Research Article

Challenges and Constraints in Hill Agriculture: Assessing Their Impact on Farmers' Income in District Pithoragarh of Uttarakhand State

Arti Joshi[1] & Dr. Ruchi Dwivedi[2]

[1]Research Scholar, Dept. of Regional Economics, M.J.P. Rohilkhand University, Bareilly, U.P. (India)
[2]Assistant Professor, Dept. of Regional Economics, M.J.P. Rohilkhand University, Bareilly, U.P. (India)

Abstract: There are numerous challenges in agriculture of hilly regions in the Indian Himalayan state like Uttarakhand. These challenges significantly impact the income and overall livelihood of the farmers in these regions. The present study is an attempt to examine the key constraints that are affecting the productivity and income levels of respondents in district Pithoragarh of Uttarakhand state which specially focused on villages of Gangolihaat Tehsil. Using primary data collected from 100 respondent farmers, the study analyses the role of financial constraints, infrastructural issues, technological barriers, environmental risks and the challenges of market in shaping the agricultural income of the respondents. By employing statistical techniques regression analysis and ANOVA, the finding reveals that market challenges and financial constraints have significant negative impact on agricultural earning of respondents, while environmental risks show a paradoxical positive association due to various reasons. The study also highlights the limited role of infrastructure and technological barriers. The research provides some suggestions regarding mitigating the challenges and constraints in agriculture and ensuring sustainable agricultural development as a policy recommendation in study region.

Keyword: Hill Agriculture, Farmers' Income, Agricultural Constraints, Market Challenges, Financial Barriers, Environmental Risks, Infrastructure Issues

INTRODUCTION

Agriculture in mountainous regions, often referred to as hill agriculture, is vital for the sustenance and livelihoods of communities living in these ecologically fragile areas. Characterized by fragmented landholdings, steep slopes, diverse agro-climatic conditions, and limited infrastructure, hill agriculture faces unique challenges that significantly affect productivity and, consequently, farmers' incomes. Farmers in the hills have been chiefly engaged in agriculture for subsistence (Rawat, 2023). Agriculture practice is not so easy in the mountain regions; a number of constraints from technique adoption to marketing of the agricultural produce are in the hilly regions (Joshi & Lohani, 2023) including youth migration, and socio-economic barriers (Sati *et al.*, n.d.). These challenges are further exacerbated by climate change, which brings altered rainfall patterns, increased frequency of extreme weather events, and rising temperatures, all of which threaten the sustainability of agricultural practices.

In India, particularly in the Himalayan region, including Uttarakhand, agriculture is a primary source of livelihood for a large portion of the population, it is nearly 70 percent (Sati *et al.*, 2025). Uttarakhand's diverse topography and agro-ecological zones illustrate the complexities of hill agriculture. Farmers in this area have been primarily engaged in subsistence agriculture (Mittal *et al.*, 2008) encounter various constraints, such as limited access to irrigation and quality inputs, as well as difficulties in marketing their produce due to inadequate connectivity and infrastructure. Traditional farming systems, often marked by low productivity and high reliance on rainfall, further heighten farmers' vulnerability to economic shocks and due to these natural constraints, the advancement of agriculture is the most important challenge (Tuteja, 2015).

Pithoragarh district, situated in the Kumaon region of Uttarakhand, exemplifies the challenges and opportunities inherent in hill agriculture. In general, this district is characterized by low agricultural productivity, lack of irrigation facilities, unavailability or inadequate availability of agricultural inputs (https://pithouragarh.kvk4.in/). The district's rugged terrain and diverse agro-climatic conditions support a predominantly agrarian economy. While there is considerable potential for horticulture, off-season vegetable production, and livestock rearing, farmers face numerous obstacles that prevent them from fully exploiting these opportunities. As a result, these constraints lead to lower agricultural productivity, reduced income levels, and increased vulnerability to poverty and food insecurity. Agriculture in this region is still largely traditional and crop management is very poor (https://pithouragarh.kvk4.in/).

