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Income diversification of farm households and its determinants in Jammu and Kashmir region of India

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Abstract

Income diversification is increasingly important for farm households in India due to rising climate risks, small landholdings, and income instability. This study examines the level and determinants of income diversification among farm households in Jammu & Kashmir and Ladakh. A multistage random sampling technique was used to select 1,410 respondents across sub-tropical, intermediate, temperate, and cold arid agro-climatic zones. The Simpson Index of Diversity (SID) was used to measure income diversification, and a multiple linear regression model was applied to identify its determinants. The mean SID values were 0.30, 0.32, 0.55, and 0.80 across the respective zones, indicating higher diversification in temperate and cold arid regions. Regression results revealed that agro-climatic conditions, unirrigated landholding, landholding size, number of land fragments, and access to government schemes such as PM-Kisan significantly influenced diversification. The findings suggest that climatic vulnerability and resource constraints drive households towards diversified income strategies. The study provides important policy insights for promoting sustainable rural livelihoods and enhancing farm resilience.

Keywords: Agro-climatic zones, farm households, income diversification, Simpson's index

Introduction

Since over 70% of Indians depend on agriculture directly or indirectly and face difficulties finding work, diversification is important for the country's people [1]. In the rural hinterland, hidden unemployment is caused by the rapid population increase and the agriculture sector's modest expansion. Indian landholding has struggled with the ongoing decrease in average landholding size, which has mostly led to tiny and fragmented holdings and poor per capita income [2]. The unpredictability of the monsoon and the availability of just 60% of rain-fed land are additional problems for rural poor people. Another issue that has an impact on farmers' life is climate change. The frequency of irregular weather instances and temperature increases are the key indicators of the variability in climatic parameters. Varying industries would see varying repercussions of climate change. Due to its utter reliance on the weather and the fact that the majority of marginal and small farmers depend on it for their living, agriculture is one sector of the economy that will have a more complicated reaction to climate change. The Himalayan area is said to be more adversely affected by climate. The whole region's native population depends mostly on agricultural operations for

their subsistence and revenue. Climate change will have a direct impact on these millions of people's lives if the agricultural situation changes. These circumstances necessitate a survival-led approach for rural families afflicted by it, while an opportunity-led strategy is required for those who are rich and wish to diversify to raise their earning and use their expenditures [3, 4, 5]. Small and marginal farmers have the opportunity to diversify their operations in order to transition from subsistence to commercial farming. Increased growth, family food security, and income stability are all benefits of diversification since the risks associated with varying levels of output and market prices are reduced to a minimum. Researchers have seen a significant change in farm households' reliance on non-farm income in developing nations [1]. Therefore, having a built-in non-farming income-generating activity to support and balance is crucial for successful farming. These additional (non-farming) income-generating activities support the expansion of rural livelihoods and agricultural production, eradicating poverty, and lowering inequality. Numerous studies from developing nations highlight the significance of rural diversification methods to non-farm activities in contrast to a solely on-farm approach, which has enormous potential to

increase farmers' income and reduce conditions like poverty and inequality^[1]. The agriculture industry may have fewer current and upcoming obstacles if resources are optimised through strategic allocation. The goal of the study is to comprehend the players and elements required to promote income diversification. In order to provide researchers more opportunities to consider and address these issues, this study is focused on analyzing the elements that determine the sources of income diversification for farmers. By doing so, it will help to alleviate the suffering of rural families and support the rise in farmers' actual income.

Objectives

1. To find out the level of income diversification of farm households in study area
2. To find out factors affecting income diversification

Limitations of the study

Since there were only 1410 respondents in the study, it was challenging to generalise the findings to the entire population.

