





The future of mountain agriculture amidst continual farm-exit, livelihood diversification and outmigration in the Central Himalayan villages

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Abstract: Agrarian patterns in mountain ecosystems have seen a considerable change in the past decades with a vast proportion of the population abandoning traditional agriculture and diversifying their livelihood options, primarily through out-migration. This trend is especially common amongst the subsistence based family-farming communities in developing countries. This study aims at assessing methods of livelihood diversification and factors influencing farm-exit in Central Himalayan villages of Uttarakhand, India, while trying to understand local perspectives on challenges in pursuing agriculture as a viable livelihood option. We collected qualitative and quantitative data from 951 households across 60 villages evenly distributed across six hill districts of Uttarakhand, using key-person interviews and household surveys. The results of the study highlight that farm-exit is significantly influenced by livelihood diversification, number of migrants, number of female family members, and availability of irrigation facilities. In general, perception of the respondents towards agriculture as a viable livelihood option is rather unenthusiastic, with 87% of the respondents citing human wildlife conflict as the main challenge in

pursuing farming, amongst several other challenges. Diversification is an integral component of present rural economy with 80.13% of the total population dependent on more than one source of income, to maintain their livelihoods. However, there is no statistically significant influence of livelihood diversification on annual income of the household. If agro-based entrepreneurial ventures are to be promoted in the region there is an urgent need for timely introduction of radical policy, institutional, and land-reforms. Economic uplifting of the local population through such efforts can also be a possible solution to the growing trends of out-migration in the state.

Keywords: Agriculture; Diversification; Rural livelihoods; Migration; Himalaya

Introduction

Agriculture is often cited as the most important contributor to rural livelihood in developing countries around the world (Aggarwal 2018), including the Himalayan region of India (Joshi 2017; Tulachan 2001). However with increasing population, marginalization of farm

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holdings, and climatic irregularities, the profitability of small-scale mountain agriculture is questionable (Awokuse and Xie 2015; Shukla et al. 2016, 2018; Tulachan 2001). There is an urgent need to re-evaluate the contribution of mountain agriculture to rural livelihoods in the light of contemporary economic and developmental settings, which challenge the relevance of agriculture as a tool for economic development (Awokuse and Xie 2015). While classical economic theories project increasing agricultural productivity as the first step towards boosting the economy of a developing country (Byerlee et al. 2005) in the present world economic scenario it has been observed that with economic growth of a nation there is a gradual decline in its agricultural sector (Byerlee et al. 2005; Timmer 2002; van Arendonk 2015). This transition is often accompanied by a conspicuous shift in occupations from farm to non-farm sectors. In rapidly developing economies, such as Central and South-East Asia, the once agriculturally inclined rural households are now moving towards non-farm activities for supporting their livelihoods, which are often supplemented by income from migrant remittances (Byerlee et al. 2005; Chen et al. 2018; Mishra 2017; Xu et al. 2015). This movement from farm to non-farm sector is specially conspicuous amongst small scale subsistence farmers and farm-based labourers, who are most vulnerable to both transitory and structural environmental and institutional stresses, which can result in crop failure and reduction in crop productivity below subsistence levels (Chapagain and Gentle 2015; Gautam and Andersen 2016). The extent and impact of such environmental and economic vulnerabilities is even more pronounced amongst mountain farming communities which practice small scale agriculture on terraced, fragmented farm lands.

Many rural households in mountainous terrains use 'livelihood diversification', i.e., creating a variety of income sources as a risk management strategy to survive and improve ones' standard of living, as a strategy to deal with economic uncertainties (Gautam and Andersen 2016; Kassie et al. 2017). A mixture of farm and off-farm activities are often used by the rural populations to manage economic risks, especially in low-return, subsistence based marginal farming population (Bryceson 2002; Kassie et al. 2017). An

example of such a rural economy is that of Uttarakhand, a hill state located in the Central Himalayan region of India. Agricultural production in the region was once enough to not only ensure household food security but surplus produce was sold to the market, therefore acting as an important informal contributor to the household economy. However, at present agriculture in this hill region, is being practiced on a much smaller scale, with households not being able to fulfil even their own requirements, let alone selling their harvests in the market. According to the recent economic survey released by the Directorate of Economics and Statistics - Uttarakhand, the contribution of primary sector (i.e., agriculture and allied services) to the state GDP has dropped from 14% in the financial year 2011-2012 to approximately 10% in the year 2017-2018 (GoU 2018). The dismal state of mountain agricultural can be gauged from the fact that only 13% of the total hill agricultural area is currently irrigated in the state (DES 2018). The contribution of crop sector to the GSDP (Gross State Domestic Product) is also on a constant decline, from 7.08% in the financial years 2011-2012 to a mere 4.56% in 2017-2018 (DES 2018).

