Measuring the Population Pressure on cultivated land: A Case Study of Champawat Districts in Uttarakhand, India

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ABSTRACT-

The rapid increase in population and the corresponding pressure on land resources are central concerns for sustainable agricultural development. This study aims to measure the proportionate pressure of population on cultivated land in the Champawat district of Uttarakhand, India. The research assesses the relationship between population density and the available arable land, identifying patterns of land use changes over time and the implications for agricultural sustainability. This study examines the proportionate pressure of population on cultivated land (PPPC) in Champawat district, located in the northern Indian state of Uttarakhand. Champawat, with its rich historical significance and diverse geographical features, presents an ideal case for assessing the relationship between population growth and agricultural land use. The district, primarily rural with agriculture as the main livelihood, faces varying degrees of population pressure on its cultivated land. These findings offer valuable insights into the sustainability of agricultural land use in the region and underscore the importance of managing population growth for long-term agricultural viability.

Key words - Population, Cultivated Land, Land-Use, Population Pressure, Agricultural Sustainability, Density.

1. INTRODUCTION-

The word population as a terminology first used by Francis Bacon in the year 1612 (Tripathi, 1999). The term Population Pressure defines the stress that is caused due to excessive population density and its consequences. This term is used for connection between both human excessive population and animal population where there are too many people in per area.

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In case of aquatic Organisms, the pressure is measured in volume. According to Thomas Malthus, population pressure generates struggle for existence in which many individuals die and better-adapted variants are prone to survive and reproduce. Many thinkers have come up with various definitions of Population pressure but no consensus has been made. Some scholars view Population pressure as a synonym with Population density (Hattingh, 1976), and some believe that pressure exists when population number increases than the available number of resources (Wilkinson, 1976) The interaction between population expansion and land utilization plays a vital role in determining agricultural sustainability in rural landscapes. The increasing pressure of population on limited land resources has the potential to affect agricultural sustainability, food security, and overall socio-economic development.

Champawat district, located in the northern state of Uttarakhand, India, offers a unique case study to explore these dynamics due to its predominantly rural population and dependence on agriculture. With its diverse geographical features, including the Shiwalik hills, alluvial plains, and proximity to Nepal, Champawat experiences varying levels of population density and land availability across its blocks. Understanding the proportionate pressure of population on cultivated land (PPPC) is vital for assessing the sustainability of agricultural practices and formulating policies for resource management in the district. This study aims to evaluate the extent of this pressure across different blocks in Champawat, identify regions most at risk, and offer insights into how population growth impacts the efficiency of land use. By doing so, it seeks to provide a deeper understanding of the challenges faced by the district's agricultural sector and contribute to the broader discourse on sustainable land management in rural India.

Agriculture remains the principal livelihood for most people in rural India, particularly in the hilly and mountainous regions like Champawat district in Uttarakhand. As populations grow, there is increasing pressure on cultivated land, affecting its sustainability and agricultural productivity. This study, titled seeks to explore how population density impacts agricultural land in this region. The term "proportionate pressure of population on cultivated land" (PPPC) is crucial in assessing the strain placed on land resources due to increasing population numbers. As Chetri (2000) explains, "The computation of population pressure has been used as a simple indicator to measure population pressure on agricultural land resources in a region." The study assesses how demographic shifts influence the available land for cultivation, with implications

for sustainable land use. By focusing on Champawat district, this paper provides insight into the effects of population density on the availability and efficiency of cultivated land in the district, which is primarily rural and dependent on agriculture for its economy. Champawat's diverse geographical landscape, ranging from the flat plains to steep mountain slopes, adds another layer of complexity to the study. With much of its population relying on agriculture, the district faces the dual challenges of maintaining productivity while accommodating population growth. This study aims to highlight these challenges and propose strategies for sustainable land use, making it an essential reference for understanding the interplay between population dynamics and agricultural land in this region.

2. STUDY AREA-

Champawat district is part of the Indian state of Uttarakhand, located in the northern region of the country. The district derives its name from Champawati, the daughter of King Arjun Deo of the Chand dynasty. The whole Kumaun region came under British control in the year 1815. Inhabitants of the district participated in large numbers in "India's struggle for freedom movement" and in pursuance of this many citizens joined Indian National Congress. From India's independence till 1972, the Champawat district was part of Almora district as Tahsil and in 1972 Champawat Tahsil was transferred to Pithoragarh district. As an independent district Champawat constituted on 15th Sep, 1997 (Census, 2011).