Methodology

In erstwhile state of Jammu and Kashmir, the current research investigation was carried out. Ladakh, Jammu, and Kashmir are the three divisions of the state. The study was designed to examine all four agro-climatic regions of the once united state of Jammu and Kashmir, which has since been partitioned into the Union Territories of Jammu & Kashmir and Ladakh. This led to the selection of the Ladakh division of Ladakh and the Jammu division of Jammu & Kashmir for the research of farming techniques. Consequently, the division has been split into three agro-climatic zones: the Sub-tropical Zone (300 to 1000 metres above mean sea level), the Intermediate Zone (1000 to 1500 metres above mean sea level), and the Temperate Zone (>1500 metres above mean sea level). For cold arid zone, Ladakh division was selected.

Collection of data: The primary data was collected through semi-structured interview schedule in selected villages of Jammu and Ladakh region.

Sampling Plan: Multistage random sampling method was

used to select the respondents. In first step, three blocks from each agro-climatic zone namely Temperate, Intermediate, Sub-Tropical and Cold Arid of J&K state were selected. This study was planned for the sample size of 1440 farmers but in actual had 1410 respondents, as one of the randomly selected blocks in Leh district (under cold arid region of Ladakh) was having only six villages. Therefore, all the six villages were selected for the study.

Analytical techniques: The income diversification was calculated by Simpson's Index of Diversity (SID). The SID takes into account both the number of sources of income and how equally they are distributed. This validates the SID's selection in this study above other diversity metrics. The SID is a number between zero and one. Therefore, 0 represents specialization and 1 represents the extreme of diversity. The household is more diverse, if value is closer to one.

General formula for SID:

$$SID = 1 - \sum P_i^2$$

Where,

SID=Simpsons Index of Diversity, n =number of income sources, P_i =Proportion of income coming from the source i , the value of SID ranges from Zero (0) to One (1), however, if there is only one Source of Income, $P_i=1$, then $SID=0$.

Model Specification: The theoretical model explaining the dependence of Simpson's index on independent variables is represented as below:

$$SID_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_n X_n + \epsilon_i$$

Where:

- SID_i = Simpson Index of household i
- X = explanatory variables
- ϵ_i = error term

Factors affecting diversification of income of farm households: To find out the factors affecting diversification of income of farm households, Step wise multiple linear regression model was applied with following variables (Table 1).

Table 1: Factors affecting income variability of farm households

Education level	:	Illiterate=0;Primary=1;Secondary=2;Graduation=3;PG & above=4
Type of family	:	Joint=1, Nuclear=0
Age	:	Age is considered for head of household (in years)
Farming experience	:	in years
KCC	:	Possession of Kisan credit card (KCC)=0 No possession of KCC =1
Social membership	:	It refers to the membership in any village organisations like the village panchayat etc.
Crop insurance	:	Opted for crop insurance=1 Not opted for crop insurance=0
Kisan Nidhi	:	Beneficiary =1 Non-beneficiary=0
Distance from the local market	:	in km
Satisfaction with farming	:	Satisfied=1, Not satisfied=0
Family expenditure	:	Monthly expenditure of household (in Rs.)
Ecological zone	:	Sub-tropical or Intermediate of Temperate or Cold arid
Family members	:	Number of family members in household
Landholding	:	in ha
Irrigated land holding	:	in ha
Unirrigated land holding	:	in ha
Number of holding	:	No. of fragments of land holding

Results

The results revealed that the diversification of income is affected by availability of resources, agro-climatic zones and institutional support in which various parameters were used for proper analysis of the study.

Descriptive statistics: The results describe the socio-economic characteristics of the sampled farm households. The mean age of respondents in the sub-tropical, intermediate, temperate, and cold-arid regions was approximately 56, 52, 50, and 44 years, respectively. Similarly, the average farming experience of the household head was about 36, 32, 32, and 28 years across these regions (Table 2).

The average family size was nearly six members in all

regions [6, 7]. The mean distance from the local market was 7.12 km in the sub-tropical region, 14.18 km in the intermediate region, 12.17 km in the temperate region, and as high as 51.04 km in the cold-arid region. This variation may be attributed to the scattered settlement patterns and lower population density in hilly and cold-arid areas, in contrast to the relatively dense and accessible sub-tropical plains.

