

Moving away from transhumance: The case of *Gaddis*[☆]

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ABSTRACT

Transhumance that involves seasonal migration of humans along with their livestock is a means of livelihood and resource management for the *Gaddi* community of the Himalaya. They have been following it for centuries but now the practice is fast declining. We, therefore, documented the current movement patterns of *Gaddis*' and the associated emerging factors that are leading to a decline in transhumance. This was done through semi-structured questionnaire recordings with the *Gaddis* ($n = 39$) in the Bharmour region which is believed to be their origin place. We find that while *Gaddis* still follow transhumance, a disinterest towards the profession is evident that is reflected in the declining number of livestock holding and movement permits. The study reveals theft of livestock enroute (~85%) and fodder scarcity (~72%) as the major limiting factors. The need of education (~49%) for children also encourages *Gaddis* to give up transhumance. During their movement, the *Gaddis* reported use of 96 plant species for fuelwood, fodder, and medicinal purposes. Thus, loss of transhumance will not only impact the age old tradition but also the associated knowledge. It is time when policies in favor of these herders are devised and implemented such that their sustainable development is ensured.

1. Introduction

Transhumance is a traditional livelihood practice that is followed by human communities in many mountainous and arid regions of the globe (Oteros-Rozas *et al.*, 2013; Bhasin 2013; Easdale and Aguiar 2018). It involves spatial and temporal movement of herders along with their livestock (Phillimore 1981) and has evolved as a strategy that maximizes seasonal utilization of resources between areas that are spatially apart for better environmental management (FAO 2001; Aryal *et al.*, 2018). It focuses on outdoor grazing of animals in natural pastures and ensures the availability of water, fodder vis-à-vis protection from harsh environmental conditions (Little and Mcpeak 2014; Ntassiou and Doukas 2019).

Transhumance is manifested in two major forms, vertical transhumance wherein the herders move from lowland winter pastures to high-altitude summer pastures, and horizontal transhumance from dry season pastures to rainy season pastures. While the latter is common in arid land areas such as Sahel (Banoïn and Jouve 2000), the former is predominant in high mountain ranges such as the Himalaya (Bhasin 2013). Both these forms vary with regards to distance covered and stay in each location (Moritz *et al.*, 2014). However, they both are guided by

predetermined routes and area-specific practices (Ntassiou and Doukas 2019). Herders' knowledge and their social networks are important factors in adopting the transhumance lifestyle to ensure a livelihood that goes far beyond the production of market goods such as meat, fiber, wool (Little and Mcpeak 2014). In addition to the traditional and cultural heritage (Oteros-Rozas *et al.*, 2013), it shapes the rural landscapes (Nori and Davies 2007) and plays an important role in guiding the ecology and economy of the region (Bhasin 2011; Moritz *et al.*, 2014). This requires deep knowledge of locations as well the availability of natural resources along the respective migratory routes (Dong *et al.*, 2011). Thus, traditional knowledge of the communities allows them to adapt to local conditions along with their livestock and ensure sustenance (Fernández-Giménez and Fillat Estaque 2012).

Despite being acknowledged worldwide; the practice of transhumance is now being reported to be at the risk because of increasing social and biophysical challenges that include market, land use transformations, and farmer-herder conflicts (Dong *et al.*, 2011; Robinson 2019; Unks *et al.*, 2019; Easdale and Aguiar 2018). State policies on forest and farming also affect the movement of transhumant communities (Bhasin 2011; Axelby 2007; Wagner 2013). Similarly, the fast-spreading weeds and the changing climate are noted to be affecting

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transhumance (Unks et al., 2019). These challenges increase the vulnerability of the transhumant communities and their livelihood. Diversifying income sources is, therefore, a key strategy to reduce vulnerability (Namgay et al., 2014; Ramprasad et al., 2020). However, it is argued to result in declining traditional knowledge of the transhumant communities that is so critical for transhumance as it not only guides their movement but also the use of natural resources on way (Dutt et al., 2015). Therefore, transhumance and traditional knowledge run hand-in-hand (Dutt et al., 2011; 2015).

Many transhumant communities such as the *Anwals*, *Bakarwals*, *Bhotiyas*, and *Gaddis* practice transhumance in the Himalaya. For hundreds of years, these communities have played a major role in managing and sustaining the pastures of the Himalaya as economically productive systems (Miller and Bedunah 1993). Even today they are dependent on livestock and continue to traverse the well-defined paths towards the pastures (McVeigh 2004; Kreutzmann 2012a). Amongst the transhumant communities of the Himalaya, *Gaddis* are common in Himachal Pradesh (HP). They rear sheep and goats and follow migration north and south of the Dhauladhar mountain range (Phillimore 1981; Tucker 1986; Saberwal, 1999). *Gaddis* are knowledgeable on ecosystems, the spatial distribution of resources, access to resources, and the use of resources (Bhasin 2013). During movement, they treat their livestock as well as themselves based on their traditional knowledge on the use of resources (Thakur et al., 2016; Thakur et al., 2020). Besides this, they hold knowledge of fodder and fuelwood species (Ramprasad et al., 2020).

Migration patterns of *Gaddis* have been previously documented by many workers (Farooque 1998; Banjade and Paundel 2009; Manzano-Baena and Casas 2010). It has been reported to be undergoing transformations and non-transhumance activities such as agriculture, livelihood based on education such as government jobs, and private sectors, etc. are taking prominence (Ramprasad et al., 2020). Recent studies have indeed noted that maintaining the profession has become challenging (Namgay et al., 2014; Aryal et al., 2018; Ramprasad et al., 2020).