2.1 Location and Geographical Area

Champawat district lies between 28º 58' 00" and 29º 31' 00" North Latitude and 79º46' 00" and 80º 16' 30" East Longitude. According to census 2011, the whole geographical region of the district is 1766 sq Km. among the Districts, Champawat ranks 13 in terms of area. The minimum height of the District is 700 meters at Tanakpur and maximum of 7550 meters at Deoguru. The district situated on the south-eastern part of Uttarakhand state and forms international boundary with Nepal in the eastern side, parallel to Kali River.

Champawat district is surrounded by Almora district on the north, Nainital on west, Pithoragarh on north and north-east and Udham Singh Nagar on south. One of the distinct physical features of Champawat district is that multiple Himalayan Rivers acts as a boundary between Champawat and other districts of the state. For example, the Ram Ganga River serves as the border between Champawat and Pithoragarh district in the north while the Pannar and

Jagbura rivers serve as the border between Almora, Udham Singh Nagar and Champawat district in the south and west (Fig-1). Long chain of Himalayan Mountain lies parallel between Nainital district and Champawat, which provides favorable spots for scenic beauty in the district (DSR Champawat, 2018).

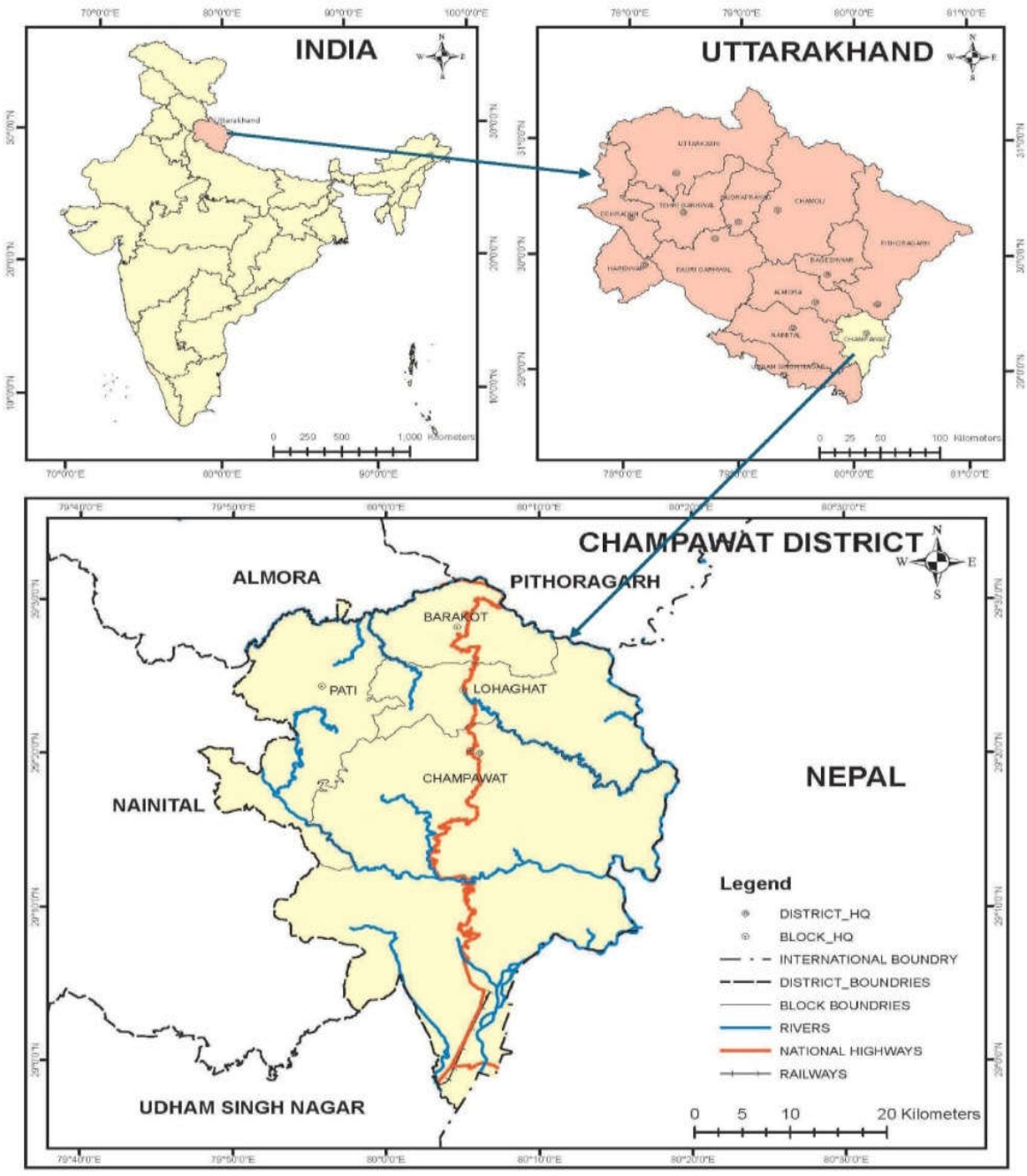

Fig -1. Location map of Champawat

3. OBJECTIVES-

The objectives of this study are:

- To assess the proportionate pressure of population on cultivated land (PPPC) in Champawat district, Uttarakhand.
- To analyze the implications of population pressure on agricultural sustainability.
- To evaluate varying population pressures across different blocks of the district.
- To identify regions with higher and lower PPPC.
- To examine the relationship between population density and cultivated land availability.
- To provide a comprehensive understanding of how population growth influences land use efficiency, resource allocation, and agricultural practices in rural areas.
- To offer insights into the challenges of balancing population demands with sustainable agricultural development.

4. MATERIAL AND METHODS-

The study primarily seeks bases on secondary data collected from various sources as census, statistical diary of Uttarakhand, and various online sources, etc. Explanatory and analytical approaches have been adopted to discuss the data. Decadal Growth rates, Average Annual Exponential Growth rate of the population and projections have been done with the help of appropriate mathematical and statistical formulas. Various cartographic techniques have been applied to make the data presentable and easily understandable.

4.1 Data Sources

The study is primarily based on secondary data collected from the following sources:

