farnsworth NR, Soejarto DD. Global importance of medicinal plants. In: Akerele O, Heywood V, Syng e H, editors. The Conservation of Medicinal Plants. Cambridge, United Kingdom: Cambridge University Press; 1991. p. 25-51.
2. Ghimire SK. Sustainable Harvesting and Management of Medicinal Plants in the Nepal Himalaya: Current Issues, Knowledge gaps, and Research Priorities. In: Jha PK, Karmarachraya SB, Chhetri MK, Thapa CB, Shrestha BB, editors. Medicinal Plants in Nepal: An Anthology of Contemporary Research. Nepal: Ecological Society of Nepal (ECOS); 2008. p. 25-44.
3. Baral SR, Kurmi PP. A Compendium of Medicinal Plants in Nepal. Kathmandu: Rachana Sharma; 2006.
4. Bhattarai S, Chaudhary RP, Quave CL, Taylor RS. The use of medicinal plants in the trans-Himalayan arid zone of Mustang district, Nepal. J Ethnobiol Ethnomed 2010;6:14.
5. Siwakoti M, Siwakoti S. Ethnomedicinal uses of plants among the Satar tribe of Nepal. In: Maheswari JK, editor. Ethnobotany and Medicinal Plants of Indian Subcontinent. Jodhpur, India: Scientific Publisher; 2000. p. 98-108.
6. Rai SK. Medicinal plants used by Meche people of Jhapa District, Eastern Nepal. Our Nat 2004;2:27-32.
7. Shrestha PM, Dhillion SS. Medicinal plant diversity and use in the highlands of Dolakha district, Nepal. J Ethnopharmacol 2003;86:81-96.
8. Kunwar RM, Nepal BK, Kshhetri HB, Rai SK, Bussmann RW. Ethnomedicine in Himalaya: A case study from Dolpa, Humla, Jumla and Mustang districts of Nepal. J Ethnobiol Ethnomed 2006;2:22-7.
9. Bhattarai S, Chaudhary RP, Taylor RS. Non-medicinal Uses of selected Wild Plants by the people of Mustang District, Nepal. J Nat Hist Mus Nepal 2009;24:47-57.
10. Acharya KP, Acharya R. Ethnobotanical study of medicinal plants used by Tharu community of Panaho VDC, Rupandehi district, Nepal. Sci World 2009;7:80-4.
11. Uprety Y, Asselin H, Boon EK, Yadav S, Shrestha KK. Indigenous use and bio-efficacy of medicinal plants in the Rasuwa District, Central Nepal. J Ethnobiol Ethnomed 2010;6:3.
12. Joshi AR, Joshi K. Indigenous knowledge and uses of medicinal plants by local communities of the Kali Gandaki Watershed Area, Nepal. J Ethnopharmacol 2000;73:175-83.
13. Malla B, Gauchan DP, Chhetri RB, Medico-ethnobotanical investigation in Parbat district of western Nepal. J Med Plants Res 2014;6:95-108.
14. Brohl M. Sustained Use of Phytodiversity in Lower Mustang/ Nepal - Concept for Laying out a Tibetan Medicinal Plant Garden. University of applied Sciences (A Bachelor’s Degree Thesis). Neustadtswall, Bremen: International Degree Course in industrial and Environmental Biology, 2006.
15. Bhattarai NK. Traditional medicine, medicinal plants and biodiversity conservation in the global and Nepalese contexts. Plant Res 1998;1:22-31.
16. Acharya E, Pokhrel B. Ethno-medicinal plants used by Bantar of Bhaudaha, Morang, Nepal. Our Nat 2006;49:96-103.
17. Bajracharya SD, Furley PA, Newton AC. Impacts of community-based conservation on local communities in the Annapurna conservation area, Nepal. Biodivers Conserv 2006;15:7265-86.
18. Francis M, Bose JN, Aron S, Mahalingam P. An ethno-botanical study of medicinal plants used by Paliyars aboriginal communities in Virudhunagar District, Tamil Nadu, India. Indian J Tradit Knowl 2014;13:613-8.
19. Ayyanar M, Ignacimuthu S. Traditional knowledge of Kani tribals in Kouthalai of Tirunelveli hills, Tamil Nadu, India. J Ethnopharmacol 2005;102:246-65.
20. Lin JH, Kaphle K, Wu LS, Yang NY, Lu G, Yu C, et al. Sustainable veterinary medicine for the new era. Rev Sci Tech 2003;22:949-64.
21. Oli BR, Nepal BK. NTFPs from Kanchenjunga conservation area. Aspects of trade and market opportunities. WWF Nepal Program 2003:39-72.
22. Nepal BK, Sapkota PP. Resource analysis and indigenous knowledge on plant use. A case study of Humla District, Nepal. Nepal J Pl Sci 2005;1:57-63.
23. Acharya KP, Nirmal BK, Poudel B, Bastola S, Mahato MK, Yadav GP, et al. Study on yak husbandry in Mustang district of Nepal. J Hill Agric 2014;5:100-5.
24. Kaphle K, Wu LS, Yang NY, Lin JH. Herbal medicine research in Taiwan. Evid Based Complement Alternat Med 2006;3:149-55.

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