There are a number of reasons for this decline in agricultural productivity, some of the more pronounced of which include, decrease in per capita land holding with increasing population, unpredictable rainfall patterns, lack of irrigation facilities, human wildlife conflict specially with reference to monkeys and wild boars, and general disinterest in agriculture among the educated youth (Bhandari 2014; Bhandari and Chinappa-Reddy 2015; GoU 2018; Mamgain and Reddy 2017). With these challenges in the agricultural sector and the declining interest of rural youth in agriculture, is small scale agriculture practiced in the hills still a relevant and viable source of livelihood? The study explores this dilemma by answering three research questions: a) How important is agriculture as a livelihood source for the current population? b) What factors influence the tendency of a household to abandon farming? and c) What are the challenges faced by mountain farmers?

1 Methodology

1.1 Study area

Uttarakhand is a hill state lying in the northern part of India, sharing international borders with China in its North and Nepal in the East (Figure 1). Geographically the region falls between 77°34' and 81°02' E longitude and between 28°43' to 31°27' N latitude, covering an area of 53,119 km². The state is divided into two divisions, 'Garhwal' and 'Kumaun' that together comprise of 13 districts (Figure 1), further subdivided into 102 *tehsils* and 95 developmental blocks for administrative purposes (GoU 2018). A substantial 88.8% of the total geographic area of the state lies in the hill region (Mamgain 2004; Mittal et al. 2008). However, a majority of the population of the state resides in the plain districts (including plain regions of Dehradun and Nainital districts, Haridwar district, and Udham Singh Nagar district) (GoU 2018).

Agriculture in the hills is mostly practiced on a subsistence level (Bhandari and Chinappa-Reddy 2015; Mamgain and Reddy 2017); and only a very small section of the hill population practices

commercial agriculture. The dismal state of agricultural production and general dis-interest in farming amongst the local rural populace has been aggravated by chronic migration of working population outside of their native villages (Grunawalt 2012; Mamgain 2004). Out-migration from the rural villages of Uttarakhand has gathered immense political and social interest in the state. According to the latest census of India, 1053 villages from amongst the total 16,793 villages of Uttarakhand have no inhabitants with another 405 villages close to desertification (Census of India 2011). A majority of the hill districts of Uttarakhand have shown very low population growth rates meanwhile there has been a sharp increase in population in the plain districts (Census of India 2011; GoU 2018; Mamgain and Reddy 2017).

1.2 Site selection

This study covers 60 villages evenly distributed across six districts of Uttarakhand, with three districts selected from each administrative

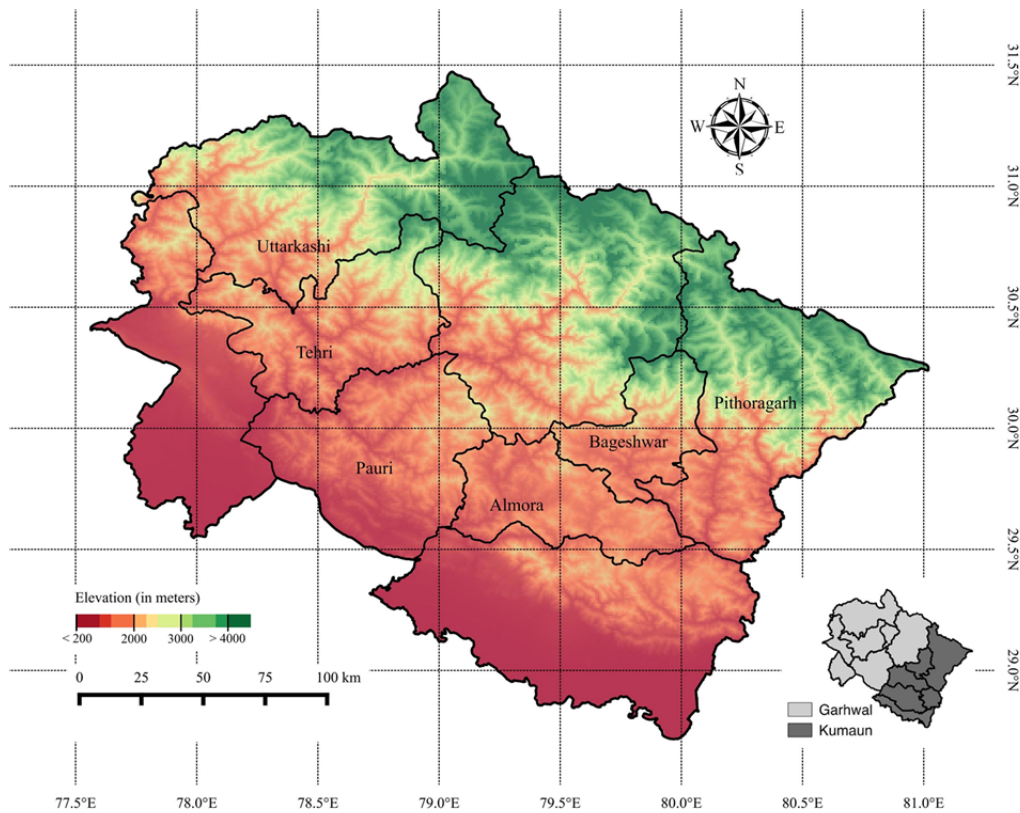


Figure 1 Map showing the location of study area in India, administrative divisions of Uttarakhand and the altitudinal profile of the state. The districts selected for field sampling have been highlighted with names.

