Livestock farming in the Uttarakhand Himalaya, India: use pattern and potentiality

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This article aims to examine the use pattern and potentiality of livestock farming in the Uttarakhand Himalaya, India. We collected and compared data on livestock population and production in 13 districts of Uttarakhand (2001–14) and noted that number of milching livestock, improved hen and milk production increased during the period. Meanwhile, population of sheep, goat, lamb and indigenous hen has decreased. The study reveals that livestock farming, including cattle, milching animals, goat and sheep has high potential in livelihood sustainability. Similarly, dairy farming has a prominent role in economic development as it shares 69.1% gross income.

Keywords: Livestock farming, livelihood, socio-economy, sustainability.

LIVESTOCK farming has an important place in agrarian economy as a user of natural resources, a source of livelihoods and a tool of economic growth during the last decades[1–4]. It occupies 30% of the world's ice-free surface, contributes 40% of global agricultural domestic products, provides income for more than 1.3 billion people and nourishes 800 million food-insecure people[5]. Livestock farming uses vast areas of rangelands, one-third of the freshwater and one-third of the global cropland as feed[6], and contributes valuable nutrients for crops. However, it is responsible for grazing land degradation. Nevertheless, livestock farming is essential for the sustainability of the global food system[7]. In 2000, the global livestock sector produced 586 million tonnes of milk and 285 million tonnes of meat[8,9]. Although livestock production at the global level is less, it plays a vital role in supporting the nutritional security and income mainly for the pastoral communities[10,11].

Uttarakhand characterizes mixed crop–livestock systems in smallholder farming. A large proportion of livestock is raised under mixed cropping system[12]. There are two systems – sedentary and migratory. Livestock are kept in a village throughout the year under sedentary system, whereas in migratory system livestock migrate seasonally to highland pastures for grazing. Livestock along with dairy animals play an important role in agriculture and economy as they provide manure to agriculture and enhance economy through milk, meat and wool production. Draught animals also support productivity and sustainability of mountain agriculture[13].

The majority of farmers in Uttarakhand operate mixed crop–livestock farming systems under different types of agro-ecosystems. Geographic variations have combined to provide a microcosm of the Earth's livestock farming systems[14]. Farmers who are involved in rearing dairy animals also keep bullocks to plough fields and sell them to supplement incomes. The whole system is referred as dairy–manure–draught cattle production system. Farmers consider the cow as a sacred animal. It is also considered as an economic animal as it provides both milk and manure, and substantiates rural livelihoods.

Uttarakhand possesses a huge natural resources base for livestock farming that includes common property resources and extensive grasslands – subtropical, temperate and alpine. In addition, fodder is alternatively managed through stall feedings, the planting of fodder trees and cultivation of grasses on private land[15]. Climatic conditions are suitable, ranging from subtropical to temperate and alpine and provide suitability for livestock farming. Livestock farming is the second most important occupation of the people after agriculture, which helps substitute livelihoods of the poor marginal farmers through providing milk, manure, meat and wool.

Uttarakhand is an agroecology-rich region with a large number of fodder plants and grass species; it also supports a large number of livestock population. Oak leaves, useful fodder for milching animals, are found extensively in the temperate region. Similarly, pasturelands – subtropical, temperate and alpine are extensive and provide a sustainable base for dairy farming. Agroforestry is practised and fodder trees grow in the agricultural fields. These fodder species substitute stall feeding to livestock at the time of fodder crises. Livestock in grazing systems consume mostly grasses, whereas in mixed system there is typically a wide array of feeds. In Uttarakhand Himalaya, most of the feeding practices in mixed systems revolve around grazing. The use of cereal stovers and paddy straws is occasional feed. Biomass use by livestock can be categorized as direct via grazing and indirect via stall feeding.

In spite of suitable climate, extensive subtropical and temperate grasslands and sufficient fodder trees, the whole Uttarakhand Himalaya could not attain sustainability

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in terms of livestock farming, though it is the second most important occupation of the people. Those who are engaged in rearing livestock are economically poor. Most of the dairy products are consumed locally, and do not receive suitable prices mainly due to lack of market and cold storages.

