

## **EXPLORING THE PARADOX OF POPULATION GROWTH AND FOOD RESOURCES IN PUNJAB – PAKISTAN: REASSESSMENT IN THE LIGHT OF MALTHUSIAN THEORY**

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**ABSTRACT:** The correlation between population growth and economic development has been a persistent subject of inquiry among demographers and development economists. While some academics assert that population growth impedes economic development, others contend that it is advantageous due to the expansion of the workforce. Thomas Robert Malthus posited that population increases surpass the growth of food resources, resulting in food shortages and a diminished standard of living. The Neo-Malthusian theory advocates for the implementation of population control measures. This research delves into the connection between population growth and economic development in Pakistan, examining the validity of Malthus' assumptions. As the sixth most populous country with limited land area, Pakistan's largest unit, Punjab, holds a substantial portion of its population and food production. Through the analysis of data spanning from 1971 to 2017, despite experiencing a rapid population growth rate of 2.4% in 2017, a positive association between population growth and food resources was identified throughout the studied period.

**Keywords:** Population Growth; Economic Development; Food Resources; Malthus Theory.

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### **INTRODUCTION**

Food is vital for human survival, obtained through diverse means, such as agriculture, an ancient practice that remains significant for many countries. Pakistan's economy and population are closely intertwined. The agrarian economy of Pakistan, attributed to perennial rivers, faces challenges from rapid population growth, ensuring food security a complex venture. Pakistan is striving for self-sufficiency and food prosperity, yet natural events like floods or water shortages often result in food shortages that must be met by imports (Elahi, 1957).

Pakistan's population almost doubled in the first half of the 20th century, from 16.6 million in 1901 to 32.5 million in 1947. In the next 50 years, it grew to around 150 million by 2000. According to the population census 2017, the total population of Pakistan was 207.8 million, growing at around 2.4% annually. In 1998, it was 132.352 million with Annual Growth rate of the region was 2.45. The 1981 census recorded 84.2 million whereas 1972 Pakistan had 65.3 million people, growing at 3.7%, higher than 1981's 3.1% (Arshad *et al.*, 2021; Gondal, 2021; Wazir and Goujon, 2021).

This tremendous population growth is continuously exerting remarkably greater pressure on food resources, making it difficult to maintain a fair food supply level for a fast-growing population (Tian, 2023). In the early 1980s, Pakistan achieved near self-sufficiency in wheat, as in the 1970s when wheat imports dropped to just 5% less than domestic production. Yet, maintaining this level became challenging due to unpredictable conditions, exacerbated by the high population growth rate. Other food resources are also affected (Petter, 1985).

Pakistan is a land of subsistence agriculture having almost 62.10% of its rural population directly engaged with agriculture. Pakistan's total land area is about 79.61 million hectares. With over 2% of the world's population, Pakistan ranks 6th in population growth and 43rd in the global economy, yet occupies only 0.6% of the world's land. Classified as an N-11 nation, it has the potential for future economic growth. Its large population faces poverty, malnutrition, inadequate healthcare, education facilities and extremely bad housing conditions (Khalid & Khalid, 2014).

The conditions outlined above make it necessary to investigate population growth and its effects on Pakistan's economic growth. The economy of Pakistan



## METHODOLOGY

**Data Collection:** This research's primary foundation for information was derived from secondary data sources. Specifically, to ascertain the population dynamics of Punjab, data was meticulously extracted from diverse census reports. These reports, spanning different periods, provided a comprehensive and historical perspective on regional population trends. Moreover, to facilitate the spatial analysis component of the study, a remotely sensed image of the study area was procured. This imagery, crucial for understanding the spatial distribution and patterns, was sourced from the US Geological Survey website. The US Geological Survey is renowned for its repository of high-quality geospatial data, making it a reliable and valuable resource for obtaining remotely sensed images suitable for detailed spatial analyses.

**Study Design:** The study was grounded in a mixed-methods research approach, signifying a deliberate and comprehensive strategy that integrated qualitative and quantitative research methodologies. This methodological choice aimed to capture the richness and complexity of the research topic by leveraging the strengths of both qualitative and quantitative data. Based on the available data of the districts of Punjab since 1971, 22 districts were selected.

