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Extent, mapping and utilization of grassland resources of Jammu and Kashmir in western Himalaya: a case study

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Abstract
The present work was conducted in Jammu and Kashmir State of India to study the extent, mapping and utilization pattern of grasslands. Four field trips were conducted during May, 2011 to October, 2014 in the alpine pastures and several pastoralist groups were randomly selected and information was collected through interviews, focus group discussions, participant observation and by administering questionnaires. A total of 120 informants, falling in the age group of 18–75 years, including various officials of state government departments and non-government organizations were selected. In this study, 21 cloud free scenes of IRS P6 LISS-3 of year 2012–13 were used for grassland identification and mapping. The study revealed that about 9595 km^2 (4.32%) area was under productive grasslands, whereas other grazing lands including scrubs and other unpalatable grasslands were 10455 km^2 (9.81%) of the total geographical area. Grassland area in Jammu, Kashmir and Ladakh region was 3.53, 13.22 and 5.76% respectively. As per the elevation, the vertical distribution of grasslands was found highest between 1500-3000 m. The grasslands of the state were classed as tropical to sub-tropical, sub-tropical to sub-temperate, sub-temperate to alpine and alpine meadows. Himalayan grasslands locally known as Bahaks/Margs are unique heritage in Jammu and Kashmir and owing to their species-rich, taxonomically diverse flora, ecological services and scenic beauty, which represent an important ecosystem. Throughout these grasslands, pastorals and other indigenous communities collect and use plants in several ways.

Keywords: Grasslands, Jammu and Kashmir, Mapping, Pastoralists, Utilization

Introduction

Grassland is a highly dynamic ecosystem and support flora, fauna, and human populations worldwide. It includes rangelands, pasturelands and fallow lands and fodder crops covered approximately 3.5 billion ha in year 2000. It is containing about 20% of the world's soil carbon stocks (Ramankutty e*t al*., 2008; FAOSTAT, 2009). The term 'grassland' is synonymous with pastureland when referring to an imposed grazing-land ecosystem and is defined as 'land (and the vegetation growing on it) devoted to the production of introduced or indigenous forage for harvest by grazing, cutting, or both'. The vegetation of grassland in this context is broadly interpreted to include grasses, legumes and other forbs and at times woody species may be present (Allen *et al*., 2011). Grasslands produce forage for domestic livestock, which in turn support human livelihoods with meat, milk, wool and leather products. The livestock industry largely based on grasslands– provides livelihoods for about 1 billion of the world's poorest people and one-third of global protein intake (FAO, 2006).

The Himalayas constitute one of the richest and most unusual ecosystems on earth (Salick *et al*., 2009). Himalayan alpine vegetation communities retain high ecological significance, because they control soil stability of their catchment areas, play a major role in ecosystem functioning, and are vital in cultural, ethical and aesthetic aspects (Stirling and Wilsey, 2001). The alpines are characterized by low productivity, high intensity of solar radiation and high degree of resource seasonality because of high ultraviolet (UV) radiation, high wind velocity, blizzards, low temperature and snow storms (Nautiyal *et al.,* 2004). Himalayan pastures have been grazed intensely for centuries (Miller, 1999). Available grazing area in subalpine and alpine pastures of Kashmir decreased from 0.15 ha/animal in 1977 to 0.10 ha/animal in 1982 (Misri, 2003) and continued to decrease thereafter (Qureshi *et al.,* 2007). Similarly in the north western Himalayan state of Himachal Pradesh, the average grazing pressure and grazing intensity in the state were 1.26 ACU/ha and 0.79 ha/ACU, respectively (Dev *et al*., 2006). In north western Himalayan state of

Jammu and Kashmir, livestock playing a crucial role both at household and state level has been identified as critical to the overall economic and social development (Wani *et al*., 2014). About 13% of the gross domestic product is contributed by the animal husbandry sector in the state (Anonymous, 2004).

Livestock rearing plays a vital role in the economy of hilly regions, where sedentary, semi–migratory and migratory systems of livestock rearing are followed (Jitendran *et al*., 1998; Dev, 2001). However, no concrete studies have been reported from the region *vis-à-vis* extent, mapping and utilization pattern of grasslands. The present investigation was therefore, undertaken to identify and characterize the grasslands of Jammu and Kashmir using remote sensing/GIS technique and their utilization by various pastoral communities of the state for sustaining livestock production.