This study examines use pattern, changes in livestock population and production, and potential of livestock farming in the Uttarakhand Himalaya. It analyses economic valuation of livestock farming, suitability of its rearing in different agro-climatic zones and questions how livestock farming can contribute in livelihood sustainability of the marginal farmers in particular and the whole region in general.

Study area

The Uttarakhand Himalaya constitutes an integral part of the Himalaya and has abundant natural resources – land, water and forests, and panoramic landscape. Stretching between 28°53′24″–31°27′50″N and 77°34′27″–81°02′22″E, its geographical area is 51,125 sq. km, of which about 90% is mountainous. It has five vertical divisions – valleys, mid-altitudes, highlands, alpine pastures and snow-clad mountain peaks, and is a source of the major rivers of India that drain from this region and feed hundreds of thousands of people in the downstream areas. It has a range of climates from subtropical to temperate, cold and frigid cold. Though rich in natural resources, this region is socially backward and economically underdeveloped, as it could not harness the abundant natural resources due to its topography, lacking infrastructural facilities and climate constraints. Agriculture is the main occupation of the people; however, agricultural land is only 12.4% of the total geographical area. Livestock play an integral role in agricultural development through providing manure and ploughing terraced farmlands. Out of the total working population (36.9%), 60.1% is engaged in agricultural and livestock practices. Forest covers 59.7% of the area and pastureland covers 3.4% of the area.

Methodology

We used both qualitative and quantitative approaches to conduct this study. Data were collected from secondary sources, mainly from the State's Statistical Report, 2015. Time series data from 2001–02 to 2013–14 on livestock population and production pattern were collected and changes in livestock number, production and economic valuation of livestock, livestock density and per capita livestock were analysed. We calculated different variables and their share at the state and national level. Economic valuation of milk-producing animals, viz. milching cow and buffalo – both indigenous and crossbreed, hens – indigenous and improved, and goat, sheep and lamb used both for wool and meat was made. Correlation of livestock farming, practiced both in mountainous and plain areas, and human and livestock ratio were found. Participatory approach was also used through rapid field visits to the study area.

Results

We analysed livestock population and use pattern, changes in livestock population, production of milk, meat and wool and observed economic value of livestock and their products. Livestock density, per capita livestock and state share of livestock population were also analysed. We now discuss livelihood sustainability and calculate forest, pastureland and arable land.

Livestock population and use pattern

The main livestock reared in the Uttarakhand Himalaya include cow, buffalo, oxen, hen, goat, sheep and lamb. Further, cow and hen were divided into indigenous and crossbreed/improved. Improved hens had the highest proportion among total livestock (45.4%), followed by milching buffalo (17.8%) and milching cow (indigenous; 15.3%). Goat shared the lowest proportion (1.8%) followed by milching cow (5.2%) and hen (6.1% indigenous). Sheep shared only 6.6% (Table 1 and Figure 1).

Changes in livestock population

Time-series data from 2001 to 2013 were collected from secondary sources and changes in livestock population were analysed. Four livestock – hen (indigenous), goat, sheep and lamb registered negative changes during the period. A decrease of 11.1% in indigenous hens was noted. Goat decreased by 26.8% followed by lamb (17.2%) and a small decrease was noticed in sheep population (0.5%). Meanwhile, improved hen increased by 643.6% followed by milching cow (crossbreed; 288.9%). Although the number of indigenous milching cow was higher and it ranked second in terms of total number of livestock, increase in its population during the period 2001–2014 was only 19.3%. Milching buffalo increased by 18.4% (Table 2).

Milk, wool and meat production

Table 3 shows the production of milk, wool and meat in Uttarakhand Himalaya. It further presents production (annual) per animal both in quantity and rupees. The highest income was earned from milching cow (crossbreed; Rs 125,000) followed by milching buffalo (Rs 75,000). Income from goat meat was Rs 46.740 and milching cow (indigenous) ranked fourth (Rs 35,000

income). Egg production was also high, ranking fifth. Goat, sheep and lamb provide both wool and meat and their economic viability is high. Improved hens were most popular than indigenous hens; income from eggs was higher than meat.

