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Comparative livelihood vulnerability to climate change: Tribal and non-tribal farmers in Surajpur district of Chhattisgarh

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Abstract

The study was carried out in Surajpur district under agro climatic zone of northern hills Chhattisgarh state in the year 2024-25. Under examine the comparative analysis of climate change-induced livelihood vulnerability among tribal and non-tribal farming communities in the Surajpur district of Chhattisgarh. The results were reported by applying the multi linear regression. A total of 148 respondents were selected using percentage-based random sampling, and the data were analyzed using appropriate statistical techniques. The findings reveal that, on average, tribal households had 2.95 working members, whereas non-tribal households had 3.07. Non-tribal farmers demonstrated greater engagement in crop production, livestock rearing, and participation in MGNREGA activities compared to their tribal counterparts. Conversely, forest produce collection was more prevalent among tribal households. Significant disparities were observed in annual income levels, with non-tribal farmers earning an average of Rs. 301,274.37, compared to Rs. 221,815.37 among tribal farmers. Farm income was notably higher for non-tribal farmers Rs. 209,104.65 than tribal farmers Rs. 153,199.03. Livestock contributed Rs. 21,549.55 to non-tribal income and Rs. 15,393.87 to tribal income, while business activities generated Rs. 28,501.48 and Rs. 12,752.50 respectively. Expenditure patterns also varied, with tribal households spending an average of Rs. 188,556.33 annually, primarily on food, alcohol, and tobacco while non-tribal households spent Rs. 234,782.85, with a greater share allocated to agricultural inputs and essential services.

Keywords: Income, Employment, Livelihood, tribal and non-tribal

Introduction

India has the largest proportion of tribals in the world, next to Africa. India is home to a wide variety of distinct tribal communities. The year 2011 Census found that 10.45 crore people, or 8.6% of the overall population, are Scheduled Tribes (ST) and Over 705 different groups make up these communities, whereby about 90 percent of the communities that live in and around forest areas, occupying about 19 percent of the land of India (A. K. Singh, 2008).

In Chhattisgarh, tribal populations are concentrated in the northern hills and Bastar plateau, where forests cover over 44% of the state. The population includes STs (37%), SCs (22%), and OBCs (14%), with a density below 132 persons/km². Agriculture is the main livelihood for over 85% of people, though productivity is low, irrigation covers less than 30% of cropped area, and rice dominates 75% of cultivation. While both tribal and non-tribal communities depend on agriculture, tribes also rely heavily on forest produce, whereas non-tribes engage in wage labour. Despite numerous development programs, outcomes for tribal communities remain unsatisfactory, highlighting the need to assess gaps in livelihoods and promote equity and sustainable development (Khan and Chauhan 2020) [10].

The Many tribe members work as cultivators or agricultural labourers, making up a sizable share of the workforce in the primary sector, which is mainly agriculture. Tribes are now more represented in regular government occupations because to reservation rules, although they are still less prevalent than other groups in high-production industries like manufacturing and services. In order to augment their income, some tribal communities also work in traditional activities including hunting, gathering, and hill agriculture. Tribal employment in non-farm industries, such as low-paying temporary positions in the public sector and construction, is on the rise. However, this trend is frequently associated with reservation policies, implying that, in the absence of affirmative action, access to higher-paying positions may be restricted (Subhi).

The entrepreneurship skills of tribal women in Bastar, Chhattisgarh, where forests cover 75.54% of the area. Women, who form 80% of NTFP gatherers, contribute the largest share (65.62%) of household income from NTFPs through collection and processing, though men dominate marketing. Processing adds higher profits (53.79%) than selling raw produce, with Kalmegh yielding the highest margin (65.40%). However, women's share in the consumer rupee remains low (53-54%), which could be enhanced to 85-95% through training, market access, and sustainable harvesting practices (Acharya et. al., 2017) [2].

The tribal and non-tribal districts of Chhattisgarh showed higher diversification in tribal areas compared to non-tribal, though Surguja and Balrampur exhibited greater specialization. Overall, diversification indices across most crop groups remained low. That despite abundant natural

resources, farmers' economic progress is limited due to poor infrastructure, erratic rainfall, and lack of technological support. Suggested that improving irrigation, quality inputs, and technology dissemination to promote diversification into high-value crops and enhance farm incomes (Kaushal and Jain 2023) [9].

