Plant Archives Vol. 25, No. 1, 2025 pp. 1969-1977 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.no.1.285

FACTORS AFFECTING LAND USE PATTERNS OVERTIME IN KATHUA DISTRICT OF JAMMU AND KASHMIR INDIA

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(Date of Receiving : 08-02-2025; Date of Acceptance : 15-04-2025)

ABSTRACT

Land and water are essential natural resources critical for sustaining human life, with their effective management being vital for food security and the rural economy. In India, where agriculture significantly outweighs manufacturing, the role of land is particularly paramount. Land use change, a complex and dynamic process, involves the conversion of land from one use to another, influenced by factors such as age, on-farm income, net irrigated area, and expenditures related to Rabi and Kharif seasons. This study focuses on the factors affecting land use patterns over time in the Kathua district of Jammu and Kashmir. Using a multi-stage sampling design, data were collected from 120 respondents across 12 villages within four strategically selected blocks. The findings reveal that constraints such as pest and disease pressures, labor shortages, inadequate irrigation facilities, and insufficient training hinder optimal crop production. Addressing these factors through targeted interventions and policies will be essential for enhancing agricultural productivity and ensuring sustainable land use in the region. Continuous monitoring of land use changes is crucial for identifying challenges and informing management strategies.
Key words **:** Land Use Patterns, food security, rural economy.

Introduction

Land and water are vital natural resources that sustain human life, with their management being crucial for food security and the rural economy (Najmuddin, 2018). The utilization of land directly influences a country's development trajectory (Laxmi *et al*., 2015). In India, where agriculture plays a more significant role than manufacturing, land is an especially critical resource (Laxmi *et al*., 2015; Chaplot, 2017; Pandey and Ranganathan, 2018). Land use change is a dynamic and complex process, characterized by the conversion of land from one usage to another, driven by various factors (Laxmi *et al*., 2015; Ahmad *et al*., 2018; Ahlawat, 2017). The global discourse on land cover and land use change (LULC) emphasizes its role as a key factor in global environmental change, influenced by both direct and indirect causes (Lambin *et al*., 2003). These causes often intertwine, involving natural variability, economic and technological shifts, demographic changes, and cultural influences (Bosselmann, 2012). Studies have highlighted that multiple factors contribute to land use changes, particularly in Bihar, where issues like increased fallows and reduced sown areas occur alongside a shift toward non-agricultural land uses. In Jammu and Kashmir, urbanization has also led to variations in land use patterns (Dwivedi *et al*., 2014). Overall, LULC transformations are complex, involving interactions among economic, political, demographic, and environmental factors, with political and economic influences being particularly significant. Such changes can lead to detrimental outcomes, including deforestation, biodiversity loss, reduced ecosystem services in urban areas, and loss of agricultural land (Cobbinah *et al*., 2015). Continuous monitoring of LULC changes is essential to identify challenges and inform management strategies.

Materials and Methods

The study employed a multi-stage sampling design to select villages and respondents in Kathua district, which comprises 19 blocks. Four blocks-Marheen, Nagri, Barnoti, and Hiranagar were purposefully chosen due to their roadside locations, making them more susceptible to changes in agricultural land use patterns. A list of these blocks was obtained from the Directorate of Economics and Statistics, Jammu. In the second stage, three villages were randomly selected without replacement from each of the four chosen blocks, using village lists from the same directorate and local Panchayat. This resulted in a total of 12 villages included in the study. For the third stage, a list of respondents from the selected villages was obtained from the Sarpanch and the Agriculture Extension Office. From each village, ten respondents were randomly chosen without replacement, leading to a total of 120 respondents for the study.

To gather primary data, the personal interview method was employed, allowing for on-the-spot recording of responses at respondents' homes, community locations, or farms. Data analysis utilized the Singh cube root method, along with percentage calculations, arithmetic mean, and multiple linear regression models to derive insights from the collected information.

Result and Discussion

The results of the study will provide a comprehensive understanding of the factors influencing agricultural land use patterns in Kathua district, highlighting the implications for local agricultural practices and policies. Detailed statistical findings will be presented in subsequent sections.