**Descriptive Statistics:** The initial phase involved the generation of descriptive statistics specific to the spatial dataset. The raw data obtained from the secondary sources, was first arranged in tables according to the need and the objectivity of the current study. The time series data regarding population (1972-2017) and food production (1971-2017) of the study area was then further processed to find the annual and average growth rate (AGR and AAGR) by using the following formulas;

$$\text{Annual Growth Rate (\%)} = \frac{(P_{end} - P_{start})}{P_{start}} \times 100 \quad (1)$$

$$\text{AAGR(\%)} = \left( \frac{P_{end}}{P_{start}} \right)^{\frac{1}{\text{Number of Years}}} - 1 \quad (2)$$

Where

- $P_{start}$  is the value at the start of the period.
- $P_{end}$  is the value at the end of the period.

In order to find the statistical difference of the AGR and AAGR of population and food production one-sample t-test was performed by using Graphpad Prism 5.

$$t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}} \quad (3)$$

Where

- $\bar{x}$  is the sample mean.
- $\mu$  is the hypothesized population mean.
- $s$  is the sample standard deviation.
- $n$  is the sample size.

**Spatial Data Analysis:** The study acquired a remotely sensed image from the United States Geological Survey (USGS) to initiate the spatial analysis component. This

image, chosen for its high-resolution and comprehensive coverage of the study area, served as the foundational dataset for further investigation into spatial dynamics. Following the data acquisition, interpolation analysis was executed using ArcGIS software, specifically version 10.8. This analytical process involved estimating values for unobserved locations within the study area based on the known values from observed locations. In ArcGIS, interpolation techniques were employed to generate spatially continuous surfaces, allowing for a more detailed understanding of the distribution patterns.