Changes in production pattern

Changes, both positive and negative, were noticed in production pattern between 2001–02 and 2013–14 (Table 4). The highest increase was observed in the production of eggs (improved), i.e. 472.6% followed by crossbreed milching cow (282.5%) and meat from lamb (185%). Meat from goat showed 147.1% increase. In terms of decrease in livestock products, the highest was recorded from indigenous egg production (38.8%) followed by wool from goat (23.4%).

District-wise livestock/sq. km and livestock/capita

We calculated district-wise livestock/sq. km and livestock/capita (Table 5). Hardwar showed the highest livestock/sq. km (172.6) followed by Bageshwar (125.8), Pithoragarh (121.8), Udham Singh Nagar (USN) (121.6) and Dehradun (104.8). Uttarkashi showed the lowest value, i.e. 30.5 livestock/sq. km and Chamoli district 45.3 livestock/sq. km. Champawat showed 71; Tehri 74.3; Rudraprayag 76.3 and Nainital 82.3 livestock/sq. km. Average livestock/sq. km was 81.5. In terms of livestock/

capita, it was highest in Chamoli, Pithoragarh and Bageshwar (1 each). This was followed by Uttarkashi, Pauri and Almora (0.8 each). Dehradun, Hardwar and USN had the lowest livestock/person, i.e. 0.2, whereas Nainital showed 0.4, Tehri and Champawat 0.6 each. Rudraprayag had 0.7 livestock/person, and average of the state was 0.5 livestock/person.

State share of different variables

We compared state share (%) of milk, egg and meat production, population and area with India and observed that area shares 1.60% of India while livestock population shares only 0.83%. State share of milk production was highest with 1.13% (Table 6). It was followed by wool production (0.92%). Egg production shared 0.45%, whereas meat production shared only 0.38% (lowest).

Potentiality of livestock farming

Livestock sustainability depends on the natural and human potential of any area or region. It includes landscape, availability of forest, grassland and water, suitability of climate and working potential of the people. It further shows how much we are able to maintain production and yield from livestock farming and how much it contributes to our livelihoods and economy. In the succeeding paragraphs, we explain the potentialities of livestock farming and how livestock can attain sustainability in the Uttarakhand Himalaya.

Extensive forest and grassland

We grouped forest, grazing and arable lands (Figure 2) into three categories according to the area they cover

Table 1. Livestock population in Uttarakhand Himalaya (in thousands) (2014)

Livestock	Population	Share (%)	Rank
Milching cow (indigenous)	466,060	15.3	3
Milching cow (crossbreed)	155,732	5.2	6
Milching buffalo	541,939	17.8	2
Hen (indigenous)	185,616	6.1	5
Hen (improved)	1,380,198	45.4	1
Goat	55,009	1.8	7
Sheep	200,361	6.6	4
Lamb	53,827	1.8	7
Total	3,038,742	100	-

Source: Data collected from the State's Statistical Report, 2015.

Table 2. Changes in livestock population

Variables	2001–02	2013–14	Change (%)
Milching cow (indigenous)	389,554	466,060	19.3
Milching cow (cross-breed)	40,041	155,732	288.9
Milching buffalo	457,600	541,939	18.4
Hen (indigenous)	208,704	185,616	–11.1
Hen (improved)	234,674	1,380,198	488.1
Goat	75,143	55,009	–26.8
Sheep	201,446	200,361	–0.5
Lamb	65,046	53,827	–17.2

