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Theme 3. Sustainability of grasslands- social and policy issues
Sub-theme 3.2. Factors affecting grassland and forage resources

Diversifying agricultural practices to meet fodder requirements in the NW Himalayas through improved land use systems.

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Introduction

True grasslands formed as climatic climaxes in India are confined to the alpine regions (>3000 m s l) in the Eastern and Western Himalayas and have been studied for their productivity (Joshi *et al.*,1988., Ram *et al.,* 1989) and vegetation diversity (Raizada *et al*., 1998). Other grasslands as they exist are stable sub-climax formations formed as a result of forest degradation and the occurrence of secondary succession in almost all over the Himalayan region. The livelihoods of mountain dwellers is mainly dependent on traditional agriculture and livestock rearing. Animal husbandry is an inseparable component of hill agriculture and the system may be referred to as dairy-manure-draught cattle production system.

In the hills, fodder trees, shrubs and open grazing in forest areas is the main source of feed for livestock including agricultural residue. Nearly 66 to75% of the fodder requirement are met from the forest in the mid hills and 26-43% in the lower hills. Summer grazing is practices the alpine regions which are overgrazed. High livestock population and diminishing fodder production have increased fodder demand on the forests which are damaged by extensive lopping and consequent poor regeneration), further contributing to the process of ecological degradation. Land degradation is now a major threat to food production and environmental security in the Himalayan region. Nearly half of the land area in the region is degraded, the major causes being soil erosion due to water, faulty land use practices and the harsh terrain conditions.

Available estimates shows that the pressure of livestock grazing on forest and pasture land is 2 to 4 times higher than the normal carrying capacity of grazing areas in some hilly areas (Tiwari, 1997). Given the status of feed-fodder deficiencies and declining per capita land availability, sustaining the livestock sector has become a formidable challenge. The major constraints for supporting livestock is inadequate availability of green forage, particularly in winter, causing deficiency of protein and vitamins, resulting in low productivity. It is therefore necessary to develop and implement suitable land use systems which will provide enough fodder and also maintain environmental security in the fragile Himalayan regions.

Materials and Methods

The data for livestock population from 18th livestock census GOI., 2007) was collected from Department of Animal Husbandry Dairying & Fisheries (DADF), Ministry of Agriculture, and Government of India. Then, employing the standard conversion factors RLUs (Ruminant livestock units) were computed. Assuming dry and green fodder requirement equivalent to 2.5 and 8% of body weight, total demand for fodder was estimated. Using the standard conversion factors and production data relating cereals, pulses, oilseeds, sugarcane, potato (TE 2009-10) the availability for dry and green fodder were estimated. Existing information on various land use and species combinations were retrieved from published literature and distributed as per elevation zones of the states of Uttarakhand and Himachal Pradesh.

Results and Discussion

As per livestock Census (GOI 2007) there are 2.5 and 2.3 million RLUs (ruminant livestock units) in Uttarakhand and Himachal Pradesh state, respectively (Table 1). To sustain this livestock population around 10.2 and 9.4 million tons dry fodder and nearly 32.7 and 30.1 million tons green fodder is required in Uttarakhand and Himachal Pradesh, respectively. However, the estimated availability of dry fodder is only 3.7 and 2.4 million tons whereas the supply of green fodder is around 8.9 and 10.9 million tons in Uttarakhand and Himachal Pradesh. To meet the shortage of dry and green fodder amid the continued degradation of natural resources, is a challenge for land use managers in the North-west Himalayan region.