Materials and Methods

***Description of the study area*:** The state of Jammu and Kashmir (33°17' - 37°20' N latitude, 73°25' - 80°30' E longitude) comprises three main physical regions *viz*., outer Himalayas with sub-tropical and intermediate type of climate representing Jammu region, lesser Himalayas with temperate climate representing Kashmir region and inner Himalayas or cold arid zone of Ladakh region (Wani and Wani, 2007). The climate of the region is determined by altitudinal gradient, the elevation increasing from 330 metres in Jammu to about 3305 meters in Ladakh. With increase in the elevation the rainfall decreases from 1052 mm in Jammu to 662 mm in Srinagar and only 92 mm in Leh with mean annual temperature of 24.5 ^{0}C in Jammu, 13.3^{0}C in Srinagar and only 5.3 ^{0}C in Leh, giving rise to sub-tropics, temperate and sub-arctic climates (Wani *et al*., 2014). The length of the crop growing season also decreases from south to north. In Jammu the crop can be grown round the year while in Kashmir valley double cropping is possible but in Ladakh region the crops can be grown during June to September only (Ahmad and Verma, 2011).

***Collection of materials and information*:** Intensive ground truthing and field samplings were carried out to generate the geo-spatial information on grasslands. Garmin GPS Map 276 was used for site locations recording in the pasturelands starting from Baralachla to Leh, Changthang area of Ladakh region, Leh-Kargil-Zozila and from Sonmarg-Srinagar-Jammu. To document the utilization of grasslands, field surveys were carried out in between May, 2011 to October, 2014 (Fig 1).

The surveys sites were spread across the region and altitudes. The timings for fieldwork were selected according to the growth and collection season of the plants.

Several pastoralist groups located along the field trips routes were randomly selected and interviewed. Total 120 informants (including farmers, shepherds, house wives, herdsmen and herbalists) aged between 18-75 years familiar with grassland issues participated in the study (Table 1). Data were collected through interviews, focus group discussions, participant observation and by administering questionnaires. Structured, semi-structured interviews, guided questionnaires and direct observations were used to collect the data following the standard ethno botanical investigations (Jain, 1995; Martin, 1995). The voucher specimens of plants were collected and identified either in the field itself or with the help of various flora besides, local literature (Dhar and Kachroo, 1983; Kaul, 1997; Dar *et al*., 2002; Wani *et al*., 2006, Dad and Khan, 2011) was consulted to reveal more details about the identified plants.

Fig 1. Field survey route, J&K, India

GIS data processing: In this study, 21 scenes of IRS P6 LISS-3 were used for grassland identification and mapping. ArcGIS and ERDAS Image software were used for the interpretation, analysis and mapping of grasslands. After the geometric/radiometric correction and histogram enhancement the selected images were processed for NDVI using ERDASI magine professional ver. 10.0.

Results and Discussion

Extent and mapping: Satellite remote sensing and geographical information system have provided very useful methods of surveying, identifying, classifying and

Table 1. Distribution of key informants (pastorals) according to their socio-economic profile

Variables	Gujjars (N=40) Frequency (%)	Bakarwals (N=40) Frequency (%)	Chopans (N=40) Frequency (%)
Age (years)			
Young (18-35)	9 (23)	7 (17)	6 (15)
Middle (36-54)	20 (50)	21 (53)	27 (68)
Old (55-75)	11 (27)	12 (30)	7 (17)
Family type			
Nuclear	15 (38)	8 (20)	18 (45)
Joint	25 (62)	32 (80)	22 (55)
Family size			
Small(1-5)	5 (13)	3 (8)	8 (20)
Medium(6-10)	10 (25)	5 (12)	10 (25)
Large(>10)	25 (62)	32 (80)	22 (55)
Education status			
Illiterate	18 (45)	26 (65)	17 (43)
Primary school	10 (25)	10 (25)	14 (35)
Secondary school	7 (18)	4 (10)	7 (17)
High school	5 (12)	0 (0)	2 (5)
Livestock holding (herd size)			
Marginal (< 100)	28 (70)	7 (18)	24 (60)
Small (100-150)	8 (20)	10 (25)	10 (25)
Medium (150-300)	3 (8)	12 (30)	5 (13)
Large (> 300)	1 (2)	11 (27)	1 (2)
Land holding			
Landless	6 (15)	31 (78)	4 (10)
Marginal (Upto 2.5acres)	26 (65)	7 (17)	32 (80)
Small (2.5-5.0 acres)	6 (15)	2 (5)	3 (8)
Medium (5-10 acres)	2 (5)	0 (0)	1 (2)
Large (> 10 acres)	0 (0)	0 (0)	0 (0)
Animal composition			
Sheep only	0 (0)	7 (17)	33 (83)
Sheep + Cattle	6 (15)	0 (0)	7 (17)
Mainly Goats + Sheep + Horses / Mules	0 (0)	33 (83)	0 (0)
Buffalo+Cattle+Horses/Mules	34 (85)	0 (0)	0 (0)
Type of pastoralism			
Sedentary	12 (30)	2 (5)	15 (38)
Semi-migratory	26 (65)	4 (10)	25 (62)
Transhumance	2 (5)	34 (85)	0 (0)