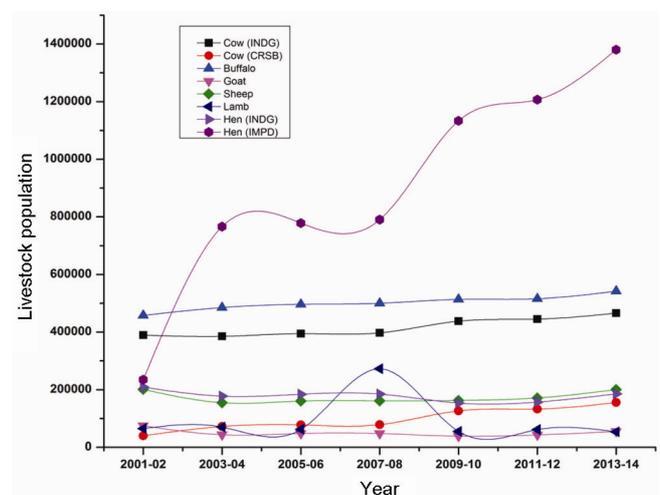Source: Data collected from the State's Statistical Report, 2015.

Figure 1. Livestock population in Uttarakhand, India (2001–2014).

Table 3. Production of milk, wool and meat in Uttarakhand Himalaya

Livestock	Production	Production/ animal	Production (Rs)/ animal	Share (%)
Milching cow (indigenous)	331,866 (MT)	0.7 (MT)	35,000	10.3
Milching cow (crossbreed)	391,342 (MT)	2.5 (MT)	125,000	36.7
Milching buffalo	826,940 (MT)	1.5 (MT)	75,000	22.1
Hen (indigenous)	208 (egg, lakhs)	208 (eggs)	2080	0.7
Hen (improved)	3,161 (egg, lakhs)	3,161 (eggs)	15,805	4.6
Hen (meat)	23,657,500 (kg)	15.1 (kg)	3,000	0.9
Goat (wool)	85,941 (kg)	1.6 (kg)	8,000	2.3
Sheep (wool)	307,325 (kg)	1.5 (kg)	7,500	2.2
Lamb (wool)	46,902 (kg)	0.9 (kg)	4,500	1.3
Goat (meat)	85.7 (lakh kg)	156 (kg)	46,740	13.7
Sheep (meat)	18.9 (lakh kg)	9 (kg)	2,730	0.8
Lamb (meat)	27.2 (lakh kg)	51 (kg)	15,150	4.4

Source: Data collected from the State's Statistical Reports, 2015.

Table 4. Changes in production pattern

Variables	2001–02	2013–14	Change (%)
Milching cow (indigenous; MT)	266,170	331,866	24.7
Milching cow (crossbreed; MT)	102,300	391,342	282.5
Milching buffalo (MT)	697,750	826,940	18.5
Hen (indigenous; lakhs)	340	208	-38.8
Hen (improved; lakhs)	552	3,161	472.6
Goat (wool, kg)	112,172	85,941	-23.4
Sheep (wool, kg)	272,244	307,325	12.9
Lamb (wool, kg)	42,054	46,902	11.5
Goat (meat, lakh kg)	34,679	85,679	147.1
Sheep (meat, lakh kg)	13,692	18,949	38.4
Lamb (meat, lakh, kg)	9,558	27,239	185

Source: Data collected from the State's Statistical Reports, 2015.

Table 5. District-wise livestock/sq. km and livestock/person

District	Livestock/sq. km	Livestock/person
Uttarkashi	30.5	0.8
Chamoli	45.3	1.0
Tehri	74.3	0.6
Dehradun	104.8	0.2
Pauri	81.9	0.8
Rudraprayag	76.3	0.7
Hardwar	172.6	0.2
Pithoragarh	121.8	1.0
Almora	104.7	0.8
Nainital	82.3	0.4
Udham Singh Nagar (USN)	121.6	0.2
Champawat	71	0.6
Bageshwar	125.8	1.0
Total	81.5	0.5