Herein, the knowledge of the community plays an important role in guiding transhumance and enabling them to adapt to changes (Berkes et al., 2003; Fernández-Giménez and Fillat Estaque 2012). Hence, identifying the underlying factors mediating changes in transhumance, and the traditional knowledge of pastoralists is of global importance (Fernández-Giménez and Fillat Estaque 2012; Osteros-Rozas et al., 2013; Pandey et al., 2017). Recognizing this, the present study was carried out with the following objectives: i) to document the seasonal migration trends of *Gaddis*, ii) to identify risk factors that are affecting changes in their profession, and iii) to study the various plant resources used by them on their migration routes.

2. Methods

2.1. Bharmour-the study area

The present study was conducted in the Bharmour region of Chamba, HP in India. Bharmour that lies between 76° 20' 0" and N 76° 52' 30" to 32° 11' 0" and 32° 36' 00" covers an area of ~1800 sq. km. The climate of the area is characterized by three main seasons: the cool winter (December–March), the warm summers (May–June), and a wet rainy season (July – mid–September). April represents spring while October–November are autumn months. The rainy season accounts for almost three-quarters of the average annual rainfall that Bharmour receives (1265 mm). On the other hand, the mean annual temperature varies between 3 °C and 30 °C (Thakur et al., 2014). River Ravi forms the lifeline of the communities as it traverses through the area. The area is hilly and therefore less suitable for intensive cropping. However, traditional crops such as “kodra” (*Paspalum scrobiculatum*), “chinay” (*Panicum miliaceum*), and “bharace” (*Fagopyrum esculentum*) which were once cultivated have given way to cash crops and apple orchards. The

cultivation of barley has also seen a downfall (Jaglan 2006). These traditional crops are argued to be nutritious and climate-resilient, they provide food security to these communities (Slariya 2014). Coming up of cash crops would certainly change the agroecology of the area and the resident communities.

2.2.1. Gaddis-the tribe

Gaddis are transhumant sheep and goat herders that derive their name from *Gadderan*, the Bharmour region of HP (Singh 1994). They own permanent houses in Bharmour and practice farming too. While the males migrate, their family stays at their permanent settlements and manages agriculture (Kaushal 2001). The importance of livestock in their life is reflected by the fact that they call it “*Dhan*” meaning money. It is primarily because of the economic benefits they derive from the sale of livestock (for meat), wool, and other products (Acharya, 1982). To sustain these, they migrate to and fro the mountain passes in search of greener pastures (Fig. 1). In winter, the *Gaddis* move to lower altitudes while in summers they camp in high altitude pastures along with their flocks (Bhasin and Bhasin, 1993). As *Gaddis* continually use the same trek across years, their knowledge of trek and the available resources is immense. From treating livestock ailments to self-care, they often use the available resources (Verma 1996; Singh and Kumar 2000). Their knowledge of wool, dyes and their processing is also noteworthy (Thakur et al., 2016; Sharma and Uniyal 2018).

2.2. Data collection

Data were collected from primary and secondary sources from April 2019 to March 2020. For primary data collection, field surveys were conducted to the high-altitude areas of Bharmour and one-to-one semi-structured interviews were held with 39 *Gaddi* respondents in the alpine areas (Fig. 2). As opposed to lower altitudes, *Gaddis* have relatively more free time in the alpine areas due to ease of fodder availability and fewer efforts towards guarding their livestock. Therefore, interactions here are expected to be more intense and fruitful. The random sampling technique was used to select the shepherds and all the *Gaddis* agreed to participate in the study. Before information collection, the respondents were apprised of the study objectives and their informed consent was obtained. The interviews were conducted in a local dialect using the questionnaire (Martin 1995). The semi-structured questionnaire was field-tested and then subjected to the final recording of the data. The questionnaire was structured into two parts (Annexure 1, Supplementary table). The first part included personal information of the respondent i.e., name, age, address, duration since in herding (years). It also included information on the summer and winter grazing grounds and the distance they travel. The second part of the questionnaire focussed on eliciting information on the current status of transhumance and changes therein. We recorded the factors impacting transhumance and later classified them into four broad categories namely environmental (related to changing environment and resource availability) social (related to sociocultural factors such as education, hardship, etc.), human wild-life conflict (livestock depredation, casualties, it also included theft of livestock, etc.) and habitat changes (spread of invasive species, forest loss, etc.). The traditional knowledge of these herders on the plant species used as fuelwood, fodder, and for medicinal purposes was also recorded.

In addition to primary information, secondary information was collected by interacting with the personnel of the State Forest Department, HP. It involved noting information on the number of grazing permits issued every year, the number of sheep and goats permitted to graze, and livestock grazing fees. This helped in validating the information collected during the primary interviews.

3. Results

The information was recorded by interacting with *Gaddi* men as they



Fig. 1. Gaddis grazing their Dhan in alpine areas.



Fig. 2. Field interactions with the Gaddis.

are the ones who migrate while the women stay at home and help in farming. The age of the informants ranged between 31 to 75 years and they had been in this profession for a minimum of four years (Table S1). It was revealed that all of them also have permanent houses in the Kangra district of HP where they spend some time during their up and downhill migration.