Socio personal profile of the respondents

The results of table 1 revealed that the sample of 120 respondents has a mean age of 50.63 years, with most farmers falling in the middle-aged group (65%), followed by 17% young and 18% older individuals. It may due to the fact that middle age persons are interested in carrying out different agricultural related activities, having more work efficiency and are more enthusiastic thus leading to these results as these findings are supported by Lyocks *et al*. (2013). On average, respondents have 7.35 years of formal education, with 74% literate and 30% having completed matriculation. As education plays an important role in bringing out desirable changes in human behaviour in the form of knowledge, skill and attitude, it is valued as means of increasing level of knowledge and information about farming. The findings are in accordance with the findings of Viswasnathna *et al*. (2014a) and Umunnakwe and Adedamola (2015). Most are male (86%), and 76% serve as heads of their families. Most (82%) have phone access, and although only 24% rely solely on agriculture, a large portion combines it with other occupations, notably labor (33%). All respondents cultivate their own land, with an average farming experience of 19.37 years. Most live in nuclear families (77%) with an average family size of 5.17 members, consisting of 2.21 males, 1.66 females, and 1.12 children. This may be due to the bifurcation of the families and the findings are in confirmation with Viswasnathna *et al.* (2014b).

Table 1: Descriptive statistics of the respondents

Parameter	Total(n=120)
Mean age(years)	50.63+16.33
Age categorization (%farmers)	
Young (15 to 34 years)	21(17)
Middle (35 to 67years)	78(65)
Above 68 years	21(18)
Mean education (formal number of schooling years completed)	7.35+4.92
Education Level (%farmers)	
Illiterate	31 (26)
Literate	89 (74)
Below primary	6 (5)
Primary	7 (6)
Middle	11 (9)
Matriculation	36 (30)
10+2	14 (11)
Graduate and above	15 (13)
Gender	
Male	103 (86)
Female	17 (14)
Head of family	
Self	91 (76)
Other	29 (24)
Phone connection	98 (82)
Primary occupation of the respondents	
Agriculture	29 (24)
Agriculture +Business	12 (10)
Agriculture +Government employment	15 (13)
Agriculture + Private employment	5 (4)
Other	19 (16)
Land cultivation	
Self	120 (100)
Average Experience of the respondent in farming (in years)	19.37+ 15.25
Family type	
Joint	28 (23)
Nuclear	92 (77)
Family size	
Average family Size (No.)	5.17+1.79
Male	2.21+1.08
Female	1.66+1.15
Children's	1.12+1.15

**Figures in parentheses are percentages, Categorization done through Singh cube root method (1975)*

Table 2 outlines the primary occupations of 465 individuals, with 52% engaged in agriculture, including 35% male and 16% female participants. Government employment involves 11% of the sample, with 10% males and 1% females. Private employment accounts for 13% of the group, predominantly male (12%), while 1% are female. Business activities involve 5%, mostly males (4%), and a small percentage of females (1%). Labor work makes up 16% of the total, with only males (9%) involved, while 3% are engaged in other unspecified occupations, all of whom are male. This data highlights a higher male participation across most sectors, particularly in agriculture, labor, and business. The significant male dominance in agricultural and employment sectors underscores persistent gender imbalances, necessitating targeted interventions to promote gender equity. Addressing these disparities is crucial for enhancing productivity and economic growth. Women constitute about 43% of the agricultural labor force globally, yet they are often over-represented in unpaid and seasonal work, receiving lower wages than men for similar tasks (Belay, 2016). Addressing these barriers through policies aimed at enhancing women's access to resources, training, and support could contribute to more equitable economic development in the region.

Table 2: Occupation status of respondent's family members

Parameter	Total (N= 465)
Agriculture	**237 (52)**
Male	161 (35)
Female	76 (16)
Government employment (% members)	**54 (11)**
Male	49 (10)
Female	5 (1)
Private employment	**60 (13)**
Male	57 (12)
Female	3 (1)
Business	**22 (5)**
Male	19 (4)
Female	3 (1)
Labour	**76 (16)**
Male	42 (9)
Female	0
Any other	**16 (3)**
Male	16 (3)
Female	0

**Figures in parentheses are percentages and are rounded off*

The table presents data on land holdings for 120 farmers over three consecutive years (2015-16, 2016-17, and 2017-18). The average operational land holding remained consistent at 1.74 hectares, with an average owned land of 1.76 hectares. Farmers leased in an average of 0.48 hectares and leased out a minimal amount (0.01 hectares). Irrigated land holdings averaged 1.55 hectares, while unirrigated land averaged 1.41 hectares. Additionally, 83% of farmers had fragmented land, with an average of 2.79 land fragments per farmer. The data highlights stable landholding patterns, with a high degree of land fragmentation. Land fragmentation presents significant challenges to agricultural efficiency and productivity, as evidenced by various studies. While some research indicates that fragmentation can lead to higher production costs and lower yields (Latruffe and Piet, 2013). And also small fragmented farm size may have affected the land use pattern, as they are not viable for agriculture, as also explained by Sharma (2015).

