



Assessment of Urban Sprawl and its Impact on Natural Environment in and around Jaipur city, Rajasthan, India

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Abstract

Study of urbanization of Jaipur city and its impact on natural environment includes remotely sensed data which is collected from LANDSAT *ei*. MSS for 1973, TM for 1998 and ETM+ for 2011 and other secondary data such as population data is collected from census of India. Land use/land cover maps are prepared by hybrid classification (visual interpretation and unsupervised classification) and calculate the statistics for different years with the help of ERDAS software. Land use data shows that built-up area is increasing at very fast rate and reached 19479.2 hact in 2011 from 1854.36 hact in 1973. Population is also increasing with time and highest growth 65.59 % is found in 1941-51 and follow 62.77 % in 1991-2001. Other land use types such as crop land, waste land and scrub/grass land is showing decreasing trend with time. The expansion of built-up area is at the cost of de-expansion of crop land, waste land and scrub land. This type land use changing trend is alarm for natural environment and agricultural land. So it is suggested that urbanization must be on waste land not to on fertile agricultural land.

Keywords: Natural environment, land use/land cover, urbanization and Jaipur city.

Introduction

Land is the most important natural resources on which all activities are based. Land use is seasonally dynamic and undeniably is more changing. The raise in population and human activities are increasing the demand of the limited land and soil resources for agriculture, forest, pasture, urban and industrial land uses. The extent of urbanization or the sprawl is one such phenomenon that drives the change in land use patterns. The sprawl normally takes place in radial direction around the city centre or in linear direction along the highways. The study on urban sprawl is attempted in the developed countries¹⁻⁷ and recently in developing countries such as China^{8,9} and India¹⁰⁻¹². Information on the rate and kind of changes in the use of land resources is essential for proper planning, management and to regularize the use of such resources¹³. As a result land use/land cover change has become a topic of tremendous interest within the human dimensions of the environmental change research community¹⁴⁻¹⁶. Consequently, quantifying and understanding the extent and spatial distribution of land use/land cover is a crucial importance to the study of environmental change at various scales¹⁷. Several studies were carried out concentrating on the impact of urban expansion on ecology¹⁸ environment¹⁹⁻²¹ and natural resources²²⁻²³. Application of remotely sensed data made possible to study the changes in land cover in less time, at low cost and with better accuracy²⁴.

Study area: The areal extension of Jaipur Urban area is between North latitudes 26°47' to 27°02' and East longitudes 75°36' to 75°55' and situated almost in the centre of the district

and covers an area of about 470 sq. km. The Jaipur urban has the parts of Sanganer (45.5%), Jhotwara (42.5%) and Amer (12%) blocks. Jhotwara block which constitutes the major part of the urban city has a population density of 2745 persons/sq. km. With the increase in the rate of urbanization the population of the city also increased many fold during the last decades. The decadal growth rate of population is highest during 1941 – 51 as 65.59 % followed by 62.77 % during 1991– 2001 (table 1).

Table-1
Population and decadal growth of Jaipur urban area

Decadal Population Growth %		
Years	Population	Decadal Growth %
1931	150000	
1941	175810	17.21
1951	291130	65.59
1961	403444	38.58
1971	615258	52.5
1981	977165	58.82
1991	1458438	49.26
2001	2374000	62.77
2011	3073350	29.45

Physiographically the city area is characterized by sandy-plains, hills, intermountain-valleys, pediments etc. Major part of the city is covered by the alluvial sandy plains. In the northern and eastern parts, the Aravalli Hill Ranges, trending north east-south west alternating with intermountain-valleys, constitute significant signatures of physiography. The ridges are generally made-up of resistant quartzite rocks. Important among these are the Nahargarh, Amer, Puranaghat and Jhalana Hills. There is no

major river drainage system in the Jaipur Urban Area. One streamlet originating from Nahargarh Hill namely Amanishah Nalla flows southerly up to Sanganer area where it takes easterly flow direction due to structural control. The Amanishah nalla and associated streamlets are ephemeral in nature and merge with the Dhund River, a tributary of Morel River (out of urban area). Surface runoff in extreme western part flows in westerly direction and discharged through Bandi (locally called Mashi) river. The mean annual rainfall at Sanganer, Amer and Jaipur raingauge stations have been 534.3, 622.78 and 546.03 mm respectively during the period 1980, 1980 and 2009. The average mean annual rainfall for these three stations is 567.70 mm.