3.1. Seasonal migration

The *Gaddis* have well-defined routes that they follow during movement. These migration routes are earmarked and monitored by the forest department. During winters (December to February) they camp in the Shivalik foothills at altitudes close to 300 m amsl where their livestock

grazes and browses on the vegetation in the tropical broadleaved forests (Fig. 3). These areas are called *Jandar*. During the summer and rainy season (July to September), *Gaddis* camp in the alpine meadows, locally called *dhars*, at around 4000 amsl where their livestock forages on herbs, forbs, and graminoids. The *dhars* are assigned to an individual *Gaddi* or a group of *Gaddis* and they strictly have to adhere to grazing their livestock in their respective *dhars*. Their uphill journey towards *dhars* starts during March and is guided by the increasing temperatures in the lowlands while their downhill journey begins during September when the growing season for plants ends and the chill starts to set in (Table 1). During their to-and-fro movement, they camp near to their permanent houses (during March while on an upward journey; and during November on their downward journey) while their livestock is kept in

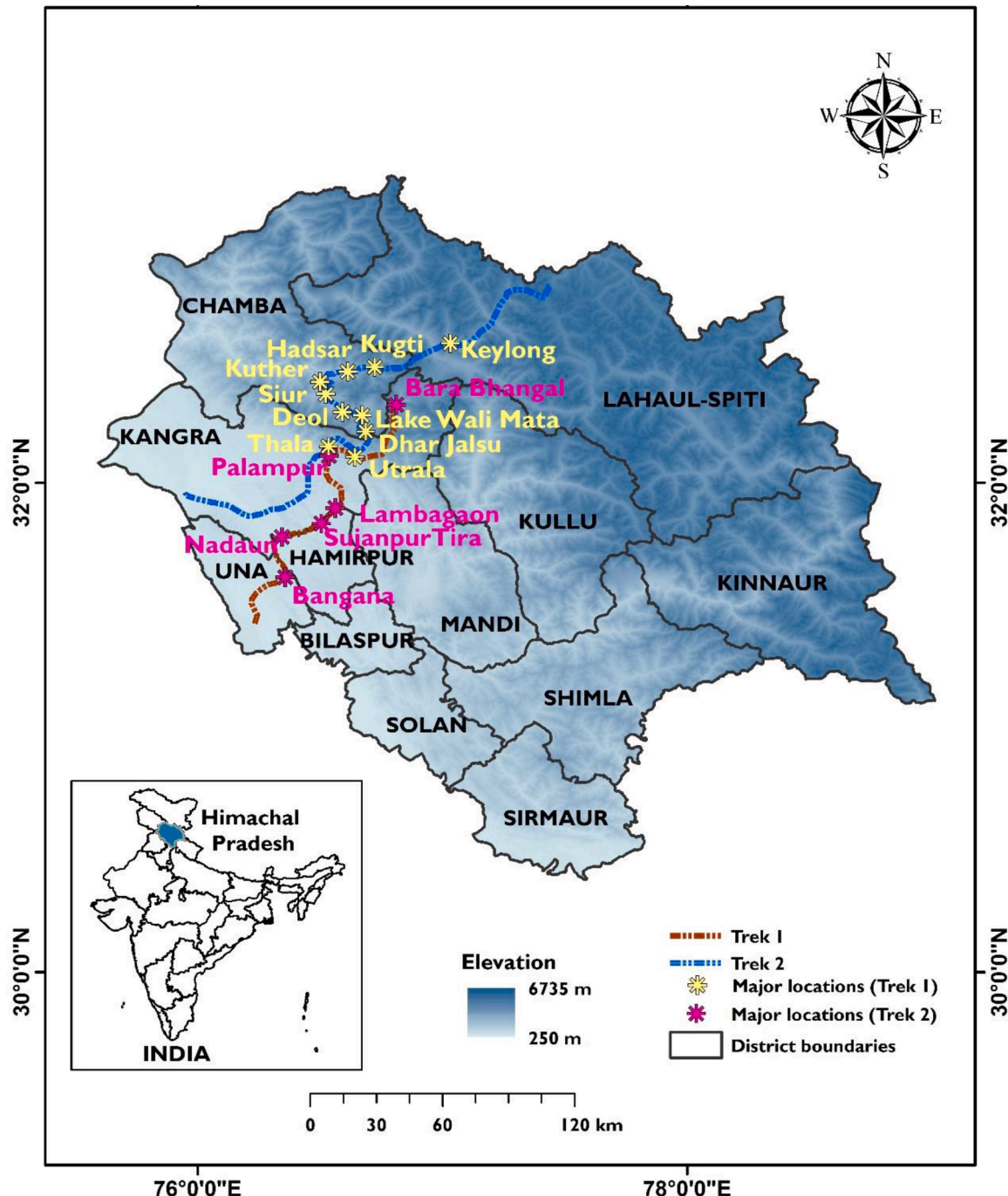


Fig. 3. Two commonly used migratory routes of the *Gaddis* (Source Ramprasad et al., 2020).

Table 1
Seasonal activity calendar of the *Gaddis*.

Months	December-February	March	Mid-March –April	May- mid June	Mid-June-Late June	July – Mid-September	Mid-September-October	October–Mid November	Late November-December
Activity	Grazing in Shivalik foothills.	Initiation of upward journey.	Traverse through lower valleys & camp close to their permanent villages. Shearing of wool.	Traverse through temperate & subalpine forests and camp in southern slopes of Dhauladhar.	Crossing of passes.	Camping in high altitude meadows.	Initiation of downhill journey.	Traverse through valleys & camp close to their permanent villages. Shearing of wool.	Towards winter grazing grounds.
Problems	Limited fodder availability in winter grazing grounds. Theft & attacks.	Migration through human landscape. Conflicts. Limited fodder.	Wildlife conflicts. Limited fodder.	Wildlife conflicts.	Uncertainty.	Livestock depredation.	Uncertainty.	Wildlife conflicts. Limited fodder.	Migration through human landscape. Conflicts.

the adjoining forests. Their permanent settlements are located in between and close to the migration routes. This is also the time when wool shearing is done. Thus, shearing is done twice a year, one before their uphill movement and then before their downhill movement (Fig. S1). Wool production per animal ranges between 2–3 kg that is sold at a rate of Rs. 40–70/kg. Further, almost 10–20% of their livestock is sold each year for meat. On average, 49 ± 6.9 days are taken by the *Gaddis* for a one-way movement that involves covering a distance of about ~400 km. During migration, movement through populated areas is a challenge that they tide by often moving in late hours.