division (Figure 1). The selection of districts for field survey was done while ensuring that they adequately represent the socio-political and environmental variability in the hill region of Uttarakhand. In order to do that three types of districts were included in the survey: a) border districts, b) interior mid-high altitude regions, and c) districts with reported high out-migration (Table 1). One district from each of the aforementioned categories from Garhwal and Kumaun division, respectively, was selected for the study. A stratified random selection procedure was used to select the villages for survey. In each of the selected districts the rate of population decline for all villages, between the Census years 2001 and 2011, was estimated and a shortlist of villages with declining population was prepared for each district. The shortlisted villages, were segregated into 3 categories based on proximity to district headquarter: <10 km, ≥10 – 50 km, ≥50 km. 10 villages were randomly selected from each district, while ensuring that there were three replicates from each category.

1.3 Survey methods

The methods adopted for primary data collection include: key informant interviews and household surveys.

1.3.1 Key informant interviews

Key informant interview is an effective, relatively-fast, and in-expensive way of anthropological field data collection which is used to derive basic information on a variety of topics through detailed interviews with selected informants (Kumar 1989). In this study the village

head (locally known as the ‘Gram Pradhan’) has been taken as the key informant for a village. However, in certain instances where the village head was unavailable, the *ex-gram pradhan* or an elderly member of the village community who was actively involved in village management, was interviewed as key informant. A pre-tested questionnaire was used for the interview, which included semi-structured closed and open-ended questions on a variety of topics including: demographic profile of the village including migration status, agriculture, and livelihood options. The interview was also recorded and transcribed to ensure that no information was overlooked while filling the questionnaire.

1.3.2 Household survey

The other method of data collection used in the study was household survey. Household survey is a commonly used second-stage method of social and demographic data collection (Sano et al. 2015; UN 2005). A single house in the study area was often found to inhabit two or more households, often a consequence division of joint families. In this study a ‘household’ is as defined as a group of people living together who share a common kitchen (Schmerbeck et al. 2015). Within each village 20 percent of the total households were selected for the household survey, using a stratified sampling technique, surveying every alternate household in a hamlet (Chakraborty et al. 2018). Ideally the head of the targeted household (male or female) was approached for the household interview, however, in case the household head was unavailable, other older members of the household were interviewed, while ensuring the respondent was older than 18 years and had been residing the village for more

Table 1 Selection of sampling villages

Criterion for Selection	Division	Selected Districts	Selected Villages
Border Districts	Garhwal	Uttarkashi	Rautal, Dang, Oliya, Jaspur, Agora, Gajoli, Panot, Jogat Talla, Sainj, Bhangeli
	Kumaun	Pithoragarh	Tola, Suring, Martoli, Garbyang, Kheda, Badet, Malli Bhaisudi, Lohathar, Pangu, Charma
Districts with high out-migration*	Garhwal	Pauri	Babina, Dhaulidhar, Juee, Dhaura, Maason, Rachuli, Takoli, Khutinda Palla, Dungri, Chawath
	Kumaun	Almora	Rond, Sironiya, Matena, Tiwari Khodi, Bauda, Jageshwar, Kana, Chamuva, Aartola, Mehertana
Interior mid-high altitude districts	Garhwal	Tehri	Jakhrana, Boodha Kedar, Siyara, Pujar Gaon, Sendul, Kotga, Camera, Koti, Almas, Matena
	Kumaun	Bageshwar	Jaulkande, Badet, Kaphalkhet, Banj Jhiroti, Musoli Chak Joshi, Aithar, Dhunga, Baret, Khantoli, Bhandari Gaon, Kafalilagga Papoli

*Based on pattern of migration as observed from the (Census of India 2011)

than 5 years (Chakraborty et al. 2018). In case there was no age-appropriate person available in a household, it was removed from the sample and the next household was interviewed. The survey aimed at collecting qualitative and quantitative data on a variety of aspects including: demographic information, education, livelihood, migration, and farming status of a household. Detailed information pertaining to livelihood and agricultural practices of a household was also collected through the surveys, using closed and open ended questions. With reference to agriculture the following aspects were discussed in detail: Perspectives on current agrarian scenario, abandoning of ancestral agricultural land and its link to rural out-migration, potential for commercial agriculture, and challenges faced by the rural farmers.

1.4 Data analysis

The research questions of the study were answered qualitatively and quantitatively after careful transcription and analysis of the data from key informant and household interviews across all study locations. Specific suitable quotes from the interviews have also been used in the results section, to qualitatively express the opinions of the interviewees. The general quantitative narrative of the sample population and study area included demographic, social capacity, and agricultural capacity among others. These were based on data from key person interviews and household surveys, and were described through descriptive statistical indices such as mean values, standard deviations, and mode.

