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Diverging Patterns of Tobacco Production and Consumption in India: Evidence from NFHS and Agricultural Statistics Data

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Abstract

Background

Tobacco continues to be a major public health challenge in India, yet the spatial dimensions of its consumption and its relationship with regional production remain insufficiently explored. This study investigated the regional variations in tobacco production across states and districts, patterns of tobacco consumption across states and the spatial clustering of tobacco consumption at the district level.

Methods

We analyzed tobacco production trends (area, production, and yield) from 2005-06 to 2022-23 using data from Directorate of Economics and Statistics. We assessed tobacco consumption using state- and district-level prevalence estimates for adult males and females aged 15–49 years from the National Family Health Survey (2005-06, 2015-16, and 2019-21). We also examined spatial pattern across 707 districts using Global Moran's I and Local Indicators of Spatial Association (LISA) with queen contiguity weights in GeoDa 1.22.

Results

Despite a decline in tobacco cultivation area since 2005–06, production increased by about 40%, with yields remaining largely stable, highlighting the efficiency of certain regions. Production is heavily concentrated in a few states and 140 districts, led by Gujarat. While national tobacco use fell sharply from 27.4% to 8.2%, northeastern states like Mizoram and Manipur remain hotspots. Moderate geographic clustering was observed for both males (0.209) and females (0.282), revealing clear patterns of high-high and low-low clustering. Interestingly, higher production did not lead to higher consumption, suggesting other social and behavioral factors shape tobacco use.

Conclusion

Regional variations in tobacco production and use reflect cultural, socioeconomic, and policy influences rather than local output alone. Targeted interventions such as promoting alternative crops, strengthening public health programs, and implementing region-specific tobacco control measures are essential to reduce health risks while supporting farmer livelihoods.

1. Introduction

Tobacco, broadly defined as the leaves of the plant *Nicotiana tabacum* (and related species) (Lewis, 2020) which are processed for use in smoking (cigarettes, bidis, cigars), chewing, snuffing or other smokeless forms, has long occupied a dual position: as a profitable commercial agricultural commodity and as a major public-health challenge (Ruckert et al., 2023). According to the World Health Organization (WHO), tobacco use is 'one of the biggest public health threats the world has ever faced, which leads to more than 7 million deaths as well as disability (IHME, 2025). Globally, tobacco use remains one of the most significant preventable causes of illness and death, responsible for over 7 million deaths annually from diseases like cancer, heart disease, and lung disease (WHO, 2015; IHME, 2025), including 1.6 million non-smokers exposed to second-hand smoke (IHME, 2025). Nearly 80% of the world's 1.3 billion users live in low- and middle-income countries (WHO, 2025). On the production side, over 124 countries grow tobacco as a cash crop, by using nearly 3.2 million hectares of fertile land, contributing to export earnings and employment (WHO, 2023); on the consumption side, the prevalence of smoking and smokeless use continues to impose high health and economic burdens (Ekpu, & Brown, 2015; Satpathy et al., 2024; Al-Hanawi & Keetile, 2025). Thus, describing tobacco solely as a public-health issue without recognizing its economic and agricultural dimensions (or vice-versa) misses its full complexity.

In terms of production, India ranks as the second-largest producer in the global tobacco economy, following China (Reddy et al., 2024; Goel et al., 2024). It is also the seventh-largest exporter of unmanufactured tobacco by value (ITC, 2025), accounting for around 9% of global tobacco production in recent years. The crop thereby contributes substantially to farm-income, employment and export revenue (HC & Srivastava, 2020). In India the tobacco industry reportedly involves about 45.7 million people in farming, manufacturing, processing and allied activities, and generating Rs. 12,005.89 crore in foreign exchange for the national exchequer during 2023–24 (Press Information Bureau, 2025). However, despite this scale of production, the relationship between production and local consumption is not straightforward.

Tobacco consumption in India is equally significant and complex. It has traditionally been used in multiple forms such as smoking (cigarettes, bidis, cigars) and smokeless preparations (khaini, gutkha, zarda, betel quid with tobacco). Beyond its historical and social presence, tobacco is deeply entwined with India's agricultural economy, providing livelihoods to millions of farmers, workers in processing units, and vendors across the supply chain. According to the Global Adult Tobacco Survey (GATS) for India (2016-17), about 28.6% of adults (aged ≥ 15 years) consume tobacco in any form (smoked and/or smokeless), including 42.4% of men and 14.2% of women (TISS & MoHFW, 2018). Smokeless tobacco, especially chewing forms such as betel quid with tobacco, zarda and khaini, is more prevalent than smoking in many regions of India, particularly in rural areas (Gupta et al., 2011; Thakur & Paika, 2018). Globally, tobacco use is shifting while many high-income countries have seen declines in smoking, low- and middle-income countries continue to bear the bulk of the consumption burden (Bharati et al., 2023; Tauras, 2024). The health risks of tobacco use are well-documented: tobacco causes cancers (oral, lung, throat), cardiovascular disease, respiratory disease, and contributes heavily to disability and premature death (Kwan et al., 2015; Jiang et al., 2020; Dai et al., 2022; Rigotti et al., 2025). India alone, accounts for nearly 1.35 million people die each year due to tobacco use (IHME, 2025). The health consequences are amplified by high social and economic costs in India the estimated cost of tobacco-related diseases for persons aged 35 + years in 2017-18 was INR 177,341 crores (≈ USD 27.5 billion). World Health Organization

India is not only one of the largest producers of tobacco in the world, but also one of the largest consumers. At the national level, this dual position suggests a positive association between production and consumption: high national production coincides with high national consumption. Given this, one might hypothesize that states producing more tobacco would also have higher tobacco use. However, most existing research in India focuses primarily on patterns of tobacco use, prevalence, and the health impacts of consumption, while the production side receives relatively little attention. Whether the national-level pattern of production and consumption holds true at the state level remains unclear. This study is therefore necessary to investigate the relationship between state-level tobacco production and consumption and to fill this important knowledge gap. While trends in state-wise production and consumption are shown to provide temporal context and highlight patterns or divergences across states, the study then tests the association between production and consumption at the state level. By tracing the trends and then analyzing state-level data, this study aims to explore whether higher state-level tobacco production corresponds to higher consumption. The main objective is thus to assess and quantify the correlation between state-wise production and consumption in India, and to identify factors that explain the alignment or divergence between them.