In this way, *Gaddis* use four types of lands during their movements i. e. Forests, High altitude pastures, villages areas, and private lands. Fig. 3 shows the two most commonly used migratory routes traversed by the *Gaddis*. To access pastures and graze their livestock the *Gaddis* pay a fee of 50 paisa/ goat/ annum and 20 paisa/ sheep/ annum to the State Forest Department, HP. They then get a grazing permit from the forest department. Every herder has a permit given by the forest department that enables them to access fodder resources during migration and camping. However, *Gaddis* are now settling in villages and gaining alternate employment as daily wage labourers, army men, teachers, etc.

Sedation in lifestyle reduces mobility.

3.2. Recent trends

The population of the sheep and goats reared by the *Gaddis* is now declining. All of the respondents unequivocally stated that now people do not prefer entering this profession. Analysis of permits issued by the State Forest Department, HP for the Tirni area revealed a significant declining trend in both the number of livestock and the permit holders after 1982–83. As opposed to 60–70 permits issued during the early eighties, only 10–20 permits were issued during this decade (Fig. 4). A permit is an official document issued by the Government in the name of individual *Gaddi*. It has their name, the number of livestock (sheep and goat), the amount realized by the forest department as grazing fee per livestock, and the forest range where the *Gaddi* is authorized to graze his livestock (Fig. S2). Alike permits, the number of livestock that *Gaddis* own is also witnessing a downfall. Both sheep and goats reared by the herders are plummeting. While during the eighties the livestock numbers mentioned in the permits are between 3500 and 4000 for sheep and between 2000 and 2500 for goats, the same has also shown a

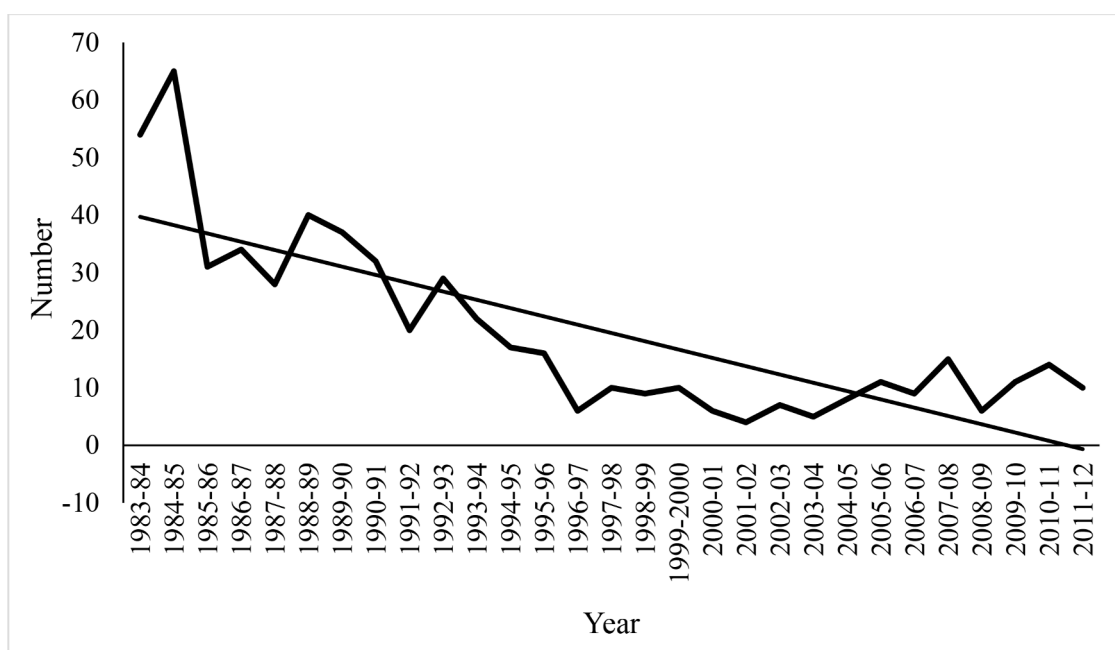


Fig. 4. Trends in number of permits being issued (Source: State Forest Department).