This paper aims to delve into the specific challenges and constraints faced by farmers in Pithoragarh district, Uttarakhand, and assess their impact on their income. By identifying the key factors limiting agricultural productivity and profitability, this study will contribute to a better understanding of the challenges faced by hill farmers and inform the development of

targeted interventions to improve their livelihoods and promote sustainable agricultural development in the region. We will examine limitations in access to resources, infrastructure, technology, and market linkages, while also considering the influence of socio-economic factors and climate change. The ultimate goal is to contribute to the development of strategies that empower farmers in Pithoragarh to overcome these challenges and enhance their income and well-being.

REVIEW OF LITERATURE

Barah (2010) find out the gaps in their study namely "Hill Agriculture: Problems and Prospects for Mountain Agriculture" that poverty remains a significant issue in hill areas, often overlooked in research on vulnerability. The lack of unified impact from various developmental schemes necessitates the convergence of initiatives for greater social benefits. Tribal farmers, reliant on traditional knowledge and facing challenging terrains, require comprehensive documentation of their needs and a tailored action plan. Additionally, the small landholdings of hill farmers highlight the need for focused studies on their livelihoods, while addressing climate change risks and resource under-investment through improved disaster preparedness and specialized credit plans is essential for sustainable agricultural development.

Pratap (2011) in their study "Hill Agriculture: Challenges and Opportunities" highlighted the sustainability of mountain agriculture is at risk unless perceptions of its challenges are transformed, necessitating hill-specific development strategies that consider the unique marginality and diversity of each area. The changing demographics, with a younger population and male out-migration, have increased the workload on women and highlighted widespread unemployment among educated rural youth. While agricultural intensification continues, marginal farmers face limited access to technology, leading to declining productivity. Additionally, unclear land rights and inappropriate policies threaten biodiversity and environmental health. Addressing water insecurity and understanding local water dynamics are crucial for improving livelihoods and enhancing agricultural productivity in these regions.

Wani (2011) in his study namely "Hill Agriculture in India: Problems and Prospects of Mountain Agriculture" suggests that to enhance hill agriculture, it is recommended to formulate separate agricultural policies for hill regions and establish a consortium of hill states with farmer representation to guide development. Regular brainstorming sessions should be held for effective planning, and market-driven production and extension services should be integrated into developmental programs. Additionally, effective trade policies, improved infrastructure, and expanded watershed development programs tailored to hill states are essential. Strengthening livestock production,

rejuvenating old apple orchards, and promoting the convergence of development activities will further benefit the agricultural landscape in these areas.

Raina *et al.* (2020) conducted namely "Studies on problems associated with farm mechanization in Kangra district of Himachal Pradesh" in their study find and the study identified key challenges to farm mechanization in hilly areas, including undulating terrain, small and scattered land holdings, poor financial conditions, and lack of training on machinery operation. It recommended that the state government increase subsidies for farm machinery from 25% to 50%, particularly for tractors and power tillers, and improve road connectivity to enhance agricultural development in these regions.

Kumar *et al.* (2021) in their study concluded that agricultural marketing has the potential to enhance farm income and create jobs, but hill populations face challenges in effectively marketing their produce. To improve this, a new distribution network connecting farmers directly to consumers is needed, along with strict actions against middlemen. Establishing village-level counselling centres for farmers, an efficient Public Distribution System, and promoting entrepreneurship through institutions like Krishi Vigyan Kendras can help ensure fair prices and reduce intermediaries, ultimately leading to a more efficient market system.

Raina *et al.* (2021) concluded in their study that if the sowing and land preparations type operations was done through mechanisation in wheat followed by maize make net saving of the farmer highest. According to their study the mechanisation in sample farms save 56 to 67 man days human labour and 23-35 bullock days/ha in case of major crops while they make their study in Himachal Pradesh a hilly state with low extent of farm mechanisation in terms of availability of mechanical power as well as power operated tools.