Table 3: Distribution of respondents on the basis of average operational landholdings

Parameter	Total (n= 120)		
	2015-16	2016-17	2017-18
	Mean ± SD	Mean ± SD	Mean ± SD
Average operational land holding (in ha)	1.74±1.43	1.74±1.43	1.74±1.43
Owned land	1.76±1.49	1.76±1.49	1.76±1.49
Leased in	0.48±0.23	0.48±0.23	0.48±0.23
Leased out	0.01±0.01	0.01±0.01	0.01±0.01
Average irrigated land holding	1.55±1.13	1.55±1.13	1.55±1.13
Average unirrigated land holding	1.41±0.85	1.41±0.85	1.41±0.85
Parameter	**Total (n= 120)**		
Land fragments (% farmers)	99 (83)		
Average no. of fragments	2.79±1.98		

The extension contacts of 120 farmers and their levels of awareness and utilization of various agricultural advisory sources are given in table 4. Most farmers were aware of and utilized fertilizer dealers (98%) and pesticide dealers (98% aware, 96% utilizing). The Department of Agriculture had a moderate reach, with 63% awareness and 61% utilization. Progressive farmers were also a notable source, with 76% awareness and 74% utilization. However, fewer farmers were in contact with extension officers (7% for both awareness and utilization), and only a small percentage were aware of or utilized resources from the State Agriculture University (3% aware, 1% utilization) and Krishi Vigyan Kendra (32% aware, no utilization). This data suggests that private sector sources, such as dealers, play a dominant role in extension services, while institutional sources are underutilized. This data indicates that private sector sources, such as dealers, play a dominant role in providing extension services, while institutional sources remain underutilized. Enhancing the outreach and effectiveness of institutional advisory services could improve overall agricultural support for farmers. Programs like agriclinics in India demonstrate how private enterprises can effectively supplement public services, providing farmers with reliable alternatives (Glendenning *et al*., 2011).

Table 4: Distribution of respondents on the basis of extension contact

Extension Contact	Total (n= 120)
Department of Agriculture	
Awareness	75 (63)
Utilisation	73 (61)
Fertilizer Dealer	
Awareness	118 (98)
Utilisation	118 (98)
Pesticide Dealer	
Awareness	118 (98)
Utilisation	115 (96)
Extension Officer	
Awareness	8 (7)
Utilisation	8 (7)
Progressive Farmer	
Awareness	91 (76)
Utilisation	89 (74)
State Agriculture University	
Awareness	4 (3)
Utilisation	1 (1)
Krishi Vigyan Kendra	
Awareness	38 (32)
Utilisation	0

**Figures in parentheses are percentages and rounded off*

The data presented in table 5 indicates that, on average, farmers in the sample are located 3.41 km from the nearest market, with substantial variation (± 2.56 km), suggesting that market access is relatively convenient but variable. The distances to the nearest pesticide shop (1.89 ± 1.45 km), fertilizer shop (1.91 ± 1.42 km), and seed store (1.93 ± 1.44 km) are quite similar, reflecting relatively easy access to essential agricultural inputs. However, the average distance to the nearest department of agriculture is notably higher at 5.10 km (± 4.85 km), indicating that access to government agricultural services might be more challenging for some farmers, potentially affecting their ability to seek formal assistance and guidance.

Table 5: Average distance from village to the important places

Distance (in Km)	Total (n= 120)
Nearest market	3.41±2.56
Nearest pesticide shop	1.89±1.45
Nearest fertilizer shop	1.91±1.42
Nearest department of agriculture	5.10±4.85
Nearest seed store	1.93±1.44

Table 6 shows that all 120 respondents sold agricultural produce, with varying participation and sales success across different market centers. Dyala Chak emerged as the most active market, with 30 respondents and 25 successful sales (83.3% participation), followed by Kathua, where 28 participants recorded 23 sales (82.1% participation). In contrast, Budhi, Hiranagar, and Palli Morh had lower participation rates of 80%. Sanji Morh and Paddiyari Seller demonstrated relatively higher sales efficiency, with 85% and approximately 83.3% participation, respectively. Overall, while sales were achieved across all centers, there is significant potential to enhance performance, particularly in the lower-performing markets.