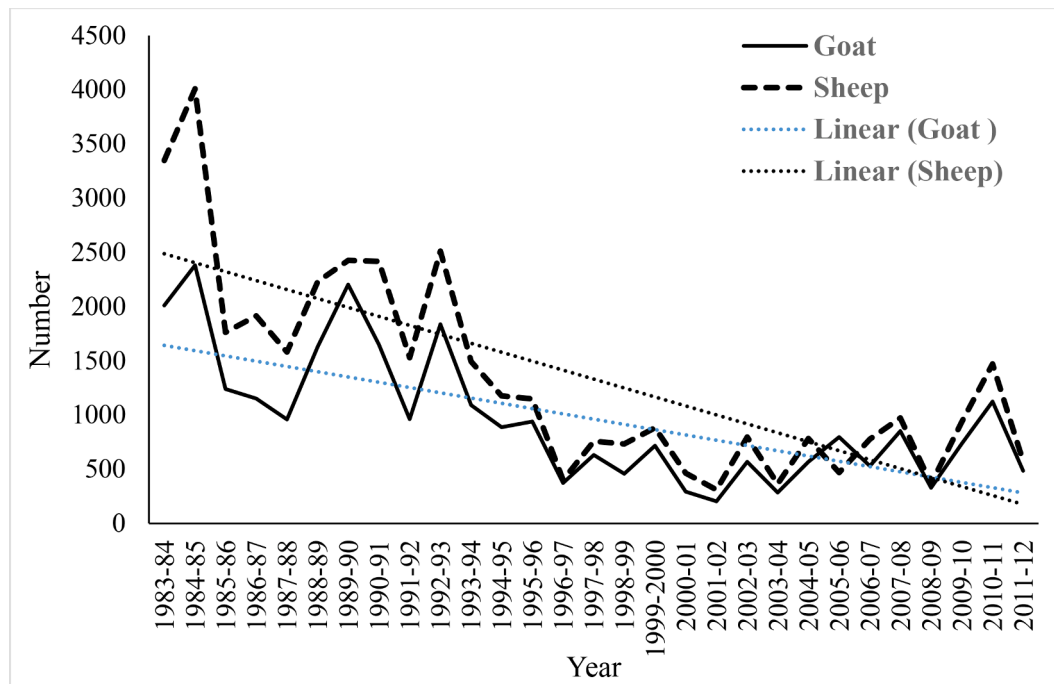


Fig. 5. Temporal patterns in number of goat and sheep (Source: State Forest Department).

declining trend (between 1000 and 2000, sheep and goats combined) during the recent years (Fig. 5). The range-wise data is available till 2012 as in the consequent years permits to *Gaddis* could be issued by any forest division of HP for their movement anywhere in HP. Earlier, permits were issued by the respective forest division. At times, to save money, the actual number of livestock is not revealed by the *Gaddis* to the forest authorities and hence the number of livestock grazing in the forests may be higher than that mentioned in the permit.

3.3. Risk Factors

The respondents identified a total of twelve factors placed in four categories that have a bearing on transhumance (Table 2). Of these twelve factors, four each related to the environmental and social categories while two each to the human-wildlife conflict and habitat changes.

Human-wildlife conflict: As revealed by the respondents, theft of the livestock and attacks by wild animals were the major risk factors that fall under this category. The theft was reported by the majority of the respondents ($n = 33$, ~85%) followed by the wild animal conflict ($n = 20$ ~51%). The *Gaddis* reported that criminals come with guns and in vehicles, they threaten them of dire consequences and loot away their livestock for the sake of economic benefits. Owing to this, transhumance

Table 2
Factors affecting transhumance.

Categories	Factors	Number of respondents (%)
Human-wildlife conflict	Theft	33 (84.62%)
	Wild animal conflict	20 (51.28%)
Environmental	Fodder scarcity	28 (71.79%)
	Changing environment	4 (10.26%)
	Lesser water availability	2 (5.13%)
	Diseases	2 (5.13%)
Social	Education	19 (48.72%)
	Younger disinterest	9 (23.08%)
	Lack of manpower	5 (12.82%)
	Hardships	3 (7.69%)
Habitat changes	Less forest	11 (28.21%)
	Invasive species	9 (23.08%)

is now becoming risky and life-threatening. The respondents categorically mentioned that it is for the sake of the livestock and livelihood that they migrate, if livestock is looted and life is threatened then they have no reason to pursue this profession. On the other hand, wild animal conflicts are also increasing particularly attacks by bears and leopards and an associated depredation of livestock.

Environmental: This category comprises four factors namely fodder scarcity, changing environmental conditions, reduced water availability and preponderance of diseases that were put forth by the respondents. Here, the highest number of responses were for fodder scarcity ($n = 28$, ~72%) followed by changes in the environmental conditions ($n = 4$, ~10%). The least responses were for the reduced water availability and increased disease incidences ($n = 2$ each, ~ 5%). According to the *Gaddis*, they now feel scarcity of fodder especially at lower altitudes and on migration routes. In the high altitude pastures, they now camp for a shorter duration at one single place and rotate camping grounds as compared to earlier times. They cite these as repercussions of changing the environment. Changing environmental conditions was also cited by the *Gaddis* as a factor directly affecting transhumance. The herders pointed that temperatures are now increasing while the snowfall is decreasing. These changing environmental conditions force changes in their migration timings and at times result in the mortality of livestock. Further, the increased frequency of natural disasters such as landslides, heavy downpours adds to the losses and challenges. Another factor in this category was the reduced availability of water. Most of the natural resources of the water are drying up. Therefore, *Gaddis* have to travel longer distances for alternative sources of water. All these add up to the health of the livestock as well as the herders. Unavailability of the health facilities at the high alpine areas makes them even more vulnerable to disease. While *Gaddis* are knowledgeable and able to treat common diseases using natural resources, emergencies become fatal.

Social: In this category, formal school education of the younger generation was the majorly reported factor ($n = 19$, ~49%). Now people understand the importance of education and wish to provide the best of it to their children. The disinterest of the younger generation ($n = 9$, ~23%) towards transhumance was the second most reported factor under this category. The *Gaddis* pointed out that their children are hesitant to adopt transhumance. Lack of manpower was another risk

factor indicated by the respondents ($n = 5$, ~13%). The unavailability of the younger generation as they either attend their schools or are pursuing other professions results in a lack of manpower. Hardship in the profession was also a factor reported by the *Gaddis* ($n = 3$, ~8%). According to them, the profession is very challenging as they are cut off from their families, and the rest of the world. They need to cook their food, treat their sickness through herbs, bear vagaries of nature, and yet be available to the livestock at all times.