In addition to descriptive statistics, ordinal logistic regression approach was used to understand the relationship between livelihood sources and annual income of a household, where annual income of household was the dependent variable and number of livelihood sources used by a particular household was the explanatory variable. Additionally, non-parametric binomial logistic regression tests were used to analyse the relationship between farm-exit and other explanatory demographic/developmental variables. Binomial logistic regression is a commonly used method for predicting the influence of a binomial dependent variable on one or more independent

variables (Chakraborty et al. 2016). The independent or explanatory variables used in the study to explain farm-exit include number of livelihood sources, annual income of household, number of male and female family members, and the availability of irrigation facilities, amongst others. The details of variables used in the regression model have been provided in Table 2. All statistical analysis was performed using IBM SPSS Statistics ver. 23.

2 Results and Discussion

2.1 Demographic and socio-economic profile of the community

The demographic profile of surveyed villages revealed that an average of 53.5% of the total population has out-migrated from their native village. The average household size across the study area was observed to be 5.5, with an average 3.3 male and 2.7 female members (Table 3). Most of the households across all surveyed districts report an annual income in the range of 50,000 to 100,000 INR (Table 3). In terms of agricultural capacity, the values across all three categories of districts were fairly similar. A majority of the households in the study area had agricultural land holding, on which they practiced small scale subsistence farming. However, a staggering 90.33% of the total households surveyed have abandoned some or all of their agricultural land-holding, which was no longer cultivated by the family or leased out to seasonal in-migrating farmers from Nepal. The state of irrigation facilities is rather poor, with only 0.56% of the total households availing irrigation facilities. Interior mid-high altitude districts fair marginally better in terms of irrigation facilities, however, the values are not remarkably high as compared to other districts (Table 3).

Even though we find 81.5% of the total households in the study area practicing agriculture on their private lands, most of this agriculture is limited to subsistence level and does not directly contribute to household income. The results of the study reveal that occasional commercial agriculture was practiced by a mere 21.2% of total farming households, whereas 12.3% of the total

Table 2 Details of variables used for binomial logistic regression

Variable	Variable Type	Explanation
Dependent Variable		
Farm-exit	Categorical	The variable highlights whether or not a household has abandoned some or all of its farm-land that was previously under cultivation. A categorical yes/no response was recorded
Independent/ Explanatory Variables		
Number of migrants	Continuous	Number of migrant family members in a household (includes all migrants and accompanying family members that might not contribute to household income through remittances)
Livelihood diversification	Continuous	Number of livelihood sources used by a household, that contribute to household income
Household income	Ordinal	Total annual income of a household, from all livelihood sources. Measured on an ordinal scale where: 1 = <50,000 INR, 2 = 50,000-100,000 INR, 3 = 100,000-300,000 INR, 4 = 300,000-500,000 INR, 5 =>500,000 INR
Number of male members	Continuous	Number of male family members in a household (excluding children below 18 years of age)
Number of female members	Continuous	Number of female family members in a household (excluding children below 18 years of age)
Education of household head	Ordinal	Education level of household head. Measured on an ordinal scale where: 1= up to 10 th standard, 2 = up to 12 th standard, 3 = graduate, 4 = post-graduate and above
Availability of irrigation facilities	Categorical	The variable highlights whether or not the members of a household own irrigated farmland within village boundaries? A categorical yes/no response was recorded

Table 3 Socio-economic and demographic profile of the study area

	High Out-Migration Districts		Border Districts		Interior mid-high altitude region		Average	
	Almora	Pauri	Pithoragarh	Uttarkashi	Tehri	Bageshwar		
Demographic Profile (Mean ± Std. Dev.)								
Percentage Out-migration	67 ± 19	76 ± 12	54 ± 25	38 ± 17	49 ± 12	37 ± 21	53.5	
Household (HH) size	5.81 ± 1.2	4.65 ± 1.6	5.66 ± 2	7.1 ± 3.1	4.9 ± 2.1	5.1 ± 1.6	5.5	
Male members	2.1 ± 1.3	2.2 ± 2	4.1 ± 1.9	3.7 ± 2	2.5 ± 1.2	3.1 ± 2.1	3.38	
Female members	2.8 ± 1.2	2.9 ± 1.7	3.1 ± 2	2.9 ± 1.1	2.7 ± 0.9	1.9 ± 0.98	2.71	
Human and Social Capacity (Mode)								
Annual income of household*	2	2	2	2	2	3	-	
Education of Household head#	2	3	3	2	2	3	-	
Agricultural Capacity (% households)								
HH with land holding	99.20	97.10	98.20	99.10	100.00	99.80	98.90	
HH with abandoned farmland	80.70	92.30	97.10	83.10	97.10	91.70	90.33	
HH with irrigated land holding	0.09	0.07	0.03	0.07	1.70	1.40	0.56	
HH practicing agriculture	73.60	71.30	81.40	89.10	83.20	90.20	81.47	
HH practicing commercial agriculture	Occasional	13.50	16.10	18.80	30.40	27.20	21.50	21.25
	Small Scale	11.50	7.20	11.30	20.30	15.10	8.20	12.27
	Large Scale	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes: *, 1 = <50,000 INR, 2 = 50,000 -100,000 INR, 3 = 100,000 -300,000 INR, 4 = 300,000 -500,000 INR, 5 =>500,000 INR;

#, 1= up to 10th standard, 2 = up to 12th standard, 3 = graduate, 4 = post-graduate and above

respondents practiced small scale commercial agriculture on a regular basis (Table 3). Occasional agriculture as defined by a respondent means that

the ‘ability to sell’ is dependent on the level of produce and is not the main livelihood source of the farmer. “We do take our fruits and vegetables

to the local market *occasionally* if the produce is enough. This is not a common practice for our household, but we can collectively sell our crop to the market if a few households come together, since transporting a small quantity is uneconomical for us”, articulates a respondent. Other respondents while highlighting the dismal state of mountain agriculture say that “We were once a flourishing agriculture rich village, however of late with out-migration and the increasing human-wildlife conflict, the crop production is very limited, and is insufficient to meet even our household subsistence needs.”