Chaudhary and Kumari (2023) in their study namely "Agricultural Diversification in Hill Regions of India: Problems and Prospects" The northwestern and northeastern hilly states are shifting from low-value crops like cereals and pulses to high-value commodities such as fruits and vegetables, enhancing food security and household income. Crop diversification offers nutritional benefits and opportunities for surplus sales, but labour shortages in some areas hinder the production of labour-intensive high-value crops. The government needs to address these labour issues while leveraging favourable agro-climatic conditions to promote high-value crop cultivation. Research institutions should also explore the cultivation of crops like asafoetida to support economic growth in these regions.

Sati and Kumar (2023) in their study related to declining agriculture in Garhwal Himalaya made a case study of eight villages in the Garhwal Himalaya indicates

a significant decline in agriculture, with factors such as increasing population, small landholdings, traditional farming practices, low fertility, and climate change contributing to this trend. The implications include low agricultural output, out-migration, land abandonment, and food insecurity. The study suggests re-demarcating agro-climatic zones and conducting crop suitability analyses to adapt to changing conditions, with government support for marginal farmers during crop failures. It emphasizes the need for a holistic approach to agricultural development and recommends further research across the entire Uttarakhand state.

Meena & Maikhuri (2024) conducted a study in Urgam valley and finally concluded that to address agricultural challenges in Urgam Valley, integrating Uttarakhand's laws and government schemes with research outcomes is essential. Soil and water conservation methods, such as terracing and micro-irrigation, alongside initiatives promoting organic farming, aim to enhance sustainability and resilience. Diversifying income through high-value horticultural crops and empowering farmers with credit and training will improve productivity and governance. Additionally, reorienting agricultural policies to support indigenous practices and community engagement is crucial for enhancing food security and ecological balance in the region. Collaboration among policymakers, researchers, and stakeholders is vital for implementing effective solutions for a resilient agricultural future.

Existing literature on hill agriculture in the Himalayan region highlights various challenges, but there is a significant gap in research focusing on the combined effects of constraints such as limited irrigation access, land degradation, market access, and climate variability on farmer income in Pithoragarh district, Uttarakhand. Additionally, quantitative analysis is needed to assess the magnitude of these impacts and evaluate the effectiveness of current policies aimed at promoting sustainable agricultural practices and enhancing farmer livelihoods.

OBJECTIVES OF THE STUDY

- To assess the socio-economic status of farmers in the selected study area.
- To identify and analyse the major problems faced by farmers in agriculture, including financial, infrastructural, technological, environmental, and market-related challenges and their effect on farmers' income in study area.

RESEARCH METHODOLOGY

Data Collection

- **Primary Data:** Structured schedule was used in the present study to collect the data from selected villages ten villages in Gangolihaat Tehsil in Pithoragarh district.
- **Sample Size:** Ten respondents from each village were selected randomly as a sample for the present study.
- **Secondary Data:** Secondary data is also adopted to make this study meaningful from different Government reports, agricultural department reports, research papers, census data and websites.

Data Analysis Tools

- Descriptive and Inferential Statistical were used to make the study meaningful.

Limitations

- The study is limited to selected villages of Gangolihaat tehsil in District Pithoragarh of Uttarakhand.

DISCUSSION

Demographic & Socio-Economic Variables

In the selected sample of respondents consists of a diverse age group, where the mean age (50.92 years) is high relatively with having the standard deviation of 15.62 years, this indicates that the respondents of sample are mature. The age composition also shows that elderly individuals are actively involved. There is dominance of General category respondents in the sample (70.0%) and overall. By the 97.0% mark of General and SC social category of respondents indicates that there is concentration of these groups in the study area. The educational level among the respondents reflects that the average education is very low (5.82 years) with the standard deviation of 4.790, where some respondents have no formal education and some have very high educational level. The average family size which is around 5, indicates a moderately large household structure among the respondents with standard deviation of 1.518. The data also reveals that there is a wide variation in the size of landholdings and the high standard deviation (5.862) shows disparity in land ownership among the respondents, which affects the agricultural productivity and the level of incomes.