The average landholding size was 0.87 ha, 0.77 ha, 0.87 ha, and 0.65 ha in the sub-tropical, intermediate, temperate, and cold-arid regions, respectively. These findings are in line with reported that the majority of farmers fall under the marginal and small landholding categories, typically possessing less than 1 hectare of land [8, 9].

Table 2: Descriptive statistics of respondent farm households

Particulars	Sub-tropical (360)	Intermediate (360)	Temperate (360)	Cold Arid (330)
Age of respondent (years)				
Mean	55.95	51.72	49.86	44.41
Standard Deviation(s)	12.89	11.82	12.65	11.20
Skewness	0.022	0.40	0.41	0.44
Kurtosis	-0.424	0.12	-0.07	-0.53
Lowest Score	22	24	24	24
Highest Score	90	85	90	80
Farm experience (years)				
Mean	36.48	31.86	31.99	27.5
Standard Deviation(s)	13.62	12.24	12.11	10.96
Skewness	0.079	0.46	0.38	0.047
Kurtosis	-0.25	0.03	-0.29	-0.95
Lowest Score	0	0	10	5
Highest Score	70	65	70	60
Family size				
Mean	5.82	6.29	5.98	5.74
Standard Deviation(s)	2.23	2.79	2.15	1.32
Skewness	1.31	2.08	1.60	0.149
Kurtosis	2.69	7.65	7.88	-0.79
Lowest Score	1	2	2	3
Highest Score	15	22	22	9
Distance of farm from local market (km)				
Mean	7.21	14.18	12.17	51.04
Standard Deviation(s)	3.38	10.65	17.74	34.41
Skewness	0.068	0.40	3.35	0.53
Kurtosis	-0.38	-1.44	11.44	-1.28
Lowest Score	1	1	1	15
Highest Score	15	35	90	116
Landholding (ha)				
Mean	0.87	0.77292	0.87	0.65
Standard Deviation (s)	1.24	0.63972	0.75	0.42
Skewness	5.08	2.07914	2.70	2.28
Kurtosis	31.45	4.29405	10.0	12.68
Lowest Score	0.1	0.05	0.15	0.1
Highest Score	11	3	6	4

Diversification of income sources: The results illustrate the extent of income diversification among farm households across different regions. Only 30%, 34%, 11%, and 10% of households in the sub-tropical, intermediate, temperate, and cold-arid regions, respectively, were exclusively dependent on agriculture as their primary source of income (Table 3). Similar trends have been observed that 24% and 22% of farm households, respectively, relied solely on agriculture [10, 11].

The relatively lower dependence on agriculture in temperate

and cold-arid regions may be attributed to harsh climatic conditions that limit agricultural productivity and reduce the feasibility of farming and allied activities for a significant part of the year.

With regard to off-farm income sources, a higher proportion of households in the sub-tropical region (31%) depended on government employment or pensions. In the intermediate region, business activities constituted the major source of income (32%). In contrast, households in temperate and cold-arid regions primarily relied on wage labour for their

livelihood. This variation can be explained by differences in infrastructure development, market access, and employment opportunities, which are relatively better in sub-tropical and

intermediate regions compared to the more remote and climatically harsh temperate and cold-arid areas.