2.2 Farm-exit and declining dependence on agriculture as a livelihood source

The results of binomial logistic regression model reveal that farm-exit is influenced by both demographic and developmental factors (Table 4). The overall regression model shows that there was a statistically significant effect of livelihood diversification, number of migrants, number of female family members, and availability of irrigation facilities, and on farm-exit. The model explained 38.3% of the total variance in farm-exit and correctly classified 71.2% of cases.

Households with diverse sources of income were found to have significantly higher chances of leaving traditional farming practices. Off-farm employment and diversification are especially prevalent among marginal land-holders, who cannot make a living from their farm produce (Ellis 2000; Gautam and Andersen 2016; Morris et al. 2017). Most farmers in the study area represent such marginal family-based agricultural populations, for whom the cost of agricultural production often exceeds the value of revenue generated from the crop. Such marginal farmers are therefore more likely to diversify their livelihood means, and farm-exit merely becomes an out-come of that diversification process. The most common form of diversification in the study area is out-migration and off-farm employment in unorganized

sectors in the plain districts of the state (Bhandari and Chinappa-Reddy 2015; Bhandari 2013; Mamgain 2004). Out-migration and diversification have a reciprocal influence on one another, while the local population can be forced to out-migrate due to failing agricultural productivity, the movement of able-bodied youth reduces the availability of farm-labour, thereby decreasing agricultural productivity further.

Human capital is extremely important for supporting hill agriculture. We find a statistically significant relationship between out-migration and farm-exit in the study area (Table 4), i.e., with increasing out-migration the tendency to abandon agriculture also increases. In subsistence-based agrarian societies, of developing countries, human capital i.e., availability of farm labour is a crucial component of sustaining agriculture. This trend is not only specific to the study area but has also been reported in various other developing countries where rural to urban out-migration, as a mode of livelihood diversification, is affecting farm-exit (Angba 2003; Loison 2015; Viira et al. 2009).

In the Himalayan region, gender specific distribution of agricultural work is prevalent, however most of the agricultural activities are undertaken by women (Bhandari and Chinappa-Reddy 2015; Rais et al. 2009). The results of the study also strengthen the pre-existing premise that women are the backbone of agriculture in the mountains, by highlighting that a decrease in female members of a household significantly increases the tendency of a household to quit farming (Table 4). In a study on the plight of

Table 4 Coefficients of factors determining likelihood of farm exit (where: β =Beta Coefficient, S.E. = Standard Error of the Estimate, Wald = Wald’s t-test; *df* = degrees of freedom, Sig. = Significance or p values. Superscript (*) shows statistically significant model is at $p < 0.05$ level)

Variable	β	S.E.	Wald	<i>df</i>	Sig.	exp (β)
Livelihood diversification	0.624	0.297	4.428	1	0.03*	1.866
Number of migrants	0.210	0.208	1.025	1	0.04*	1.234
Household income	0.522	0.325	2.580	1	0.07	0.593
Number of male members	-0.318	0.218	2.135	1	0.14	0.835
Number of female members	-0.486	0.222	4.784	1	0.03*	0.594
Education of household head	-0.215	0.229	0.879	1	0.34	0.755
Availability of irrigation facilities	-1.478	0.650	5.160	1	0.02*	0.039
Constant	2.929	1.148	6.510	1	0.01*	4.783
Nagelkerke <i>R</i> ²	38.3%					
Hosmer and Lemeshow test	<i>p</i> =0.02					
Classification accuracy	71.2%					

women in the event male out-migration in Nepal, [Maharjan et al. \(2012\)](#) highlight that women drudgery increases following out-migration due to excess physical load on female members of the households. This can either lead to empowerment or disempowerment depending on the amount of remittances received and farm-investment made by the household. Male family members of a large number of the respondent in the study area were found to be working as unskilled labour in unorganized sectors in plain areas, which did not bring in a very high income, but just enough to maintain livelihoods. In such scenarios the feminization of agriculture, often leads to women drudgery thereby increasing the rate of farm-exit ([Bhandari and Chinappa-Reddy 2015](#)).

2.3 Challenges in commercial farming in mountain areas

The undulating topography, remote locations, inherent fragility of the mountain systems, and general difficulties in availing the most basic of farming facilities makes it a herculean task to practice large scale commercial level agriculture in the Himalayan region ([Bhandari and Chinappa-Reddy 2015](#); [Chapagain and Gentle 2015](#); [Pratap 2011](#)). Even though there are a limited number of success stories of cooperative and individual entrepreneurs who have been able to sustain an economically viable agro-based business in the

mountain region ([DES 2018](#)), general interest of the populace in practicing commercial agriculture is fairly low.