Objectives

- To examine the extent and characteristics of income, employment, and consumption patterns among tribal and non-tribal farming communities in the study area.
- To identify the major determinants of livelihood vulnerability and propose evidence-based policy interventions aimed at enhancing the income and employment adaptive capacity and resilience of tribal and non-tribal farmers.

Methodology

The study was conducted during 2024-25 in the Surajpur district of Chhattisgarh, Surajpur district have six blocks namely (Surajpur, Odagi, Bhaiyathan, Pratappur, Premnagar, and Ramanujnagar) out of which Premnagar, Pratappur and Odgi are selected purposively for study. The total six villages were selected purposively from selected three blocks namely, Premnager block- Raghunathpur, Kotal, from Pratappur block- Darhora and Sarhari and from Odgi block- Bhanvarkhah and Aanandpur for the study. The number of respondents from each village varies, with 30 Raghunathpur, 25 Kotal, 31 Sarhari, 34 Darhora, 15 Bhanvarkhoh and13 Anandpur. This results in a total of 148 respondents across all divisions by using percentage random sampling technique. The data provides insights into the tribal and non-tribal community participation in these areas. Primary data for the study were obtained from selected farmers through individual interviews using pre-tested schedules. Secondary data are collected from various government sources like; Directorate of agriculture, Directorate of land revenue, Directorate of economics & statistic govt. of Chhattisgarh, tribal affairs govt. of India and district profile of Surajpur.

Analysis

The following tools and techniques were employed, and an analysis has been carried out in simple average, probability packages, and MS Excel sheet for the study. Socio-economics and demographical feature was calculated by using simple arithmetic averages and percentages. Income, employment and consumption were examined through regression analysis and using simple arithmetic averages and percentages.

Income

The analysis of data is done keeping in view the objectives of the study. It is proposed to use both tabular and statistical methods for analysis. The following functional analyses were carried out to know the factors influencing income of selected samples by using the following multiple linear regression equations.

$$Y = a + b1X1 + b2X2 + b3X3 + b4X4 + \mu$$

Where,

Y = Gross family income (Rs./ year)	X2 = Total employment (Rs./annum)
a = Intercept	X3 = Working expenditure on crop and livestock(Rs./annum)
bi = Partial regression coefficient of respective explanatory variables (i = 1,2,n)	X4 = Working members (No.)
X1 = Gross cropped area (Ha)	μ = Error term

Employment

Data analysis is carried out with the study goals in mind. Both statistical and tabular approaches are suggested for analysis. Using the following multiple linear regression equations, the following functional analyses were performed to determine the factors impacting the employment of the chosen samples.

$$Y = a + b1X1 + b2X2 + b3X3 + b4X4 + \mu$$

Where,

Y = Gross family employment (Days)	X2 = Working expenditure (Rs. / year)
a = Intercept	X3 = Working members (No.)
bi = Partial regression coefficient of respective explanatory variables (i = 1, 2,…,n)	X4 = Number of livestock (No.)
X1 = Gross cropped area (Ha)	μ = Error term

Consumption

The study's goals are taken into consideration when analyzing the data. It is suggested that analysis be done using both statistical and tabular methods. The following functional analyses were performed using the following multiple linear regression equations to determine the factors impacting the consumption of chosen samples.

$$Y = a + b1X1 + b2X2 + b3X3 + u$$

Where,

Y = Total expenditure (Rs.)	X2 = Family size (No.)
a = Intercept	X3 = Capital assets (Rs.)
bi= Regression coefficient of respective explanatory variables, (z= 1,2,3)	u = Error term
X1 = Total income (Rs.)	

Garretts ranking method was used to investigate advantages, preferences, and changes of constraint orders into numerical scores. The constraints are arranged according to their severity from the respondent's point of view, which is the primary advantage of this method over conventional frequency distribution.