Table 3: Diversification of income sources of sampled farm households

Particulars	Sub-tropical (360)	Intermediate (360)	Temperate (360)	Cold Arid (330)
On farm income				
Exclusively dependent on agriculture	107 (30)	121 (34)	39 (11)	36 (10)
Crop Production	360 (100)	360 (100)	360 (100)	330 (100)
Horticulture	0 (0.00)	0 (0.00)	93 (26)	84 (25)
Livestock	284 (79)	288 (80)	322 (89)	322 (98)
Sericulture	0 (0.00)	15 (4)	0 (0.00)	0 (0.00)
Sheep & Goat rearing	7 (2)	21 (6)	176 (49)	16 (5)
Apiculture	0 (0.00)	0 (0.00)	10 (3)	0 (0.00)
Vermicompost	1 (0.3)	0 (0.00)	2 (1)	0 (0.00)
Poultry	4 (1)	0 (0.00)	3 (1)	1 (0.3)
Fisheries	0 (0.00)	0 (0.00)	1 (0.2)	0 (0.00)
Off farm income	253 (70)	239 (66)	321 (89)	322 (98)
Govt. (Employed+Pension)	111 (31)	66 (18)	79 (22)	12 (4)
Private job	54 (15)	49 (14)	44 (12)	142 (43)
Business	85 (24)	116 (32)	44 (12)	156 (47)
Labour Migrating	2 (1)	0 (0.00)	0 (0.00)	24 (7)
Labour Local	62 (17)	55 (15)	198 (55)	102 (31)
Figures in parentheses indicate percentages				

Average annual expenditure: The average annual expenditure of farm households was ₹104, 250 in the sub-tropical region, ₹144, 300 in the intermediate region, ₹132,

210 in the temperate region, and ₹129, 050 in the cold-arid region (Table 4).

Table 4: Average annual expenditure of respondent farm households

Expenditure (Rs.)	Zone / No. of households			
	Sub-tropical (360)	Intermediate (360)	Temperate (360)	Cold Arid (330)
Mean	104250	144300	132210	129050.90
Standard Deviation (s)	62881.00	74917.96	62922.00	82430.44
Skewness	1.62	1.06	1.16	12.36
Kurtosis	4.85	1.93	4.99	195.199
Lowest Score	18000	12000	17000	12000
Highest Score	420000	420000	3520000	1440000

Average annual income: The average annual income of farm households from different sources. The overall average income from farming, government jobs/pensions, private jobs, business, migrating labour, and local labour was ₹181, 254, ₹102, 000, ₹96, 923, ₹129, 803, ₹69, 500, and ₹78,

346, respectively (Table 5). Except in the cold-arid region, where income from business activities was the highest, government employment/pension emerged as the dominant income source in the remaining regions.

Table 5: Average annual income of respondent farm households

Zone	Farming	Govt. job /Pension	Private Job	Business	Migrating Labour	Local labour
Sub-tropical	85160.00	504107.14	158400.00	171219.51	0.00	120193.55
Intermediate	89050.00	419909.09	198857.14	181706.90	0.00	129818.18
Temperate	90280.00	612151.90	114925.71	166090.91	0.00	106130.65
Cold-arid	181254.55	102000.00	96923.08	129803.92	69500.00	78346.15

Diversity Index: The income diversification levels across different agro-climatic regions using the Simpson Index of Diversity (SID). The mean SID values were 0.30, 0.32,

0.55, and 0.80 in the sub-tropical, intermediate, temperate, and cold-arid regions (Table 6, 7, 8, 9).

Table 6: Diversification index of sampled farm households of subtropical region

SID	N=360
Minimum	0.00
Maximum	0.72
Mean	0.30
Std. deviation	0.19
Low (<0.21)	137(38.06)
Medium(0.21-0.49)	151(41.94)
High (>0.49)	82(20)

Table 7: Diversification index of sampled farm households of intermediate region

SID	N=360
Minimum	0.00
Maximum	0.68
Mean	0.32
Std. deviation	0.19
Low (<0.13)	92(25.56)
Medium (0.13-0.51)	218(60.56)
High(>0.51)	50(13.89)