A perception based analysis on the key challenges in practicing commercial agriculture in the study area highlights concerns spanning social, demographic, environmental, and policy domains ([Table 5](#)). The results of this study reveal that human-wildlife conflict poses the biggest challenge in practicing commercial agriculture in the study area, with 88% of the total respondents of the study citing it as a factor that limits the potential expansion of commercial agriculture in the state ([Table 5](#)).

Crop raiding animals such as monkeys, porcupine, and wild boars were a major concern across the study area. The respondents' express reasonable views about their issues with wildlife, "We do not want to exterminate the monkey population, but there can be measures to reduce their fertility rate through animal birth control measures"; another respondent shared their disillusionment with governmental support, "We have approached the local forest offices several times in the last year to control the monkey population in the area, but nothing substantial has been done by them. At the most the local forest department captures monkeys from one zone and releases them elsewhere, near forested areas, but they find their way back. It is temporary and ineffective solution to our problem." There is an

Table 5 Percentage response to major factors limiting the opportunity for commercial farming in the study area

	High out-migration districts		Border districts		Interior mid-high altitude region		Mean (n = 951)
	Almora	Pauri	Pithoragarh	Uttarkashi	Tehri	Bageshwar	
	123	179	180	175	182	112	
Land and labour issues							
Small land-holding size	45.53	18.99	23.89	30.86	12.64	27.68	26.60
Fragmented land-holding	45.53	37.43	28.33	22.29	25.82	28.57	31.33
Lack of farm labour	54.47	51.40	31.11	40.57	31.32	43.75	42.10
Environmental Factors							
Human Wildlife Conflict	95.12	98.32	62.22	93.71	98.35	79.46	87.87
Erratic rain/snowfall pattern	61.79	51.40	40.00	53.71	31.32	56.25	49.08
Landslide and other disasters	9.76	3.91	12.78	13.14	9.34	3.57	8.75
Infrastructural drawbacks							
Lack of irrigation	49.59	31.28	15.00	24.00	24.73	27.68	28.71
Lack of road connectivity	17.07	15.08	23.89	21.14	9.34	16.96	17.25
Lack of cold storage facilities	1.63	2.23	2.78	1.71	1.10	0.00	1.58
Policy and Institutional challenges							
Lack of awareness	18.70	17.32	20.56	13.71	13.74	15.18	16.53
Lack of market linkage	25.20	20.67	23.89	30.86	17.03	14.29	21.99
Lack of funding/ loan facilities	13.82	12.85	13.33	7.43	11.54	25.89	14.14
Improper implementation of existing schemes	25.20	20.67	11.67	15.43	15.93	18.75	17.94

increasing body of literature that highlights issues of crop raiding and human-wildlife conflict, especially in case of farming communities residing in an around forested areas (Chakravarty 2015; Ogra 2009; Pirta et al. 1997; Shukla et al. 2018), however a significant effort in resolution of this conflict on an institutional and policy level, is currently lacking. In some cases the non-resolution of conflict can also be associated with the socio-cultural and religious beliefs of the local community according to which primates are worshipped and revered (Hill and Webber 2010; Khatun et al. 2012; Lee and Priston 2005). According to a recent news report the forest department of Uttarakhand intends to start with sterilization of monkeys in the Kumaun region on trial basis, however given the huge population of monkeys in the region the lack of skilled monkey catchers and government veterinarians is going to be a colossal challenge in completing this task (Sharma 2018).

In addition to wildlife conflicts, climatic aberrations (i.e., lack of timely rain and snowfall) and the lack of irrigation facilities have been identified as factors restricting hill agriculture by 49% and 28.7% of the respondents across the study area, respectively. Since most of the agricultural land in the state is rain-fed, the local people are highly dependent on timely rainfall for supporting their crop production. In the last decade there have been significant fluctuations in the rain and snowfall patterns in western Himalayan region, and other parts of north India (Haq 2018; Jethi et al. 2016; Rautela and Karki 2015; Sally and Saluja 2018). A conspicuous lack of winter rainfall in particular has significantly impacted productivity of crops in the study area. A number of farmers in the study area were found to be distressed over the failure and low production of wheat crops, due to the lack of winter rainfall and irrigation facilities. This is not only a concern for commercial farmers but also for subsistence level farmers whose household economy strongly depends on fulfilling their nutritional needs through their own farmland as opposed to buying food grains from the market. Climatic changes not only effect food crops but also horticultural crops such as apples, peach, plum, and citrus fruits amongst others (Pratap 2011; Singh 2013; Singh et al. 2016). Most notably the shifting pattern of winter snowfall from December

and January to late February and March in the last few years, has considerably effected the apple production in other parts of the Indian Himalayan region (Singh 2013; Singh et al. 2016), a tendency that can be expected in the study area as well.