Percent position = 100 (Rij - 0.5)/ Nj)

Where,

- Rij = Rank given for ith constraint by jth respondents
- Nj = Number of constraints ranked by jth respondents

Results and Discussion

An overview of the socioeconomic standing of selected respondents, land holdings, cropping methods, irrigation, and family size was provided by the results. It also looked at the cost and returns, resource use efficiency, and major obstacles.

Table 1: Overview of sample farmers profiles.

S. No.	Particulars	Respondents		
		Tribal	Non - Tribal	Overall
1.	Number of households	80	68	148
2.	Family size (Average)	5	5	5
3.	Literacy percentages	65.50	75.21	70.00
4.	Average land holding (ha.)	1.36	2.46	1.86
5.	Area under irrigated (ha.)	0.72	1.84	1.23
6.	Rainfed agriculture area (ha.)	0.64	0.62	0.63
7.	Gross cropped area (ha)	2.08	4.30	3.09
8.	Net cultivated area (ha)	1.36	2.46	1.86
9.	Cropping intensity (%)	152.94	174.79	166.37

Comparative employment pattern under tribal and non-tribal farmers

Table 2, on average, non-tribal households have slightly more working members (3.07) than tribal households (2.95). Male participation was higher among non-tribals, while female participation was nearly equal in both groups. In crop production, both groups shows high engagement; tribal farmers contribute more workdays 94.31 but earn less Rs.19,066 wages compared to non-tribal farmers, who work fewer days 78.13 yet earn more Rs. 21,216. In livestock activities, tribal farmers put in more days 56.64 than non-tribals 49.98, but again their earnings are lower Rs. 6,769 and Rs. 7,562 respectively.

MANREGA employment shows stronger reliance among tribal households, who work more days 56.57 and earn more Rs.12, 719 than non-tribals 46.91 days and Rs. 11,715. Government jobs remain the least represented activity for both groups, but non-tribal households secure significantly higher earnings Rs. 47,412 compared to tribal households Rs. 25,400, reflecting better access to regular or better-paying positions. In business, tribal households participate less and work more days, but non-tribals earn more than double Rs. 28,501 and Rs. 12,753 respectively. Forest produce collection highlights the stronger dependence of tribal households, with higher participation 2.62 and 2.42 members, more workdays 82.59 of tribal and 69.17 days of non-tribal, and slightly higher earnings Rs. 11,165 and Rs. 10,598 respectively.

Table 2: Indicate a comparative employment pattern under Trible and Non- Trible Farmers

S. No.	Particulars	Numbers		Days		Wages	
		Tribal	Non -Tribal	Tribal	Non -Tribal	Tribal	Non -Tribal
1	Working members	2.95	3.07	-	-	-	-
a)	Male (no.)	1.56	1.67	-	-	-	-
b)	Female (no.)	1.38	1.39	-	-	-	-
2	Crop production	2.52	2.61	94.31	78.13	19066.36	21216.30
3	Livestock	1.31	1.54	56.64	49.98	6768.95	7562.26
4	MGNREGA	1.82	2.14	56.57	46.91	12718.76	11714.79
5	Government service	0.08	0.10	37.64	53.80	25400	47411.76
6	Business	0.30	0.35	83.39	50.80	12752.5	28501.48
7	Forest produce	2.62	2.42	82.59	69.17	11165.43	10597.57

Comparative employment pattern under tribal and non-tribal farmers by using model

The regression analysis of employment functions shows that for tribal farmers; the model has very high explanatory power with an R-square of 0.96. Non-farm employment emerges as the strongest positive determinant with a coefficient followed by livestock, service and business activities. In contrast, working expenditure shows a significant negative effect on employment, while MANREGA participation also exerts a small but significant negative influence. Gross cropped area and family workers are not statistically significant in the tribal model.

For non-tribal farmers, the model also fits well with an R-square of 0.89. Livestock was the most important factor while non-farm employment contributes positively but moderately. Service and business activities remain highly significant, confirming their role in generating employment. Similar to the tribal case, gross cropped area, working expenditure, and family workers are not significant. MANREGA participation has a negative coefficient with a marginal p-value, suggesting a near-significant substitution effect.