The monsoon rainfall, which contributes about 90% of the total annual rainfall extends from June end till September, July and August being the wettest months. Summer season starts in the month of March and continues till mid June. The mean daily maximum temperature is highest (40.6°C) in May, whereas mean daily minimum temperature is highest (27.3°C) in June. The on-set of monsoon in June end/July brings down the temperature.

Material and Methods

The present study involved in the utilization of remotely sensed data of Jaipur city for getting the spatio-temporal information of urban land use. The study urban sprawl followed by land use change and its impact on natural environment. LANDSAT images MSS (1972, resolution 56 meters), TM (1990, resolution 30 meters) and ETM+ (2011, resolution 15 meters) are used for land use preparation and to analyze the urban sprawl pattern. SOI toposheets (Open Series Map) is used for survey of land use/land cover verification. Boundary of Jaipur urban area is taken from development authority of Jaipur city and digitized with the help of Arc GIS. To assess the urban sprawl and its impact on environment of Jaipur city, land use/land cover is prepared by hybrid classification (visual interpretation and unsupervised classification) and calculates the area statistics using ERDAS software. After this compare the land use statistics and find land use change and growth pattern.

Results and Discussion

Study of analysis of urbanization in Jaipur city and its impact on environment holds; land use of different years are prepared with the help of Erdas and detail is given blow.

Built-up area: Land use of different year's shows that built up area is increasing with time. Population is also increasing at very fast rate and reached 3073350 in 2011 from 150000 in 1931. Highest population growth 65.59 % is found in between 1941-51 and follows 61.77 % in between 1991-2001 (table-1).

Built-up area is increasing at the cost of decreasing of agricultural land, waste land and scrub/grass land. In 1973 built-up area covered 1854.36 hact which increased and reached 13175.2 hact in 1998 (table-2). Between 1998 to 2011 built-up area increased by 6304 hact and reached 19479.2 hact. The average growth rate of built-up area is 476.35 hact/year. It is expected that built-up area will cover 24242.7 hact area in 2021.

Crop land: Crop land is the land which is used for cultivation. Satellite data shows that in 1973 crop land covered 80683.6 hact area and 70006.5 hact in 1998. In 2011 crop land covered 69203.4 hact area (table-2). In between 1973 to 2011 crop land decline and average decreasing rate is 310.28 hact/year. De-expansion of crop land is at the cost of expansion of built-up land. Between 1973 to 1998, crop land reduced 10677.4 hact and between 1998 to 2011 reduced 803.1 hact.

Waste land: Waste land is the land which is not used for cultivation and characterized with rocky out crops. By the analysis of land use of different years shows that waste land is showing decreasing trend. In 1973 waste land covered 48280 hact and 45069, 38708.3 hact in 1998 and 2011 respectively (table-2). Waste land is decreasing at very fast rate and average decline rate is 258.69 hact/year.

Scrub/grass land: Scrub/grass land is also showing decreasing trend. In 1973 scrub land covered 22340.2 hact area and in 1998, 20303.5 hact area. In 2011 scrub/grass land covered 14535.4 hact area (table-2). Land use data shows that scrub/grass land is continuously decreasing.

After the analysis of land use statistics of different years, data shows that built-up area is continuously increasing (figure-1) and crop land, waste land and scrub/grass land are continuously decreasing (figure-2). This land use changing trend is alarm for natural environment. So it suggested that new urbanization must be take on waste land not to on cultivable agricultural land and grass land (pastures) (figure-4, 5 and 6).

Table-2
Land use types of different years and changing pattern of Jaipur urban area

Land use/land cover	1973	1998	Change	1998	2011	Change
Builtup Area	1854.36	13175.2	11320.84	13175.2	19479.2	6304
Crop land	80683.9	70006.5	-10677.4	70006.5	69203.4	-803.1
Waste land	48280	45069.2	-3210.8	45069.2	38708.3	-6360.9
Scrub/grass land	22340.2	20303.5	-2036.7	20303.5	19535.4	-768.1