Table 6. State share of different variables

Variable	State share (%)
Milk production (2014)	1.13
Egg production (2014)	0.45
Wool production (2014)	0.92
Meat production (2014)	0.38
Population (2011)	0.83
Area (2013)	1.60

separately (Table 7). Forest area (percentage of total geographical area) was grouped into three ranges <40 (low), 40–60 (medium) and >60 (high). Hardwar and USN had <40% forest cover. Chamoli, Dehradun, Pauri, Pithoragarh, Almora, Champawat and Bageshwar had 40–60% forest cover and the highest area under forest cover (>60%) was for Uttarkashi, Tehri, Rudraprayag and Nainital districts. Similarly, grazing land was categorized into <2% (low), 2–5% (medium) and >5 (high). The highest area under grazing was registered in Pithoragarh, Almora, Champawat and Bageshwar (>5%). All these districts are mountainous and remotely located. Chamoli, Dehradun and Pauri districts possessed 2–5% grazing land. Other districts had <2% grazing land.
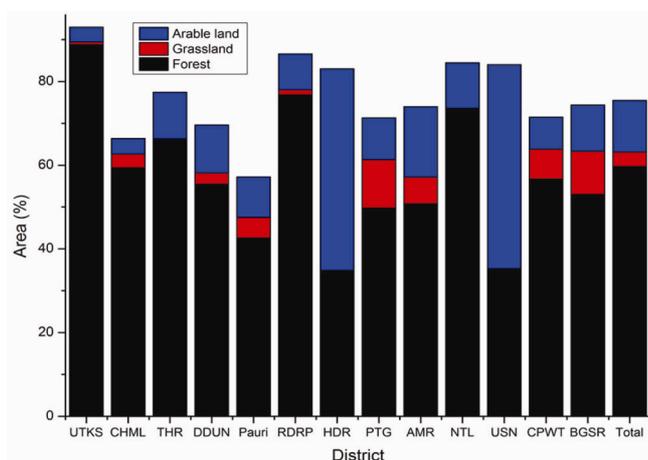
Less arable land

Although Uttarakhand has agricultural economy, arable land is limited to only 12.4% (average). We categorized district wise arable land into three groups, i.e. <10% (low), 10–20% (medium) and >20% (high). Hardwar and USN had the highest arable land (>20%). While Uttarkashi, Chamoli, Pauri, Rudraprayag and Champawat districs had the lowest arable land (<10%). Tehri, Dehradun, Pithoragarh, Nainital, Bageshwar and Almora had medium 10–20% arable land. This provides a suitable base for livestock farming.

Suitable climate and ample water supply

Uttarakhand has a varied climate ranging from subtropical to temperate, alpine and cold, and it supports sustainable livestock farming. Thus farming of goat, sheep and lamb in the highlands, milching buffalo and cow in the highlands and middle altitudes, and poultry in the valley region is highly suitable. The water is ample for livestock farming as numerous perennial streams originate and flow in the region.

Table 7. Status of forest, grazing and arable land in Uttarakhand

Land use	Status	Area (%)	District
Forest	Low	<40	Hardwar and Udham Singh Nagar
	Medium	40–60	Chamoli, Dehradun, Pauri, Pithoragarh, Almora, Champawat and Bageshwar
	High	>60	Uttarkashi, Tehri, Rudraprayag and Nainital
Grazing land	Low	<2	Uttarkashi, Tehri, Hardwar, Rudraprayag, Nainital and Udham Singh Nagar
	Medium	2–5	Chamoli, Dehradun and Pauri
	High	>5	Pithoragarh, Almora, Champawat and Bageshwar
Arable land	Low	<10	Uttarkashi, Chamoli, Pauri, Rudraprayag and Champawat
	Medium	10–20	Tehri, Dehradun, Pithoragarh, Nainital, Bageshwar and Almora
	High	>20	Hardwar and Udham Singh Nagar

Figure 2. District-wise forest, grassland and arable land (2014).

Discussion and conclusion

Dairy farming has high potential in the Uttarakhand Himalaya as climate and landscape promote it in all the altitudinal zones. The other important factors that promote dairy farming in the Uttarakhand Himalaya are vast forest (59.7%), grazing land (3.4%) and ample water. One of the important forest types is oak, growing largely in the temperate region, which is an important fodder tree. Grasslands in the Uttarakhand Himalaya vary from subtropical to temperate and alpine; they have high potential for rearing livestock. Although agriculture is the main occupation of the people, arable land is limited to 12.4% thus, leading to food insecurity and malnutrition. Under such a situation, livestock farming is one of suitable options to attain food security. Milk production may be a promising sector for livelihood sustainability. Already milk production shares 1.13% of the country's share, which is quite high compared to other agricultural and livestock products.