Table 1.0 Descriptive Statistics of Demographic and Socio-economic Variables

	N	Minimum	Maximum	Mean	Std. Deviation
Income	100	1400	85000	20357.00	18305.942
Age	100	24	90	50.92	15.626
Formal Edu (in Years)	100	0	17	5.82	4.790
F_size	100	2	10	5.09	1.518
Landsize	100	1	25	5.93	5.862

Source: Primary data

The economic category of respondents shows that more than half of the respondents (53%) fall under Below Poverty Line (BPL) category which highlights the high economic distress among the respondents in study region. Only 44 percent of the respondents which belongs to Above Poverty Line (APL) category has a relatively stable financial situation but they also have to struggle with economic security. The mean income from agriculture of respondents in study region is Rs. 20357.00 but there is a significant agricultural income disparity among them as this can also be seen through the large standard deviation of Rs. 18305.94. Some respondents earn substantially more than others. 59% respondents have non-farm income sources for their survival in the study region and they earn from small trade, any kind of informal job and by working as a labour in and nearby areas. 63% respondents save money for their future requirements and only 52 percent have their access to the bank and only 39% possesses Kisan Credit Card borrowing loan from formal source.
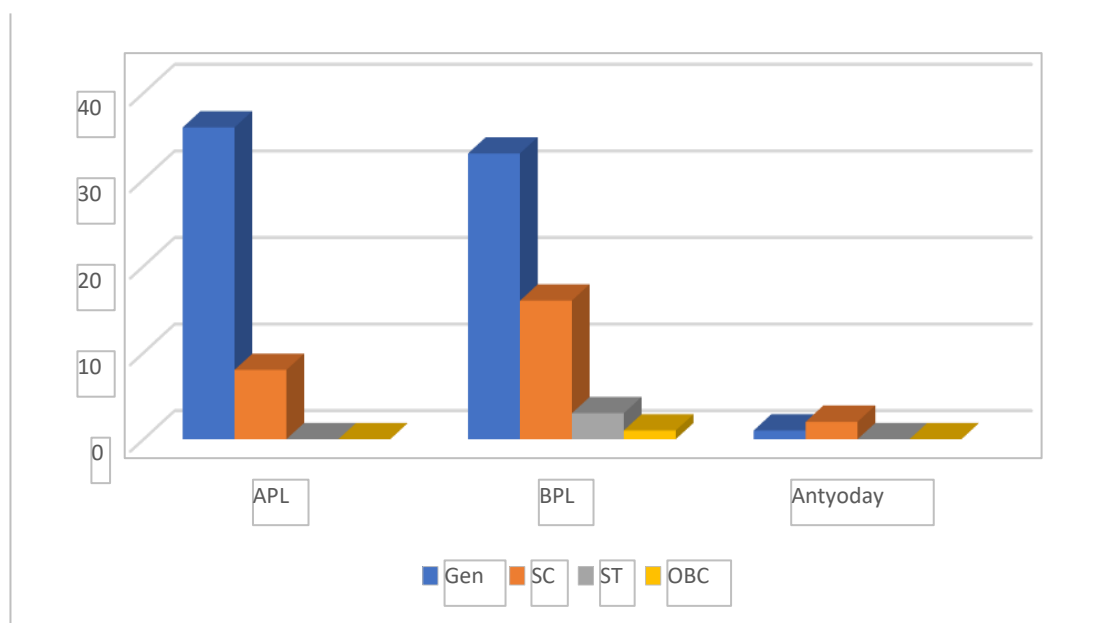

Figure 1: Social and Economic category of respondents

Challenges and Constraints faced by the respondents

The major challenges and constraints in the study region were divided in five different categories i.e., Financial Constraints, Infrastructure Constraints, Technological Barriers, Environmental Risks and Market Challenges. The data was collected through Likert Scale to know better these constraints and Garret ranking method was adopted to rank these constraints

Impact of Challenges and Constraints on Respondents income

To study the impact of selected challenges and constraints on the selected respondent farmers income in study region the following model was prepared to study the impact -

$$Y=\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\epsilon$$

Where:

Y = Farmers' Income (Dependent Variable)

X1 = Financial Constraints (Independent Variable - Likert Scale)

X2 = Infrastructure Issues (Independent Variable - Likert Scale)