Table 8: Diversification index of sampled farm households of temperate region

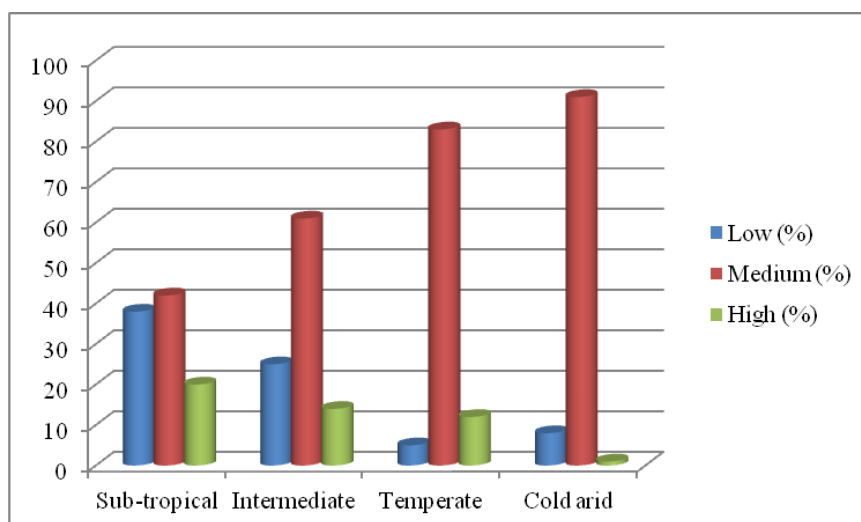
SID	N=360
Minimum	0.00
Maximum	0.79
Mean	0.55
Std. deviation	0.12
Low (<0.33)	18(5)
Medium (0.33-0.67)	299(83.06)
High (>0.67)	43(11.94)

Table 9: Diversification index of sampled farm households of cold-arid region

SID	N=330
Minimum	0.16
Maximum	0.88
Mean	0.80
Std. deviation	0.07
Low (<0.73)	25 (7.58)
Medium (0.73-0.87)	302 (91.52)
High (>0.87)	3(0.91)

of medium diversification. However, the higher SID values observed in temperate and cold-arid regions indicate a greater degree of income diversification. This can be attributed to the unfavorable climatic conditions in these regions, which increase the risks associated with agriculture and compel households to adopt multiple income sources as a risk mitigation strategy. These findings are highlighted the significant role of climate risk in influencing income diversification ^[1]. This illustrates the distribution of households across different levels of income diversification (fig.1.).

Most households across all regions fell under the category

**Fig 1:** Distribution of farm households according to level of income diversification

Factors affecting income diversification: The regression results indicate that agro-climatic conditions, particularly in cold-arid ($p < 0.001$) and temperate ($p < 0.001$) regions, have a significant positive effect on income diversification (Table 10). This may be due to the harsh and uncertain climatic conditions, which reduce agricultural productivity and encourage households to diversify their income sources as a coping mechanism ^[1].

Unirrigated landholding ($p < 0.001$) was also found to significantly influence income diversification. The lack of

irrigation increases the risk of crop failure, thereby pushing households to seek alternative income sources beyond agriculture.

The size of landholding ($p < 0.008$) and the number of land fragments ($p < 0.005$) were also significant determinants of diversification. Larger and more fragmented landholdings may enhance financial stability and risk-bearing capacity, enabling households to invest in multiple livelihood activities ^[12].

Table 10: Factors affecting Income diversification of farm households

Independent variables	Coefficient β	Std. Error	t-value	p-value	Model summary
(Constant)	0.278	.011	25.617	0.00	R Square=.627 Adjusted R Square=.625
Cold arid	0.521	.012	42.415	0.00*	
Temperate	0.219	.011	20.418	0.00*	
Unirrigated	0.002	.000	4.876	0.00*	
KCC	-0.035	.009	-3.808	0.00*	
Holding No	0.010	.004	2.783	0.05*	
Land holding	0.000	.000	-2.636	0.08*	
Kisan Nidhi	0.021	.010	2.069	0.04*	

*Significant at $p < 0.05$, **significant at $p < 0.05$

Access to institutional factors also plays an important role. Possession of a Kisan Credit Card (KCC) was found to have a negative effect on diversification, whereas access to government support schemes such as PM-Kisan (Kisan Samman Nidhi) showed a positive association with income diversification ($p < 0.039$). This suggests that direct income support from government schemes enhances the financial security of farmers and enables them to explore additional income-generating opportunities, thereby contributing to the broader objective of improving farmers' income in India.