- **Population Data:** Census of India (2011) for total population, number of households, and block-wise demographic data (Champawat, Pati, Barakot, and Lohaghat blocks).
- **Projected Population (2021):** Calculated using the geometric population growth formula.
- **Land Area and Agricultural Data:** Obtained from the District Statistical Office, official government publications, and district-level reports for both 2011 and 2021.
- **Geographical and Physiographic Data:** Gathered from district maps, topographical surveys, and official reports to analyze the relationship between population density, agricultural density, and physiographic factors.

4.2 Formulas used for the calculation

i. Decadal Growth Rate in %

$$g = \frac{P2-P1}{P1} \times 100$$

P1 = population of the base year

P2 = population of the present year

ii. Annual Growth Rate

$$(R) = [(Pn/Po)^{1/N} - 1] \times 100$$

Pn = Population now;

Po = Population Originally;

N = Number of years.

iii. Projected Population Growth:

$$P = P^1 (1+r/100)$$

P = Projected population

P^1 = Present population

r = Decadal growth rate of population

iv. Proportionate Pressure of Population on Cultivated Land (PPPC) Calculation:

$$PPPC = \frac{\left\{\frac{Pi}{Pt} \times 100\right\}}{\left\{\frac{CLi}{CLt} \times 100\right\}}$$

Where Pi=Population is each unit

CLi= Cultivated land in each unit

Pt= Total population of all units

CLt= Total cultivated land of all units

The PPPC index helps measure the strain placed on cultivated land by the population, indicating the per capita availability of agricultural land in each block.

4.3 Density Index Calculations:

- **Arithmetic Density:** This refers to the total population divided by the total area of the block (people per km^2).

- **Agricultural Density:** This refers to the number of people dependent on agriculture per unit area of agricultural land.
- **Physiological Density:** This measures the number of people per unit area of arable land, indicating the pressure on agricultural resources in relation to the actual area available for cultivation.

5. RESULT AND DISCUSSSION

5.1 Proportionate pressure of Population on cultivated land (PPPC)

Population pressure can be effectively measured through simple indicators reflecting the stress on agricultural land resources. (Chetri, 2000). This concept highlights the strain or demand placed on agricultural land by the population and can be used to assess the sustainability and efficiency of land use. It is very important in an area like Champawat district, where most of the population is rural and their main occupation is agriculture. The proportionate pressure of population on cultivated land (PPPC) is defined as of the formula given above.

