

```
In [13]: ► import numpy as np
import geopandas as gpd
import pandas as pd
import matplotlib.pyplot as plt
```

```
In [2]: ► df = gpd.read_file(r"D:\QGIS\QGIS dataset\QGIS 3d\SDA shapefile\places.shp")
```

```
In [3]: ► df.head()
```

Out[3]:

	osm_id	name	type	population	geometry
0	16175031	Islamabad	city	0	POINT (73.06295 33.69469)
1	16175073	Lahore	city	0	POINT (74.32285 31.56219)
2	30670223	Rawala Kot	city	0	POINT (73.78522 33.88149)
3	58568637	Gilgit	city	0	POINT (74.31407 35.92084)
4	58744442	Rawalpindi	city	3000000	POINT (73.06312 33.59726)

```
In [50]: ► df['population'].unique()
```

Out[50]: array([ 0, 3000000, 20000000, 172800000, 350000, 200000,  
500000, 5429547, 300000, 100000, 185000, 288056,  
175000, 10247362, 3116851, 520000, 450000, 853000,  
250000, 955629, 700000, 313405, 81845433, 6318745,  
46378000, 3363911, 20215000, 4567982, 202562, 2019118,  
850000, 6500000, 1800000], dtype=int64)

```
In [69]: ► df['type'].unique()
```

