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RESEARCH ARTICLE

Total Utility Values and Extraction of Some Ecological Important Plant Species in the Timberline Zone of NDBR, Uttarakhand, Western Himalaya.

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Abstract

The present investigation deals with the total utility value of some ecologically important plant species and their collection from the timberline zone of Nanda Devi Biosphere Reserve (NDBR). The study was carried out in the timberline zone of Niti valley in district Chamoli, Uttarakhand, India. The inhabitants of the valley have tremendous traditional knowledge of plants species and their medicinal uses. Present study exhibited 30 ecological important plant species belonging 18 families for curing 42 different kinds of ailments in the selected villages of Niti valley. The maximum total use value (70.92 %) was recorded for *Betula utilis*, followed by *Taxus baccata* (66.67 %) from the region. The present investigations reveal that 41% of the documented plant species in the study area are threatened. Of the 20 threatened plant species, 14 are endangered, 3 critically endangered, 2 vulnerable and 1 species are Rare as per the IUCN threat assessment. The inhabitants collected different plants species for some common health problems, traditional customs, and economic purposes.

Introduction:-

The Himalayan region is inhabited by a large number of ethnic communities, many of them with distinct tradition, culture and life style. Most of the local communities at higher altitudes (>2000 m) are subsistence farmers or agropastoralists with a long history of settlement and land use practices ranging from few to several centuries (Atkinson 1982). The natural vegetation, usually above 2000 m in the western and north-western Himalaya abounds in numerous economically important species. The alpine and subalpine regions are also well known for the large number of rare and valuable medicinal herbs, which are consumed locally or sold in the local markets. Demand for several medicinal plants in national and international markets has increased rapidly in the recent decades (Tandon 2001, Sharma 1998) this has resulted in the selective removal of highly valuable species from many sectors of the Himalaya. Thus, traditional practices of livestock grazing, the harvest of commercially important species and demand for fuelwood and fodder are the major anthropogenic activities throughout the northwestern Himalaya. The present study revealed that Nitti valley of NDBR inherits a rich traditional knowledge of medicinal and aromatic plants and their uses. Still, several households in the region depend on the plants for medicinal purposes. Many wild species are commonly used by the people to cure simple to the more complex problems facing in the routine life. They collected folk medicinal plants for different purposes and used to cure various ailments in village level, depending on plant species, technique of preparation, standard of doses and mode of application. It is believed that out of over 1600 species of medicinal plants traditionally used in India (Uniyal et al., 2002), more than 50% species come from the Himalayan region. Regarding NDBR, a series of studies which examined local resource utilization and valuation of surrounding forest/alpine communities, have been carried out (Maikhuri et al., 2001; Samant and Pant 2006; Joshi et al., 2000; Samant et al., 1996; Maikhuri et al., 1998; Bhatt 1999; Farooque 2000).

Study area:-

Nanda Devi Biosphere Reserve (NDBR) is situated in the northwest part of the Himalaya and comprises in the three districts of Uttarakhand viz., Chamoli, Bageshwar and Pithoragarh (Fig.1). The Biosphere Reserve located between 30^0 05' - 31^0 02' N latitudes and 79^0 12' - 80^0 19' E longitudes spreads over 5860.69 km2 of land area with two core zones, viz. Nanda Devi National Park (624.62 km^2) and the world famous 'Valley of Flowers National Park' (87.50 km^2) and covers a wide altitude range from 1700 -7817 m asl. The buffer zone is inhabited with 47 villages, out of which 34 villages fall in the Chamoli district. The inhabitants of the area belong to both Indo-Mangoloid (Bhotias, Tolchhas) and Indo-Aryan groups (Garhwalis). The Nanda Devi Biosphere Reserve is well known for its rich biodiversity. The diverse ecosystems in NDBR harbor a tremendous array of floral and faunal diversity and includes about 400 species of trees, 570 species of herbs and shrubs, 86 species of mammals, 534 species of birds and 54 species of reptiles and amphibians. Floristic excursion in the Nanda Devi Biosphere Reserve has been undertaken by Hajra (1983), Hajra and Balodi (1995), Naithani (1984 & 1985), Dangwal (1993), Gaur et al. (1995), etc. Although some information on the utilization of plant species has been provided by the workers such as Uniyal (1977), Negi et al. (1985), Tiwari (1986), Gaur et al.(1983), Samant (1993), Gaur (1999), Samant and Pal (2003), Nautiyal et al. (2010), yet a detailed study on collection of medicinal plants and their quantification from the alpine region has not been carried out. The climatic year consists of three seasons –summer (April- June), rainy season (June- September) and winter (October - March). Average annual rainfall is 928.81 mm. About 47.8% of annual rainfall occurs over a short period of two months (July- August) featuring a strong monsoonal influence. The maximum temperature ranges from 11^0 C to 24 ^{0} and minimum from 3^0 C to 7.5^0 C. The altitudinal range of the biosphere reserve varies from 2100 m asl to 7817 m asl. The present investigation has resulted in information on plants used as food, fuel, timber, medicinal and aromatic values and their collection. Detailed information on plant parts used, ailments and total use value have been recorded.

