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Regional Disparities in Terms of Infrastructural Development of Punjab: A District Level Study

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Abstract: The present study provides valuable insights into the complex dynamics of infrastructure development within the state. By identifying key factors contributing to disparities and proposing policy recommendations, the study contributes to efforts aimed at promoting inclusive and sustainable development in Punjab. This study evaluated the relative performance of 22 districts of the state of Punjab in terms of infrastructural development at different points in time (1991, 2001, 2019). Twenty-one indicators of infrastructural facilities have been used in this study, and a composite index has been constructed with the help of the Wroclow Taxonomic Method to identify the development of the districts. There are enormous inter-district variations in infrastructural development, and districts near Grant Trunk Road are more developed in infrastructural facilities. The results of the study suggested that the policy formulation of the state government could be made based on resource potentials and the level of development of the districts. The infrastructural variations could be reduced by equally lifting the districts in infrastructural development.

Keywords: Infrastructural development, regional disparities, growth and equality, performance

JEL: R58, O10, O18, R1, R11

INTRODUCTION

The economic development of any region of the country depends upon various factors, among them infrastructural facilities are determinant factors of economic development. At present, "there is a rapid global infrastructure transition across all countries of the world, which has renewed the interest of scholars, researchers, and even policymakers in the need for infrastructure as a pivot for economic development" (Oswald *et al.*, 2011). Intra-regional

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disparities in the state in terms of infrastructural facilities may hinder the growth and equality process of the state. Infrastructure encompasses various aspects such as transportation, communication, energy, and social amenities like healthcare and education. Disparities in infrastructure can impact economic growth, quality of life, and overall development within a region.

In the current global scenario, infrastructure plays an important role in sustainable economic growth as a key element that is essential to ensure incremental productivity and attract industrial framework and service in the state. The achievement of sustainable economic development is one of the top goals of each state. Moreover, infrastructural facilities are required to upgrade the level of development in different sectors of the economy. Infrastructure is crucial for agriculture, industries, services, and the overall economic development of any state. It provides the basic requirements of society and improves the quality of life. In the same way, infrastructural development is a key determinant and supplier to the economic growth of any state. Regional disparities in infrastructural development are a common issue in many countries, including the Indian state of Punjab. Punjab, located in the northern part of India, is known for its fertile land and agricultural productivity. The land frontiers of the state touch Pakistan in the west and Haryana and Rajasthan in the south. The northern part of the state touches Jammu and Kashmir, and Himachal Pradesh lies in the north-eastern part of the state. Punjab has made significant progress in various aspects of infrastructure development, although there are still some challenges and disparities to address. The state of Punjab known for its agricultural prowess and industrial development, exhibits significant differences in infrastructural facilities across its districts. Reducing these disparities is essential for promoting balanced economic growth, improving living standards, and fostering social equity. However, infrastructural development in Punjab is not uniform across the entire state, and there are notable regional disparities. The present study is conducted to elaborate on the level of infrastructural development at the district level in the state of Punjab by capturing the values of 21 indicators of infrastructural facilities for three points in time, i.e., 1991, 2001, and 2019.

The enhancements needed in various indicators to upgrade the level of infrastructural development, along with policy recommendations for reductions in regional disparities, are also suggested. Identifying these disparities can help policymakers priorities investment and development efforts to ensure more balanced growth and improved living standards across all districts within Punjab. Studying the regional disparities in infrastructural development is essential for promoting balanced economic growth, social equity, and sustainable development. It empowers

policymakers with the knowledge needed to target investments, policies, and interventions where they are most needed, ultimately leading to a more prosperous and inclusive society. The focus of this study is to provide a composite index of infrastructural development at the district level in the state of Punjab. The remaining part of the paper is organized as follows: A review of the literature for the study is covered in Section 2. Section 3 describes data analysis and methodology. Results and discussion will be covered under Section 4, and Section 5 will deal with the conclusion and suggestions.