Table 3: Table shows the employment function of tribal and non-tribal farmers

Particulars	Trible farmers			Non - Trible farmers		
	Coefficients	Standard Error	P-value	Coefficients	Standard Error	P-value
Intercept	2.98***	0.35	2.243E-12	3.61***	0.59	1.08128E-07
X1 GCA	0.02	0.01	0.1421469	-0.01	0.02	0.426048109
X2 working expenditure	-0.06**	0.03	0.0457131	-0.02	0.04	0.632924605
X3 family worker	-0.03	0.02	0.2711091	0.05	0.03	0.191258927
X4 non-farm employment	0.49***	0.05	3.782E-13	0.13***	0.05	0.016657273
X5 Livestock	0.18***	0.02	1.568E-12	0.38***	0.09	0.000100463
X6 MNREGA	-0.03***	0.01	0.0021922	-0.04**	0.02	0.052975518
X7 Service and business	0.12***	0.00	3.834E-46	0.12***	0.00	6.95303E-29
R Square	0.96			0.89		

Note: indicates *** 1% significance level, **5% significance level

The income patterns of tribal and non-tribal farmers

Table 4, presented significant differences in income patterns between tribal and non-tribal farmers. On average, non-tribal farmers earn significantly more, with an annual income of Rs. 301,274.37 compared to Rs. 221,815.37 for tribal farmers. Farm income remains the backbone of livelihoods for both groups, though tribal farmers are proportionally more dependent on it. They earn Rs. 153,199.03 from agriculture and livestock, making up 71.06 percent of their total income, whereas non-tribal farmers earn Rs. 209,104.65, which accounts for 65.34 percent. Rice cultivation emerges as the dominant source of farm income, contributing 53.82 percent for tribal and 41.67 percent for non-tribal farmers. Non-tribal households, however, shows greater diversification with crops like wheat contributing 7.17 percent compared to only 1.48 percent for tribal farmers. Livestock income also favors non-tribal farmers, who earn Rs. 21,549.55 against Rs. 15,393.87 among tribal households.

Non-farm income plays a more prominent role for non-tribal farmers, contributing 34.65 percent of their total earnings compared to 28.93 percent for tribal farmers, reflecting better diversification and access to alternative livelihoods. Government service is the most important non-farm source for both, providing 11.78 percent of tribal and 14.81 percent of non-tribal income. Business income further widens the gap, with tribal farmers earning Rs. 12,752.50 compared to Rs. 28,501.48 among non-tribals. MANREGA wages are almost equal in absolute terms Rs. 11,741.73 for tribal and Rs. 11,714.79 for non-tribal households but form a larger share of tribal income due to their lower overall earnings. Across private jobs, support schemes, and miscellaneous sources, non-tribal farmers consistently report higher incomes, underscoring their stronger economic base and greater livelihood diversification compared to tribal households.

Table 4: Indicate the income patterns of tribal and non-tribal respondents

S. No.	Particulars	Tribal farmers		Non -Tribal farmers	
		Average (Rs.)	Percent	Average (Rs.)	Percent
1	**Own farm income**				
A.	**Crop production**				
i	Rice	116019	53.82	133338.05	41.67
ii	Black gram	6404	2.97	11184.48	3.49
iii	Wheat	3204.67	1.48	22962.54	7.17
	Other crops	12177.48	5.64	20070.00	6.27
ii	Livestock activities	15393.87	7.14	21549.55	6.73
	Total own farm income	153199.03	71.06	209104.65	65.34
B.	**Non- farm income**				
i	Business	12752.5	5.91	28501.48	8.90
ii	Government service	25400	11.78	47411.76	14.81
iii	Private job	4915.43	2.28	10597.57	3.31
iii	MNREGA	11741.73	5.44	11714.79	3.66
iv	Earning from government	6000	2.78	6000	1.99
v	Miscellaneous other	1556.66	0.72	6742.64	2.10
	Total non-farm income	62366.33	28.93	110880.02	34.65
	Total Income	221815.37	100	301274.37	100