2. Data and Methodology

2.1 Data Source

2.1.1 Source of production data

Data on the area and production of tobacco have been sourced from the Directorate of Economics and Statistics (E&S Division), Department of Agriculture and Farmers Welfare (DA&FW), Ministry of Agriculture and Farmers Welfare, Government of India. Although tobacco cultivation is reported in 22 states, some states (such as Haryana and Himachal Pradesh) had recorded cultivation area but no actual production in several years. These states were considered for regional trend analysis; however, the state-level analysis includes only those states that reported either cultivation area or production across most of the study years (2005–06, 2015–16, 2019–21, and 2022–23). To facilitate better understanding, the states have been grouped by region:

1. **North**: Jammu and Kashmir, Himachal Pradesh, Haryana, Uttarakhand, and Rajasthan
2. **Central**: Uttar Pradesh, Chhattisgarh, and Madhya Pradesh
3. **East**: Bihar, West Bengal, and Odisha
4. **North-East**: Mizoram, Meghalaya, and Assam
5. **West**: Gujarat and Maharashtra
6. **South**: Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Puducherry, and Telangana

The region- and state-wise relative changes in area, production, and yield were estimated using 2005-06 as the base year for analysis.

2.1.2 Sources of Consumption Data

The study used data on tobacco consumption from three rounds of the National Family Health Survey (NFHS) in India. To examine the trends in tobacco consumption over the decade, data were drawn from the third (2005–06), fourth (2015–16), and fifth (2019–21) rounds of NFHS. The NFHS is a nationally representative cross-sectional survey that follows the general structure of the Demographic and Health Surveys (DHS) conducted worldwide. For the present analysis, a total of 69,834 men and 124,385 women from the third round, 103,525 men and 699,686 women from the fourth round, and 93,267 men and 724,115 women from the fifth round of NFHS were included. Information on tobacco use was obtained from the survey question: “In what other form do you currently smoke or use tobacco?” The survey recorded responses across various forms of tobacco use, including cigarettes, *bidis*, pipe, cigars, *hookah*, other smoking forms, chewing tobacco, snuff, *paan masala* or *gutkha, khaini, paan* with tobacco, and other forms of tobacco. Individuals reporting the use of any of these forms were considered current tobacco users. District-level prevalence estimates for current tobacco consumption among adult males and females in India were derived from nationally representative survey data National Family Health Survey (NFHS-2019-20), aggregated to the district level (n = 707 districts).

2.1.3 Sources of Projection Data

The primary data used in this study were obtained from the *Population Projections for India and States 2011–2036* (National Commission on Population, 2019). This report provides population estimates and projections at both the national and state levels, covering the period from 2011 to 2036. The projections are based on the Census of India 2011 and incorporate demographic indicators such as fertility, mortality, and migration trends. These population figures were used to calculate per capita tobacco consumption at the state and national levels, allowing an assessment of regional variations in tobacco use across India.

2.2 Statistical Analysis

2.2.1 Descriptive Statistics

The study first employed descriptive statistics to summarize tobacco production and consumption patterns across India. Production trends, including area under cultivation, total output, and yield, were analyzed at the national and regional levels (North, Central, East, Northeast, West, and South) using data spanning from 2005-06 to 2022-23. To quantify the magnitude of change over this period, relative change (RC) percentages were calculated. For tobacco consumption, prevalence estimates for adult males and females were derived from the National Family Health Survey (NFHS-5, 2019-21) and aggregated across 707 districts.

2.2.2 Spatial Weights and Autocorrelation

To evaluate the spatial distribution of tobacco consumption, we utilized exploratory spatial data analysis (ESDA) techniques. Spatial relationships were defined using a queen contiguity weight matrix (first-order), where districts sharing a common boundary or vertex were assigned as neighbors. The matrix was row-standardized to account for the varying number of neighbors per district. Isolated districts with no contiguous neighbors were excluded from the spatial computation to ensure unbiased estimates.

2.2.3 Global and Local Spatial Analysis

Global spatial autocorrelation was assessed using the Global Moran's I statistic to determine whether tobacco consumption exhibited a non-random spatial pattern across the country. Moran's I values range from − 1 (perfect dispersion) to + 1 (perfect clustering), with a value of zero indicating spatial randomness. The statistical significance of Moran's I was evaluated using a permutation test with 999 iterations (alpha = 0.05) (Luc Anselin, 1995).

To pinpoint specific geographical hotspots and cold spots, Local Indicators of Spatial Association (LISA) were computed. This analysis categorized districts into five distinct spatial regimes:

High-High (Hotspots)

Districts with high prevalence surrounded by neighbours with high prevalence.

Low-Low (Cold spots)

Districts with low prevalence surrounded by neighbours with low prevalence.

High-Low and Low-High (Spatial Outliers)

Districts whose prevalence values significantly differ from those of their neighbours.

Not Significant

Districts where no discernible spatial pattern was detected.

LISA results were visualized through cluster maps and Moran scatterplots. All spatial analyses and visualizations were conducted using GeoDa version 1.22 (Luc et al., 2023), while descriptive trends and data processing were performed using Microsoft excel and Stata version 17.

2.2.4 Correlation between production and consumption

As population projections are available on a financial-year basis and tobacco production data are reported by calendar year, both datasets were interpolated to ensure temporal alignment. Based on the available production data for 17 states during 2019–21, per capita tobacco production was computed for each state. Thereafter, the relationship between per capita production and consumption was examined through correlation analysis using Microsoft Excel.

3. Results

3.1 Trends in tobacco cultivation area, production, and yield in India

Table 1 presents trends in tobacco cultivation area, production, and yield over time starting from 2005–06. The cultivated area shows an overall decline from 357.2 thousand hectares in 2005–06, with relative changes indicating an initial fluctuating decrease followed by a slight increase of 3% in 2022–23. Production exhibits variability relative to 2005–06, with notable increases in years such as 2017–18 (+ 78.2%), 2014–15 (+ 74.6%), 2016–17 (+ 67.4%), and 2010–11 (+ 63%), resulting in an overall rise of 40.5% by 2022–23. Yield remains relatively stable compared with 2005–06, generally ranging between 1.4 and 2.3, with modest improvements reflected in relative gains of up to 55.1% in 2017–18. A notable exception occurred in 2018–19, when yield declined due to a sharp reduction in cultivated area, which in turn reduced production.