Improved land use practices consisting of fruit and fodder yielding tree species with combinations of fodder grasses (Table 2) and medicinal plants (Table 3) as understory components have immense potential to be developed in close

vicinity to settlements. Cluster based approaches for production of a wide range of fruits (subtropical to temperate) and medicinal plants and the subsequent value addition of produce is an activity that can be tapped for increasing environmental security, improved employment and income opportunities for stakeholders in the region (Dhyani *et al.*, 2009), by providing incentives to small scale industrial units for fruit processing and value addition. Exploitation of medicinal plants, presently done in the grey market, needs to be scientifically carried out and stakeholders sensitized to the potential of organized cultivation of medicinal plants. Food and energy (firewood & LPG) availability to the residents can be provided though a modified and revamped public distribution system (PDS), while stakeholders can diversify to improved land use practices. This can also be linked to payment for ecosystem services by appropriate legislation of Clean Development Mechanism (CDM) provided by stakeholders for conserving forest and soil cover using various suitable land use combinations.

Technological options for these land use modifications already exist. There is a need for convergence of various line departments in planning, providing quality inputs (planting material, technical knowledge, capacity building) and consequent implementation at the ground level. It is expected that over the next decade these practices (combinations of forest and fruit trees, understory fodder grasses and/or medicinal plants) will contribute significantly to improved environmental and livelihood security for the small and marginal landowners of the north west Himalayas.

Table 1: RLU and green and dry fodder requirements in two Himalayan states

Particulars	RLU units (millions)		Green fodder requirement (m tons)		Dry fodder requirement (m tons)	
	UK	HP	UK	HP	UK	HP
Cattle	1.44	1.51	18.87	19.85	5.90	6.20
Buffalo	0.89	0.57	11.72	7.44	3.66	2.33
Sheep	0.03	0.09	0.38	1.18	0.12	0.37
Goat	0.13	0.12	1.75	1.63	0.55	0.51
Total	2.49	2.29	32.73	30.11	10.23	9.41

UK: Uttarakhand; HP:Himachal Pradesh; RLU: Ruminant livestock units

Table 2 : Horti-pastoral systems suitable for various open forest areas in four zones in the states

Zone I < 800 msl	Zone II 800-1800 msl	Zone III 1800-2500 msl	Zone IV >2500 msl
Citrus fruits, Lemon, Kinnow, Plum, Peaches, Pear, Ritha Orange, Pomegranate + *Cenchrus ciliaris, Chrysopogon fulvus, Napier* hybrid, *Setaria anceps, Panicum maximum, Eragrostis curvula,*	Lemon, Pear, Peach, Plum, Persimmon, Galgal, Kinnow, Kiwi + *Setariaanceps, C. fulvus, Napier* hybrid, *Oats, Brachiara mutica, Heteropogon contortus*	Apple, Plum, Apricot, Peach, Walnut, Almond, Pear, Cherry Olives + *Dactylisglomerata, Phleum pretense, Festuca sp., Lolium perenne, Trifolium pratense*	Apricot, Walnut, Chilgoza, Apple, Almond, Leh-Berry + *Dactylis glomerata., Poa alpina,*

Table 3: Suitable medicinal and aromatic plants that can be grown in the 4 broad zones in the three states.			
Zone I < 800 msl	Zone II 800-1800 msl	Zone III 1800-2500 msl	Zone IV >2500 msl
Aloe barbadense, Centella asiatica, Gloriosa superba, Costusspeciosus, Ocimumsanctum, Mint, Datura metel, Rauwolfia serpentina, Withaniasomnifera, Bacopa monnieri	*Acoruscalamus, Atropa belladona, Digitalislanata, Eclipta alba, Plumbago zeylanica, Viola serpens, Xanthoxylumarinatum*	*Aconitum hetrophyllum, Acruscalamus, Digitalislanata, Valeriana jatamansi, Viola canescens*	*Angelica glauca, Carum carvi, Podophyllum hexandrum, Saussurealappa*

Conclusion

In order to ensure ecological balance and environmental security in the fragile Himalayan ecosystem, there is a need to review present land use practices and encourage development and maintenance of permanent green cover by diversification into different land use practices which will ensure production of fodder for livestock and also provide other products which on value addition can provide enhanced opportunities for farm level employment and income.

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