Table-1. Proportionate pressure of Population on cultivated land in Champawat District, 2011

S. N.	Blocks / District/ State	Population (as per 2011 census)	Area (km^2)	Cultivated area (hect)	Cultivated land (%)	Population (% of the total)	Cultivated land (% to the total)	Prop pressure of population on cultivated land	Remarks	Per capita share of cultivated land
1	Champawat	96667	434.69	11572	26.62	43.81	39.97	1.09	Normal	0.12
2	Pati	51971	247.33	8729	35.29	23.55	30.16	0.78	Low	0.16
3	Barakot	26676	127.98	3301	25.79	12.09	11.40	1.06	Normal	0.12
4	Lohaghat	45333	210.06	5346	25.45	20.55	18.47	1.11	Normal	0.12
5	Total	259648	1765.78	28943	24.93	100.00	100.00	1.01	Normal	0.13

Source: District census handbook of Champawat -2001, 2011 & Computed by Authors

Due to increase in Population pressure on cultivable land, the area of land availability per capita decreases. In the Study area the proportionate pressure of population on cultivated land is normal in Lohaghat Block, Champawat Block and Barakot Block that is 1.11, 1.09 or 1.06. But among these three blocks, the highest the proportionate pressure of population 1.11 is in Lohaghat block. Pati Block have 0.78 proportionate pressure of population on cultivated land is

relatively low. The proportionate pressure of population on cultivated land in this District is 1.01. (Table-1)

Table-2. Physiographic zone wise Density index

S. N.	Blocks / District/ State	Arithmetic density	Agricultural density	Physiological Density	PPPC	Physiographic Zone	Density Zone
1	Champawat	222	187	835	1.09	Alluvial Plain /Shivalik hills	Medium
2	Pati	210	189	595	0.78	Lesser Himalaya	Low
3	Barakot	208	272	808	1.06	Lesser Himalaya	Medium
4	Lohaghat	216	295	847	1.11	Lesser Himalaya	Medium
5	Total	147	221	897	1.01	-	-

Source: District census handbook of Champawat -2001, 2011 & Computed by Authors

From the table 2 it is observed that, all the four measurements employed for measurements of population density show a similar pressure scenario in different geographical areas. The Medium density indicates are found in Champawat, Lohaghat or Barakot Blocks which are located in Alluvial plain or shiwalik. The Low density found in Pati Block which is located in shiwalik region or rural area of the District Champawat.

5.2 Projected population for 2021

Projected population refers to an estimate of the future population based on current data and trends. This projection uses various demographic factors. The population projection method has been used for estimating the future population (the year 2021) of Champawat District at Block level. Table 3.6 shows the Block wise projected population and population density in Champawat District in 2021. The following formula of geometric population growths has been used for estimating the future population.

Table-3. Champawat District, Projected population and Density (2021)

S.N.	Blocks	Projected population (2021)	Projected population Density / km2 (2021)
1	Champawat	143214	329
2	Pati	57163	231
3	Barakot	27955	218
4	Lohaghat	50599	240
5	Total	**278932**	**273**

Source: Computed by Authors

From the Table 3 it is observed that the population of 2021 highest recorded in Champawat Block and lowest recorded in Barakot Block. The highest increase of decadal growth

has also happened in Champawat block. After observed that the population density the highest density is in Champawat block which is 329 /km2 and the lowest density is in Barakot block which is 218 /km2 but as far as we look at the density, it has increased everywhere, which means that the population is increasing in Champawat.

5.3 Proportionate pressure of Population on cultivated land (2021)

The computation of a Proportionate pressure of Population has been used as a handy indicator to measure population pressure on agriculture land resources in an area (Chetri, 2000). Here the Proportionate pressure of Population on cultivated land has been calculated based on the projected population of 2021.