THEORETICAL FRAMEWORK OF THE STUDY

The study can provide a comprehensive understanding of the drivers and consequences of regional disparities in infrastructural development in Punjab at the district level. It enables policymakers to formulate targeted interventions aimed at reducing disparities and promoting more equitable development outcomes across the region. During the British colonial rule, Punjab was a significant agricultural region, and infrastructure development was primarily focused on facilitating agricultural production and trade. Pollard (1983) examined the agricultural development scenario of Punjab along with a comparative study with other Indian states. The study also studied the relationship between agriculture and infrastructure. The results of the study revealed that Punjab state was in a better position than other Indian states in economic and infrastructural indicators, i.e., per capita income, surfaced road length, per capita electric consumption, wheat and rice yields, per capita milk availability, etc. Gayathri (1997) explored the role of infrastructure facilities in the industrial development of Karnataka at three points in time (1966–67, 1984–85, and 1989–90). The results revealed that there was a significant positive effect of infrastructure facilities on industrial development. Rai and Bhatia (2004) examined the socio-economic development variations at the district level in Assam by using 48 developmental indicators for the year 2001. In addition, the study also constructed the development indices for the agricultural, infrastructural, and industrial sectors. The composite index results showed that there were only two districts that were highly developed in terms of industrial and infrastructure facilities. There was a significant, highly positive relationship between agricultural development and industrial and socio-economic development and no association with infrastructural facilities. Moreover, infrastructural facilities were highly positively associated with socio-economic development. Fedderke *et al.* (2006) examined the importance of infrastructure investment in the economic growth of South Africa for a long period, i.e., 1875–2001. The result of the study provides strong evidence

regarding the positive role of infrastructural investment in economic growth, both directly and indirectly. After the 1970s, the elasticity of infrastructure investment for economic growth was reduced because of the low level of investment. Moreover, the causal relationship between economic growth and infrastructural development was less significant during the study period. Jatain (2007) examined the inter-district development variations in terms of the agricultural sector, industrial sector, and infrastructural sector by constructing the district economic development index using principal component analysis from 1966–67 to 2000–2001 in Haryana. The degree of infrastructural disparities among districts has increased during the studied period and also from decade to decade, except from 1978–79 to 1990–91. However, it was observed that infrastructural disparities were less than the disparities in the agricultural sector and industrial sector in the state. Kaur (2008) examined the disparities in infrastructural development at the district level in Punjab during the period 1990–2007 and revealed that there are large variations in infrastructural development. In the case of irrigation facilities, Hoshiarpur, Rupnagar, and Bhatinda districts enjoyed higher growth rates, while Gurdaspur district recorded a negative growth rate. Kaporthala, Gurdaspur, Ludhiana, Rupnagar, and Firozpur enjoyed high growth rates in transportation. In the case of electricity facilities, Patiala, Bhatinda, and Sangrur recorded higher growth rates, while Firozpur, Gurdaspur, Amritsar, and Kapurthala had negative growth rates. The study also found that there was a positive and significant effect of bank offices, road length, and electricity connections on per capita income. Sahoo and Dash (2009) investigated the causal relationship between economic growth and infrastructural development in India for the period of 1970 to 2006. The study made a composite infrastructural development index with the help of seven indicators of infrastructural facilities to examine the impact on economic growth. The result of the Granger causality test shows a positive causal direction from infrastructural development to economic growth. Patra and Acharya (2011) attempted to examine the disparities in infrastructure facilities among 16 major Indian states for the year 2002–03 and revealed that there was a significant positive relationship between infrastructure and economic growth; however, infrastructural development has a negative relationship with poverty. Punjab has the top position as a highly developed state, while Uttar Pradesh has the lowest developed state rank. Singh and Kaur (2014) examined the importance of infrastructure in the growth of agriculture in Punjab for the period 1990–91 to 2011–12 and found that there were high growth rates of production and market arrivals and a positive correlation between agricultural infrastructure and agricultural production during the studied period. The coefficient of correlation of the number of

commercial banks with the production of wheat was the highest, followed by cooperative banks, regulated markets, and total storage capacity. Owolabi-Merus (2015) explored the relationship between infrastructure development and economic growth in Nigeria between 1983 and 2013 by using Gross Domestic Product (GDP) and Gross Fixed Capital Formation (GFCF) and showed that 63 percent of the variation was explained by the GFCF, which revealed a significant relationship between economic growth and infrastructural development. However, the result shows that there was an absence of casualty economic growth and infrastructural development in Nigeria in the short run as well as in the long run. Kumar *et al.* (2015) evaluated the inter-district infrastructural developmental variations in Haryana for the year 2010–11 with the help of the composite development index, mean, and standard deviation. The study showed that there were wide variations in inter-district disparities in terms of infrastructural development, and the government of Haryana has to spend more on social and economic services to enhance the level of development at the district level. From the above literature, it is found that infrastructure development has a positive effect on economic growth in most countries. Moreover, development in the form of infrastructural facilities is a crucial deciding factor in economic growth. The present study was conducted to explore the infrastructural development variations among districts in Punjab and to investigate the stages of development in these districts.