We observed that decline in the population of goat (28.8%), sheep (0.5%) and lamb (17.2%) was due to lack of interest in rearing them particularly during the recent past. Generally, these animals are reared in the highlands with extensive temperate grasslands and suitable climatic conditions. During the recent past, a large number of people (about 20%) have migrated from the highlands to the valleys and other parts of the state, and also their occupational structure has changed. This has resulted in a decrease in goat, sheep and lamb population. Milching cow and buffalo are reared at all altitudes and they have high potential to develop dairy farming. In addition, development of poultry farming along the roadsides gained momentum mainly because market is available and it gives immediate benefits. The state government initiatives to promote crossbreed milching animal and improved hens through providing subsidies to the marginal farmers have also led to increase in their population. The other reasons are high output, accessibility and availability of market since, their rearing areas lie in the valleys. As already mentioned, the number of households in the mid-altitudes and highlands has decreased due to migration and this led to a decrease in the number of indigenous milching cow. As a result, milk production has also decreased. Although growth of milching buffalo is slow, their population is large and thus milk production from them is higher.

While analysing data on production pattern, we observed that the scope of rearing crossbreed milching cow and milching buffalo is tremendous, as it earns the highest income (36.7% and 22.1% respectively). This was mainly because of the increase in population of crossbreed milching cow and buffalo in the recent past, which resulted in increase in milk production as well. An increase in income share from cow and buffalo reveals that potential of milk and products made from it is significant and can assist livelihood sustainability of people and economic development of the region. Production of wool and meat from goat and sheep showed a decrease. This was due to lack of market facilities and decrease in their population. Although wool and woollen clothes are expensive, there is no proper market available for them. Goat population decreased by 38.8%, also due to lack of market facilities.

Livestock/sq. km and livestock/capita in the districts of Uttarakhand were analysed. Average livestock density

was 81.5 livestock living/sq. km, whereas human population density was 189 persons living/sq. km. In most of the cases, we observed that districts, which had high livestock density showed less per capita livestock and vice versa. It was also observed that the mountainous districts had higher per capita livestock than those located in the plains. For example, Hardwar district had 172 livestock/sq. km, whereas per capita livestock was only 0.2. Meanwhile, Chamoli district had 45.3 livestock/sq. km and per capita livestock was 1.0. Area and human population are the two driving forces that determine livestock density and per capita livestock. Mountain districts have less human population; thus per capita livestock is high. In contrast, those in the plains have comparatively large population and as a result, per capita livestock is low. In terms of livestock density, it is high in the plains because of small area, whereas it is low in mountainous districts because of large area.

We observed that livestock farming has high potential in terms of economic sustainability. Our study shows that the Uttarakhand Himalaya has feasible climatic conditions and large forest (59.7%) and pasturelands (3.4%) – subtropical, temperate and alpine. However, arable land is limited (12.4%), which supports promotion of livestock farming, mainly of dairy animals. We need a holistic approach for sustainable livestock farming.

We can divide the districts in the hills and plains for livestock farming. Suppose the hilly districts have less arable land and more forest and grazing land, livestock farming can be developed here. Further, the highlands are suitable for rearing of grazing animals, mainly goat, sheep and lamb. Meanwhile, in the valleys, middle altitudes and the highlands, milching livestock such as crossbreed cows and buffaloes can be reared. Although forest and pastureland in the plains are less, crop residues, like paddy straw (stall feeding) can meet livestock requirement. Need-based policies and their implementation is required for sustainable development of livestock. Dairy farming and small-scale wool and meat industries can be established. Government initiatives to provide market, cold storage and processing centres for milk, wool and meat products, and financial assistance to livestock herders during adverse circumstances are noteworthy. Similarly, community participation is inevitable to promote dairy farming.

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