Figures in parentheses indicates percentage values presented in round figures

monitoring several forms of earth resources (Suresh *et al.*, 2004). Remote sensing data provides accurate, timely and real time information on various aspects such as size, shape and terrain of the area of interest. However, lack of precise estimates of the area under grasslands prevents proper planning and management of such resources. The only document at national level on grasslands is the book entitled '*Grass Covers of India'*, which is now over 45 years old and that grassland status has considerably changed. The study revealed that about 9595 km^2 (4.32%) area was under productive grasslands (Fig 2) and whereas other grazing lands including scrubs and other unpalatable grasslands occurred in 10455 km^2 (9.81%) of the total geographical area. Grassland area in Jammu, Kashmir and Ladakh was 3.53, 13.22 and 5.76%, respectively together contributing about 6756.5 km^2 or 6.34% of the total geographical area (Table 2).

Elevation wise, the vertical distribution of grasslands was found highest between 1500-4500 m (Table 3), the grasslands of the state were classed as tropical to sub-tropical, sub-tropical to sub-temperate, sub-temperate

to alpine and alpine meadows. A close relationship was found between extent of grasslands and landform/ agro-climatic conditions. Tsuchida and Numata (1983) have identified four zones of grasslands in Nepal Himalaya as: Zone I (<1100 m): *Cynodon dactylon*, *Chrysopogon aciculatus*, *Desmodium triflorum.*, Zone II (1100–2600 m): *Paspalum scorbiculatum*, *Pycreus sanguinolentus*, *Fimbristylis* spp., *Setaria* spp., Zone III (2600–3800 m): *Carex* spp., *Poa* spp. and Zone IV (>3800 m): species of *Carex*, *Calamogrostis*, *Festuca* and *Agrostis*. It was observed that scientific management of grasslands was important to address the livelihood options and environmental issues in the region. The alpine grasslands of Jammu and Kashmir account for 77% of the total alpine grassland area of 171464 km^2 of the Indian Himalaya (Lal *et al*., 1991). Rawat (1998) identified five types of grasslands in the Himalaya as: warm temperate grasslands (1500-2500 m); cool temperate grassy slopes (2600-3300 m); sub-alpine meadows (3300-3700 m); alpine meadows (3700-4500 m); and steppe formations of trans-Himalaya (>4500 m). Dev et al. (2009) observed *Festuca gigantea* dominated the pastureland of the area at higher altitude, while *Sibbaldia, Phleum, Artemisia* and *Potentila* were the other edible species observed in the western Himalayan state of Himachal Pradesh.

Table 2. Spatial distribution of grasslands in Jammu and Kashmir*

Region (J&K)	Geographical area (km^2)	Grasslands	
		(km^2)	(%)
Jammu	25636.16	906.09	3.53
Kashmir	15936.43	2106.59	13.22
Ladakh	64957.76	3743.86	5.76
Total	**106530.35**	**6756.54**	**6.34**

*Author's estimates

Table 3.Vertical distribution of grasslands in Jammu and Kashmir*

Elevation (m)	Geographical area (km^2)	Grasslands	
		(km^2)	(%)
<500	6836.33	24.41	0.36
500-1000	10768.47	85.46	0.79
1000-1500	10349.04	546.60	5.28
1500-3000	30369.48	2039.33	6.72
3000-4500	52891.77	3250.24	6.15
>4500	111020.91	3648.99	3.29
Total	**222236.00**	**9595.04**	**4.32**

*Author's estimates

Fig 2. Spatial distribution of grasslands, Jammu and Kashmir, India

Alpine grasslands of Jammu and Kashmir are a storehouse of numerous plants, besides serving as summer pastures for the flocks of various ethnic communities (Dad and Reshi, 2015). Throughout these grasslands, pastorals, nomads and other indigenous communities collect and use these plants in different ways (Dad and Khan, 2011). Gathering of these plants plays an important role for subsistence and primary health care of millions of people, especially in developing countries (Hamilton, 2003).