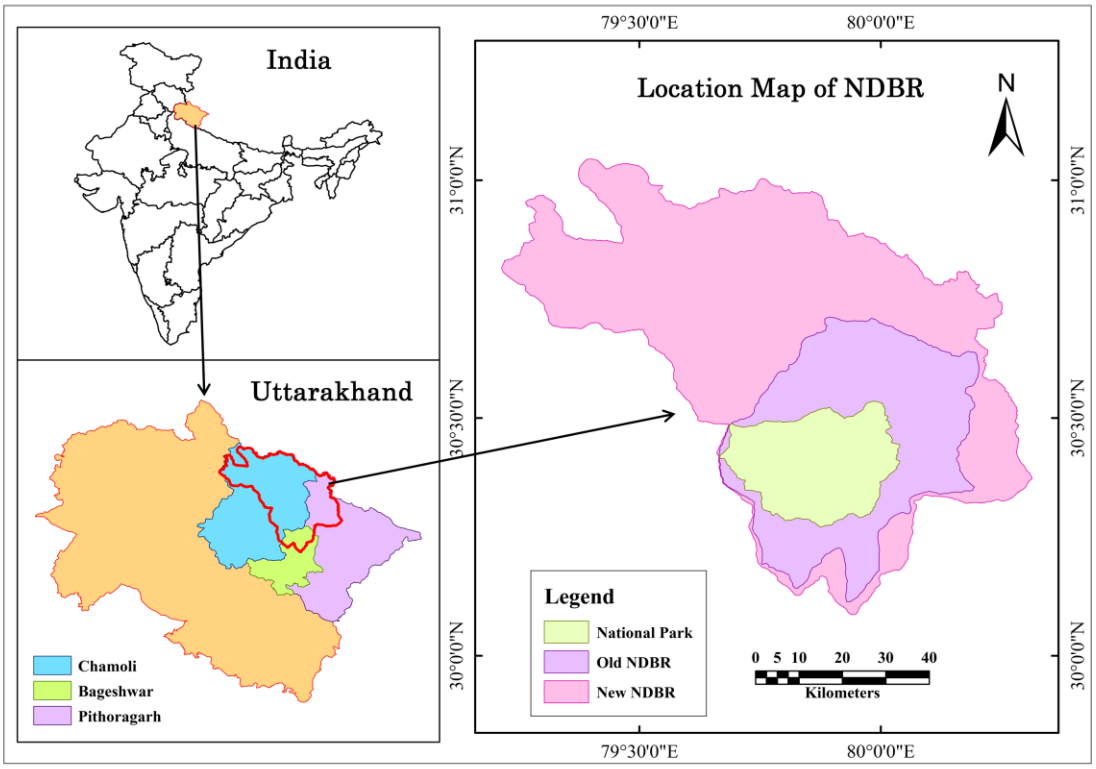

Fig. 1: Location map of study area

Methodology:-

The study was conducted in the tribal inhabitant of NDBR, part of district Chamoli, Uttarakhand. The present study is based on the extensive survey of the selected villages and field work in the Valley. The most frequent villages (3000 – 3600 m asl.) were Dronagiri, Malari, Kailashpur, Bampa, Gamshali and Nitti, which are much closed to the alpine area and engage in the collection. The information was collected through field surveys by undertaking formal and informal group discussions and personal interviews with local inhabitants and herbal practitioners (Vaidhyas) of the village and also based on direct observations of traditional community and their collection pattern for different