Habitat: Under this category, the decreasing forest was reported as a factor by eleven respondents (~28%). Deforestation as reported by many *Gaddis* affects their paths and fodder availability. At the same time, habitat alteration by species especially Phulunu (*Lantana camara*) and Kala-basunti (*Eupatorium adenophorum*) was categorically mentioned as a risk factor ($n = 9$, ~23%).

3.4. Resource use

During their migration, the *Gaddis* use plant species as fuelwood for cooking and to keep themselves warm, fodder for their livestock, and as medicine for primary health care. Hence they are knowledgeable in terms of different resource use. A total of 95 plant species were reported to be commonly used by them (Table 3). Of the total, 40 species were used as fuelwood, 50 species as fodder, and 38 for medicinal purposes. Multiple utilities of *Aesculus indica*, *Juglans regia*, etc. were noted while species such as *Abies pindrow* and *Betula utilis* were used as fuelwood only. Species including *Aconitum heterophyllum* and *Ajuga parviflora* were used for medicinal purposes only while *Carex nubigena* and *Festuca nubra* alongwith others were used as fodder only (Table 3).

4. Discussion

“The *Gaddis*’ transhumance system has gone on for centuries and will continue so long as it is profitable; this involves hard work, seasonal separation from the family, and an uncertain future” (Dev et al., 2003). The *Gaddis* now feel that access to alpine pastures during transhumance is not that smooth as it was in the past and is often associated with conflicts and heavy losses, and the hardship and separation from family are not so remunerative now. A decrease in the number of permits being issued by the State Forest Department and the population of sheep and goats is indicative of the declining status of transhumance (Figs. 4 and 5). This thereby modulates a shift towards alternate sources of income. How this change will affect their socio-economics and the associated ecosystems will be visible in the due course of time.

Through the study various factors that make the profession challenging could be identified wherein theft of livestock was prime. This had not been a serious issue for the community earlier (Namgay et al., 2013; Oteros-Rozas et al., 2013). However, with changing times, it has gained prominence and is now a major deterrent to practicing transhumance. The livestock is mostly looted by the robbers when the *Gaddis* are on their way or camping at night in the lowland areas. As opposed to *Gaddis*’ camping in the alpine areas, camping in low altitudes is much more problematic for them because of the increasing incidences of livestock thefts. The network of roads in the lowland areas makes it easy for looters to rob the *Gaddis* of their *dhan* and carry them on vehicles. On the other hand, access to alpine areas requires trekking. Thus, livestock thefts are prominent in lowlands areas. Taking cognizance of the fact, the State government has directed the Police to ensure the safety of the migrants and take serious actions against the culprits (<https://www.hindustantimes.com>).

Additionally, signs of resource competition between wildlife and traditional pastoralism are visible in the Himalaya (Rao et al., 2000) as has been noted in Africa (Prins 1992). Human-wildlife conflicts have increased with considerable impact on the livelihood of the transhumant communities owing to damage and losses of their livestock (Wang et al., 2006a, (Wang et al., 2006b); Rosen et al., 2012). Similar observations of attacks by wild animals have also been reported in other studies on

Table 3

Different plants cited and used as a fuelwood, fodder and medicinal purpose.

Plant species	Fuelwood	Fodder	Medicine
<i>Abies pindrow</i>	+		
<i>Achyranthes bidentata</i>			+
<i>Aconitum heterophyllum</i>			+
<i>Aconogonum molle</i>		+	
<i>Aesculus indica</i>	+	+	
<i>Ajuga parviflora</i>			+
<i>Alnus nepalensis</i>	+	+	
<i>Anemone tetrasepala</i>			+
<i>Angelica glauca</i>			+
<i>Arnebia benthamii</i>			+
<i>Artemisia dracunculoides</i>			+
<i>Asparagus racemosus</i>			+
<i>Berberis aristata</i>	+	+	+
<i>Berberis lycium</i>	+	+	
<i>Bergenia ciliata</i>			+
<i>Betula utilis</i>	+		
<i>Boschniakia himalaica</i>			+
<i>Cannabis sativa</i>			+
<i>Carex nubigena</i>		+	
<i>Cedrus deodara</i>	+		
<i>Celtis australis</i>	+	+	
<i>Chrysopogon gryllus</i>		+	
<i>Cirsium wallichii</i>			+
<i>Cotoneaster bacillaris</i>	+	+	
<i>Cotoneaster microphyllum</i>		+	
<i>Cynoglossum lanceolatum</i>			+
<i>Cynodon dactylon</i>		+	
<i>Dactylus glomerata</i>		+	
<i>Dactylorhiza hatagirea</i>			+
<i>Daphne mucronata</i>			+
<i>Desmodium elegans</i>	+	+	
<i>Fagopyrum esculentum</i>		+	
<i>Festuca rubra</i>		+	
<i>Geranium wallichianum</i>			+
<i>Heracleum candicans</i>			+
<i>Hordeum vulgare</i>		+	
<i>Impatiens sulcata</i>			+
<i>Indigofera heterantha</i>	+	+	
<i>Juglans regia</i>	+	+	
<i>Lonicera quinquelocularis</i>		+	
<i>Malus domestica</i>	+	+	
<i>Mentha longifolia</i>			+
<i>Morus serrata</i>	+	+	
<i>Olea cuspidata</i>	+		
<i>Origanum vulgare</i>		+	+
<i>Oxyria digyna</i>		+	
<i>Parrotia jacquemontiana</i>	+	+	
<i>Phaseolus vulgaris</i>		+	
<i>Picea smithiana</i>	+		
<i>Picrorhiza kurrooa</i>			+
<i>Pinus roxburghii</i>	+		
<i>Pinus wallichiana</i>	+		+
<i>Plantago ovata</i>			+
<i>Poa alpina</i>		+	
<i>Poa annua</i>		+	
<i>Polygonum amplexicaule</i>		+	
<i>Polygonum polystachyum</i>		+	
<i>Populus ciliata</i>	+	+	
<i>Prinsepia utilis</i>	+		+
<i>Prunus armeniaca</i>	+	+	
<i>Prunus persica</i>	+	+	
<i>Pyrus pashia</i>	+	+	
<i>Pyrus communis</i>	+		
<i>Quercus dilatata</i>	+	+	
<i>Quercus leucotrichophora</i>	+	+	
<i>Quercus floribunda</i>	+	+	
<i>Quercus semecarpifolia</i>	+	+	
<i>Rabdostia rugosus</i>			+
<i>Rhododendron arboreum</i>	+		
<i>Rhododendron campanulatum</i>	+		+
<i>Robinia pseudoacacia</i>	+	+	
<i>Rubia cordifolia</i>			+
<i>Rumex nepalensis</i>		+	+
<i>Salix disperma</i>	+	+	