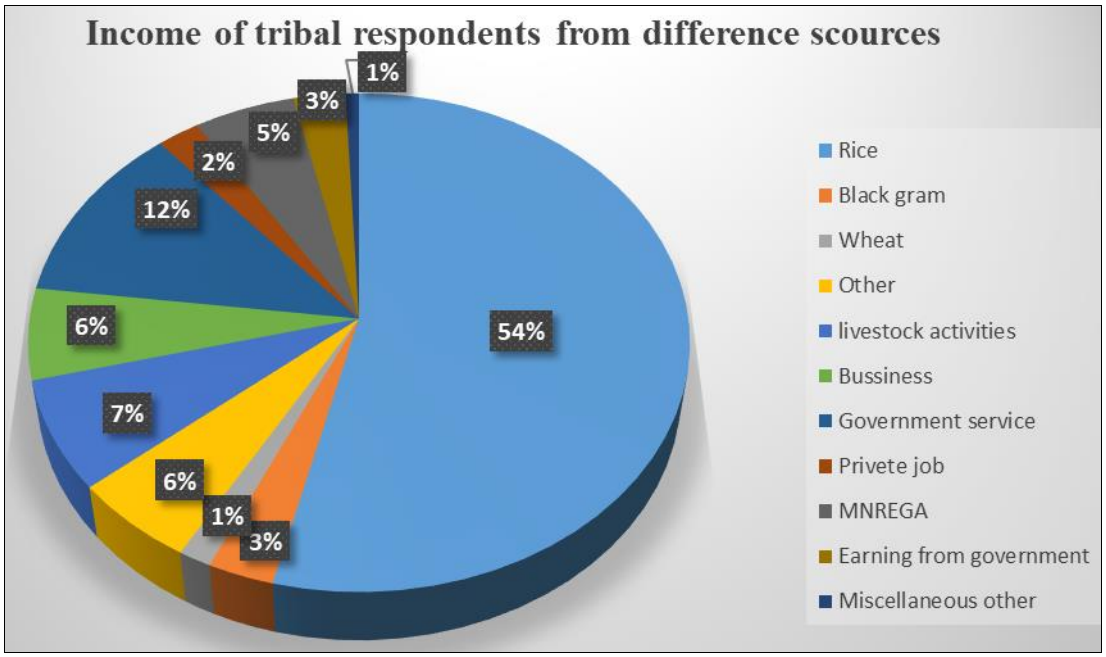

Fig 1: Indicate the income pattern of tribal respondents

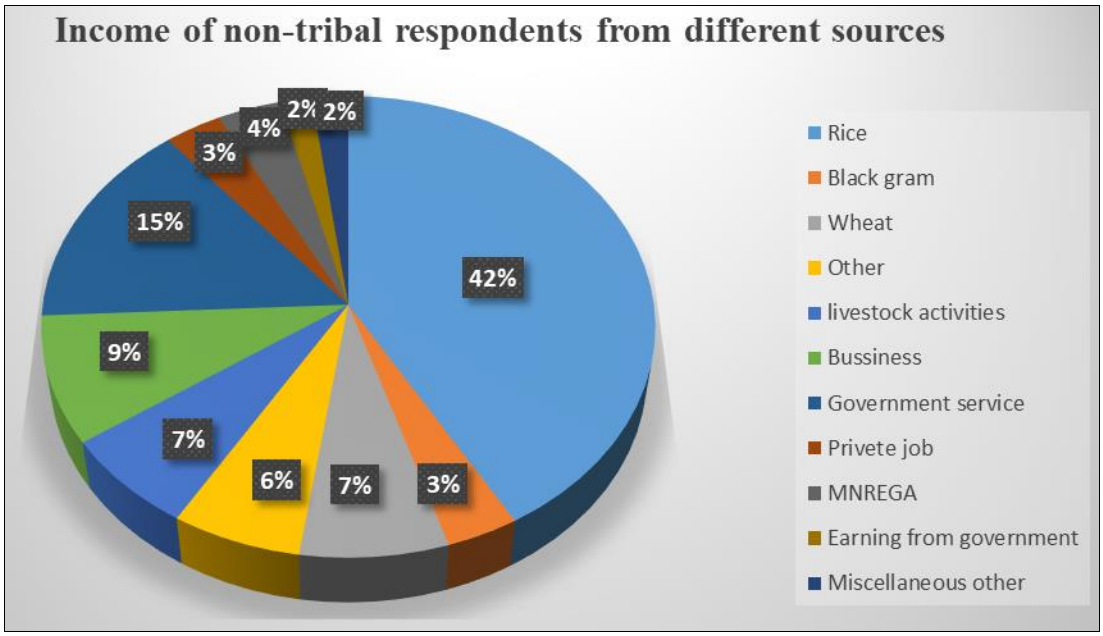

Fig 2: Indicate the income pattern of non-tribal respondents

The income pattern of tribal and non-tribal respondents by using model

Table 5, presents the regression analysis of income determinants for tribal and non-tribal farmers, both models showed a strong fit with R-square values of 0.94 and 0.93 respectively. For tribal farmers, the intercept was significant, indicating a substantial base income. Gross cropped area (GCA) was the most important determinant, with a strong positive effect, showed that larger landholdings directly raise incomes. Family workers also contribute positively, while livestock adds further support. In contrast, working expenditure reduces income slightly but significantly, and employment (on-farm and non-farm) has a negative effect, suggesting that such work may be low-paying or substitute more productive sources. Participation in MANREGA and income from service and business are statistically insignificant, meaning they do not play a meaningful role in tribal household income.

For non-tribal farmers, the results are broadly similar but with some important differences. GCA has an even stronger impact on income, underlining the role of land in agricultural returns. Family workers remain significant with the same coefficient, while livestock also contributes positively p-value. Like in the tribal case, the employment variable shows a negative and significant effect on income, again pointing to low returns from such activities. Working expenditure does not significantly affect income for non-tribal households. However, unlike tribal farmers, service and business income was statistically significant, reflecting its growing importance as a diversification source. MANREGA participation was again insignificant, showing little contribution to household income.

Table 5: Indicate the income pattern of tribal and non-tribal respondents

Particulars	Tribal			Non-tribal		
	Coefficients	Standard Error	P-value	Coefficients	Standard Error	P-value
Intercept	3.48***	0.35	7.93031E-15	0.82	0.57	0.160212575
