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GIS & RS based assessment of grazing resources for livestock development in Kangra valley

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Abstract

Precise estimate on grasslands area, extent and conditions, forage and production can be generated with the help of remotely sensed satellite data, Geographical Information System (GIS) and Global Position System (GPS). In the present study of Kangra valley of Himachal Pradesh, India was found that about 12.38% area was under grasslands. The spatial distribution was presented in map using ArcGIS. The forage production (2.52 DM t/ ha) and grazing pressure (7.86 ACU/ha) was estimated for livestock based developmental plan.

Key words: GIS, GPS, Grasslands, Grazing pressure, Himachal Pradesh, Kangra, Remote Sensing.

Introduction

Grazing lands play a vital role in the rural economy and eco-development. Precise information on the extent, conditions and forage availability from grazing lands is essential for developmental planning of sustainable livestock production. There are evidences of excessive degradation of tropical/temperate grazing lands. Excessive grazing and deforestation further converted them into heavily degraded wastelands. The current data shows that about 158 million ha area in India has turned into wastelands. This is a worldwide phenomenon as over 88 percent grazinglands of the world are at least moderately degraded and the rate of degradation is 17.7 m ha annually. About 40 per cent of the world surface area is used by grazing animals for the bulk of their diet (Van Dyne *et al.*, 1978). According to Ministry of Agriculture, grassland area of Kangra is 15.212 % (87928 ha) of the total geographical area (578003 ha). These grasslands were situated between the 1000 m to 1800 m above the msl (Singh *et al.*, 2009). In the present study, efforts were made to evaluate these grasslands with the help of GIS & RS techniques, using satellite data and to find out the grazing pressure on these grasslands for the solution of the above problems.

Materials and Methods

The study area, *i.e.*, Kangra valley, located in Himachal Pradesh, ranging between 31°41'37.15"-32°27'44.02"N latitude and 75°36'26.47"-77°04'55.13"E longitude with altitude ranging from 353 m to 4568 m, comprises of 19 sub- tehsils/blocks. Total geographical area of Kangra is 563832.26 ha, the average annual rainfall ranges between 1200 - 2000 mm. Geodatabase was created by using ArcGIS, ERDAS Imagine and GPS tools and IRSP6L3 data. The assessment of these grasslands was based on IRSP6L3 data of Sept - Oct 2008. Ground-truthing and sampling of these grasslands has been done using GPS (Global Positioning System). Livestock population was converted in to ACU (Adult Cattle Unit) for the estimation of grazing pressure. The estimation of forage yield is based on field sampling conducted during survey.

Result and Discussion

Spatial distribution of grasslands: Satellite imagery (IRSP6L3 dated Sept-Oct, 2008) was rectified, classified and mapped. The study revealed that about 1.4 lakhs ha land is under grassland. It is about 12.38% of the total geographical area of Kangra (Fig.1). Maximum area (24.85%) under grassland was observed in Khundiyan and minimum (0.08%) in Multan. The location of Multan is in high altitude zone and much of the area is covered with barren rocks, snow and glaciers. The concentration of grasslands was found along the hill ranges slopes and forest fringe area. On the basis of spatial coverage of grasslands the entire region was grouped in to 4 zones *viz.*, very high (> 20%), high (15-20%), medium (10-20%) and low <10%). Out of 19 sub- tehsils/ blocks, grasslands was found very high in 2, high in 8, medium in 7 and low in 2 sub- tehsils/ blocks.

Table 1: Estimation of grassland, livestock and forage availability in Kangra Valley of Himachal Pradesh

Name Dist./Tehsil / Sub Tehsil	Geographical Area (ha)	Grasslands		Livestock (number in ACU)					Grasslands (ACU/ha)	Fodder availability (tDM/y)
		(ha)	(%)	Cattle	Buffaloes	Sheep	Goat	Total		
Baijnath	21325.19	1529.77	7.17	21154	2028	2488	2235	27904	18.24	3862.67
Baroh	13477.15	2271.79	16.86	5943	5746	86	1588	13363	5.88	5736.27
Dehra Gopipur	65416.26	10526.42	16.09	30948	32071	320	2176	65516	6.22	26579.21
Dharamsala	34843.39	5457.08	15.66	23614	4404	2082	2680	32780	6.01	13779.13
Dhira	8377.78	1208.33	14.42	4676	2990	130	730	8525	7.06	3051.03
Fatehpur	24360.32	3431.92	14.09	17513	11239	213	1204	30170	8.79	8665.60
Harchakkian	7395.88	1415.03	19.13	5041	1804	81	680	7606	5.37	3572.95
Indora	32980.15	4073.64	12.35	19564	13946	247	999	34756	8.53	10285.94
Jaisinghpur	13275.65	1768.03	13.32	9671	7196	771	1205	18843	10.66	4464.28
Jaswan	25389.44	4408.67	17.36	8555	7133	164	239	16091	3.65	11131.89
Jawali	31415.85	5108.8	16.26	28818	15411	1193	3251	48673	9.53	12899.72
Kangra	28429.39	5803.18	20.41	30729	12810	920	3560	48020	8.27	14653.03
Khundiyan	16511.09	4102.44	24.85	8242	8866	181	1280	18570	4.53	10358.66
Multhan	94693.05	74.17	0.08	4458	0	3241	2132	9831	132.54	187.28
Nurpur	58782.46	6960.03	11.84	44225	15146	1416	3724	64511	9.27	17574.08
Palampur	44426.4	5946.24	13.38	39192	6225	3378	3136	51931	8.73	15014.26
Rakkar	10035.25	1952	19.45	6351	8706	69	202	15328	7.85	4928.80
Shahpur	26866.01	2821.58	10.5	22018	4413	961	2312	29704	10.53	7124.49
Thural	5831.55	922.61	15.82	3021	2623	151	437	6233	6.76	2329.59
Kangra District	563832.26	69781.73	12.38	333734	162758	18091	33772	548355	7.86	176198.87