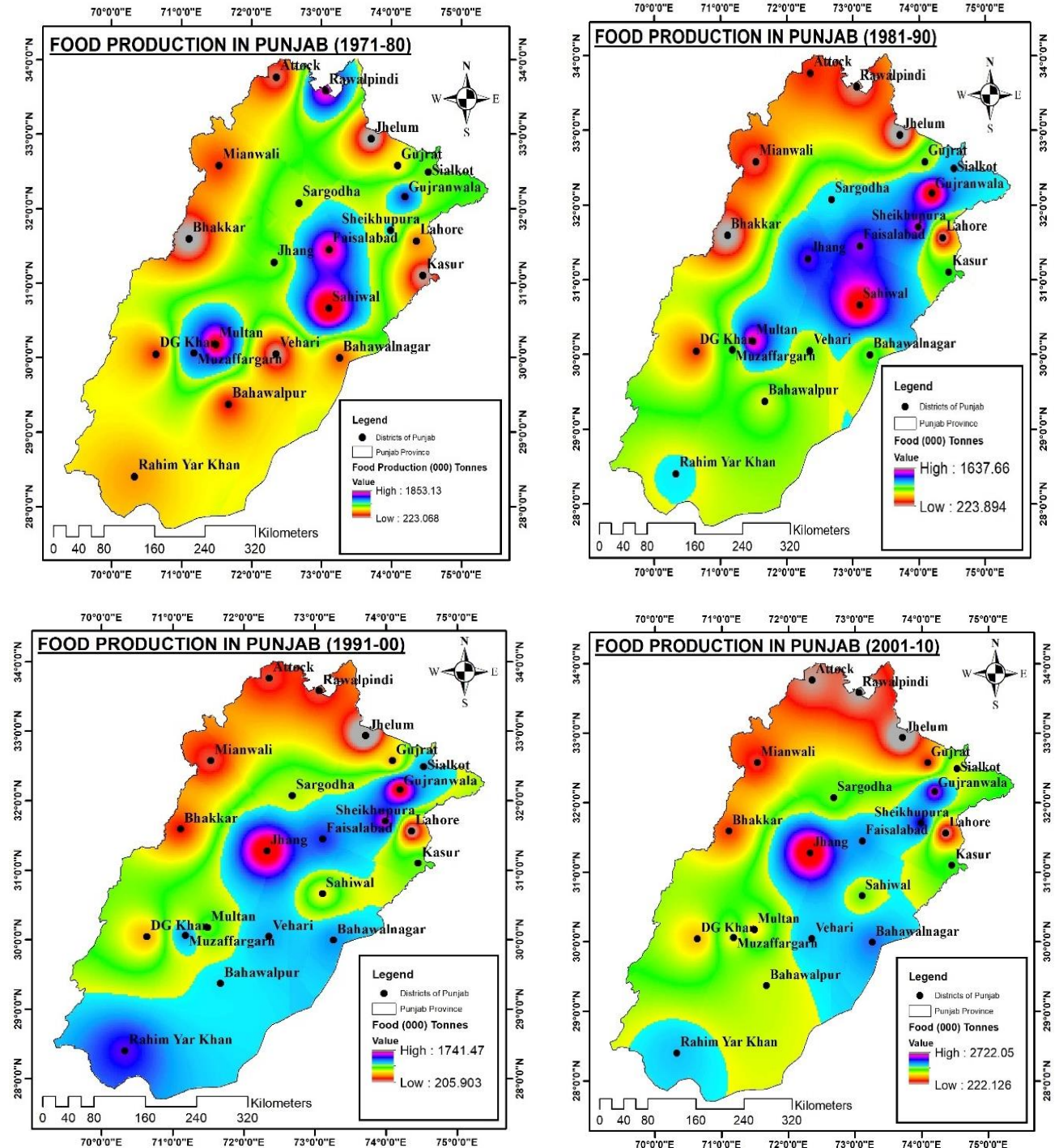
## RESULTS AND DISCUSSION

The results cover the population trends and annual growth rate, food production and annual growth rate and their comparisons in the selected Punjab's districts from 1972 to 2017. Regarding the population trends, diverse demographic changes were observed. Rawalpindi experienced substantial growth, reaching 5.4 million with a 2.09% annual growth rate, indicating notable urbanisation and development. Lahore's population soared from 2.6 million to 11.1 million at a 3.30% annual growth rate (Appendix – 1), suggesting an influx linked to economic opportunities and urban amenities as concluded by Hunter *et al.*, 2005, Opoko and Oluwatayo, Saint and Lori, 2009, 2014, Turok, 2012. Zhang and Liu, 2023. In contrast, Sahiwal showed marginal growth, declining to 2.5 million with a -0.06% annual growth rate, potentially influenced by migration or limited economic growth, as concluded by Lorenzen *et al.*, 2020, Manashe and Bocquier, 2021, Zhong *et al.*, 2023. Overall, districts exhibited varying population dynamics, reflecting a complex interplay of regional influences and socio-economic factors across Punjab.

Figure 2 provides a detailed overview of food production trends in the study area spanning the years 1971 to 2017. Notably, Bhakkar, Vehari, and Bahawalnagar emerge as areas with substantial and consistent growth in food production. Bhakkar, in particular, experienced a remarkable surge from 223 thousand tonnes in the period 1971-80 to an impressive 1,366 thousand tonnes in the later period of 2011-17. This surge corresponds to an extraordinary annual growth rate of 5.13%, highlighting Bhakkar's significant contribution to the overall increase in food production. Conversely, Rawalpindi and Sahiwal exhibit less pronounced trends, characterised by fluctuations and marginal growth. Rawalpindi, for instance, witnessed a decline from 1,546 thousand tonnes in 1971-80 to 648 thousand tonnes in 2011-17, accompanied by a negative average growth rate of -0.01%. These contrasting patterns underscore the regional heterogeneity in food production dynamics within the study area. The cumulative food production for Punjab as a whole demonstrates an impressive escalation from 17,927 thousand tonnes in the

initial period of 1971-80 to a substantial 74,099 thousand tonnes in the later period of 2011-17. This indicates a noteworthy average growth rate of 0.07%, emphasising Punjab's significant role in contributing to the overall increase in food production. These findings align with similar results reported in studies conducted by Arshad *et al.* (2021), Janjua *et al.* (2021), Khan *et al.* (2022), Shah and Khattak (2022), and Shahzad and Amjad (2022). The

consistency across multiple studies reinforces the robustness and reliability of the observed patterns in food production dynamics within the study area. The collective evidence presented in these studies underscores the need for nuanced analyses that consider regional variations and growth trajectories, contributing valuable insights to the broader discourse on the relationship between population growth and food resources in Pakistan.