purposes (Maikhuri et al. 1991; Dhyani et al. 2011). The potential and actual uses of plants found in the timberline region was assessed following the informal interviews with old age people and also based on direct observation of the life style of traditional society and their collection pattern of the economic important plants for different purposes (Belal and Springuel, 1996). The potential use value of some dominant species was calculated on the basis of its uses i.e., grazing, medicinal/aromatic plants, human food, fuelwood, timber and other uses (i.e., animal bedding, oil and fiber etc). Total potential use value (TUV) was calculated separately for the trees and herb species since they are used in different ways. Thus, for each species, suppose a use value is 0, which indicate that a particular use of species has no potential economic value. A score of 4 suggests minimal potential use while a maximum of 8 suggest the species is abundant all year round, palatable/effective of commercial value and already frequent in local use. The sum of the potential use value for all uses was further expressed as the relative percentage of a maximum possible score. This total potential use value expressed as in the equation below can be taken as a measure of the potential importance of the plant to the local community.

$$TPU\% = \frac{U1+U2+\ldots\ldots Un}{U\ max\ X\ Total\ no\ of\ uses} \quad X\ 100$$

Where U = use value for each particular and U max =8

If we considered six uses to calculate the TPUV then a maximum value (8) for all six gives an overall maximum potential use for 48, which would produce a total use value of 100 % for that plant species. TUV was calculated separately for herb and trees on the basis of their uses. Information was also noted on, total households living in the representative villages and households particularly involved in the collection, and individual from each household, distance traveled, uses of plant species and require for ailments were noted.

Result and Discussion:-

The Bhotiya communities of the study area possess the immense knowledge of traditional plant species and used 30 medicinal plant species belonging 18 families for curing 48 different kinds of ailments. The medicinal plants, used in traditional health care system are categorized into underground parts (61 %), leaves (20 %), flower (8 %), seeds (5 %), fruits (4 %), bark (0.62 %), and whole plant (1.482 %) as per their parts used. These medicinal plant species collected from high altitude forests in a particular season/time for curing a variety of ailments and prescribed by traditional Vaidyas. Total use value (TUV) of different tree and some selected ecological important species occurring in the timberline region of NDBR is presented in Table1 and 2, respectively. Among the trees maximum use value (70.92 %) is recorded for the *B. utilis* followed by *T. baccata* (66.67 %) and *Prunus cornuta* (58.33 %). Among the use categories, *B. utilis*, *T. baccata* and *P. cornuta* all these three species have maximum of five uses. Almost all the species are mostly used for the timber and fuelwood beside other uses like leaves used for animal bedding, temporary roof etc. and grazing of livestock reared by traditional communities of the area. Among the selected herbaceous species, the majority of the species are being used for the medicinal and aromatic purposes. The maximum use value is recorded for *Allium* species (68.75 %) followed by *Pleurospermum angelicoides* & *Angelica glauca* (65.63%), *Carum carvi* (59.38 %), *Bergenia* spp (56.25%) and *Dactylorhiza hatagirea* (53.13 %)etc as presented in Table 2. Thorough observations were made to enumerate the purpose of collection, quantity, socio-cultural and religious ethics, and part used by the villagers. It was noticed that huge amount of MAPs are harvested from wild by the villagers for various purposes and even for economic benefits through illegal marketing. The present study revealed that local people and traditional herbal healers collect or harvest the huge amount of medicinal plant species for various purposes and even for economic benifits through illegal marketing in the valley. The maximum collection (239 kg year^{-1}) was recorded for *Berberis aristata* followed by *Bergenia ciliata* (210 kg year^{-1}), *Hippophae rhamnoides* (201.94 kg year^{-1}) and *Zanthoxylum armatum* (200.73 kg year^{-1}) in lower elevations while *Rehum australe* (94.9 kg year^{-1}), *Swertia chirata* (90.03 kg year^{-1}), *Angelica glauca* (89.13 kg year^{-1}) and *Picrorhiza kurrooa* (75.15 kg year^{-1}) was collected higher in upper elevation zone, respectively. The total seasonal collection was found higher in Dronagiri village (335.35 kg year^{-1}) followed by the Nitti (313.91 kg year^{-1}) and Malari village (273.5 kg year^{-1}). The present investigations reveal that 41% of the documented plant species in the study area are threatened. Of the 20 threatened plant species, 14 are endangered, 3 critically endangered, 2 vulnerable and 1 species are Rare as per the IUCN threat assessment (Table. 3). The critically endangered species are *Nardostachyus jatamansi*, *Sweria chirayita*, and *Picrorhiza kurrooa*.