Table 1
Trends in Tobacco: All-India Area, Production and Yield.

Years	Area	RC (%)	Production	RC (%)	Yield	RC (%)
2005–2006	357.2	0.0	533.8	0.0	1.5	0.0
2006–2007	331.6	-7.2	477.9	-10.5	1.4	-3.6
2007–2008	337.3	-5.6	491.9	-7.8	1.5	-2.4
2008–2009	372.4	4.2	602.6	12.9	1.6	8.3
2009–2010	499.5	39.8	837.8	57.0	1.7	12.2
2010–2011	482.4	35.0	869.9	63.0	1.8	20.7
2011–2012	461.4	29.2	823.7	54.3	1.8	19.5
2012–2013	413.1	15.7	716.0	34.1	1.7	16.0
2013–2014	439.2	22.9	805.9	51.0	1.8	22.8
2014–2015	467.4	30.8	932.0	74.6	2.0	33.4
2015–2016	363.3	1.7	812.5	52.2	2.2	49.6
2016–2017	386.0	8.1	893.5	67.4	2.3	54.9
2017–2018	410.5	14.9	951.5	78.2	2.3	55.1
2018–2019	389.2	9.0	625.9	17.2	1.6	7.6
2019–2020	409.6	14.7	806.2	51.0	2.0	31.7
2020–2021	357.4	0.0	756.4	41.7	2.1	41.6
2021–2022	385.8	8.0	816.8	53.0	2.1	41.7
2022–2023	368.1	3.0	750.2	40.5	2.0	36.4

Note: Area in ‘000 hectares, production in ‘000 tonnes, and yield in tonnes/hectare. RC indicates Relative change.

3.2 Regional distribution of tobacco cultivation area, production, and yield

Figure 1 illustrates the temporal distribution of tobacco cultivation across regions from 2005–06 to 2022–23. The cultivated area remained comparatively lower in the northern, northeastern, eastern, and central regions than in other parts of the country. Relative to the base year 2005–06, both the northern and northeastern regions showed a consistent decline, indicating a steady reduction in cultivation area (Appendix Table A1). The eastern and central regions displayed fluctuations over time. Among the regions with higher levels of cultivation, the southern region recorded a gradual decline from the base year, whereas the western region, despite fluctuations during 2012 to 2014, showed an overall increasing trend in tobacco cultivation.

Figure 2 illustrates the regional patterns in tobacco production over time. Production remained lowest in the northern region, followed by the northeastern, eastern, and central regions (Appendix Table A2). In the central region, production generally declined, with a brief increase during 2020–22. The eastern region saw a rise between 2011–12 and 2013–14, followed by a subsequent decline. The southern region shows a gradual downward trend with periodic fluctuations, including a noticeable increase in 2014–15. In contrast, the western region shows a steady upward trend, particularly during 2017–18, indicating its growing contribution to overall production.

Figure 3 presents the regional distribution of tobacco yield (t/ha = tons per hectare) over time. Yield remained lowest in the northeastern region, followed by the eastern, southern, and northern regions. Although overall production showed an increasing trend, yield in the northern region remained relatively low, ranging from 1.0 t/ha in 2009–10 to 3.5 t/ha in 2018–19. Despite having a large cultivation area and high production, the western region also recorded comparatively low yields, ranging from 1.4 t/ha in 2008–09 to 3.0 t/ha during 2016 to 2018. In contrast, the central region recorded the highest yields among all regions, despite a decline in production over time, with values decreasing from 6 t/ha in 2005–06 to 2.2 t/ha in 2018–19, indicating a downward relative change (Appendix Table A3).

3.3 State-wise trends in tobacco cultivation, production, and yield

Table 2 presents the trends in tobacco cultivation area, production, and yield across Indian states from 2005–06 to 2022–23. According to the 2022–23 data, the largest areas under tobacco cultivation were recorded in Gujarat, Karnataka, Andhra Pradesh, Uttar Pradesh, and Bihar. Analysis of relative changes shows that, among states with more than 10 thousand hectares under cultivation in 2022–23, the area increased in Gujarat (3.0 times) and Uttar Pradesh (10.5%) compared with 2005–06, while it declined in Andhra Pradesh, Karnataka, and Bihar. Tobacco production largely mirrored the trends in cultivated areas. The highest production (exceeding 10 thousand tonnes) was observed in Gujarat, Andhra Pradesh, Uttar Pradesh, Karnataka, Bihar, and Telangana. Relative changes indicate increases in Gujarat (4.4 times), Chhattisgarh (73.3%), Meghalaya (58.9%), and Bihar (5.2%), whereas production declined in the remaining states over the study period. In terms of yield, 2022–23 data show the highest levels (above 2 t/ha) in Uttar Pradesh, Telangana, Maharashtra, Gujarat, and Andhra Pradesh. Relative analysis from 2005–06 to 2022–23 indicates that yield increased in Bihar, Gujarat, Telangana, and Andhra Pradesh, while in Uttar Pradesh, despite having the highest yield, it unexpectedly declined during this period.