RESEARCH PROBLEM

In recent years, the state of Punjab has practiced wide infrastructural transformation in terms of building more schools, hospitals, transportation, telecommunication, and irrigation facilities. Moreover, there is a shortage of studies that have explored the infrastructural development at the district level in Punjab, and inter-district development variations have not been explored adequately. Thus, the present study tries to explore the inter-district infrastructural development variations in the state of Punjab at different points in time, i.e., 1991, 2001, and 2019.

RESEARCH METHODOLOGY

The relative performance of 22 districts in the state of Punjab has been evaluated in terms of infrastructural development at three points in time, i.e., 1991, 2001, and 2019. Economic infrastructural development and social infrastructural development are complementary to each other in the process of development. Thus, there are various indicators to measure infrastructural development. However, in the present study, 21 indicators of infrastructural facilities have been taken and collected from the various issues of statistical

abstracts of Punjab. These indicators are; number of banks, population served per commercial bank, population served per post office, power consumption (million kwh) average (units) sale of electricity, population served per primary school, population served per middle school, population served per high school, number of college (arts, commerce, science, numbers of industrial training institute, number of vehicles, length of roads in km, length of roads per 100 sq. km, percentage of villages linked with roads, membership of co-operative societies per 1000 population, area served per market committee (sq. km), number of medical institution, population served per medical institution, number of bed installed in medical, population served per bed and number of doctors.

METHOD OF ANALYSIS

The development of the infrastructural sector is a multidimensional process, and a single factor is not capable of finding the infrastructural development in any region. For the comprehensive nature of the indicators, it is necessary to integrate all the indicators into a single factor, which provides the overall picture of the development. There are various methods to construct a single factor of development based on different developmental indicators (i.e., principal component analysis, ranking method, ratio index aggregation method, monetary index, and multiple factor analysis). The above-mentioned methods have their usefulness with limitations like nonlinearity, weightage in the combined analysis, and scale of measurement. According to Harbison *et al.* (1968) it ''provides a useful tool for interpolation of statistical data, sets up a measure of social and economic maturity and introduces a concept of the pattern of development which may prove to be very useful in planning''. Frederick *et al.* (1970) and Gostowski (1970) provide the brief description of this method and argues that the taxonomic distance is a more sensitive and valid measure of development intensity because it consider the dispersion among component indicators, i.e., structural similarities among districts. In addition to it, some other study Arief (1982), Narain *et al.* (2000, 2005 and 2009) and Bhatia & Rai (2004) have used this method due to its wide applicability in the development model. Keeping in view the limitations of various methods, the Wroclow Taxonomic Method (Florek *et al.*, 1952) is used to construct the single development unit in this study in the following procedure:

Let $[X_{ij}]$ be the data matrix giving the values of the *i*th district and the *j*th indicators I = 1,2,3,4…n (no of districts) and j= 1,2,3…k (no of indicators)

For combined analysis $[X_{ij}]$ is transformed to the matrix of standardised indicators $[Z_{ij}]$ as follows

$$[Z_{ij}] = \frac{Xij - \bar{X}}{\sigma}$$

where $\bar{X}j$ = mean of the *j*th indicators and σ is the standard deviation of the *j*th indicators. From $[Z_{ij}]$, identify the optimal value of each indicator. The optimal value can be maximum or minimum depends upon the direction of impact of the indicators. The increase in road and banking facilities would positive affect the facilities of infrastructural development and higher density of population may hinder the development process. To achieve the pattern of development C_i of the district, firstly we will calculate the square of the deviation of the individual value of a transformed variate from the optimal value (which is the P_{ij})

$$P_{ij} = (Z_{ij} - Z_{0j})^2$$

For each *i and j*

Pattern of Development is given by

$$C_i = \sqrt{\sum_{j=1}^{n} P_i \ / (cv_j)}$$

Where (cv_j) is the coefficient of the *j*th indicator in X_{ij} infrastructural development is given by

$$D_i = C_i / C$$

$$C = \bar{C} + 3\sigma C_i$$

Where $\bar{C} = \frac{\sum_{i=1}^{N} C_i}{N}$ and $\sigma C_i = \sqrt{\sum_{i=1}^{n} (C_i - \bar{C})^2}$

Smaller values of Di i.e. near to 0 will indicates the high level of development and near to 1 will shows the less developed district.