X3 = Technological Barriers (Independent Variable - Likert Scale)

X4 = Environmental Risks (Independent Variable - Likert Scale)

X5 = Market Challenges (Independent Variable - Likert Scale)

β0= Intercept

β1,β2,...β5 = Coefficients measuring the effect of each challenge on income

ε = Error term

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.418(a)	.175	.131	17062.404

a Predictors: (Constant), Infra, Env, Mar, Tech, Financial

The value of R (+0.418) in this model shows that moderate positive correlation between farmers income and independent variables (Financial Constraints, Infrastructure Constraints, Technological

Barriers, Environmental Risks and Market Challenges). The ANOVA table shows that p-value (Sig.) = 0.003, which is highly significant (p<0.05) and the overall model is statistically significant. The F=3.991 shows that there is collective impact of independent variables (meaning that financial constraints, infrastructure issues, technological barriers, environmental risks, and market challenges jointly influence farmers' income) on farmers' income.

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5809836662.867	5	1161967332.573	3.991	.003(a)
	Residual	27365808437.133	94	291125621.672		
	Total	33175645100.000	99			

a   Predictors: (Constant), Infra, Env, Mar, Tech, Financial

b   Dependent Variable: Income

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	95% Confidence Interval for B Lower Bound	Upper Bound	Collinearity Statistics Tolerance	VIF	B	Std. Error
1	(Constant)	27600.334	4917.695		5.612	.000	17836.136	37364.532				
	Env	4325.291	2178.066	.207	1.986	.050	.690	8649.892	.805	1.242		
	Tech	-2834.312	2357.401	-.150	-1.202	.232	-7514.987	1846.363	.565	1.771		
	Financial	-3938.813	2224.461	-.226	-1.771	.080	-8355.532	477.906	.538	1.859		
	Mar	-4516.806	2083.422	-.250	-2.168	.033	-8653.490	-380.122	.662	1.511		
	Infra	3173.117	2601.938	.144	1.220	.226	-1993.092	8339.325	.627	1.595		

a. Dependent Variable: Income

The regression analysis examines the influence of challenges and constraints which were selected as an independent variable on farmers' income shows that Rs. 27600.334 is the income of farmer when all independent variables are zero. Environmental Risks (B=4325.291, p=0.50) shows this variable as positive and it is just on threshold od significance, may be this is due to any kind of support for these regions (in the form of government interventions) which may help the farmers to mitigate the income loss. The market challenges (B=-4516.806, p=0.033) which is significant directly involved in lowering the respondent farmers' income in study region. While Technological Barriers (B=-2834.312, p=0.232), Infrastructure Issues (B=3173.117, p=0.226) are non-significant variables in the model and do not affect farmers' income significantly. But Financial constraints (B=-3938.813, p=0.080) is a borderline significant variable and suggests that financial constraints may have a negative impact on income of the respondents.

CONCLUSION AND SUGGESTIONS

The study shows that there is a significant economic disparity due to the income variation among the respondents. The age composition among the respondents concludes that there is aging population which affects the labour availability and productivity in agriculture, this may be due to the cause of migration. The low level of education can be said that it may be a concern for skill development and employment prospects. The large family size among the respondents could impact the economic dependency and household expenditures among them. A disparity in landholding indicates that there may be differences in access to agricultural resources and productivity among the respondents.

Market challenges are significantly reducing the farmers income in study region and addressing these issues i.e., access to market, fair pricing, middlemen exploitation could help in increasing the income of the respondents. The environmental risk has a positive impact on income of respondent farmers which may be due to government support or climate-adaptive farming practices among respondents. The financial constraints show a negative impact (but are not statistically significant), suggests that better access to credit could still be beneficial. While, two other constraints (Technological Barriers and Infrastructure Issues) which are not significant in the dataset, they do not strongly influence income levels.

It is suggested that there should be need improvement in market access by strengthening the supply chains and by reducing intermediaries and enhancing the respondent's income by making their direct access to the buyers. Increasing loan accessibility could still be helpful for the farmers in study region.

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