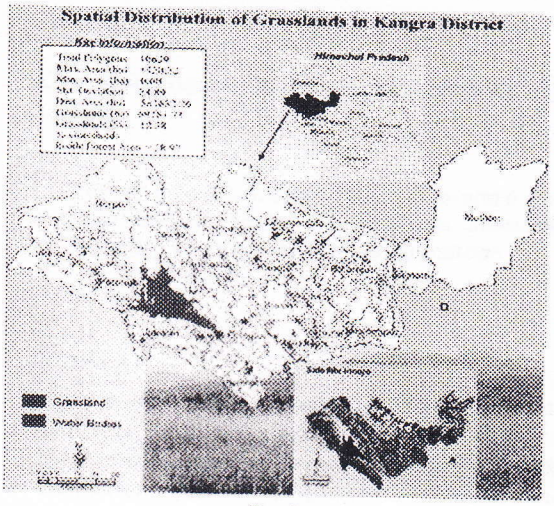

Fig. 1

Forage Production: On the basis of pixel tone, texture and pattern as well as reflectance values, these grasslands (12.38%) were further classified into good, average and poor conditions. The average forage production was 2.52 t DM/ha/year. Highest productivity was found in Baijnath, Baroh, Dharamsala, Fatehpur, Jaisinghpur, Jawali, Kangra, Multhan, Nurpur, Palampur, Rakkar and Shahpur whereas it was found very low (1.65 t DM/ha) in Dehra gopipur, Dhira, Harchakkian, Indora, Jaswan, Khundiyan and Tharul. The basic reason of low productivity was high grazing pressure and deterioration of existing grasslands. At many places good grazinglands were brought under cultivation for crop production. There were no protection of these grasslands from excessive grazing even social fencing rule were not being followed by many farmers. To make the grassland sustainable and enhance the productivity, it is essential to reduce the grazing pressure and manage the existing grasslands with suitable management practices *viz;* reseeding of suitable grasses/legumes during monsoon season and reclamation of grasslands from unpalatable shrubs and weeds. The CP content in range forage was found between 5.82 to 6.65 percent.

Livestock and grazing pressure: Livestock play a key role in the Indian agricultural economy and form an integral part of the farming system. They provide livelihood to more than 70% of the rural households assuring year-round employment. Livestock provide draught power, rural transport, manure, fuel, milk and meat. They provide income and employment to the smallholder farmers and other weaker sections of the society including women and the landless. Most often livestock is the only source of cash income for subsistence farms and also serves as insurance in the event of crop failure. Areas with a high share of livestock husbandry have low poverty percentage (Taneja, 2003).

Livestock population was assessed to be 5.4 lakhs ACU. As the grazing area was limited (12.38 %), the grazing pressure on per ha grazing lands was very high (7.86 %). It was found more than 10 ACU/ha in Baijnath, Jaisinghpur, Multhan and Shahpur (Table 1). Grazing pressure calculated according to the grassland area was found 7.86 ACU/ha, which is very high. The availability of fodder calculated by the received satellite images was found highly asymmetrical in fodder availability per unit area, for *e.g.* in Baijnath it is 18.24 ACU/ha whereas in Jaswan it is 3.65 ACU/ha on the basis of grassland area. This is highly asymmetrical. Available fodder is not satisfactory for the livestock production system and it can be improved by applying the advanced fodder production techniques.

Grasslands improvement/management techniques: For the better outputs and the development of livestock based fodder production system, following point need attention-

* Protection of grassland areas by fencing, cattle proof trenching ***etc.***
* Use of high quality pure seed for better productivity and good yield.
* Fodder crop cultivation/ Pasture development in wastelands.
* Storage and conservation of forage for lean period feeding.
* Application of rotational grazing system for the better forage production.
* Maintenance of grassland through regeneration and weed control *etc.*

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