The Wroclaw Taxonomic Method (Florek *et al.*, 1952) holds importance in measuring regional disparity at the district level due to its systematic approach to plant classification. By utilizing morphological characteristics, geographic distribution, and ecological factors, this method allows for a comprehensive understanding of regional flora diversity. It provides a structured framework for cataloging plant species, enabling comparisons across districts and regions.

RESULTS AND DISCUSSION

Key findings of the study highlight the uneven distribution of infrastructure across Punjab. Developed urban centres and industrial hubs tend to have

better infrastructure compared to rural and remote areas. Factors such as historical development patterns, government policies, investment allocation, and geographical location influence the disparities observed. Infrastructure plays a crucial role in economic development. Districts with robust transportation networks, access to reliable energy sources, and efficient communication systems are more attractive to businesses and investors. Consequently, regions lacking such infrastructure face challenges in attracting investment and stimulating economic growth. Infrastructure disparities have socio-economic implications, affecting the quality of life and opportunities available to residents. Districts with inadequate infrastructure face challenges in accessing essential services such as healthcare, education, and clean water. This can perpetuate poverty and inequality, hindering overall development and exacerbating regional disparities.

The index of infrastructural development has been calculated for three points in time, i.e., 1991, 2001, and 2019. The districts are ranked based on the value of the infrastructural index, which is given in Table 1. In the year

Table 1: Infrastructural Development Index (IDI) and Rank of Districts

Sr. No	*District*	*1991*		*2001*		*2019*	
		IDI	*Rank*	*IDI*	*Rank*	*IDI*	*Rank*
1	Gurdaspur	0.6757	9	0.637	11	0.660	14
2	Fatehgarh Sahib@	-	-	0.6297	10	0.588	6
3	Barnala$	-	-	-	-	0.67	15
4	Fazilka*	-	-	-	-	0.719	21
5	Taran Taran$	-	-	-	-	0.639	11
6	Jalandhar	0.3651	1	0.4056	1	0.445	2
7	S.B.S Nagar#	-	-	0.51	5	0.681	17
8	Amritsar	0.4424	3	0.5071	4	0.567	5
9	Hoshiarpur	0.4605	4	0.4754	3	0.614	8
10	Roop Nagar	0.5727	6	0.5333	6	0.676	16
11	S.A.S Nagar$	-	-	-	-	0.63	9
12	Kapurthala	0.8152	12	0.5392	7	0.656	13
13	Ludhiana	0.417	2	0.4531	2	0.124	1
14	Firozpur	0.7597	11	0.8253	17	0.644	12
15	Fridkot	0.5407	5	0.7128	14	0.699	20
16	Muktsar	-	-	0.6633	12	0.693	19
17	Moga#	-	-	0.5868	8	0.637	10
18	Bhatinda	0.6937	10	0.6987	13	0.588	7
19	Mansa@	-	-	0.8157	15	0.692	18
20	Sangrur	0.613	8	0.8159	16	0.497	4
21	Patiala	0.5764	7	0.6022	9	0.468	3
22	Pathankot*	-	-	-	-	0.721	22

Source: Author's own calculation
Note: sign shows the no availability of the data.
@ established in 1992.
# established in 1995.
$ established in 2006.
*established in 2011.