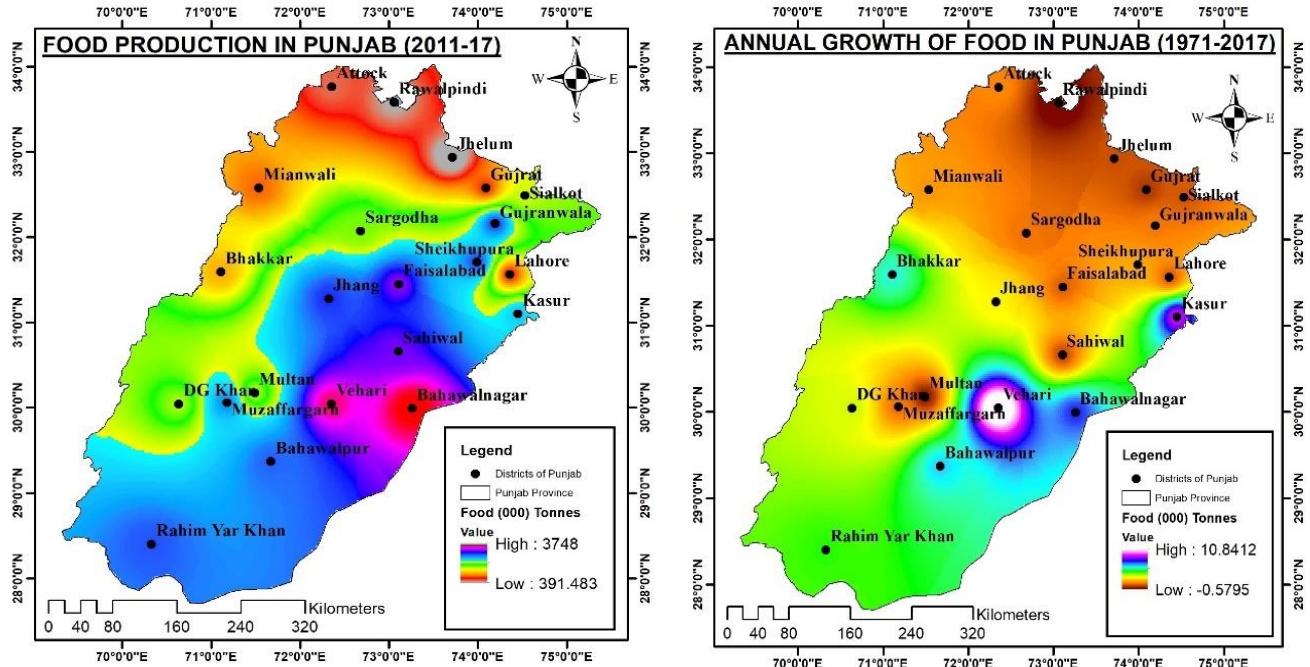


Figure 2: Food Production from 1971 to 2017 and Annual Growth

Figure 3 presents a comprehensive overview of population and its growth in the study area, offering valuable insights into the dynamics of food production and demographic changes. Notably, Bhakkar emerges as a standout case, showcasing an exceptional annual food production growth rate of 5.13%, which significantly surpasses its population growth rate of 0.41% (refer to Fig. 2). This distinctive pattern suggests that Bhakkar has managed to achieve substantial agricultural productivity despite a relatively slower population growth rate.

In contrast, Sahiwal presents a contrasting scenario, exhibiting minimal food production growth (0.66%) despite experiencing a marginal decline in population (-0.06%). This indicates a decoupling of food production and population dynamics in Sahiwal, highlighting the presence of other influential factors affecting agricultural output. Mianwali, on the other hand, demonstrates a noteworthy correlation ( $P=0.126$ ) between higher food production and population growth, unlike most other districts and Punjab's total, where no significant relationship is observed ( $P=0.151$ ) (refer to Appendix – 3). This implies that Mianwali agricultural output is more closely tied to its population growth compared to other regions in the study area. These findings underscore a lack of a direct and uniform correlation between food production and population growth across Punjab's districts, in line with results reported by Abbas *et al.* (2022), Khushi *et al.* (2020), Atif *et al.* (2020), and Siddiqui and Shirazi (2023) in their respective studies.