Table 2

Trends in tobacco cultivation area (in hectare), tobacco production (in tonnes), and tobacco yield (tonnes per hectare) across states of India, 2005-0

States	Area				Relative Change (%)	Production				Relative Change (%)	Yield		
	2005-06	2015-16	2019–21	2022-23	2005-06 to 2022-23	2005-06	2015-16	2019–21	2022-23	2005-06 to 2022-23	2005-06	2015-16	2019–21
Gujarat	65100	196847	173597	192847	196.2	101500	381,771	400755	447145	340.5	1.6	1.9	2.3
Andhra Pradesh	125549	97769	69988	58402	-53.5	181167	221,514	154305	119938	-33.8	1.4	2.3	2.2
Uttar Pradesh	20591	31638	29316	22755	10.5	123362	138,639	104994	92431	-25.1	6.0	4.4	3.7
Karnataka	100798	–	80921	76220	-24.4	63879	–	67599	56715	-11.2	0.6	–	0.8
Bihar	14901	9104	10336	10324	-30.7	17242	15,805	18147	18136	5.2	1.2	1.7	1.8
Telangana	8790	5791	2615	3141	-64.3	16896	15,157	6776	8964	-46.9	1.9	2.6	2.5
Tamil Nadu	5102	3348	1705	2094	-59.0	7792	5,161	2564	3194	-59.0	1.5	1.5	1.5
Maharashtra	–	1606	519	848	–	–	2,803	938	2236	–	–	1.7	1.8
Meghalaya	721	790	604	810	12.3	475	775	601	755	58.9	0.7	1.0	0.7
Rajasthan	520	538	240	264	-49.2	710	845	464	314	-55.8	1.4	1.6	2.2
Mizoram	511	353	295	286	-44.0	364	121	369	271	-25.5	0.7	0.3	1.2
Assam	657	243	107	65	-90.1	351	125	59	45	-87.2	0.5	0.5	0.6
Chhattisgarh	29	–	26	32	10.3	15	–	15	26	73.3	0.5		0.6
Kerala	43	9	6	7	-83.7	69	15	11	10	-85.5	1.6	1.7	1.8
West Bengal	13884	15073	14218		-100.0	19890	25,335	19593	–	-100.0	1.4	1.7	1.4
Odisha	–	–	43	–	–	–	–	30	–	–	–	–	0.2
Uttarakhand	26	–	2	–	-100.0	97	–	5	–	-100.0	3.7	–	2.0
Madhya Pradesh	–	–	–	–	–	–	–	–	–	–	–	–	–
Jammu and Kashmir	4	–	–	–	-100.0	1	–	–	–	-100.0	0.3	–	–
Puducherry		209	–	–	–	–	4,388	–	–	–	–	21.0	–
India	**357226**	**363318**	**384537**	**368095**	**3.0**	**533810**	**812,454**	**777223**	**750180**	**40.5**	**1.5**	**2.2**	**2.0**

Note: Area in Hectares, Production in Tonnes, Yield – Tonnes/HectareStates are arranged in descending order based on production during 2022–23.

3.4 District-wise trends in tobacco production –

District-level tobacco production in India during 2022–23 shows that cultivation was limited to 140 out of 707 districts (Map 1). Among these, two districts Anand (184 thousand tonnes) and Kheda (130 thousand tonnes), both in Gujarat, recorded the highest production. Five districts reported moderate production of 20–30 thousand tonnes, while 11 districts produced between 10–20 thousand tonnes. The remaining 122 districts produced up to 10 thousand tonnes. The top 20 high-producing districts included Anand, Kheda, Mahesana, Banas Kantha, Vadodara, Sabar Kantha, Patan, and Gandhinagar in Gujarat; Prakasam, Eluru, Bapatla, East Godavari, Sri Potti Sriramulu Nellore, and Palnadu in Andhra Pradesh; Etah, Kasganj, and Farrukhabad in Uttar Pradesh; Mysore in Karnataka; and Vaishali and Samastipur in Bihar.

3.5 State-specific prevalence of tobacco use among population aged 15–49 years

Table 3 presents trends in tobacco use across Indian states. Nationally, tobacco use declined substantially from 27.4% in 2005–06 to 8.2% in 2019–21. Despite this overall reduction, northeastern states consistently reported higher prevalence throughout the period, with Mizoram showing particularly high levels, decreasing from 68.9% to 52%. In 2019–21, the highest prevalence was observed in Manipur (45.9%), Tripura (42.6%), and Meghalaya (31.2%), followed by Nagaland (20.6%) and Assam (20%). Outside the northeastern region, Odisha (14.9%) and West Bengal (14.1%) also reported relatively higher prevalence, whereas Puducherry (0.8%), Punjab (1.1%), and Chandigarh (1.5%) recorded the lowest levels. Among men, tobacco use declined from 57% to 39.6% over the study period. However, prevalence remained particularly high in northeastern states, with Mizoram (70.2%), Manipur (67.3%), and Meghalaya (62.3%) reporting rates above 60% in 2019–21. In contrast, tobacco use among women declined from 10.8% to 4.2%, although Mizoram (48.5%) and Manipur (41.6%) continued to show notably high prevalence. Most states experienced reductions among women, except Manipur, where use slightly increased. Overall, tobacco use declined across all states by 70.1%, with the largest reductions observed in Punjab (91.5%), Haryana (88.3%), Tamil Nadu (86.6%),

Uttarakhand (85.3%), Jharkhand (83.1%), and Uttar Pradesh (81.7%). In contrast, the smallest decline was recorded in Manipur (7.9%). Among men, the greatest reductions were observed in Kerala (59%) and Punjab (55.1%), whereas among women, the largest declines occurred in Punjab (84.6%) and Haryana (80.5%).

Table 3
Percentage and relative change in tobacco use among the population aged 15–49 years, States/UTs and India, 2005–06 to 2019–21