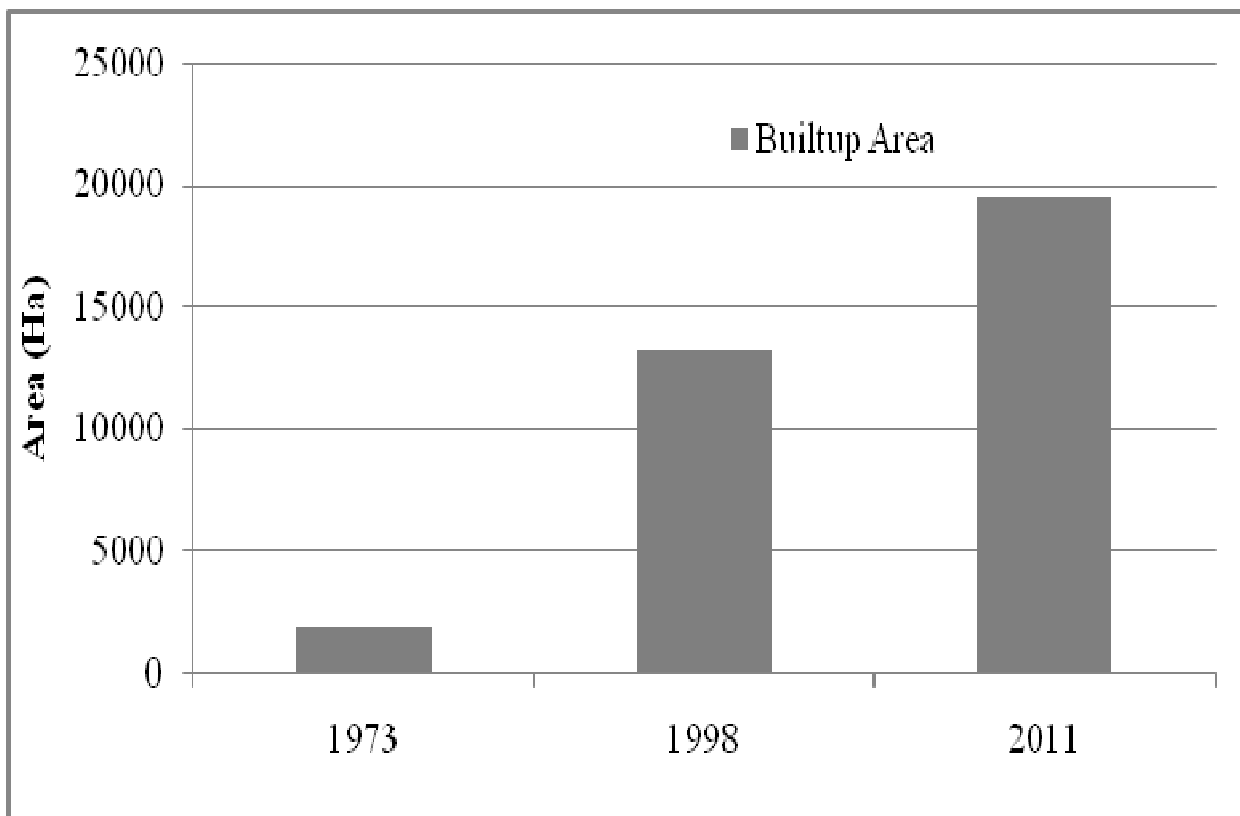


Figure-1
Built-up area growth pattern of Jaipur urban area

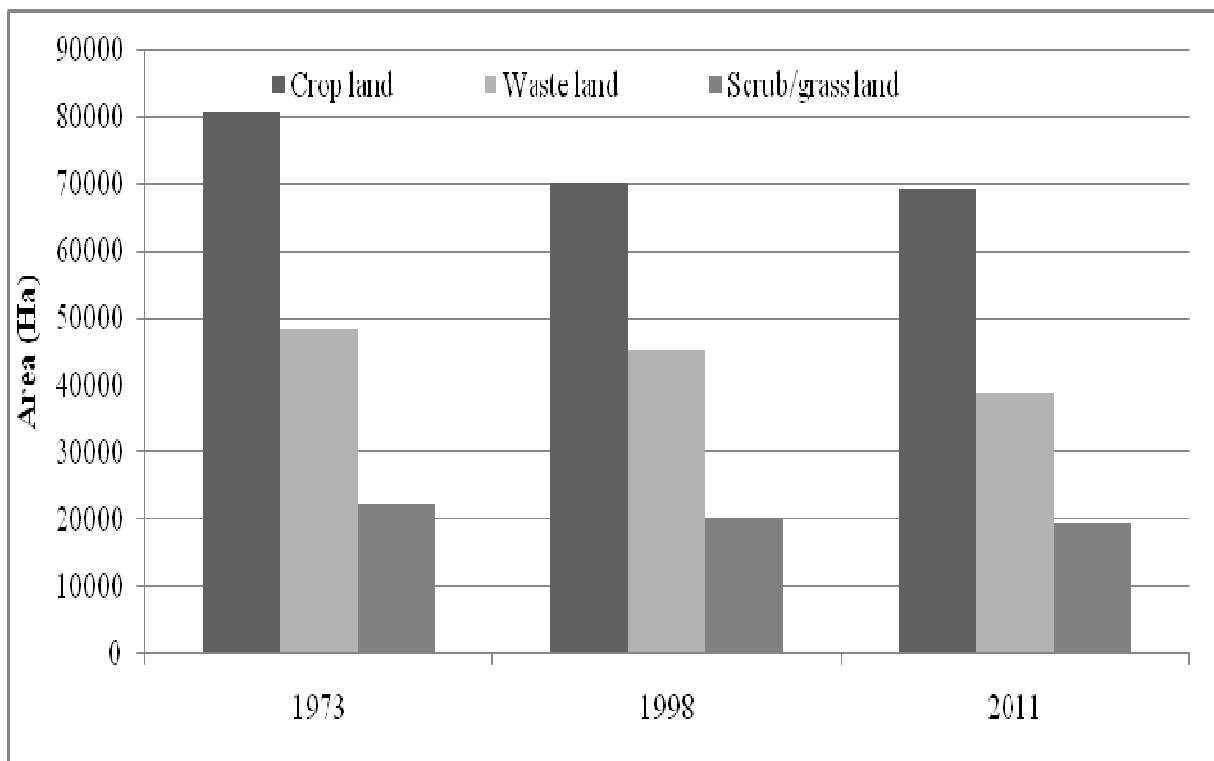


Figure-2