X1 GCA	0.59***	0.02	8.79466E-35	0.66***	0.03	5.6368E-28
X2 working expenditure	-0.03***	0.00	0.000940169	0.003	0.007	0.637717472
X3 family worker	0.11***	0.01	2.90449E-09	0.11***	0.02	1.86931E-05
X4 On - farm and non- farm employment	-0.04***	0.009	1.38735E-05	-0.04***	0.008	2.13716E-05
X4 Livestock	0.16***	0.01	7.81104E-14	0.17***	0.01	1.97388E-12
X5 MNREGA	0.04	0.04	0.228927764	0.01	0.04	0.702713724
X6 Service and business	-0.04	0.069	0.479153626	0.19***	0.05	0.000891929
R Square	0.94			0.93		

Note: indicates *** 1% significance level, **5% significance level

The consumption patterns of tribal and non-tribal farmers

Table 6, presented compares the consumption expenditure pattern of tribal and non-tribal farmers. It reveals that the total consumption expenditure of non-tribal farmers Rs. 2,34,782.85 which was higher than tribal farmers Rs. 1,88,556.33, indicating that non-tribal households enjoy a relatively higher standard of living and purchasing power. Tribal farmers spend 41.25 percent of their total expenditure on food items, whereas non-tribal farmers spend 34.39 percent, showing that tribal households allocate a larger share of income to food, reflecting their lower income levels and limited capacity for non-food expenditure.

In terms of non-food items, non-tribal farmers spend Rs. 1,03,521.59 compared to Rs. 68,433.86 among tribal farmers. That was higher non-food expenditure among non-tribal farmers suggests better access to education, healthcare, communication, and modern facilities. The share of other miscellaneous expenses was also similar for both groups 22.43% for tribal and 21.50% for non-tribal farmers respectively.

Looking at specific food items, cereals account for the largest share among both groups, accounted with 9.63% of total spending for tribal and 8.69% for non-tribal farmers. Milk and meat consumption are relatively higher among tribal farmers 5.14% and 3.08% than among non-tribal farmers 3.23% and 1.92% respectively, likely due to their dependence on livestock and self-production. On the other hand, non-tribal farmers spend more on oil, ghee, and vegetables, reflecting greater dietary diversity and higher purchasing power.