The lack of a straightforward relationship suggests the influence of multifaceted factors beyond

population dynamics on regional agricultural output. These factors may include technological advancements, agricultural practices, climate conditions, infrastructure development, and policy interventions. The complexity of the relationship between population growth and food production highlights the need for nuanced and context-specific analyses to understand the underlying factors driving agricultural outcomes. These results contribute valuable insights to the broader discourse on the intricate interplay between demographic changes and agricultural productivity within the studied regions of Punjab.

Comparing the available food (crop production) per person/year in the districts of Punjab, Faisalabad stands out with a substantial increase in available food per person, rising from 381 kg/person in 1971-1980 to 396 kg/person in 2011-2017, despite a significant surge in population from 4.2 million to 7.9 million during the same period. Conversely, several districts, such as Rawalpindi, Jhelum, or Multan, indicate no significant change in available food per person despite population growth. Notably, districts like Attock, Bhakkar, and Sahiwal exhibit a minor increase in available food per person but fail to reach statistical significance (Appendix – 4). Overall, while some districts portray marginal improvements in food availability concerning population growth as indicated by Ahmed and Faridi, 2020; Haq *et al.*, 2021; Munawar *et al.*, 2021; Shah *et al.*, 2022), a majority of districts in Punjab display relatively stable food production per capita despite fluctuations in population figures (Khan, 2020; Nadeem *et al.*, 2022; Salam and Hameed, 2022).