Alpine pastures as grazing paradise for pastoral communities

The area under grasslands in alpine pastures (above 3000 m) of the western Himalaya have been an age-old summer grazing regions for pastoral communities (Table 4) and is seasonally visited by them along with their herds (*Jhabs*) of sheep and goat (Dad and Khan, 2011). The Himalayas are not only rich in diversity of flora and fauna but cultural diversity of people as well. The main ethnic communities of the study area, *Gujjars* and *Bakarwals*, live mostly around sub-alpines and alpines (Bhasin, 2011). *Bakarwals* are pastoral nomadic community of Rajauri and Poonch districts of Jammu province of the state and are goat/sheep herders, whereas *Gujjars* are distributed in both Kashmir and Jammu provinces and are divided into two sections on the basis of their occupation-the Zamindar and Dodhi. The primary occupation of Zamindar *Gujjars* is agriculture, supported by animal husbandry whereas *Dodhi Gujjars* are pastoral nomads and are cow/buffalo herders. From June to September *Bakarwals* graze their herds in alpine pastures above 3000 m, whereas *Gujjars* use resources

of the pastures below 3000 m, and in October they start their return journey to areas that are located at comparatively lower altitudes (1800 m). Their movement patterns from one place to another are guided by their traditional practices and local knowledge. Pastoralists make substantial contributions to the economy of developing countries, both in terms of supporting their own households and in supplying protein, both meat and milk, to villages and towns. Pastoralism is successful strategy to support a population with the limited resources of land (Ahmad *et al*., 2016). The major potential high yielding temperate grasses/legumes which offer significant diversity are found in various regions (Table 5). The average dry matter yield of both native and exotic grasses varies considerably from 2.5 t/ha in *Agrostis* spp. to 10.0 t/ha in *Dactylis glomerata* (Dar *et al*., 2007).

Misri (1988) enlisted various important grasses in alpine pastures of Himalaya as *Agrostis*, *Agropyron, Dactylis, Elymus, Festuca, Lolium, Phalaris, Phleum* and *Stipa* etc. and the major temperate legumes as *Astragalus, Lespedeza, Lotus, Medicago, Melilotus* and *Trifolium* etc. In case of forage legumes, the diversity is extensive and the same is being expanded by natural hybridization. Ladakh and adjoining areas are considered as one of the centres of origin for *Medicago* and *M. falcata* is the original species found there. The traders who used to traverse through Ladakh along the old silk route noticed better forage yield of *M. sativa* in Yarkand (Uzbekistan) and introduced this in Ladakh. Now both *M. falcata* and *M. sativa* have hybridized to such an extent that at least five undifferentiated forms are found. Grazing activity was prevalent throughout the study area, with clear impacts on vegetation structure evidenced by the dominance of rosette herbaceous flora. The dominance of unpalatable species such as *Primula, Stipa*, *Cirsium* and *Sibbaldia* indicated high grazing pressure in the alpine pastures.

Socio-economic profile of pastoralists

Age, family size, livestock holding, land holding and pastoralism play an important role in determining the socio-economic conditions of the pastoralists. A perusal of the data (Table 1) indicated that most of the pastoralists were in the age group of 36-54 years (middle age). It was also observed that most of the pastoralists preferred to stay in joint family and majority of the pastoralists consisted of large family size (> 10 members) followed by medium (6-10 members). A perusal of the data with respect to livestock holding indicated that most of the pastorals belonged to marginal followed by small and medium categories which is also true regarding land holding size of the Indian farmers. Regarding composition of the animals, data indicated that *Chopans* preferred to keep sheep, *Bhakarwals* preferred to keep mainly goats+sheep+horses/mules and *Gujjars* had preference

Table 4. Major pastoralists of Jammu and Kashmir

Name of the community	Composition of livestock	Type of pastoralism
Bakarwal	Mainly goats, sheep, horses and dogs	Transhumance
Gujjars	Cattle, buffaloes, sheep, horses and dogs	Semi-sedentary and sedentary
Chopans and *Gaddies*	Mainly sheep	Semi-sedentary
Changpas	Pashmina goats, sheep and yak	Nomadic