Table-4. Proportionate pressure of Population on cultivated land in Champawat District, 2021

S.N.	Blocks / District/ State	Projected Population (2021)	Area (km2)	Cultivated area (hect)	Population (% of the total)	Cultivated land (% to the total)	Prop. pressure of population on cultivated land	Remarks
1	Champawat	143214	434.69	11572	51.34	39.97	1.28	Normal
2	Pati	57163	247.33	8729	20.49	30.16	0.67	Low
3	Barakot	27955	127.98	3301	10.02	11.40	0.87	Normal
4	Lohaghat	50599	210.06	5346	18.14	18.47	0.98	Normal
5	Total	278932	1765.78	28943	100	100.00	1.28	Normal

Source: Computed by Authors

Population pressure on cultivated land increases as per capita land decreases. Proportionate pressure of Population in Champawat District is much higher in Champawat Block which is 1.28. The per capita share of cultivated land is poor in Pati block is 0.67. Barakot Block share per capita land is 0.87 and Lohaghat Block share per capita land is 0.98. The scenario of cultivated land in the blocks is changing.

5.4 Comparison of Proportionate pressure of Population on cultivated land (2011-2021)

Table 1 and 4 shows the difference between 2011 -2021 data. Between 2011- 2021, the Proportionate pressure of Population on cultivated land in Champawat District has risen. In 2011, the proportion was 1.01 hectare per person, which increased to 1.28 hectare per person by 2021. This indicates that the population has grown over this decade, leading to increased demand for cultivated land.