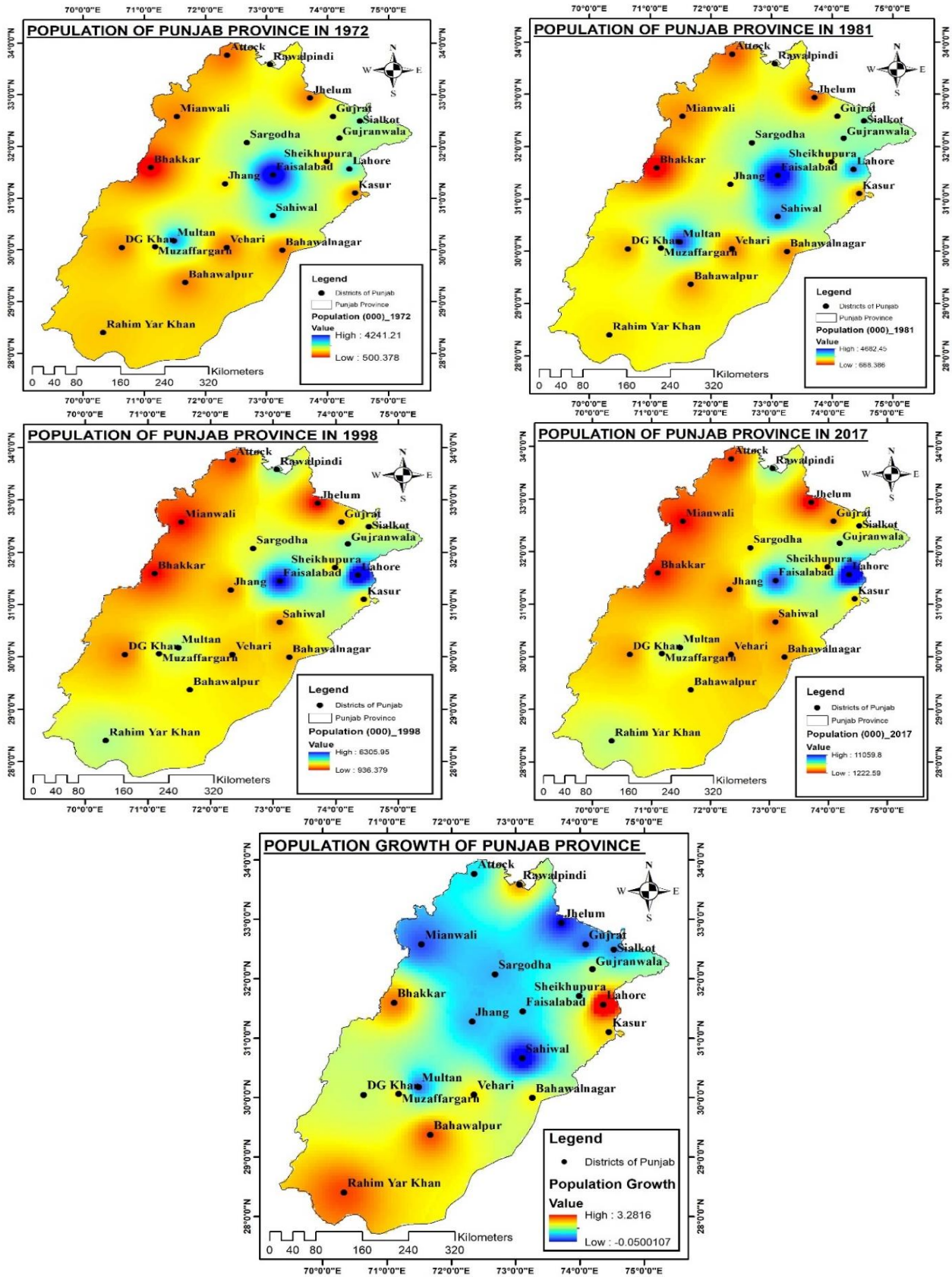


Figure 3: Population Different Census from 1972 to 2017 and Growth

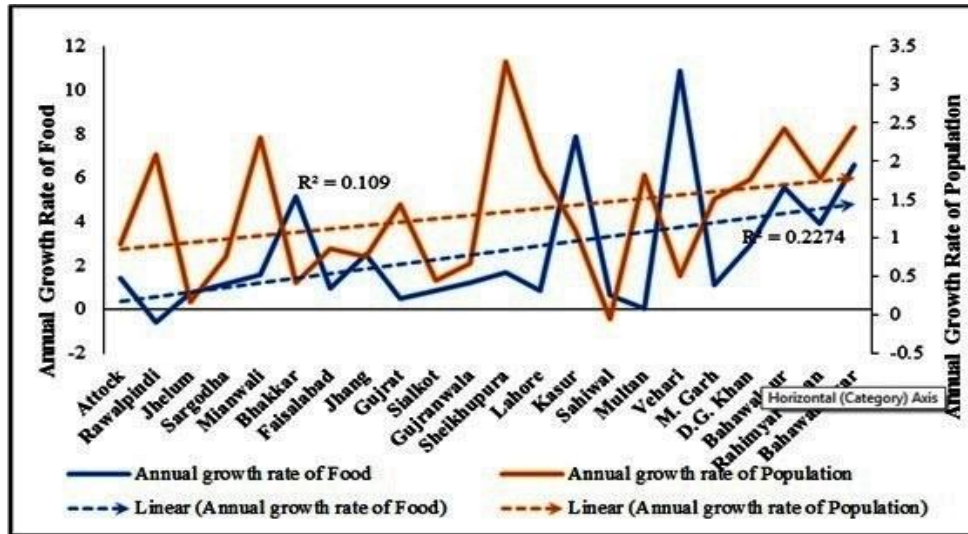


Fig. 4. Comparison of Annual Growth Rate between Population and Food

**Conclusion:** In conclusion, the comprehensive analysis of Punjab's demographic and agricultural dynamics from 1971 to 2017 reveals a complex interplay of factors shaping the region's socio-economic landscape. Urbanisation and economic opportunities drive substantial population growth in districts like Rawalpindi and Lahore, contrasting with Sahiwal's marginal growth potentially influenced by migration or limited economic development. Concurrently, the agricultural landscape showcases diverse trajectories, with Bhakkar, Vehari, and Bahawalnagar experiencing significant growth in food production, emphasising the dynamic nature of Punjab's agricultural sector. Intriguingly, the comparison of food production and population growth reveals varied patterns across districts, with Faisalabad standing out in achieving increased food availability per person despite population growth. However, several districts display relatively stable food production per capita despite demographic fluctuations. The results negate the Malthusian theory who argued that the human population grows more rapidly than the food supply as the trends shown in fig. 4. It is evident from the present study that with the increasing population, food resources also increase due to mechanisation and intensification in agriculture sector. Furthermore, these findings underscore the complexity of the relationship between population dynamics and agricultural output in Punjab, urging further nuanced exploration for effective policy interventions to enhance food security and sustain agricultural productivity in the region.