Table 5. Diversity of important grasses and legumes in various agroclimatic zones of Jammu and Kashmir

Zone	Grasses	Legumes
Temperate zone	*Dactylis glomerata, Festuca arundinacea, Lolium perenne, Phleum pratense, Bromus unioloides, Phalaris spp., Poa pratensis, Lolium multiflorum, Agrostis spp. Avena sativa*	*Trifolium pratense, T. repens, Onobrychis viciifolia, Medicago sativa, Trifolium alexandrinum*
Intermediate zone	*Dactylis glomerata, Festuca arundinacea, Lolium perenne, Dicanthium annulatum, Chloris gayana, Chrysopogon fulvus, Heteropogon contortus, Setaria spp., Avena sativa*	*Trifolium alexandrinum, Stylosanthus hamata, Macroptelium atropupreum*
Sub-tropical zone	*Dicanthium annulatum, Chloris gayana, Chrysopogon fulvus, Heteropogon contortus, Cenchrus ciliaris, C. setigerus, Paspalum notatum, Avena sativa*	*Trifolium alexandrinum, Stylosanthus hamata, Stylosanthus scabra*
Cold arid zone	*Festuca arundinacea, Avena sativa, Phalaris spp., Dactylis glomerata*	*Medicago sativa, Medicago falcata, Lotus corniculatus, Astragalus spp., Caragana spp., Melilotus officinalis, Cicer microphyllum*

for buffalo+cattle+horses/mule. Semi-migratory system of livestock rearing was found to be the most dominant system of livestock rearing in *Gujjars* and *Chopans*, while transhumance was the dominant animal production system in *Bakarwals*. Rao and Casimir (1982) also witnessed the similar herd composition in case of the studied pastoral communities. Our findings were also in conformity with those of Akhtar and Hussain (2016) who reported that *Gujjars*, who were primarily a nomadic community, now combine the cultivation of land with nomadism. In search of green pastures for their flock, they move to the lower and middle mountain areas like Pir Panjal in the summer and retreat back to the plains in the winters. *Bakarwals* on the other hand, are the goat and sheep herders. They go to the higher reaches of the Himalayas, reaching up to Gurez and spend their winter in plains of Jammu. The climatic variation, physiography, topography and altitude greatly influence livestock rearing activities of these communities. The size and composition of livestock kept by households directly affect their economy and determine the demand for fodder (Dev *et al*., 2009; Dev *et al*., 2011).

Important herbs distributed in studied alpine pastures

***Medicinal plants*:** Respondents mentioned that about 50 herb species were medicinally important and were regularly collected and used by the *Gujjar* and *Bakarwal* pastoral communities. A large proportion (75%) of the respondents was involved in the use of medicinal plants for treating health problems. Some high valued medicinal herbs included *Arisaem awallichi* Blume, *Achillea millefolium* L, *Artemisia maritama* L, *Geranium wallichianum* D. Don ex Sweet, *Rheum emodi* L., *Prunella vulgaris* L., *Nepetaerecta* (Bth) *Onopordum acanthium* L, *Malva neglecta* Wallr., *Plantago major* L, *Indigofera heterantha* Wall. ex Brands, *Rumex hastatus* D Don, *Rumex nepalensis* Spreng, *Taraxacum officinale* Weber, *Thymus linearis* Benth, *Valeriana pyrolifera* Medik, *Valeriana jatamansii* Jones, and *Viola canescens* Wall ex Roxb. These important medicinal herbs were distributed throughout the study area. Various ailments treated by ethno-medicinal plants were fevers, cough, cold, asthma, rheumatism, stomach disorders, parasitic worms, kidney stones and body weaknesses. Studies have revealed that Himalayan region is home for over 10,000 species of medicinal and aromatic plants, supporting the livelihoods of about 600 million people living in the area (Shengji, 2001). Extensive use of plants as ethno-medicine at higher altitude is attributed to the absence of modern medical facilities (Uniyal *et al*., 2006).