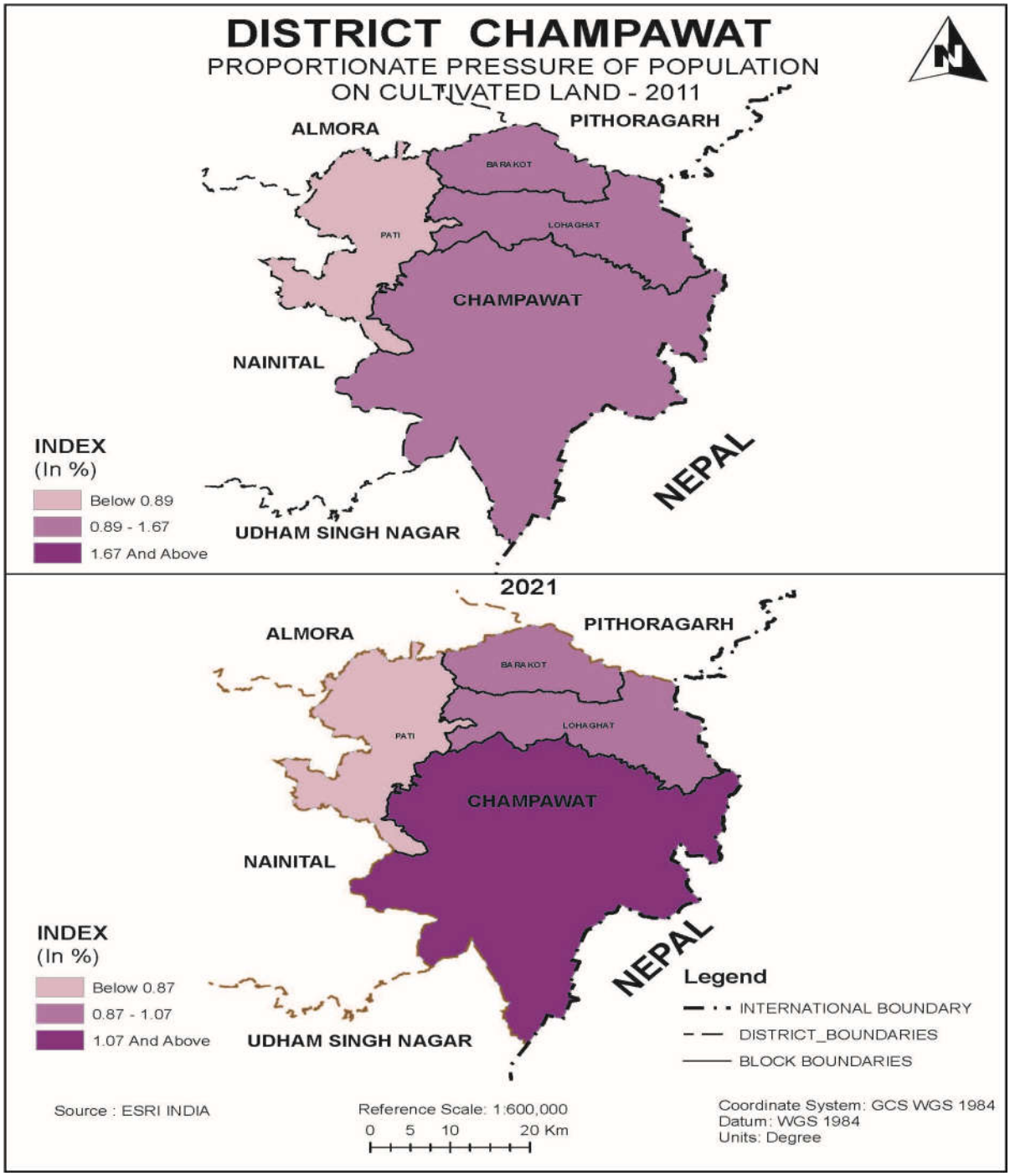

Fig.-2. Proportionate Pressure of Population on Cultivated Land in District Champawat

Fig. 2 shows the changes in Population pressure on cultivated land from 2011-2021 in Champawat District. Among the development blocks, Pati block has the lowest pressure in both years. In Pati, the pressure has significantly decreased from 0.78 hectares per person in 2011 to 0.67 in 2021. Conversely, Champawat block has the highest pressure, which has increased from

1.09 hectares per person in 2011 to 1.28 in 2021. This indicates that while some areas have seen a reduction in population pressure on cultivated land, others have experienced an increase.

5.5 Major Findings

1. **Population Growth and Land Pressure:** The proportionate pressure of population on cultivated land (PPPC) in Champawat District increased from 1.01 in 2011 to 1.28 in 2021, indicating a rising demand for agricultural land due to population growth.
2. **Block-level Differences:** Among the blocks, Champawat Block exhibited the highest PPPC in both 2011 (1.09) and 2021 (1.28), whereas Pati Block consistently had the lowest pressure (0.78 in 2011 and 0.67 in 2021). This highlights the differential impact of population growth across geographical zones.
3. **Per Capita Land Availability:** The per capita share of cultivated land decreased in most blocks, particularly in Champawat and Lohaghat, reflecting the strain on limited agricultural land due to increasing population density.
4. **Projected Population Implications:** Projected population densities for 2021 show a significant increase, with Champawat Block reaching 329 persons/km² compared to 218 persons/km² in Barakot Block. These projections emphasize the need for sustainable land management and agricultural planning in high-density areas.
5. **Changes in PPPC over Time (2011–2021):** While **Pati Block** managed to reduce population pressure on cultivated land, Champawat and Lohaghat Blocks experienced an increase. This trend underscores the urgency of implementing strategies to balance population growth with available land resources.
6. **Implications for Agricultural Sustainability:** The rising population pressure, coupled with limited cultivable land, suggests potential challenges for agricultural sustainability. Effective land use planning, adoption of sustainable farming practices and community awareness are essential to maintain productivity and ecological balance in the district.

Conclusion

The study reveals that population growth in Champawat District has increasingly strained the limited cultivated land resources. In 2011, the overall proportionate pressure on cultivated land was 1.01, indicating a balanced relationship between population and farmland. By 2021, however, this value had risen to 1.28, reflecting a clear rise in pressure due to growing

population and limited cultivable area. Among the district's blocks, Champawat and Lohaghat have recorded higher pressure levels, while Pati Block continues to show relatively lower pressure, pointing to uneven population–land distribution across the district.

These findings highlight the urgent need for effective land-use planning and sustainable agricultural practices. Local authorities should promote efficient land management through crop rotation, soil conservation, and planned land utilization. In hilly areas, techniques such as terrace and contour farming can help prevent soil erosion and enhance productivity. Encouraging alternative livelihoods—including eco-tourism, handicrafts, and agro-based activities—can reduce overdependence on agriculture and lower pressure on farmland.

Raising community awareness about sustainable farming, providing access to modern agricultural tools, irrigation facilities, and high-yield seeds can further enhance productivity without expanding cultivable land. Moreover, integrated rural development, focusing on improved education, healthcare, and infrastructure, can help stabilize population growth and ensure the balanced use of resources.

Overall, the study emphasizes that achieving harmony between population growth and cultivated land availability in Champawat District requires a coordinated and long-term approach that combines sustainable farming, technological innovation, livelihood diversification, and effective governance. Through these efforts, agricultural sustainability and environmental balance in the region can be secured for the future.

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