1991, it can be observed from Table 1 that out of the twelve districts of the state, the district of Jalandhar (0.365) is grade one, followed by Ludhiana (0.417), Amritsar (0.442), and the district of Kapurthala (0.815) is grade one. The index values of infrastructural development vary from 0.365 to 0.815. As regards the year 2001, out of seventeen districts, the district of Jalandhar (0.405) was again found to be in first rank, followed by the districts of Ludhiana (0.453), Hoshiarpur (0.453), and Firozpur (0.825), which got the last position. Moreover, the score of infrastructural development at this time varies from 0.405 to 0.825. The development pattern in terms of infrastructural facilities changed in the year 2019, and the district of Jalandhar (0.445) lost its rank to Ludhiana (0.124). At the same time, a newly born district, i.e. Pathankot (0.721) got the last position among 22 districts. The index value varies from 0.124 to 0.721. It can be said on behalf of the results that there are inter-district disparities in terms of infrastructural facilities in the state of Punjab in the studied period.

Table 2: Classification of Districts under Stages of Development (1991, 2001, 2019)

Sr. No	*District*	*1991*	*2001*	*2019*
1	Gurdaspur	Second	Second	Second
2	Fatehgarh Sahib	-	Second	Third
3	Barnala	-	-	Second
4	Fazilka	-	-	Second
5	Taran Taran	-	-	Second
6	Jalandhar	Fourth	Fourth	Fourth
7	S.B.S Nagar	-	Third	Second
8	Amritsar	Third	Third	Third
9	Hoshiarpur	Third	Fourth	Second
10	Roop Nagar	Third	Third	Second
11	S.A.S Nagar	-	-	Second
12	Kapurthala	First	Third	Second
13	Ludhiana	Fourth	Fourth	Fourth
14	Firozpur	First	First	Second
15	Fridkot	Third	Second	Second
16	Muktsar	-	Second	Second
17	Moga	-	Third	Second
18	Bhatinda	Second	Second	Third
19	Mansa	-	First	Second
20	Sangrur	Second	First	Third
21	Patiala	Third	Third	Fourth
22	Pathankot	-	-	Second

First = low developed, Second = low middle developed, Third = high middle developed, Fourth = high developed.
Source: Author's own calculation
Note: sign shows the no availability of the data

DIFFERENT STAGES OF DEVELOPMENT

The ranking of the districts based on their respective score on the development index would give the classified picture of development. Moreover, to find out the stages of development of the districts a classification should be made from the assumed distribution of the mean of calculated development index.

For relative comparison of different districts regarding the level of infrastructural development, it is necessary to find out whether the district having the Di value less than or equal to (- ó) is highly developed (fourth stage of development) and district having the Di value less than or equal to (+ ó) are less developed (first stage of development). In the same manner, the districts having the Di value in between and (- ó) are classified as high middle infrastructural developed districts (third stage of development), and districts having a Di value between and (+ ó) are classified as low middle infrastructural developed districts (second stage of development).

For the year 1991, it is evident from Table 2 that the districts of Jalandhar (0.3651) and Ludhiana (0.417) are in the group of highly infrastructurally developed districts. Amritsar (0.4424), Hoshiarpur (0.4605), Fridkot (0.5407), Roop Nagar (0.5727), and Patiala (0.5764) fall into the category of high-medium development. Gurdaspur (0.6757), Bhatinda (0.6937), and Sangrur (0.6130) fall into the low-medium development category, whereas Firozpur (0.7597) and Kapurthala (0.8152) come in the group of low-developed districts.

As far as the developed category of the districts in the year 2001 is concerned, Jalandhar (0.4056), Ludhiana (0.4531), and Hoshiarpur (0.4754) are enjoying the category of highly developed districts. Amritsar (0.5071), Roop Nagar (0.5333), Kapurthala (0.5392), Moga (0.5868), and Patiala (0.6022) fall into the category of high medium developed districts. The districts of Fatehgarh Sahib (0.6297), Gurdashpur (0.637), Muktsar (0.6633), Bhatinda (0.6987), and Faridkot (0.7128) fall into the low medium category of infrastructural developed districts whereas the districts Mansa (0.8157), Sangrur (0.8159) and Firozpur (0.8253) are in the category of low infrastructural developed.