Fig.2 Some ecological important herbaceous species in the timberline zone of NDBR. (a). *Aconitum hetrophyllum* (b). *Arnebia benthami* (c). *Dactylorhiza hatagirea* (d). *Angelica glauca* (e). *Rheum austral* (f). *Saussurea obvallata*

Table 1: Total use value (TUV) of the some Tree species present at the timberline zone of the NDBR in western Himalaya.

Name of species	Grazing	Medicinal and Aromatic	Human food	Timber	Fuelwood	Other uses	TUV %
Abies pindrow	-	-	-	8	8	5	43.75
Betula utilis	7	7	-	8	7	5	70.92
Acer caesium	5	-	-	5	8	4	45.83
Acer acuminatum	4	-	-	5	8	4	43.75
Prunus cornuta	5	-	6	6	7	4	58.33
Pinus wallichiana	-	-	-	8	7	4	39.58
Sorbus foliolosa	4	-	6	-	4	4	37.5
Sorbus microphylla	5	-	6	-	4	4	39.58
Populus ciliata	-	-	-	7	5	5	35.42
Rhododendron campanulatum	-	5	-	6	7	-	37.5
Taxus baccata	-	8	4	8	5	7	66.67

Table 2: Total Use Value of some ecological important herbaceous species in and around the timberline zone of NDBR.

Name of species	Grazing	Medicinal and Aromatic	Human food	Other uses	TUV %	Part uses	Uses
Aconitum atrox	0	8	0	0	25	Rt	Rheumatism and leprosy
Aconitum heterophyllum	0	8	0	0	25	Rt	Chronic fever, diabetes, leucorrhoea
Allium humil	4	7	5	6	68.75	Lv	Cough, cold
A. wallichi	4	7	5	6	68.75	Lv	Carminative
Anaphalis contorta	0	4	0	6	31.25	Lv	Cuts, wounds & boils, insect repellent
A. triplinervis	0	4	0	6	31.25	Lv, Fl	Laceration of toes, Dressing wounds
Angelica glauca	5	8	0	8	65.63	Rt	Colic, aphrodisiac
Arnebia benthami	0	8	0	7	46.88	Rt	Antiseptic, hair tonic, leucorrhoea, piles, cardiac complaints.
Asparagus filicinus	0	6	4	4	43.75	Rt	leucorrhoea
Berginia ciliata	4	8	0	6	56.25	Rt	Hair tonic, Fevers, diarrhoea & pulmonary infections
B. stracheyi	4	7	0	6	53.13	Rt	Kidney and Urinary tract problems
Carum carvi	0	8	6	5	59.38	seeds	Indigestion
Cypripedeum himalicum	0	6	0	0	18.75	Rt	General weakness
Dactylorhiza hatagirea	4	8	0	5	53.13	Rt	Colic, arthritis, diabetes, leucorrhoea, aphrodisiac.
Impatiens sulcata	4	0	0	5	28.13	Rt	Haematuria, Abdominal complaints
Megacarpia polyandra	6	0	8	0	43.75	Rt	Chronic fever, abdominal ailments
Morina wallichii	0	4	0	0	12.5	Rt	Haematuria.
Nardostachys grandiflora	4	8	0	5	53.13	Rt	Arthritis, piles, hysteria, epilepsy
Origanum vulgare	4	8	0	5	53.13	Lv	Bronchitis, colic, diarrhea
Picrorhiza kurrooa	0	8	0	5	40.63	Rt	Chronic fever, stomachache urinary complaints, flatulence
Pleurospermum angelicoides	4	7	6	4	65.63	Rt	Cardiac complaints
podophyllum hexendrum	0	8	0	5	40.63	Rt	Carminative, leucorrhoea, Chronic fever, diabetes
P. verticillatum	4	7	0	0	34.38	Rt	Tonic in general weakness, Aphrodisiac, leucorrhoea, diabetes
Potentilla atrosangiunea	4	7	0	0	34.38	Rt	Antiseptic
P. fulgens	4	5	0	0	28.13	Rt	Antiseptic
Rheum australe	5	8	4	0	53.13	Rt	Internal injury, leucorrhoea, abdominal complaints, tonic in general weakness
Saussaria costus	5	7	0	5	53.13	Rt	Asthma, bronchitis, headache dysmenorrhoea, eczema, ring worm.
Thalictrum elegans	4	5	0	0	28.13	Rt	Piles
Verbascum thapus	4	0	0	0	12.5	Rt	Bronchitis and asthama