Overall, the data indicates a clear economic disparity between the both groups. Tribal farmers spend more on basic food necessities due to limited income, while non-tribal farmers demonstrate a more diversified spending pattern, with higher expenditure on non-food and lifestyle-related items, reflecting better socio-economic conditions and living standards.

Table 6: Show the consumption patterns of tribal and non-tribal respondents

S. No.	Particulars	Tribal farmers		Non-tribal farmers	
		Average (Rs.)	Percent	Average (Rs.)	Percent
A.	Food items				
i	Cereals	18160.18	9.63	20425.80	8.69
ii	Pulse	7011.96	3.71	8877.83	3.78
iii	Milk	9700.28	5.14	7602.94	3.23
iv	Vegetables	9537.5	5.05	10230.17	4.35
v	Fruits	1713.54	0.90	1532.35	0.65
vi	Oil & ghee	4185.10	2.21	6939.52	2.95
vii	Meat	5818.31	3.08	4529.11	1.92
B.	Other - food items	21675.25	11.49	20616.76	8.78
	Sub - total	77802.14	41.25	80754.52	34.39
C.	Non-food items	68433.86	36.29	103521.59	44.09
D.	Other expenses	42330.31	22.43	50506.73	21.50
	Total consumption expenditure	188556.33	100	234782.85	100

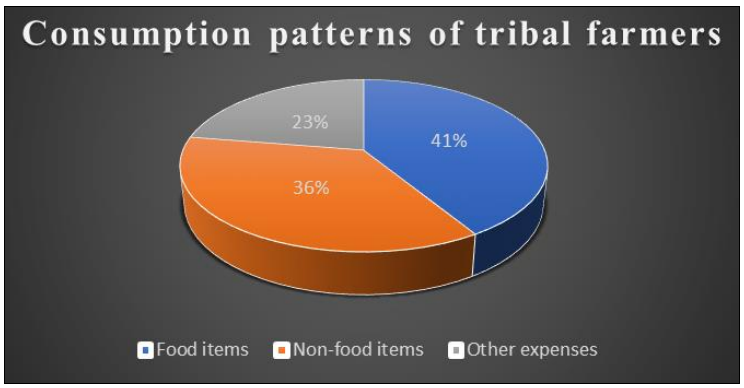

Fig 3: Indicate the consumption pattern of tribal respondents

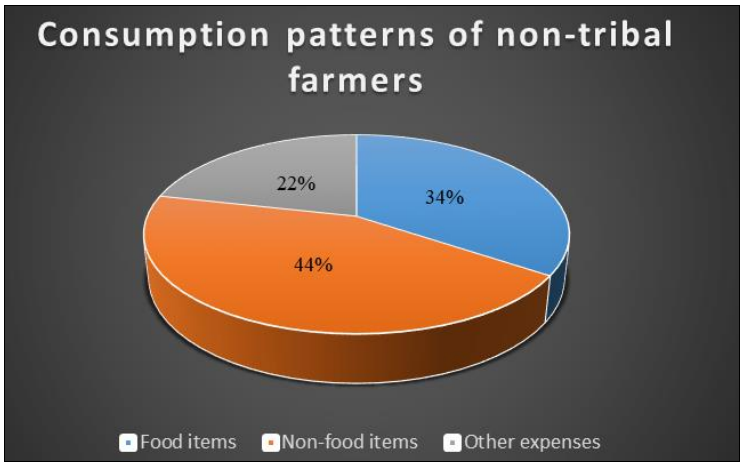

Fig 4: Indicate the consumption pattern of non-tribal respondents

Consumption pattern of tribal and non-tribal farmers

Table 7, presents the regression results of consumption patterns for tribal and non-tribal farmers, both models showing an excellent fit with R-square values of 0.98. For tribal farmers, the intercept was statistically significant, indicating a strong base level of consumption. Food expenditure contributes positively, while non-food items also have a positive and significant effect. Input materials emerge as one of the most influential factors, and very high significance, highlighting their centrality in household consumption. Livestock expenditure makes a smaller but significant contribution. The strongest positive determinant, however, it was essential living expenses such as healthcare, education, and social obligations. By contrast, capital asset expenditure shows a negative and significant relationship, suggesting that investment in durable goods reduces regular household consumption in the short term.