Changing pattern of land use types from 1973 in and around Jaipur city

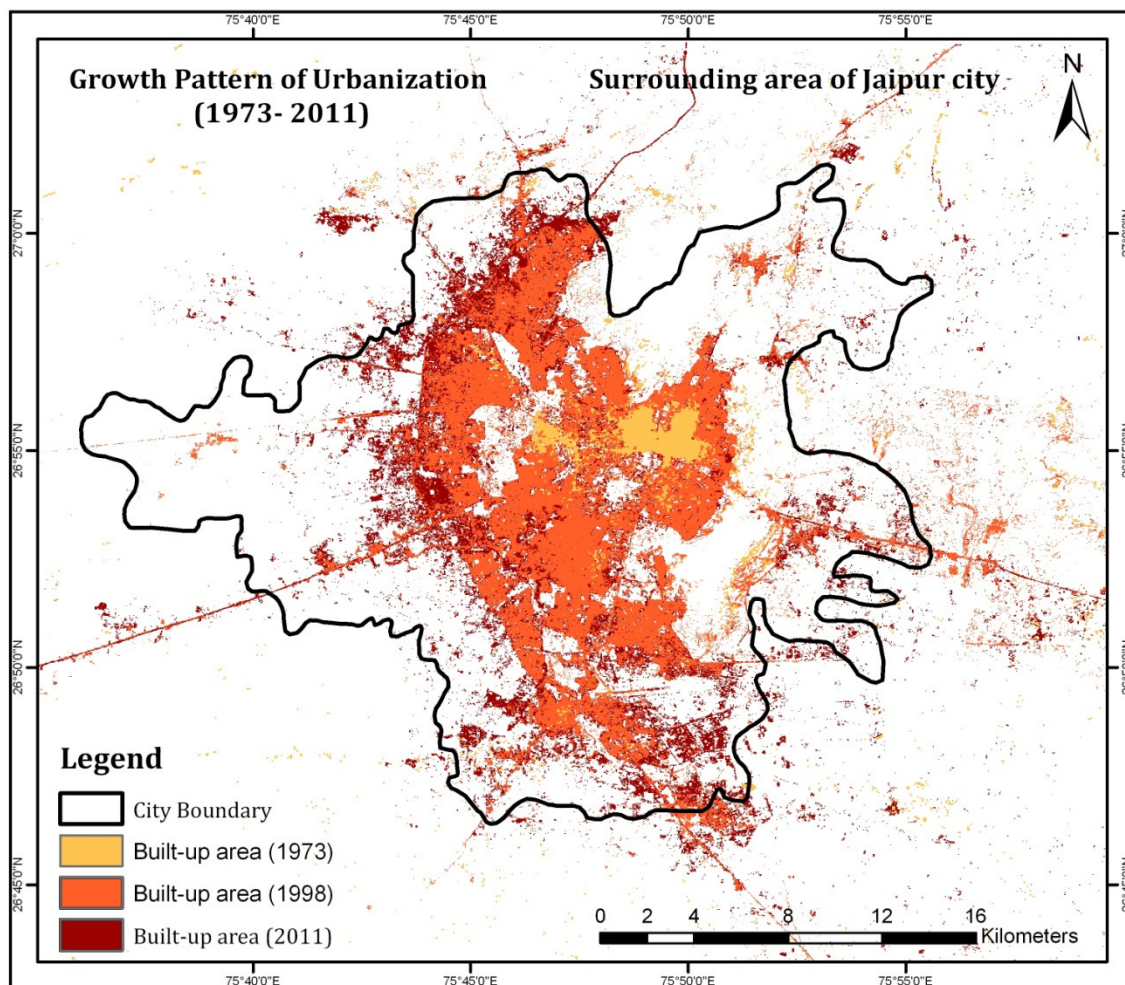


Figure-3
Urbanization of Jaipur city since 1973 to 2011

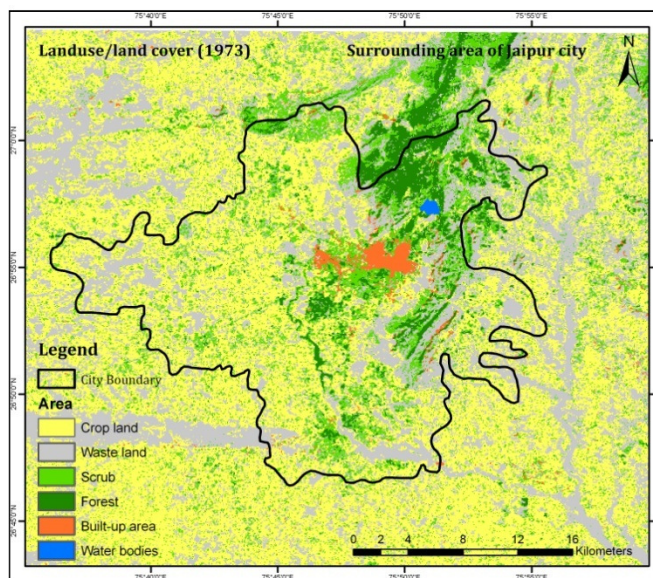