(continued on next page)

Table 3 (continued)

Plant species	Fuelwood	Fodder	Medicine
<i>Salix fragilis</i>	+	+	
<i>Saussurea costus</i>			+
<i>Scrophularia himalensis</i>			+
<i>Silene vulgaris</i>		+	
<i>Skimmia laureola</i>			+
<i>Solanum nigrum</i>			+
<i>Solena heterophylla</i>			+
<i>Sorbaria tomentosa</i>	+	+	
<i>Spiraea canescens</i>	+	+	
<i>Stellaria media</i>		+	
<i>Stipa concinna</i>	+		
<i>Taxus baccata</i>	+		
<i>Themeda anathera</i>		+	
<i>Thymus serpyllum</i>			+
<i>Triticum aestivum</i>		+	
<i>Ulmus wallichiana</i>	+	+	
<i>Urtica dioica</i>			+
<i>Urtica parviflora</i>			+
<i>Viburnum cotinifolium</i>		+	
<i>Viburnum cylindricum</i>	+	+	
<i>Viola pilosa</i>			+

Gaddis (Namgay et al., 2013) and other areas of HP. A recent study reported that on average a *Gaddi* household with a livestock strength of 250 annually earns between INR 250,000 to INR 300,000 (Ramprasad et al., 2020). Therefore, increased livestock losses are a matter of grave concern. The *Gaddis* feel that after facing all the hardships, all goes in vain and leaves them at crossroads.

Also, the scarcity of fodder on their migration routes is making the profession very challenging. The herders relate the scarcity of fodder to environmental changes and the expanse of invasive species. A recent study in HP showed that almost 14% of the Flora of HP comprised of alien species and that they are fast spreading (Jaryan et al., 2013). The non-availability of fodder species impacts livestock growth and health (Cruz et al., 2007). The socio-ecological implications of species such as *Lantana* sp. and *Parthenium* are well known (Kohli et al., 2004; Sundaram and Hiremath 2012). It should be noted that the non-availability of quality fodder during the winter months is a major constraint for *Gaddis* (Bahru et al., 2014). This is further aggravated by the spread of invasive species. The declining resources and their limited availability often results in conflicts between local people and transhumant communities (Axelby 2007; Easdale and Aguiar 2018). Sometimes transhumant communities face problems while passing through common lands (Negi 1998; Schilling et al., 2012; Turner et al., 2014). Fodder scarcity promotes the selling of livestock so that a lesser number of livestock can be managed using limited resources. Declining livestock numbers in a herd due to fodder scarcity and coming up of other options have also been reported from other Himalayan states (Anonymous, 1995; Nautiyal et al., 2003) and from across the globe (Callahan 2012; Kreutzmann 2012b). Further, owing to environmental changes, the production systems are changing which has a negative impact on transhumance. Changing environmental conditions is a major concern in the Himalaya because of its potential impact on socio-economics and vegetation dynamics in the rangelands (Liu and Rasul 2007; Zhong et al., 2010). The *Gaddis* feel that changing the environment is not only affecting their movement patterns but also the productivity of meadows and animal health. The timing of the rainfall, grass production, persistence and melting of the snow, and availability of water near grazing areas is highly affected by climatic changes (Aryal et al., 2016). Community perception of early onset of summers, rapid melting of snow, and unpredicted precipitation in the Dhauladhar mountains, where the *Gaddis* camp, are now validated (Sharma et al., 2020). The *Gaddis* also indicated lesser water availability in the traditional streams and sources which forces them to fetch water from long distances and also to shift camps in new locations. This is done so that the herds do not suffer. Changing environmental conditions not only alters the seasonal

migration patterns (Macchi 2011) but also result in casualties and heavy economic losses. *Gaddis* incurred heavy losses owing to the mortality of more than 3500 sheep and goats while crossing the Dhauladhar mountains in 2005 (Uniyal et al., 2005). News of migratory communities getting trapped in inclement weather are now common (Anonymous 2010; Feroze et al., 2019; Mishra and Pandey 2019) and increase their vulnerability. Globally also, environmental changes are leading to increased livestock disease incidences (Bett et al., 2017; Caminade et al., 2019).