States/UTs	2005-06			2015-16			2019-21			2005-06 to 2019-21		
	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total
Jammu & Kashmir	52.7	5.3	22.6	38.2	2.8	9.6	32.0	1.3	6.4	-39.2	-76.1	-71.7
Himachal Pradesh	40.0	1.2	14.1	40.5	0.5	8.0	34.2	0.3	5.7	-14.6	-72.9	-59.3
Punjab	33.8	0.8	13.3	19.2	0.1	2.7	15.2	0.1	1.1	-55.1	-84.6	-91.5
Chandigarh	–	–	–	22.5	0.4	3.5	21.5	0.0	1.5	–	–	–
Uttarakhand	53.3	5.4	22.3	43.7	2.9	7.5	38.6	1.3	3.3	-27.6	-75.7	-85.3
Haryana	46.3	3.3	20.3	35.8	1.6	6.2	28.0	0.7	2.4	-39.6	-80.5	-88.3
NCT of Delhi	40.0	3.1	18.9	30.4	1.6	5.6	34.5	1.7	4.0	-13.8	-43.9	-79.1
Rajasthan	60.4	7.8	26.8	46.9	6.3	11.2	41.6	4.4	6.6	-31.1	-43.4	-75.5
Uttar Pradesh	64.3	12.1	30.8	53.0	7.6	12.9	44.4	3.4	5.6	-31.0	-71.5	-81.7
Bihar	66.5	8.0	25.8	50.1	2.8	7.7	47.6	1.0	7.6	-28.4	-87.3	-70.4
Sikkim	61.8	18.7	34.5	40.3	7.3	11.4	35.5	9.0	13.2	-42.5	-52.2	-61.8
Arunachal Pradesh	62.7	27.3	41.2	60.0	17.7	22.8	55.5	11.0	13.4	-11.4	-59.7	-67.6
Nagaland	67.9	28.1	42.8	69.2	27.4	32.1	54.7	14.1	20.6	-19.4	-49.9	-51.9
Manipur	69.5	39.6	49.8	70.7	48.8	51.2	67.3	41.6	45.9	-3.1	5.1	-7.9
Mizoram	83.4	60.8	68.9	80.5	59.5	61.9	70.2	48.5	52.0	-15.7	-20.3	-24.5
Tripura	76.0	48.2	58.3	67.8	42.2	46.0	58.6	39.5	42.6	-22.9	-18.0	-26.9
Meghalaya	69.3	31.9	45.6	72.2	32.3	36.7	62.3	25.3	31.2	-10.1	-20.6	-31.6
Assam	72.4	23.2	41.2	63.9	19.7	25.1	54.8	13.3	20.0	-24.4	-42.7	-51.4
West Bengal	70.2	15.6	35.6	58.9	8.7	14.6	58.6	5.7	14.1	-16.4	-63.3	-60.4
Jharkhand	61.7	11.6	28.9	48.6	5.8	10.8	48.6	2.5	4.9	-21.2	-78.6	-83.1
Odisha	68.8	31.4	44.1	55.9	17.3	21.5	54.6	12.6	14.9	-20.6	-59.8	-66.3
Chhattisgarh	68.6	25.2	40.4	55.2	21.6	25.7	42.5	7.8	9.8	-38.1	-69.2	-75.8
Madhya Pradesh	68.5	16.0	35.9	59.5	10.4	16.6	48.7	6.2	8.7	-28.9	-61.3	-75.8
Gujarat	60.2	8.4	27.9	51.4	7.4	16.2	46.2	5.6	13.0	-23.4	-32.8	-53.5
D&NH and D&D	NA	NA	NA	36.4	1.5	10.2	47.7	1.2	10.8	–	–	–
Maharashtra	48.3	10.5	24.9	36.5	5.8	10.0	34.0	4.4	9.7	-29.6	-58.7	-61.0
Andhra Pradesh	42.8	5.2	18.6	26.8	2.3	5.3	21.8	1.2	4.6	-49.0	-76.7	-75.3
Karnataka	44.7	4.8	19.3	34.3	4.2	8.0	27.7	2.7	7.0	-37.9	-43.6	-63.8
Goa	27.8	4.4	12.8	20.8	1.9	7.7	24.5	1.1	4.6	-11.7	-76.1	-63.7
Lakshadweep	NA	NA	NA	24.7	16.4	17.5	36.4	4.4	8.3	–	–	–
Kerala	43.5	1.8	15.2	25.7	0.8	4.3	17.8	0.4	3.1	-59.0	-77.4	-79.7
Tamil Nadu	40.1	2.8	15.6	31.7	2.2	6.3	20.2	1.1	2.1	-49.6	-60.6	-86.6
Puducherry	NA	NA	NA	14.4	1.1	2.9	11.1	0.2	0.8	–	–	–
A&N Islands	NA	NA	NA	61.6	25.1	29.4	54.4	17.6	24.1	–	–	–
Telangana	–	–	–	28.2	2.8	6.0	20.1	1.9	4.8	–	–	–
Ladakh	–	–	–	–	–	–	27.0	2.9	6.7	–	–	–
India	**57.0**	**10.8**	**27.4**	**44.5**	**6.8**	**11.7**	**39.6**	**4.2**	**8.2**	**-30.5**	**-61.6**	**-70.1**

*D&NH and D&D: Dadra & Nagar Haveli and Daman & Diu; A&N Islands: Andaman and Nicobar Islands

3.6 Spatial clustering of tobacco use at the district level in India

The spatial analysis revealed significant clustering of tobacco use across districts in India for both men and women (Figs. 4.1 and 4.2). Among men, the Global Moran's I value was 0.209, indicating a moderate positive spatial autocorrelation. A total of 41 districts were identified as high–high clusters (hotspots), primarily concentrated in the northeastern states (particularly Assam, Manipur, and neighboring regions) and parts of eastern India. In contrast, 50 districts formed low–low clusters (cold spots), largely located in southern states such as Karnataka, Tamil Nadu, and parts of Maharashtra. Additionally, 20 districts were classified as low–high clusters and 23 as high–low clusters, indicating the presence of spatial outliers and localized heterogeneity, while the majority of districts (n = 567) were not statistically significant. Among women, a relatively stronger spatial clustering was observed, with a Moran's I value of 0.282. A total of 20 districts were identified as high–high clusters, predominantly in the northeastern region, while 62 districts formed low–low clusters, mainly concentrated in southern India. Furthermore, 18 districts were categorized as low–high clusters and 13 as high–low clusters, reflecting transitional spatial patterns. The majority of districts (n = 588) were not statistically significant (Fig. 4.2).

Figure 4.1: Spatial Clustering of Male Tobacco Use	**Figure 4.2: Spatial Cluster of Female Tobacco Use**
Cluster Map	**Cluster Map**
Moran's, I Map	**Moran's, I Map**

3.7 Association between per capita tobacco production and tobacco use

The association between per capita tobacco production and tobacco use among the population aged 15–49 years across 17 states during 2019–21 was examined (Table 4). The analysis revealed a very weak negative correlation (r = − 0.044), indicating that higher per capita tobacco production was slightly associated with lower tobacco use. However, the magnitude of the correlation is extremely small, suggesting a negligible relationship between the two variables. This implies that variations in tobacco production across states do not meaningfully correspond with differences in tobacco use among individuals aged 15–49 years, and other socio-economic or behavioral factors may play a more important role in influencing tobacco consumption patterns.