Figure-4
Land use map in and around Jaipur city (1973)

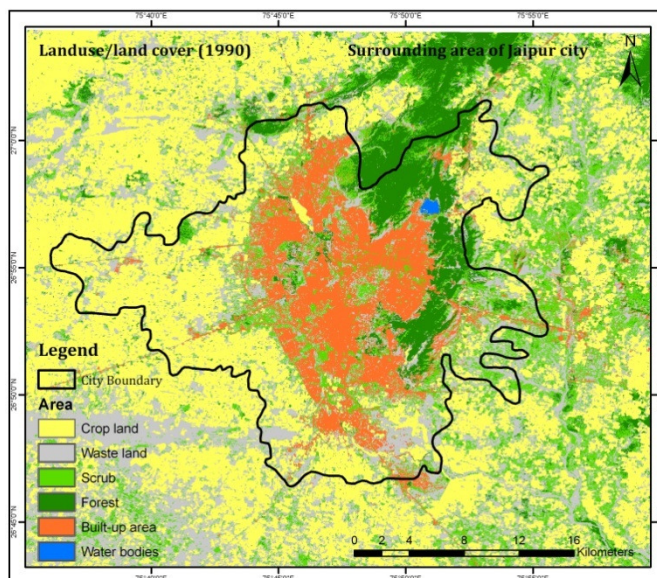


Figure-5
Land use map in and around Jaipur city (1998)