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**Appendix – 1 Population growth (000) in the Punjab by districts from 1972 to 2017.**

Sr. No.	Districts	1972	1981	1998	2017	Annual growth rate	Average growth rate
		Population (000)	Population (000)	Population (000)	Population (000)		
1	Attock	982	1144	1274	1883	0.92	0.02
2	Rawalpindi	1748	2121	3363	5404	2.09	0.05
3	Jhelum	1052	1167	936	1222	0.16	0.01
4	Sargodha	2101	2553	2665	3703	0.76	0.02
5	Bhakkar	500	665	1051	1650	2.30	0.05
6	Mianwali	1096	1377	1056	1546	0.41	0.01
7	Faisalabad	4242	4689	5429	7873	0.86	0.02
8	Jhang	1561	1978	1869	2743	0.76	0.02
9	Gujranwala	2060	2676	3400	5014	1.43	0.03
10	Gujrat	1899	2254	2048	2756	0.45	0.01
11	Sialkot	2344	2711	2723	3893	0.66	0.01
12	Lahore	2588	3545	6340	11126	3.30	0.07
13	Kasur	1186	1528	2354	3454	1.91	0.04
14	Sheikhupura	1657	2110	2276	3460	1.09	0.02
15	Sahiwal	2684	3612	1843	2517	-0.06	0.01
16	Vehari	1027	1329	2090	2897	1.82	0.04
17	Multan	3133	4080	3116	4745	0.51	0.01
18	D.G. Khan	1142	1583	1643	2872	1.51	0.03
19	Muzaffargarh	1565	2164	2635	4322	1.76	0.04
20	Bahawal pur	1071	1453	2433	3668	2.42	0.05
21	Bahawalnagar	1074	1374	2061	2981	1.78	0.04
22	Rahimyarkhan	1399	1841	3141	4814	2.44	0.05
<b>Punjab Total</b>		<b>37610</b>	<b>47292</b>	<b>73621</b>	<b>110012</b>	<b>1.93</b>	<b>0.04</b>

Source: Computed from PCR, 1972-2017

**Appendix – 2 Total Food Production (000) Tonnes in the Punjab from 1971-2017**

Sr. No.	Districts	1971-80	1981-90	1991-2000	2001-10	2011-17	Annual growth rate	Average growth rate
		1	Attock	348	455	493		
2	Rawalpindi	1546	344	481	460	648	-0.58	-0.01
3	Jhelum	225	223	205	221	390	0.73	0.02
4	Sargodha	984	1009	1024	1291	2092	1.13	0.02
5	Mianwali	456	401	483	650	1163	1.55	0.03
6	Bhakkar	223	274	522	729	1366	5.13	0.11
7	Faisalabad	1617	1319	1330	1837	3114	0.93	0.02
8	Jhang	824	1284	1742	2723	2902	2.52	0.05
9	Gujrat	706	888	703	668	1040	0.47	0.01
10	Sialkot	940	1071	1170	1560	1733	0.84	0.02
11	Gujranwala	1313	1640	1710	2243	2883	1.20	0.03
12	Sheikhupura	1070	1377	1479	2084	2855	1.67	0.04
13	Lahore	538	318	365	473	1008	0.87	0.02
14	Kasur	280	848	975	1376	2485	7.88	0.17
15	Sahiwal	1855	1612	794	1417	3072	0.66	0.01
16	Multan	1705	1459	891	1082	1778	0.04	0.01
17	Vehari	293	883	1185	1712	3473	10.85	0.23
18	M. Garh	1271	826	1197	1599	2688	1.11	0.02
19	D.G. Khan	457	471	687	988	1794	2.93	0.06
20	Bahawalpur	424	742	1104	1523	2784	5.57	0.12
21	Rahimyar Khan	579	1005	1379	1713	2825	3.88	0.08
22	Bahawalnagar	496	811	1226	1886	3748	6.56	0.14
<b>Punjab Total</b>		<b>17927</b>	<b>22254</b>	<b>29566</b>	<b>43811</b>	<b>74099</b>	<b>3.13</b>	<b>0.07</b>