Table 4
Association between tobacco production per person of projected population and tobacco use among population aged 15–49 years, 2019–21.

State	Production (tonnes)	Projected population (2019-21)	Per capita average production (tonnes/person)	Tobacco use prevalence (2019-21)	Correlation
Uttarakhand	5	11270	0.000	3.3	
Rajasthan	464	78273	0.006	6.6	
Uttar Pradesh	104994	227943	0.461	5.6	
Bihar	18147	121302	0.150	7.6	
Mizoram	369	1204	0.306	52.0	
Meghalaya	601	3256	0.185	31.2	
Assam	59	34668	0.002	20.0	
West Bengal	19593	97516	0.201	14.1	
Odisha	30	43852	0.001	14.9	
Chhattisgarh	15	29109	0.001	9.8	
Gujarat	400755	68862	5.820	13.0	
Maharashtra	938	123295	0.008	9.7	
Andhra Pradesh	154305	52504	2.939	4.6	
Karnataka	67599	66322	1.019	7.0	
Kerala	11	35307	0.000	3.1	
Tamil Nadu	2564	76049	0.034	2.1	
Telangana	6776	37473	0.181	4.8	
India	**777223**	**1347121**	**0.577**	**8.2**	**-0.0440**

4. Discussion

This descriptive study utilized data from the Directorate of Economics and Statistics (E&S Division), NFHS of India to examine the trends in tobacco cultivation area, production, and yield across Indian states and districts, as well as to analyze patterns of tobacco consumption. It also explored the relationship between tobacco production and consumption, providing a comprehensive view of how regional variations in cultivation corresponded with use.

The consistent decline in tobacco-cultivated area and production in India aligned with Kumar (2019), suggesting that economic and labor-related challenges had contributed to the reduction in land devoted to tobacco. Region-wise analysis showed that cultivation declined consistently in the northern, northeastern, and southern regions, possibly due to rising input and labor costs, soil degradation, and fluctuations in market demand and prices, which had reduced profitability and encouraged farmers to switch to alternative crops (Prasad, 2007). In contrast, the western region experienced an overall increase in cultivation, which may have been due to favorable agro-climatic conditions and better market access, while the eastern and central regions displayed fluctuating trends, reflecting variability in rainfall, labor availability, and market conditions.

The higher tobacco yields in the central region may be attributed to favorable agro-climatic conditions and fertile soils, as well as the adoption of high-yielding varieties and improved agricultural practices, including proper irrigation, fertilization, and pest management, which likely enhanced per-hectare productivity (Kesamsetty et al., 2016). These factors may have contributed to the region's sustained performance despite overall declines in cultivation elsewhere. Overall, these regional differences indicate that economic, environmental, and policy factors collectively shaped the dynamics of tobacco cultivation and its relationship with consumption across India. The study found that high-yield tobacco production was mainly observed in districts of Andhra Pradesh, Uttar Pradesh, Rajasthan, and Telangana, which highlights these states as major tobacco producers due to their favorable agro-climatic conditions and established cultivation practices (Utkarsh Agro, 2024).

The study further revealed a steady decline in tobacco use across India over the past decade, although regional and gender disparities persisted (Lahoti & Dixit, 2021; Shaikh et al., 2022). Northeastern states such as Manipur and Mizoram continued to exhibit higher prevalence compared to other regions, whereas several southern and northern states reported comparatively lower usage. The elevated prevalence in the Northeast may be linked to the social normalization of locally consumed products like tobacco water, which is often perceived as less harmful because of its lower nicotine content relative to other forms of tobacco (Singal et al., 2023; Halder et al., 2025).

In India, tobacco production and consumption were both high at the national level, which suggested a direct relationship. However, at the state level, this scenario did not hold. Analysis across states showed a very weak correlation between per capita production and consumption, indicating that higher production in a state did not necessarily lead to higher local use. States that produced more tobacco per person did not necessarily have higher levels of consumption, suggesting that factors such as cultural practices, state level tobacco control policies, pricing, the availability of alternative products, public health initiatives, and socioeconomic conditions played a more decisive role in shaping consumption patterns. Tobacco produced in many states was primarily intended for commercial sales or export rather than local consumption, which helped explain the lack of a strong positive association and highlighted the complexity of tobacco use dynamics at the state level in India.

5. Conclusion

This descriptive study highlights the complex relationship between tobacco production and consumption in India and reveals significant regional and demographic variations. While national-level production and consumption remain high, the overall area under cultivation and total production have generally declined over the past decade, with high yield districts concentrated in Andhra Pradesh, Uttar Pradesh, Rajasthan, and Telangana. Tobacco use has also decreased nationally, although northeastern states continue to have the highest prevalence among men and women, reflecting cultural practices and local norms. State-level analysis shows a weak correlation between per capita production and consumption, indicating that socioeconomic conditions, public health initiatives, pricing, and policy enforcement influence use more than local production. The findings highlight the importance of region specific strategies that address public health goals while considering the economic role of tobacco farming. Effective interventions could include promoting alternative crops and income generating activities such as spices, horticultural crops, oilseeds, medicinal and aromatic plants, pulses, and floriculture, strengthening targeted public health programs, and implementing policies that balance economic incentives for farmers with efforts to reduce tobacco related harms. Such integrated approaches can provide sustainable livelihoods for farmers, reduce tobacco related health burdens, and support agricultural and economic sustainability across high production regions of India.

Declarations

Ethics approval and consent to participate: This study did not involve human and/ or animal directly studies. Therefore, ethical approval does not apply to this study.

Consent for publication: Not applicable.