For non-tribal farmers, the regression also explains 98 percent of the variation, but the pattern of significance differs. The intercept was not statistically significant, implying less importance of baseline consumption once variables are controlled. Food expenditure has a higher coefficient but it was statistically insignificant, indicating that food consumption levels were relatively stable and not a major driver of variation in total spending. Non-food items contribute only marginally but were statistically significant. Input materials remain a crucial determinant, while essential living expenses again shows the strongest effect, confirming their dominance in overall household consumption. Unlike in the tribal model, livestock and capital assets do not have a significant effect on non-tribal consumption, showing that these categories are less relevant for explaining differences in non-tribal household expenditure.

Table 7: Consumption pattern of respondents

Particulars	Tribal farmers			Non-tribal farmers		
	Coefficients	Standard Error	P-value	Coefficients	Standard Error	P-value
Intercept	3.49***	0.51	3.26276E-09	1.61	1.30	0.221479809
X1 Food items	0.12***	0.02	2.63955E-08	0.27	0.34	0.423069597
X2 non-food items	0.07***	0.01	3.07679E-06	0.007***	0.00	0.00995011
X3 Input materials	0.26***	0.01	1.20457E-37	0.25***	0.00	7.29291E-35
X4 Livestock's	0.15***	0.05	0.003853531	0.05	0.34	0.870286755
X4 Other essential expenses	0.32***	0.03	7.24904E-13	0.36***	0.03	2.01796E-13
X5 Capital assets	-0.08**	0.03	0.023113043	0.01	0.02	0.539718656
R Square	0.98			0.98		

Note: indicates *** 1% significance level, **5% significance level

Major constrains faced by respondents

Table 8, identifies the major constraints faced by respondents using Garrett ranking techniques, economic, social, and institutional challenges. The most severe issue was the erratic rainfall and changing climatic conditions, which received the highest average score followed by insecure land tenure and ownership issue as the second most critical problem, while limited access to education facility and inadequate health care facility at infrastructure ranked third, reflecting serious gaps in basic services. Limited economic opportunities and resource scored fourth. Seasonal employment opportunities and income source ranking sixth. The seventh constraint was weak implementation of government policies and programs, highlighting governance gaps. Interestingly, unpredictable weather patterns, though important, ranked last showing that respondents perceive economic hardship, institutional inefficiencies, and social disadvantages as more pressing constraints than climate variability.

Table 8: Constraints faced by respondents

S. No.	Particulars	Total score	Average score	Rank
1.	Erratic rainfall and changing climatic conditions	10154	68.60	I
2.	Insecure land tenure and ownership issue	8646	58.41	II
3.	Limited access to education facility and inadequate health care facility at infrastructure	7339	49.58	III
4.	Limited economic opportunities and resource	6982	47.17	IV
5.	Seasonal employment opportunities and income source	6562	44.33	V
6.	Lack of forest and forest produce	6450	43.58	VI
7.	weak implementation of government policies and programs	6035	40.77	VII

Conclusion

The analysis reveals substantial disparities between tribal and non-tribal farming households in terms of landholding size, income generation, consumption behavior, and access to productive resources. Non-tribal farmers exhibited higher economic stability, diversified income sources, and greater investment in agricultural inputs and essential services. In contrast, tribal households remained more reliant on subsistence agriculture, forest produce, and low-wage employment, while facing systemic challenges such as limited access to education, healthcare, and secure land tenure.

The study underscores the critical need for targeted interventions to bridge these livelihood gaps. Enhancing irrigation infrastructure, promoting crop diversification, improving access to markets, and strengthening institutional support systems are essential to build resilience among tribal communities. Furthermore, tailored policy measures that address socio-economic vulnerabilities and promote inclusive agricultural development can significantly improve the adaptive capacity of both tribal and non-tribal farmers in the face of climate change.

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