Discussion

The observed pattern of income diversification across agro-climatic regions reflects broader processes of rural economic transformation. The relatively low dependence on agriculture, particularly in temperate and cold-arid regions, aligns with the structural shift described in the rural livelihood literature, where households increasingly combine farm and non-farm activities to stabilize income. This finding is consistent with the framework which conceptualizes livelihood diversification as a rational household strategy to manage risk, overcome market imperfections, and respond to limited agricultural opportunities ^[3]. In regions characterized by climatic constraints and limited agricultural productivity, such as the temperate and cold-arid zones, households are compelled to diversify into non-farm activities. This supports the argument that diversification is often "push-driven", where adverse conditions force households to seek alternative income sources. Conversely, in relatively better-endowed regions such as sub-tropical and intermediate zones, diversification may also be "pull-driven", arising from improved access to markets, infrastructure, and remunerative opportunities ^[5].

The significantly higher diversification index in temperate and cold-arid regions highlights the critical role of climatic risk in shaping livelihood strategies. In line with risk management theory, households facing greater production

uncertainty tend to allocate labour and resources across multiple income-generating activities to reduce income variability. This behaviour is consistent with the portfolio diversification principle in economics, where diversification minimizes risk exposure ^[3]. The findings also emphasized that environmental stress and vulnerability are key drivers of livelihood diversification in rural areas. In the present study, harsh weather conditions, shorter cropping seasons, and limited irrigation facilities increase the probability of agricultural failure, thereby encouraging

The positive association between landholding size and income diversification suggests that asset endowment plays a crucial role in enabling diversification. Households with larger landholdings are likely to have better access to credit, higher savings, and greater capacity to bear risk, which allows them to invest in non-farm enterprises. This finding supports the "asset-based approach" to livelihood diversification, which posits that access to physical and financial capital enhances households' ability to pursue multiple income streams. Similarly, the significance of land fragmentation indicates that smaller and scattered plots may reduce the efficiency of agricultural production, thereby incentivizing households to diversify. This aligns with the theory that inefficiencies in factor markets and production constraints encourage labour reallocation towards non-farm sectors. Households to diversify into wage labour, migration, and small-scale business activities.

The positive impact of government support schemes such as PM-Kisan (Kisan Samman Nidhi) on income diversification reflects the importance of institutional interventions in shaping rural livelihoods. Direct income transfers enhance liquidity and reduce financial constraints, enabling households to invest in alternative income-generating activities. This finding is consistent with the argument that improved access to capital and institutional support facilitates entry into non-farm sectors ^[5]. On the other hand, the negative relationship between Kisan Credit Card (KCC) access and diversification suggests that households with

better access to formal agricultural credit may remain more focused on farming activities. This indicates a specialization tendency among credit-access households, highlighting the trade-off between agricultural intensification and diversification.

The findings reveal that income diversification in the study area is driven by a combination of push (climatic risk, lack of irrigation, land fragmentation) and pull factors (government support, market opportunities, asset base). This dual nature of diversification is consistent with the theoretical distinction highlighted by emphasizing that diversification is not a uniform process but varies across regions depending on socio-economic and environmental conditions^[3, 5].

Conclusion

The study concludes that income diversification is significantly influenced by agro-climatic conditions, resource endowments, and institutional support. Households in climatically vulnerable regions exhibit higher diversification as a risk management strategy. Factors such as unirrigated land, land fragmentation, and access to government schemes play a crucial role in shaping diversification behaviour. The findings highlight the need for region-specific policies focusing on irrigation development, livelihood diversification programs, and strengthening rural non-farm opportunities to enhance income stability and resilience among farm households.

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