While climatic aberrations and wildlife conflict are environmental concerns, which need stronger policy backed solutions, following intensive research and expert consultations, on a more fundamental level the marginal size and fragmentation of land holdings, and lack of agricultural labour pose a huge challenge in pursuing commercial farming in the study area (Table 5). Most of the farmland in the study area is fragmented with large distances between the land-holdings. Since agriculture is usually practiced on a family level with household members engaging in the field themselves, it is often difficult to keep all agricultural lands operational, and in most cases land-holdings which are far from the village are being gradually abandoned. This has further aggravated the problem of marginalization, with households abandoning land-holdings situated in difficult terrains, and at farther distances. According to data from the agricultural census of India the number of operational marginal land holdings (<1 hectare in size) in the state, is considerably higher in comparison to other land-holding sizes including small, medium, and large land-holdings. It is noteworthy that the number of operational land holdings in the marginal category has seen a considerable decline between the years 2005-2006 and 2010-2011 (Figure 2). Meanwhile

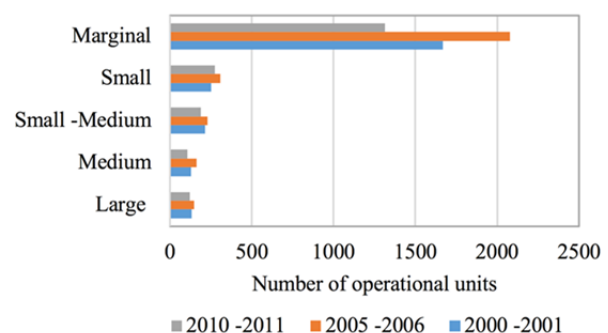


Figure 2 Distribution of marginal (<1 hectare), Small (1 to 2 hectare), Small-Medium (2 to 4 hectare), Medium (4 to 10 hectare), and Large (>10 hectare) land holdings in Uttarakhand. The bars represent number of operational units under each land-holding category for the years 2000–2001, 2005–2006, 2010–2011. (Data source: Agriculture Census of India, available at: <http://agcensus.nic.in/>).

there has not been an increase in the number of operational units in any other land-holding class, indicating that an increasing number of marginal small-scale farmers are choosing to abandon their farm-lands, which is also corroborated by the findings of this research work (Table 3). The reasons for farm exit as discussed earlier range from general disillusionment with farming as a viable livelihood option to the lack of farm labour due to out-migration of family members.

Another issue that was emphasised during the study was the lack of proper institutional and governmental support for hill agriculture. Lack of proper market linkage was highlighted as one of the most significant shortcomings in this category, with 22% of the respondents citing it as a factor that discourages them from pursuing commercial agriculture (Table 5). Lack of awareness about existing policies and schemes amongst rural farmers often limits the scope of their implementation and therefore does not bring about the reformatory change it is expected to create. According to 16.5% of the respondents in the study area, the lack of awareness was an enormous challenge in pursuing agriculture commercially while another 14.14% cite the lack of funding and loan facilities as a limiting factor (Table 5). Another important concern that was highlighted during the interviews was lack of proper and fair implementation of existing policies and schemes. Often agricultural policies and schemes are developed on a blanket basis on state or national level, in such scenarios the topography, environmental conditions, resource availability, and socio-cultural setting of the mountain agricultural communities are often ignored (Pratap 2011). This has been a main reason for the lack of mainstreaming of hill agriculture in the state. However, even in situations where there are schemes which local farmers can benefit from, unfair selection of beneficiaries stands in the way of policies benefiting the population that most needs it.

2.4 Livelihood diversification

With increasing challenges in pursuing agriculture, it is only natural for rural households to diversify their income sources. Livelihood

diversification is a common tactic used by rural household for overcoming economic vulnerabilities. The causes for such vulnerabilities may include lack of policy support and market linkages, and unpredictable environmental fluctuations (Gautam and Andersen 2016; Loison 2015; Morris et al. 2017). Therefore, rural populations in developing nations often diversify their income options to fulfil their household needs (Loison 2015). Household-structure, gender, culture, location, and education levels of the farming household are often important factors that govern their ability to diversify their income sources (Kassie et al. 2017).

We find that 80.13% of the total households surveyed in the study area were currently dependent on more than one source of income, to maintain their livelihoods, which included both on-farm and off-farm activities. However, the proportion of households that state farming as a primary income source is fairly low in the study area (Figure 3). Such 'mixed' strategies of livelihood diversification have been observed in many developing countries around the world (Barrett et al. 2001; Kassie et al. 2017; Morris et al. 2017). Remittances, off-farm jobs, and pension had the strongest contribution towards household income, for a majority of the households in the study area (Figure 3). More than 30% of the total households surveyed enlisted remittances received from out-migrated family members as their primary income source, followed by off-farm jobs (26%), and pension from previous government employment (20.5%) (Figure 3). The low risk nature, and lack of capital investment in most off-farm employments (governmental and non-governmental) and daily-wage labour act as major pull factors that encourage the rural poor population to move out of the farming sector. Most daily-wage labourers in the study area are generalists who can be involved in short-term assignments such as construction, transportation of utilities and local produce, and other odd-jobs. This push towards off-farm jobs is further strengthened by the high susceptibility of farming sector to economic (e.g. market failure) and environmental fluctuations (e.g. lack of timely rainfall, excess rainfall, and cloud bursts) (Barrett et al. 2001; Ellis 2000; Loison 2015; Morris et al. 2017).