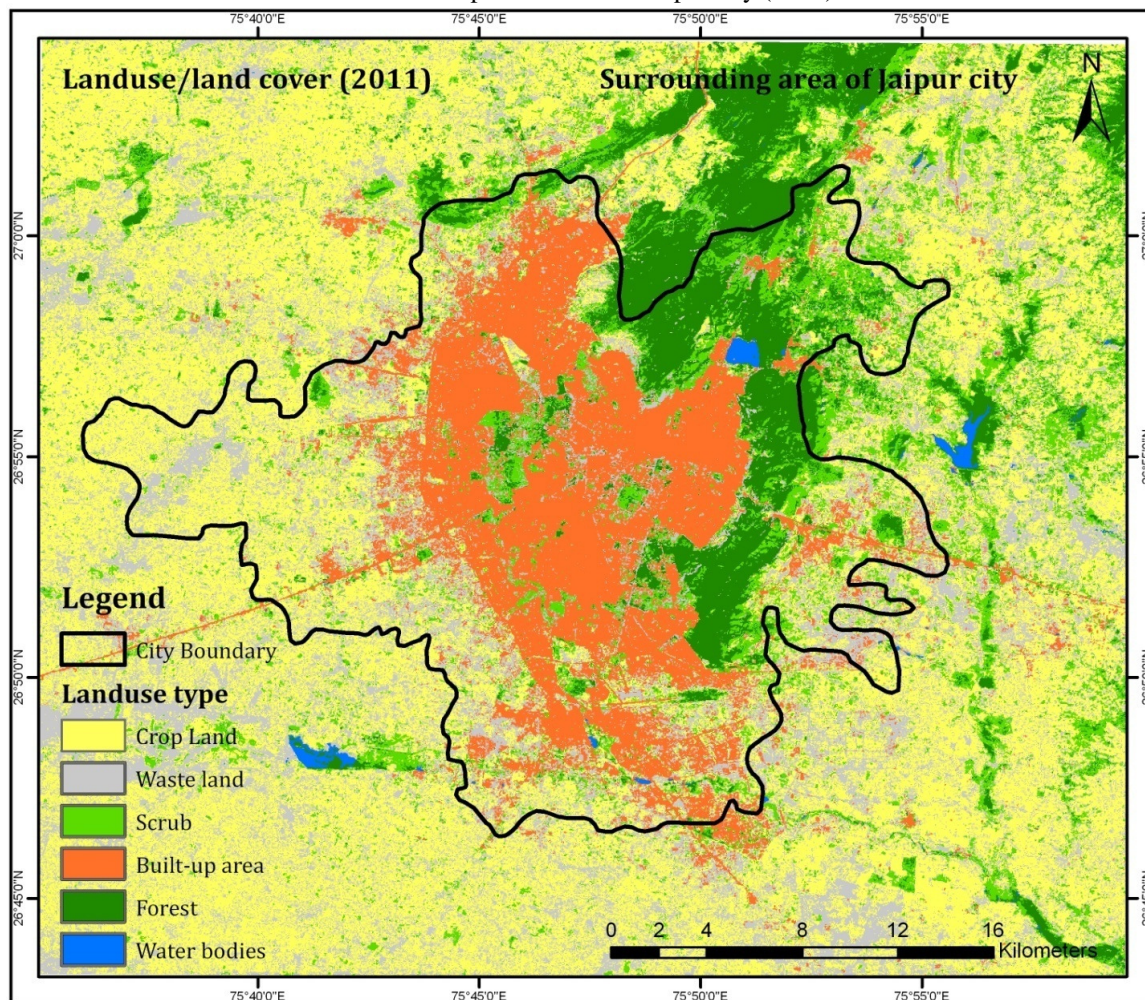


Figure-6
Land use map in and around Jaipur city (2011)

Conclusion

The study of urbanization shows that built-up area is increasing at very fast rate and acquires the area of crop and grass land. Maximum expansion of urban is found on fertile agricultural land in northern west and southern east direction (figure 3). Crop land, scrub/grass land and waste land is showing decreasing trend. This changing pattern is alarm for natural environment.

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