Table 6: Markets where respondents market their agricultural produce

Parameter	Total (n= 120)
Sold agriculture produce	120
Market Centres	
Budhi	10 (8)
Dyala Chak	30 (25)
Hiranagar	10 (8)
Kathua	28 (23)
Palli morh	10 (8)
Sanji morh	20 (17)
Paddiyari seller	12 (10)

**Figures in parentheses are percentages and rounded off*

The results presented in Table 7 indicate that the electric tube well is the primary source of irrigation for 55% of the respondents. This significant reliance on electric tube wells suggests a trend towards modern irrigation methods, which likely enhances water efficiency and crop yields due to its attractive payback period, the results are supported by Bakshsh *et al.* (2016). Following this, 44% of respondents utilize canal water, indicating the importance of traditional irrigation systems still in practice. Seasonal river/nallah was the main source of irrigation for 31 per cent of the respondents, followed by 2 per cent of the respondents who had hand pump as the source of irrigation. Only 1 per cent of the respondents had a diesel tube well as the source of irrigation. Overall, these findings illustrate a diverse array of irrigation sources, reflecting both modern and traditional practices in the region. This diversity is crucial for understanding the agricultural landscape and the varying capacities of farmers to adapt to challenges such as climate variability.

Table 7: Distribution of respondents on the basis of source of irrigation

Parameter	Total (n=120)
Diesel tube well	1 (1)
Canal water	53 (44)
Electric tubewell	66 (55)
Seasonal river/nallah	37 (31)
Hand pump	2 (2)

**Multiple responses, Figures in parentheses are percentages*

The table 8 presents data on the possession of various agricultural tools among farmers, highlighting both the percentage of farmers who own each tool and the average number owned. The most commonly possessed tool is the pumpset, owned by 67% of farmers, followed by sprayers at 27% and tractors at 21%. Hoes are also widely held, with 40% ownership and an average of 1.62 per owner. Other tools, like the iron plough (13%), wooden plough (11%), and thresher (5%), show lower ownership percentages, indicating less prevalence. Notably, the rotavator has the lowest possession rate at just 1%. The data suggests that while certain tools like pumpsets and hoes are prevalent, there is potential for increased adoption of other equipment, which could enhance agricultural efficiency.

Table 8: Farm inventory possession by the respondent farmers

Parameter	Possession (% farmers)	Owned numbers
Iron plough	13	1±0
Wooden plough	11	1
Seed drill	2	1
Hoes	40	1.62±0.81
Cultivator	19	1
Levellers	18	1
Tractors	21	1.28±0.96
Sprayers	27	1.18±0.39
Pumpset	67	1.29±0.72
Rotavator	1	1
Tractor trolley	18	1.33±1.03
Thresher	5	1±0

Factors affecting changes in land use pattern from 2015 to 2018

The data presented in table 9 outlines the factors affecting the area under food crops, non-food crops, and total cropped area over three agricultural years (2015-16, 2016-17, and 2017-18).

For food crops in 2015-16, significant factors include on-farm income (β=4.57, $p<0.001$) and net irrigated area (β=1.241, $p<0.001$), with an R^2 of 0.898 indicating a strong model fit. This suggests that increased income and access to irrigation are crucial for enhancing food crop production. Investments in irrigation not only improve food security but also empower women and promote better nutrition through diversified food production (Descarrega, 2015). In 2016-17, on-farm income again significantly influenced the area (β=1.78, $p<0.001$), along with owned land (β=-2.36, p=0.010), with a higher R^2 of 0.965 further underscores the model's robustness, suggesting that despite owning land, other factors may limit crop area expansion (Zabel *et al.*, 2019). For 2017-18, on-farm income remained significant (β=1.36, $p<0.001$), while net irrigated area negatively affected the area under food crops (β=-0.346, p=0.035). This pattern indicates potential challenges in water management or distribution that could adversely affect food crop production, maintaining a strong R^2 of 0.969.