Data Availability Statement: The findings of this study are based on secondary data analysis of two publicly available national datasets:

1. **Tobacco Production Data:** Data regarding the area under cultivation, total production volume, and yield for tobacco were sourced from the **Directorate of Economics and Statistics (E&S Division)**, Department of Agriculture and Farmers Welfare (DA&FW), Ministry of Agriculture and Farmers Welfare, Government of India. This information is publicly accessible via the official Crop Production Statistics portal at:

Data Link: https://data.desagri.gov.in/website/crops-apy-report-web

2. **Tobacco Consumption Data:** The district and state-level prevalence estimate for tobacco consumption were derived from the **National Family Health Survey (NFHS)** rounds 3 (2005–06), 4 (2015–16), and 5 (2019–21). These datasets are part of the global Demographic and Health Surveys (DHS) program. The raw data and methodology can be accessed through the DHS program gateway at:

Data Link: https://dhsprogram.com/data/available-datasets.cfm

Both datasets used in this research are open-access and were utilized in accordance with the respective terms of use provided by the Government of India and the DHS Program.

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Figures

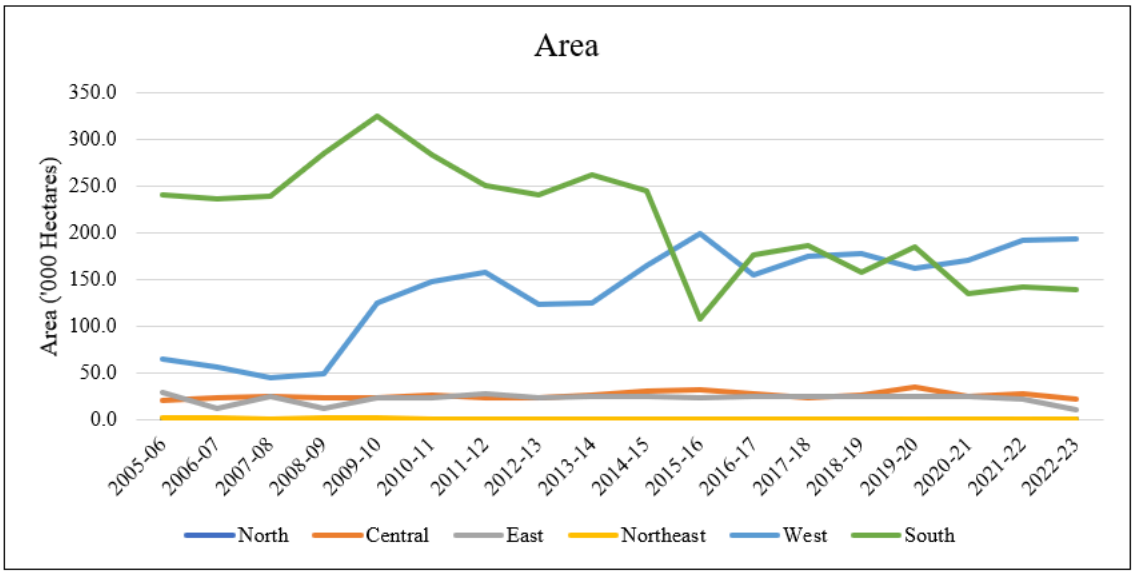


Figure 1

Trends in Tobacco: Area by Regions (2005-06 to 2022-23).

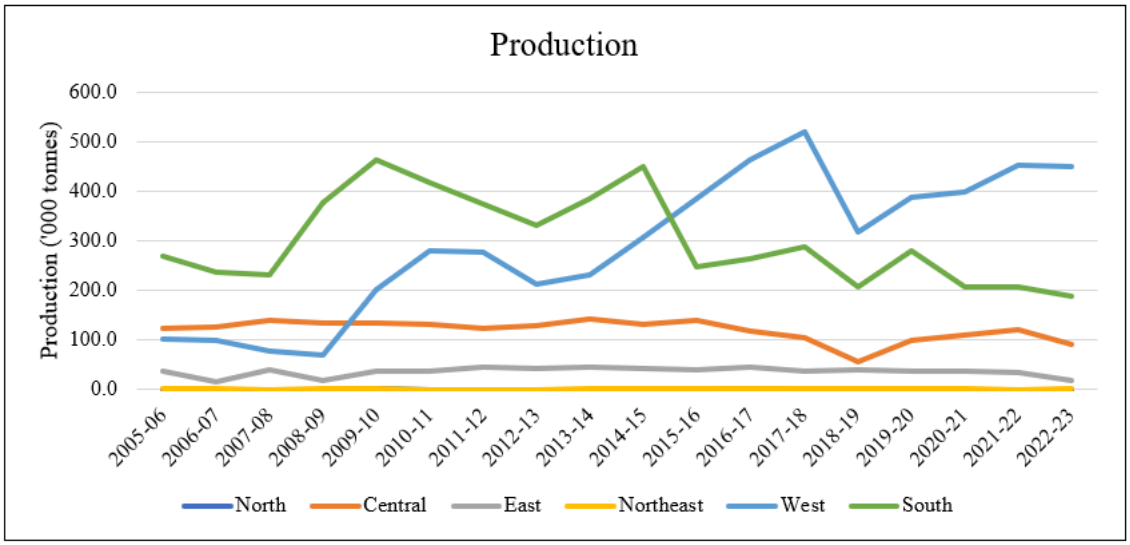


Figure 2

Trends in Tobacco: Production by Regions (2005-06 to 2022-23).