In the year 2019, there were again only three districts namely Ludhiana (0.124), Jalandhar (0.445), and Patiala (0.468) which are enjoying the status of high infrastructural development while the districts Sangrur (0.4971), Amritsar (0.5669), Fatehgarh Sahib (0.5877) and Bhatinda (0.5879) are in the third stage of development. The districts namely Gurdaspur (0.660), Pathankot (0.721), Taran Taran (0.639), Kapurthala (0.656), SBS Nagar (0.681), Hoshiarpur (0.614), Roop Nagar (0.676), SAS Nagar (0.610), Firizpur (0.644), Fazilka (0.719), Faridkot (0.699), Muktsar (0.693), Moga (0.637), Mansa (0.692)

and Barnala (0.67) fell in to the category of low medium infrastructural developed districts, however, there is no district which is fell into the category of low infrastructural developed district.

NUMBER OF DISTRICTS UNDER DIFFERENT STAGES OF DEVELOPMENT

In the case of infrastructural development in the year 1991, there are only two districts out of twelve, which are found to be highly developed category. In the same way, there are five and three districts found to be in the high-middle and low-middle development category respectively. There were only two districts found to be in the category of low-level development (see Table 3).

As far as the developed category of the districts in the year 2001 is concerned, there are only three districts out of seventeen, which are found to be a highly developed category. In the same way, there are seven and four districts found to be in the high-middle and low-middle development category respectively. There are only three districts are found to be in the category of low level of development. For the year 2019, three districts have the category of developed, whereas, four districts are classified under the category of high middle developed. There are fifteen districts found to be low-medium developed categories.

Table 3: Numbers of District under different Stages of Infrastructural Development

	Numbers of Districts		
Stages of Infrastructural Development	*1991*	*2001*	*2019*
High	2 (≤ 0.436)	3 (≤ 0.482)	3 (≤ 0.472)
High Middle	5 (0.436 - 0.577)	7 (0.482 - 0.612)	4 (0.472 - 0.604)
Low Middle	3 (0.577 - 0.718)	4 (0.612 - 0.742)	15 (0.604 - 0.736)
Low	2 (≤ 0.718)	3 (≤ 0.742)	0 (≤ 0.736)
Total Districts	12	17	22

Source: Author's own calculation

Note: Figure in bracket shows the values of infrastructural development index at various stages of development.

POLICY RECOMMENDATIONS

Addressing infrastructure disparities requires a multi-faceted approach. Governments must prioritize equitable distribution of resources and investment in underserved regions. Strategic planning and infrastructure development programs should consider the unique needs and challenges of each district. Additionally, promoting private sector participation and

leveraging innovative financing mechanisms can supplement government efforts to bridge the infrastructure gap.

In the present study, the level of infrastructural development has been measured at the district level in the state of Punjab with the help of a composite index of different indicators of infrastructural facilities. The results of the infrastructural development index show the wide level of disparities in the State. The districts that are near Grant Trunk Road are more infrastructural developed as compared to the districts that are far away. The districts of Jalandhar and Ludhiana are in the category of high development. It is suggested that the government should upgrade the potential of agricultural development by increasing investment in the infrastructure of dams, canals, and power supplies and must provide more marketing facilities, suitable agricultural credit, and policy in the state.

There should be more efforts for infrastructural development at the state level to raise the state domestic product and reduce disparities. There should be a proper need for improving the rural infrastructure for the development of the farming community, and suitable agricultural infrastructural policies are extremely essential for agricultural development in the state. The study suggested some more recommendations for balanced agricultural development in the state, like public investment in critical areas of agricultural infrastructure, increasing facilities for qualitative agricultural infrastructure, improving the quality of farm products, and minimising political interference in the state. According to the study, there should be proper attention paid to infrastructural development to achieve significant economic growth.

CONCLUSION

The study employs a district-level analysis to understand the nuances of infrastructural development. Punjab consists of 22 districts, each with its unique socio-economic characteristics and developmental challenges. Infrastructural development can play an important role in the growth process than public and private investment. The study concludes by emphasizing the importance of addressing regional disparities in infrastructure for sustainable development and inclusive growth. By fostering balanced and equitable development across all districts, Punjab can harness its full potential and create opportunities for prosperity and advancement for all its residents.

Key findings indicate disparities in transportation, communication, and social amenities, impacting economic growth and quality of life. Historical legacies, government policies, and investment priorities contribute to uneven development. Addressing these disparities necessitates equitable resource

allocation, strategic planning, and private sector involvement. Bridging the infrastructure gap is crucial for fostering sustainable development and ensuring inclusive growth across all districts of Punjab.

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