Source: PDS & ESP, 1971-2017

**Appendix – 3 Comparison between Annual Growth Rate of Food and Population of Punjab 1971-2017.**

Sr. No.	Districts	Annual growth rate of Food	Annual growth rate of population	P value (two tailed)	Significant (alpha=0.05)?
1	Attock	1.40	0.92	0.136	No
2	Rawalpindi	-0.58	2.09	0.691	No
3	Jhelum	0.73	0.16	0.398	No
4	Sargodha	1.13	0.76	0.130	No
5	Mianwali	1.55	2.30	0.126	Yes
6	Bhakkar	5.13	0.41	0.455	No
7	Faisalabad	0.93	0.86	0.026	No
8	Jhang	2.52	0.76	0.322	No
9	Gujrat	0.47	1.43	0.312	No
10	Sialkot	0.84	0.45	0.202	No
11	Gujranwala	1.20	0.66	0.190	No
12	Sheikhupura	1.67	3.30	0.206	No
13	Lahore	0.87	1.91	0.236	No
14	Kasur	7.88	1.09	0.416	No
15	Sahiwal	0.66	-0.06	0.614	No
16	Multan	0.04	1.82	0.504	No
17	Vehari	10.85	0.51	0.473	No
18	M. Garh	1.11	1.51	0.100	No
19	D.G. Khan	2.93	1.76	0.159	No
20	Bahawalpur	5.57	2.42	0.242	No
21	Rahimyar Khan	3.88	1.78	0.230	No
22	Bahawalnagar	6.56	2.44	0.276	No
<b>Punjab Total</b>		<b>3.13</b>	<b>1.93</b>	<b>0.151</b>	No

**Appendix – 4 Comparison between Food Production (000) and Population (000) of Punjab 1971-2017.**

Sr. No.	Districts	1972	1971-80	Available food kg/person	2017	2011-17	Available food kg/person	P value (two tailed)	Significant (alpha=0.05)?
		Population (000)	Food Production (000) Tonnes		Population (000)	Food Production (000) Tonnes			
1	Attock	982	348	354	1883	836	444	0.072	No
2	Rawalpindi	1748	1546	884	5404	648	120	0.414	No
3	Jhelum	1052	225	214	1222	390	319	0.124	No
4	Sargodha	2101	984	468	3703	2092	565	0.060	No
5	Bhakkar	500	456	912	1650	1163	705	0.081	No
6	Mianwali	1096	223	203	1546	1366	884	0.356	No
7	Faisalabad	4242	1617	381	7873	3114	396	0.012	Yes
8	Jhang	1561	824	528	2743	2902	1058	0.205	No
9	Gujranwala	2060	706	343	5014	1040	207	0.154	No
10	Gujrat	1899	940	495	2756	1733	629	0.076	No
11	Sialkot	2344	1313	560	3893	2883	741	0.088	No
12	Lahore	2588	1070	413	11126	2855	257	0.146	No
13	Kasur	1186	538	454	3454	1008	292	0.136	No
14	Sheikhupura	1657	280	169	3460	2485	718	0.353	No
15	Sahiwal	2684	1855	691	2517	3072	1221	0.172	No
16	Vehari	1027	1705	1660	2897	1778	614	0.275	No
17	Multan	3133	293	94	4745	3473	732	0.419	No
18	D.G. Khan	1142	1271	1113	2872	2688	936	0.055	No
19	Muzaffargarh	1565	457	292	4322	1794	415	0.110	No
20	Bahawalpur	1071	424	396	3668	2784	759	0.194	No
21	Bahawalnagar	1074	579	539	2981	2825	948	0.171	No
22	Rahimyarkhan	1399	496	355	4814	3748	779	0.228	No
<b>Punjab Total</b>		<b>37610</b>	<b>17927</b>	<b>477</b>	<b>110012</b>	<b>74099</b>	<b>674</b>	<b>0.108</b>	No