The importance of education and its future prospects in terms of job opportunities especially among the pastoral communities is now well recognized (Namgail et al., 2007; Namgay et al., 2013). Always on-move hampers school education, as children are not able to regularly attend classes. Education brings about several socioeconomic and ecological changes (Mishra 2000; Mishra et al., 2003; Singh et al., 2015) that limit seasonal migration of the pastoral families (Hoon 1996; Hoffman and Rohde 2007). The younger generation is increasingly choosing a sedentary lifestyle, preferring private land over communal ownership and competing for Government jobs (Lesorogol 2003). Education and a life less threatened is what the *Gaddis* now aspire for. This is also reflected in the high response given by the *Gaddis* in favour of these factors (Table 2). The new generation of *Gaddis* is better aware of the advanced technologies and alternate means of higher earnings as against transhumance (Singh et al., 2015). In the Johaar valley of Uttarakhand, as a result of the stoppage of migratory trade with Tibet and opportunities for government jobs [because of their Schedule Tribe (ST) status and reservation of jobs for ST candidates], reduction of 96% in the transhumant household of *Bhotiyas* has been reported since 1961 (Negi 2007). Schedule Tribe is a term applied to Indigenous people who are regarded as socially disadvantaged as detailed in article 342 of the Constitution of India. They are provided reservations in Government jobs and also in higher Institutes of education (Louis 2003). It is worthwhile to mention here that ST status is also available to *Gaddis* and so the interest in government jobs is fast catching up. Many studies have noted a shift from transhumance to other work areas amongst the children of transhumant societies (Farooque 1998; Namgail et al., 2007). This leads to a lack of manpower in this profession (Namgay et al., 2013). A large herd requires more members for herding, which now are hard to get. Also, the herders reported that more families are now nuclear and smaller in size. This trend also contributes to the reduced availability of manpower at the household level making it difficult for individual households to conduct transhumance to an extent that some families have now left it.

Already a preference for a settled lifestyle is evident amongst the *Gaddi* youths. The Village Patti in tehsil Palampur, Kangra (HP) has permanent settlements of the *Gaddis* most of whom have migrated from Chamba. Coming up of their permanent settlements in Kangra and Bilaspur districts of HP is noteworthy. *Gaddis* who have settled down, and have taken to farming & other services maintain livestock for generating extra money. Now the well-off *Gaddis* do not migrate from one place to other themselves, rather they hire persons to rear their livestock (Phillimore, 1981). Pastoralists with limited capital are heavily dependent on natural resources, they are often forced to abandon their livelihood in the face of such challenges resulting in further marginalization (Nori and Davies, 2007). In HP, the goat population reported a compound annual growth rate of -0.29% between 1997 and 2012, the same was -1.90% for sheep (Dogra et al., 2018). Also, a decline in sheep and goat populations in HP from 11,10,062 and 11,19,491, respectively in 2014 (Ministry of Agriculture Department of Animal Husbandry, Dairying and Fisheries 2014) to 8, 64, 4166 (sheep) and 11,08,413 (goats) in 2019 has been reported in HP (Ministry of Agriculture Department of Animal Husbandry, Dairying and Fisheries 2019).

The higher number of sheep and goats possessed by the *Gaddis* was once a symbol of prosperity however, this no longer holds true (Dangwal 2009). Thus, *Gaddi* people are moving away from transhumance. The nomadic lifestyle creates a dependency on natural

resources (Dutt et al., 2015) which also seems to be decreasing. In the words of Verma (1996) “It is a loss of enormous treasure trove of wisdom and our cultural heritage”. We reported use of the 95 plant species by the *Gaddis* as fuelwood, fodder, and for the medicinal purpose which is lower as compared to earlier estimates (Singh and Kaushal 2000). As the transhumance communities face various challenges, their changing lifestyle will also hamper the traditional knowledge and its future prospects.

5. Conclusions

The *Gaddis* are an important component of the rich cultural heritage of the western Himalaya. They seasonally migrate between lower and higher altitudes to ensure resource availability for livestock, which are their prime means of livelihood. However, they are now facing multiple challenges during their seasonal migration and, therefore, the transhumance practice of *Gaddis* is seeing a shift towards a settled lifestyle. Theft of livestock on way was a major risk factor cited by them. Their security, therefore, becomes prime, the Government has initiated steps in this direction and that is a welcome step. It is fodder for livestock that motivates the spatial migration of the community. Herein the spread of invasive species was revealed to be a key risk factor that limits forage resources for the *Gaddi* livestock. Therefore, effective forest management for curbing the spread of invasive species is of utmost importance. The vast field knowledge of the *Gaddis* on the resources, their distribution, and uses may be helpful in such a management exercise. The natural calamities due to the changing environment were also highlighted by the *Gaddis*. It is pertinent to mention that the incidences of *Gaddis* being trapped in erratic weather are fast emerging and so are the casualties to their livestock. These factors put an economic burden on the *Gaddis*. Setting up helplines for the *Gaddis* will build confidence and also help in minimizing losses. Losing a traditional lifestyle will have serious implications on traditional wisdom, economy, livelihood, and the environment. Therefore, there is a need for policies in favour of the *Gaddis* that target livelihood-associated pastoralism. These are of utmost importance for revitalizing transhumance and the associated folk knowledge.

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Supplementary materials

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