Figure 3 Contribution of income sources to livelihoods. Livelihood sources categorised as primary, secondary, and tertiary based on respondent households' dependence, as indicated during the survey.

Livelihood diversification has garnered immense policy interest as a method to check rural poverty in developing countries (Loison 2015). However, there are conflicting opinions on diversification as a livelihood improvement strategy. The results of the ordinal logistic regression highlight that increasing the number of livelihood sources does not have a statistically significant influence on the annual income of a household ($\chi^2= 8.62, p > 0.05$). This indicates that increasing one's livelihood options does not necessarily put a check on rural poverty. The inability of livelihood diversification in supporting rural livelihoods has also been highlighted by Bryceson (2002), who states that livelihood 'multiplexity' often fails to generate adequate employment or foster technological innovation in a developing country, and also fails to make a significant contribution to the purchasing power of the rural community. The choice by a rural household to diversify their means of livelihood can either be driven by necessity or by choice (Ellis 2000; Kassie et al. 2017). While some households diversify for survival others diversify for accumulation, in either of these situation, depending on the reason, the outcomes of livelihood diversification can be quite contradictory between one household and another (Loison 2015). Diversification originating from necessity can make households more susceptible to ending up in a

more insecure economic condition (Gautam and Andersen 2016; Morris et al. 2017) while diversification arising from desire for accumulation can lead to prosperity. It can be inferred that in the study area, most of the households diversify their livelihood options as a means of survival rather than accumulation.

3 Conclusion

The research work tries to comprehend the future of subsistence based mountain-farming practices amongst the rural communities of the Indian Himalayan region, with Uttarakhand as the study location. The results of this study highlight that livelihood diversification and out-migration are at the core of agricultural abandonment in the region, with a large proportion of marginal family level farmers forsaking their traditional agriculture practices. The research provides evidence for the changing socio-economic dynamic in the rural mountain communities from small scale subsistence level farmers to off-farm migrant workers. The main causal factors that limit agricultural production in the state include crop-raiding by wild animals, land holding and labour issues, environmental concerns including dependence on rain fall for irrigation, and various policy and institutional level drawbacks. There is a

reciprocal influence of out-migration on farm exit, with one influencing the other, however this is not a universal rule and farm-exit can be motivated by other socio-economic and personal factors, which have not been covered in the study. In general, a vast majority of the rural populace has abandoned some or all of their farming lands, especially in cases where farmlands are fragmented and spatially separated from the village. The rural youth is particularly disinterested in practicing farming as a livelihood support option, which contributes to the general lack of farm labour.

Given the aforementioned challenges and constraints the future of mountain agriculture seems bleak, however, agriculture is likely to continue to play a role in diversified livelihoods for many people in the area, and efforts can be made to improve practices, technologies, and institutions that aim at making agriculture an economically viable livelihood option for the local population that chooses to pursue it. In order to do that it is critical to develop policies that address challenges faced by mountain farmers, as opposed to blanket policies that mainly benefit agriculture in the plain regions. For instance, a majority of the respondents in the study area were not keen on using subsidized power-tillers for tilling due to the terraced nature of their farm lands and other logistic concerns, instead they preferred animal driven tillers, for which there are no effective schemes. In such situations policies that promote mechanized tilling only benefit the farmers in plain regions and are not beneficial for hill-farmers. Therefore, segregated policies based on stakeholder demands, that recognise the diversity within an administrative zone (such as Uttarakhand) are extremely critical for supporting sustainable rural development initiatives in an area. Policies and schemes that promote land and labour consolidation amongst local inhabitants can address some of the key challenges in pursuing agriculture in Uttarakhand. In regions where land consolidation is achieved, organic agriculture, horticulture, and cultivation of medicinal/aromatic plants hold considerable promise, as sustainable

livelihood sources for the local population. At the same time, is also crucial to provide market linkages and marketing support upcoming agro-entrepreneurs.

While agriculture is an integral part of the socio-cultural fabric in the region, given its present state, concentrating all resources and investment in the agriculture sector alone, would not be a suitable livelihood support strategy for the hills. Meanwhile, non-farm livelihood sources have often proved fruitful in situations where land-degradation, population growth, climatic changes, resource unavailability, and stagnant technology, have rendered commercial farming unprofitable. Therefore, in the study area, resources can be diverted towards developing other sectors such as tourism, sericulture, handloom and handicrafts, livestock, and fisheries, for supporting local livelihoods. It is also important to highlight that often information on existing schemes and policies (e.g., Dairy Entrepreneurship Development Scheme, Village Tourism, and Homestay Policy) is not conveniently accessible to the local rural population. This lack of information about potential livelihood avenues impedes the efforts being made towards livelihood support. Therefore, while it is important to develop and revise policies, it is also equally essential to disseminate information and properly implement existing policies and schemes in both farm and non-farm sectors.

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