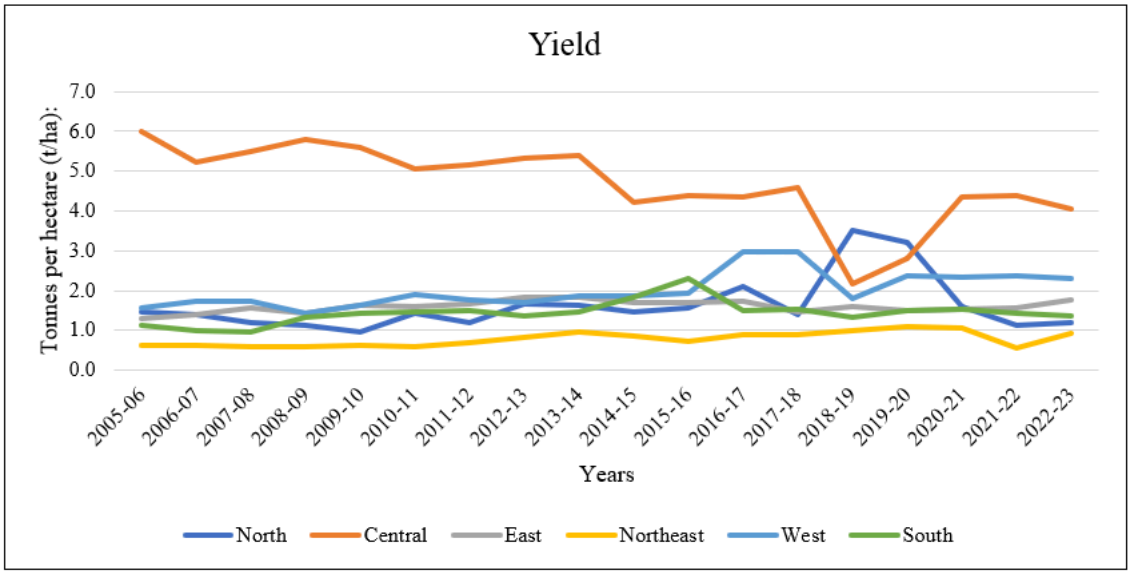


Figure 3

Trends in Tobacco: Yield by Regions (2005-06 to 2020-21).

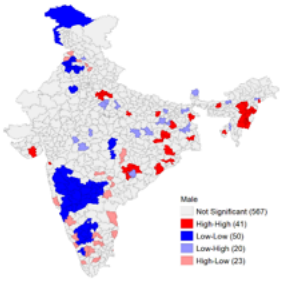
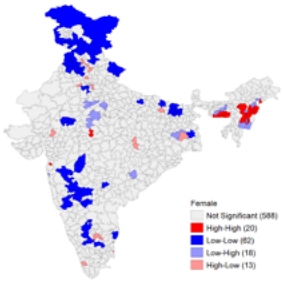
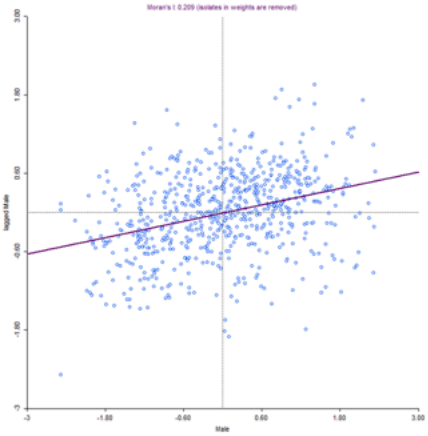
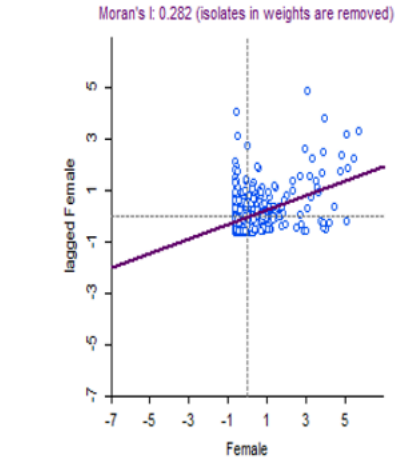
Figure 4.1: Spatial Clustering of Male Tobacco Use	Figure 4.2: Spatial Cluster of Female Tobacco Use
Cluster Map	**Cluster Map**
	
Moran's, I Map	**Moran's, I Map**
	

Figure 4

See image above for figure legend.

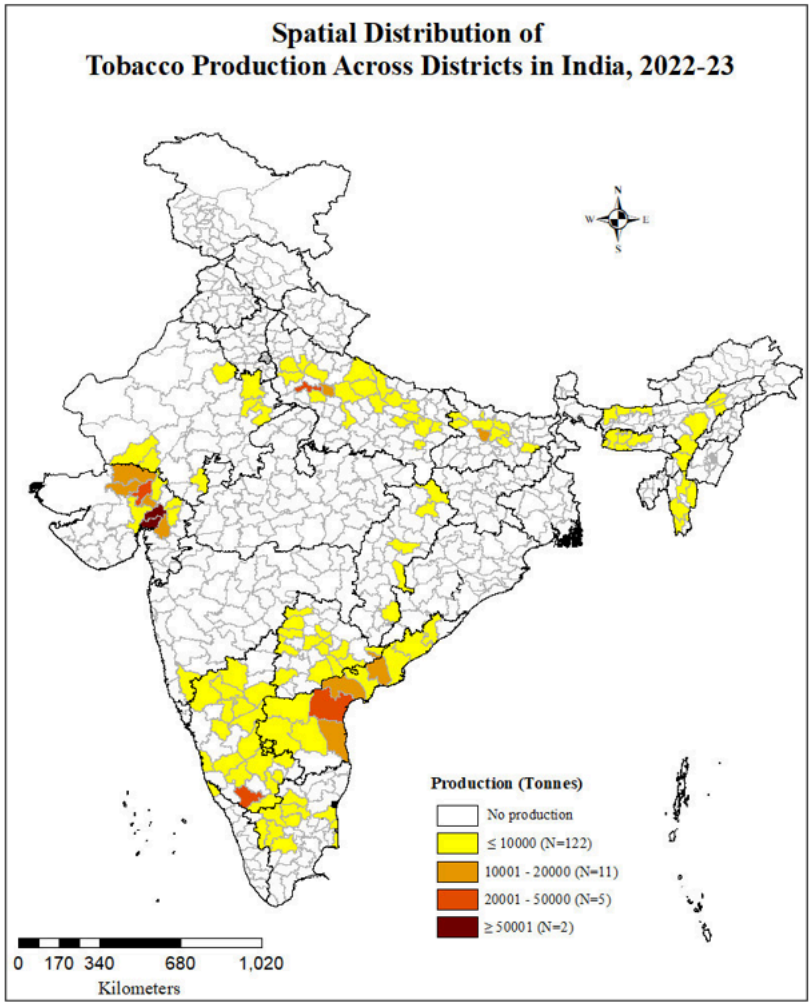


Figure 5

Unnumbered image in the results section.

Supplementary Files

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- AppendixTables.docx