***Ethno veterinary plants*:** Several plant species belonging to 20 families were documented in the present study for their use in treating various livestock ailments (Table 6) by pastoralists in Jammu and Kashmir. Out of the plant species reported, 4 belonged to family Asteraceae, 3 each to Amaranthaceae and Fabaceae, 2 each to Amaryllidaceae, Lamiaceae, Meliaceae, Pinaceae and Salicaceae while as the families of Apiaceae, Betulaceae, Brassicaceae, Canabaceae, Convolvulaceae, Euphorbeaceae, Gramineae, Malvaceae, Polygonaceae, Rananculaceae, Rhamnaceae and Zingeberaceae were represented by one species each. In earlier such studies Khuroo *et al*. (2007) reported ethno veterinary medicinal uses of 24 angiosperm species belonging to 23 genera and 15 families by the *Gujjars* of Kashmir Himalaya, while Sharma and Singh (1989) reported 18 herbs from Northwest Himalayan region used to treat various diseases in livestock. It was also observed that compared to younger generation, elderly people beyond 70s including both men and women had sound traditio-

Table 6. Important ethno-veterinary plants of studied pastures

Livestock ailment	Medicinal plants used
Internal parasites/abdominal worms	*Artimisia* spp., *Achillea millifolium* L., *Mentha* spp., *Pinus wallichiana* L., *Salix* spp.
Stomach disorders	*Trigonella foenum-graecum* L., *Foeniculum vulgare* Mill., *Rumax patientia* L.
Milk deficiency	*Trifolium pretense* L., *Taraxacum officinale* Webber, *Trifolium repens* L., *Convolvulus arvensis* L.
Skin infections	*Ziziphus vulgaris* L., *Salix* spp., *Cedrus deodara* L., *Brassica campestris* L.
Wound healing	*Chenopodium album* L., *Rheum emodi* L.
Diarrhea and dysentery	*Trigonella foenum-graecum* L, *Foeniculum vulgare* Mill
Weakness	*Amaranthus viridis* L., *Ziziphus vulgaris* L., *Amaranthus caudatus* L., *Malva neglecta* Wallr

-nal knowledge about use of plants in treating ailments in both humans and livestock. In fact, older persons and traditional healers had greater knowledge about traditional medicines than younger persons (Yadav *et al*. 2010). Medicinally important rare herbs were observed to be confined to remote and isolated places in the pastures. According to the local elders, the medicinally important plants previously enjoyed abundant distribution in the alpines, but because of overgrazing and overharvesting, their distribution and abundance has been reduced. Unsustainable anthropogenic activities are posing serious threat to these precious plant resources.

***Wild edible plants*:** Wild edible plants play an important role in the food and nutritional security of large section of people living in harsh climate of geographically remote regions (FAO, 2004). The pastoralists used mostly 10 wild edible plant species which included *Allium humile* Kunth, *Capsella bursa-pastoris* Medic, *Cichorium intybus* L., *Fragaria nubicola* (Hook.f.) Lindl., *Malva neglecta* Wallr., *Rumex hastatus* D. Don, *Taraxacum officinale* Weber, *Polygonum aviculare* L., *Plantago major* L and *Viola biflora* L. The tradition of gathering plants for different human uses persists in many aboriginal communities worldwide (Kala, 2002; Tilahun and Giday, 2010). Dad and Khan (2011) identified 26 plants under 21 genera and 14 families from the surveyed grasslands of Gurez valley of Jammu and Kashmir, which have been used by the pastorals as wild edibles. The study revealed that valuable traditional knowledge about biodiversity is playing a very important and crucial role in supporting both livestock and improving lives and livelihood of pastoralists in Jammu and Kashmir. However, there is a need to generate awareness among these people regarding the sustainable utilization and conservation of some of the rare medicinal herbs as excessive use may result in loss of biodiversity. Besides these rare but valuable ethno-botanicals, traditional knowledge is in danger of extinction because of current rapid change in communities all over the world (Kubkomawa *et al*., 2013).

Conclusion

The wide spread grassland of Jammu and Kashmir is an important natural resource for sustainability of livestock, which is also one of the main livelihood. But so far, no study was conducted to map or document the utilization of the grassland. The present study has used remote sensing technology which is capable to map the vast grassland of the state and also rigorous survey work conducted to gain knowledge about its traditional usage to treat different ailments of human as well as livestock. IRS P6 LISS-3 image was used to classify the grasslands at different altitudes, to calculate its proportion to total geographic area and to assess present status of it. Thus, the study has generated very useful information which will help to formulate and plan any policy related to grassland management or restoration work in future.

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