For non-food crops**,** the 2015-16 analysis showed low significance with only area sown more than once (β=0.076, p=0.12), resulting in a low R^2 of 0.339. In 2016-17, significant factors included kharif season fertilizer expenditure (β=5.41, $p<0.001$) and cultivation expenditure (β=-3.99, $p<0.001$), yielding an R^2 of 0.670. For 2017-18, net area sown was significant (β=0.225, p=0.001), with a modest R^2 of 0.604, suggesting ongoing variability in non-food crop cultivation practices (Paria *et al.*, 2022).

For total cropped area, the 2015-16 model indicated strong factors like net area sown (β=2.148, $p<0.001$), resulting in an R^2 of 0.922. In 2016-17, owned land (β=0.378, p=0.014) and net area sown again showed strong significance (β=1.66, $p<0.001$), with an R^2 of 0.870. The 2017-18 analysis revealed occupation (β=0.224, p=0.024) and net area sown (β=1.945, $p<0.001$) as significant, achieving an R^2 of 0.934. This stability across years highlights the importance of both area sown and land ownership in shaping agricultural outcomes. The findings are in accordance with the findings of Ahmed *et al*. (2018).

Overall, on-farm income and net area sown consistently emerged as key factors across the years, while net irrigated area showed both positive and negative effects, emphasizing its complex role in agricultural productivity. These findings underscore the dynamic interactions between economic factors, resource availability, and agricultural practices, emphasizing the need for tailored interventions to support farmers in optimizing crop production.

Table 9: Factors affecting changes in land use pattern from 2015 to 2018.

Year 2015-16					
Factors affecting area under food crops					
Coefficient					
S. No.	**Model**	**B**	**Std. error**	**t-value**	**Sig.**
1.	(Constant)	0.001	0.512	0.001	0.999
2.	Age (X1)	0.018	0.006	2.965	0.004
3.	Family size (X3)	-0.166	0.060	-2.785	0.006
4.	On-farm income (X12)	4.57	0.001	6.526	0.001
5.	Owned land (X5)	-0.510	0.152	-3.359	0.001
6.	Net irrigated area (X18)	1.241	0.260	4.480	0.001
7.	Area sown more than once (X20)	0.745	0.105	7.064	0.001
8.	Rabi season cultivation expenditure (X15)	-9.45	0.001	-2.699	0.008
9.	Rabi season fertilizer expenditure (X17)	9.78	0.001	3.189	0.002
R^2=0.898 & Adjusted R^2=0.880					
Factors affecting area under non-food crops					
1.	(Constant)	0.075	0.179	0.422	0.674
2.	Area sown more than once (X20)	0.076	0.030	2.561	0.12
R^2=0.339 & Adjusted R^2=0.224					
Factors affecting total cropped area					
1.	(Constant)	0.745	0.474	1.572	0.119
2.	Owned land (X5)	0.378	0.151	2.502	0.014
3.	Net irrigated area (X18)	-0.996	0.278	-3.582	0.001
4.	Net area sown (X19)	2.148	0.184	11.681	0.001
R^2= 0.922& Adjusted R^2=0.907					
Year 2016-17					
Factors affecting area under food crops					
1.	(Constant)	-0.074	0.293	-0.251	0.802
2.	On-farm income (X12)	1.78	0.001	4.142	0.001
3.	Owned land (X5)	-2.36	0.089	-2.636	0.010
4.	Net area sown (X18)	1.327	0.090	14.708	0.001
5.	Area sown more than once (X20)	0.297	0.070	4.266	0.001
R^2=0.965 & Adjusted R^2=0.961					
Factors affecting area under non-food crops					
1.	(Constant)	0.052	0.133	0.388	0.699
2.	Type of family (X3)	0.148	0.072	2.409	0.043
3.	Kharif season fertilizer expenditure (X16)	5.41	0.001	5.322	0.001
4.	Kharif season cultivation expenditure (X14)	-3.99	0.001	-3.549	0.001
R^2=0.670 & Adjusted R^2=0.611					