*Rt= Root; Lv= Leaf; Fl= Flower

Table 3: Collection of dry MAPs from the timberline zone of NDBR.

Scientific name	Selected villages in the buffer zone of NDBR					
	Dronagiri	Malari	Kailashpur	Bampa	Gamshali	Niti
Aconitum heterophyllum	7.42±0.70	5.66±0.18	2.23±0.20	2.22±0.15	3.8±0.24	6.46±0.28
Angelica glauca	11.46±0.20	9.89±0.41	4.56±0.27	5.92±0.46	6.69±0.55	10.33±0.58
Arnebia benthamii	10.38±0.35	7.37±0.66	2.64±0.73	3.89±0.54	6.78±0.49	8.62±0.53
Berberis aristata	31.69±0.42	28.26±0.22	21.42±0.31	19.49±0.37	26.33±0.68	33.68±0.11
Bergenia ciliata	23.66±0.83	31.44±0.56	16.99±0.23	21.88±0.59	13.44±0.12	27.27±0.49
Centella asiatica	27.82±0.21	21.56±0.86	16.9±0.70	13.08±0.19	18.33±0.17	29.66±0.91
Dactylorhiza hatagirea	8.72±0.11	5.96±0.21	3.66±0.47	2.77±0.24	4.33±0.73	6.44±0.21
Hippophae rhamnoides	19.77±0.39	27.37±0.16	23.44±0.64	14.94±0.79	8.77±0.27	28.43±0.40
Morina longifolia	11.84±0.52	4.74±0.97	6.66±0.89	7.56±0.43	9.42±0.64	12.32±0.17
Nardostachys grandiflora	8.46±0.86	5.67±0.38	2.41±0.34	2.88±0.40	3.6±0.96	6.44±0.37
Paeonia emodi	26.44±0.40	16.23±0.86	-	-	-	7.88±0.24
Picrorhiza kurrooa	12.4±0.90	9.66±0.07	4.9±0.23	2.6±0.86	2.8±0.20	8.66±0.29
Podophyllum hexandrum	9.44±0.38	7.78±0.99	2.22±0.75	3.06±0.55	4.66±0.27	11.44±0.56
Polygonatum verticillatum	16.66±0.18	13.22±0.09	5.48±0.09	3.67±0.02	8.82±0.86	12.46±0.37
Potentilla lineata	18.44±0.11	11.62±0.02	6.4±0.30	2.38±0.05	4.8±0.60	16.44±0.17
Rheum australe	16.54±0.11	11.66±0.97	6.8±0.40	5.88±0.06	5.78±0.63	13.86±0.33
Saussurea obvallata	17.78±2.05	9.88±0.03	5.46±0.11	4.46±0.10	8.69±0.13	13.46±0.54
Swertia chirata	16.44±1.00	8.38±0.82	4.82±0.05	4.68±1.15	5.29±0.16	12.62±0.89
Taxus baccata	23.44±0.13	12.68±0.07	7.88±0.04	9.48±0.05	8.99±0.09	19.88±0.77
Zanthoxylum armatum	16.55±0.06	24.47±0.01	16.44±0.94	17.6±0.85	18.8±0.24	27.56±0.94

The study indicates that traditional health care knowledge of plant species is disappearing rapidly and lacking exchange of traditional knowledge in upcoming generation with increasing monetary economy among the Bhotiya tribals. Besides, overall utility value and importance of native plant species needs to be studied before it gets extinct from the region. The cultivation of certain highly medicinal and economical value plant species can help to meet the requirement of raw material for industrial purposes and reduce the pressure on the existing species at timberline areas in natural habitats. Therefore, there is a need to develop adequate strategy and action plan for the conservation and management of habitats and species.

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