Factors affecting total cropped area					
1.	(Constant)	0.511	0.618	0.828	0.410
2.	Net irrigated area (X_{18})	-0.768	0.337	-2.275	0.025
3.	Net area sown (X_{19})	1.66	0.209	7.956	0.001
R^2=0.870 & Adjusted R^2=0.847					
Year 2017-18					
Factors affecting area under food crops					
1.	(Constant)	-0.044	0.276	-0.159	0.874
2.	On-farm income (X_{12})	1.36	0.001	3.36	0.001
3.	Net irrigated area (X_{18})	-0.346	0.162	-2.137	0.035
4.	Net area sown (X_{19})	1.38	0.089	15.572	0.001
5.	Area sown more than once (X_{20})	0.273	0.066	4.153	0.001
R^2=0.969 & Adjusted R^2=0.965					
Factors affecting area under non-food crops					
1.	(Constant)	0.093	0.170	0.544	0.587
2.	Net area sown (X_{19})	0.225	0.066	3.416	0.001
3.	Area sown more than once (X_{20})	-0.80	0.041	-1.959	0.05
R^2=0.604 & Adjusted R^2=0.532					
Factors affecting total cropped area					
1.	(Constant)	0.200	0.432	0.462	0.645
2.	Occupation (X_9)	0.224	0.098	2.294	0.024
3.	Net irrigated area (X_{18})	-0.590	0.247	-2.390	0.019
4.	Net area sown (X_{19})	1.945	0.167	11.632	0.001
R^2=0.934 & Adjusted R^2=0.922					

**All figures are significant*

Constraints faced by the respondents in crop production

Different constraints which hinder the cultivation of crops have been grouped in Table 10.

(a) Natural Constraints: The most significant challenge is insect/pest and disease attacks, affecting 98% of farmers. Weather variability (70%) and erratic rainfall (49%) are also notable issues, while less land fertility impacts 48% of respondents. This vulnerability to climatic fluctuations calls for adaptive strategies, such as resilient crop varieties and climate-smart agricultural practices, to enhance productivity and sustainability.

(b) Social Constraints: A lack of available labor is reported by 49% of farmers, along with 43% noting the limited working capability of available labor. Additionally, 34% face challenges due to mismanagement of family labor. Labor availability and capability, point to an urgent need for initiatives that support labor management and skill development. This is essential for ensuring timely agricultural operations and maximizing productivity and these findings are supported by Arowolo *et al*. (2013) and Lyocks *et al*. (2013).

(c) Economic Constraints: A lack of capital is a concern for 56% of respondents, and 57% report insufficient irrigation facilities, highlighting economic limitations on agricultural productivity. Addressing these issues through accessible credit facilities and improved irrigation infrastructure could significantly enhance agricultural productivity. The findings are in accordance with the findings of Viswanatha *et al*. (2014a) and Hassan *et al*. (2014) who found the less irrigation facility, lack of availability of capital, rainfall, lack of technology for cultivation, sowing and other agriculture activities were the factors which influence changes in land use pattern.

(d) Technical Constraints: Seventy-six percent of farmers express a lack of technical knowledge, while 98% feel the absence of training and demonstration severely affects their operations. Furthermore, 36% report low adoption rates of recommended technologies, and 58% cite the high cost of improved technology as a barrier. Providing farmers with training and access to information on best practices and technologies can empower them to adopt more effective farming methods and increase their resilience to various constraints.

Overall, the data indicates that farmers are predominantly hindered by pest-related issues, inadequate technical support, and economic constraints, which collectively impact their agricultural productivity.

Table 10: Constraints faced by the respondents in crop production

Sr. No.	Constraints	Total (n= 120)
A	**Natural constraints**	
1.	Less fertility of land	57 (48)
2.	Weather variability	84 (70)
3.	Erratic rainfall	59 (49)
4.	Insects/pests and disease attacks	118 (98)
B	**Social constraints**	
1.	Less availability of labour at a time	59 (49)
2.	Less working capability of labour	52 (43)
3.	Mismanagement of family labour	41 (34)
C	**Economic constraints**	
1.	Lack of availability of capital	67 (56)
2.	Lack of proper facility of irrigation	68 (57)
D	**Technical constraints**	
1.	Less technical knowledge	76 (63)
2.	Lack of training and demonstration	118 (98)
3.	Less adoption of recommended technology	43 (36)
4.	Costly improved technology	69 (58)

**Multiple responses, Figures in parenthesis are percentages.*

Conclusion

The changes in land use patterns can be attributed to a variety of factors, including age, on-farm income, net irrigated area, and various expenditures associated with Rabi and Kharif seasons. These elements significantly influence agricultural practices and productivity. Additionally, the constraints faced by respondents, such as pest and disease pressures, labor shortages, inadequate irrigation facilities, and insufficient training, present substantial barriers to optimal crop production. Addressing these factors and constraints through targeted interventions and policies will be essential for enhancing agricultural productivity and ensuring sustainable land use in the region.

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