Out[69]: array(['city', 'town', 'suburb', 'village', 'Lahore Airport', 'airport',  
'country', 'Haripur', 'locality', 'Lahore', 'island',  
'Noor Colony', 'HAripur', 'Mohallah Gojar M', 'Police Station H',  
'NADRA Office Har', 'Mohallah Kund', 'Kotnajibullah',  
'Hattar Industria', 'Sultanpur', 'Havellian', 'hamlet',  
'NS Palace', 'Hospital', 'Colony', 'county', 'historical\_divis',  
'state', 'historical\_state', 'Research Institu', 'Rawalpindi',  
'School'], dtype=object)

```
In [51]: ▶ df['name'].unique()
```

```
Out[51]: array(['Islamabad', 'Lahore', 'Rawala Kot', 'Gilgit', 'Rawalpindi',
'Landi Kotal', 'Karachi', 'Gujranwala', 'Jhelum', 'Kharian',
'Gujrat', 'Ghakhar Mandi', 'Gujar Khan', 'Chaklala Scheme 3',
'G-6', 'G-7', 'G-8', 'G-9', 'G-10', 'G-11', 'F-11', 'F-10', 'F-8',
'F-7', 'F-6', 'E-7', 'E-9', 'H-8', 'H-10', 'H-11', 'I-9', 'I-10',
'I-11', 'Mirpur', 'Dagaar', 'Dadyal', 'Chaksawari', 'Jarai',
'Ú@Ù\x880'Ú¹Ù\x81', 'Adiala', 'Khasala Khurd', 'Saddar',
'Hyderabad', 'Nawabshah', 'Sukkur', 'Matiali', 'Sekhat', 'Hala',
'Qazi Ahmad', 'Daulatpur', 'Moro', 'Naushahro Firoz', 'Bhiria',
'Kandiaro', 'Hingorja', 'Ranipur Riyasat', 'Gambat', 'Khairpur',
'Rohri', 'Pano Aqil', 'Ghotki', 'Sarhad', 'Ubauro', 'Sadiqabad',
'Sanjarpur', 'Zahir Pir', 'Khan Bela', 'Janpur',
'Tarind Muhammad Panah', 'Kotri', 'Gawadar', 'Kamra', 'Nowshera',
'Pabbi', 'Risalpur', 'Ú\x860$0±0³0~Ú\x81', 'Model Town',
'Pindi Bhattian', 'Kot Momin', 'Bhera', 'Kalar Kahar', 'Saidpur',
'Allam Iqbal International Airport', 'Valencia Town', 'Golra',
'Satellite Town', 'Bhara Kaho', 'Wah', 'Shahdara Bagh',
'Kala Shah Kaku', 'Muridke', 'Sadhoke', 'Faisalabad', 'Cantonment',
'Liberty Market Round About', 'Mazung', 'Walled City', 'Samanabad',
'Fatehjang', '0$Ú\x8c0~Ú¹ 0¢0~0$0~',
'Mansehra / Ú\x850$Ú\x860³Ú\x810±Ú\x81', 'Chakwal', 'Misriot',
'Khewera', 'Pind Dadan Khan', 'Ú\x850±Ú\x8c', 'Sialkot', 'Chakri',
'Kharian Cantt', 'Faisal Town', 'Johar Town', 'Sensah', 'Banjosa',
'Arja', 'Timarkot', 'Chakothi', 'Rakot', 'Kotli', 'Sehra',
'Kallar Syedan', 'Rajdhani', 'Thrarkel', 'Behari', 'Islamgarh',
'Channi Raiki', 'Panjeri', 'Gulpur', 'Unknown', 'Chorch', 'Kakhra',
'Bhimber', 'Kumahari', 'Samani Cross', 'Poona', 'Sahar', 'Calgud',
'Muzaffarabad', 'Jatli', 'Chechian', 'Hajira', 'Abbaspur', 'Kuian',
'Khanjeri', 'Blouch', 'Baithek', 'Qilaan', 'Panjeeri',
'Peer conoy', 'Isur', 'Kundar mor', 'Nakodar', 'Dina', 'Dultala',
'Shahbargh', 'Chowk Pindori', 'Sarsubasha', 'Changralla',
'Challayar', 'Gurrah Kanjal', 'Keeney', 'Unknown Village',
'Dandly', 'Tatta Pani', 'Bandra Town', 'Plahal Klan', 'Khuiratta',
'Dongi', 'Dhanna', 'Chirri', 'Bindian', 'Baratla', 'Charhoi',
'Sarahota', 'Village', 'Big Village', 'Village (v)', 'Andra',
'Andra Kalaan', 'Anhar', 'Bagh', 'Bang-e-yal', 'Bangrela',
'Boghor', 'Broota', 'Bunbehak Serrari', 'Chah Mochian', 'Chambah',
'Channi Thotha', 'Chattroh', 'Chura Gali', 'Daraik', 'Dhri Susral',
'Dublia', 'Durooni', 'Namnoota Bala', 'Noor Kot', 'Kainchikot',
'Pajjay Ali Saujal', 'Ali Saujal', 'Magray Town', 'Naili',
'Miral Gala', 'Rahar Bun', 'Pakhar', 'Mangora',
'Mahmoud Gali Army Base', 'Ghameer', 'Hussain Kot', 'Kahuta',
'Dwarandi', 'Kandore', 'Onaah', 'Samlotha', 'Unknown (v)', 'Ganoi',
'Natthal', 'Tangdaw', 'Jumee', 'Kadda', 'Rara town', 'Kanilie',
'Kas Hara', 'Porana Akalgarh', 'Machat', 'Gangrara',
'Potha Bekriyan', 'Pehra', 'Siyotha Potha Bansi', 'Potha Bansi',
'Kalyal Bainsi', 'Khadora', 'Khalaqabad', 'Gurha', 'Gumma',
'Thathi', 'Haleemabad', 'Ibrahimabad', 'Ghazi Gurrah',
'Muzaffarabad Airport', 'Smarifkhan Bhagsar', 'Moolia', 'Dalola',
'Boi', 'Lamnan', 'Tetwal', 'Drek', 'Sudhan Gali', 'Noshara',
'Alisojal', 'Maira Burka', 'Dhamni', 'Trani', 'Chotagala',
'Mutial Mera', 'Deewan', 'Dhaki Pondi', 'MOUNT Peedbraser Pahri',
'Murshadabad', 'Jandali', 'Danna Pothi Mir Khan', 'Thhundabun',
'Baitran', 'Bloh', 'BRIDGE Mooley', 'Nar', 'Jandala', 'Tangigala',
'Samala', 'Trochi Killa (Castle)', 'Nakyal', 'Sarda Cross',
'Thub Jagir', 'Mallah Maqadma', 'BRIDGE Dungee Kotli', 'Andraal',
'Athroin Kalah', 'Manila', 'Khanka Katehra valley', 'Seri',
'Gulhur', 'Samahni', 'Chack Sagar', 'Manana', 'Kharak',
'Khari Sharif, pk', 'Nageal, pk', 'Channu Chak, pk', 'Kote Jamel',
'Awam Sharif, pk', 'Pindi Abdal', 'Ahi, pk', 'Gura Khurd',
'Chhamb', 'Maghlora', 'Barnala', 'Sadabad', 'Sargodha', 'Chiniot',
'Mandi', 'Kund Shergarh', 'Dinghal', 'Thara', 'Karara', 'Bhalot',
```

'Sahalia', 'H-9', 'Thalian', 'Dhamial', 'G5', 'G4', 'Westridge 1',  
'Misrial', 'Pakistan', 'Gharibabad', 'Chaklala Scheme 1',  
'Bahawalpur', 'Lodhran', 'Vihari', 'Kahror Pakka', 'Khanewal',  
'Ahmadpur East', 'Liaquatpur', 'Rahimyar Khan', 'Chung', 'Manga',  
'Manga manor', 'Kot Asadullah Khan', 'Kalalwala', 'Nauthe',  
'Bhai Pheru', 'Pattoki', 'Jambar Kalan', 'Renala Khurd', 'Okara',  
'Sahiwal', 'Harappa', 'Chichawatni', 'Mian Channun',  
'Qadirpur Ran', 'Basti Maluk', 'Khanqah Sharif', 'Mirpur Mathelo',  
'Abad', 'Shikarpur', 'Lakhi', 'Jahan Khan', 'New Pind',  
'Old Sukkur', 'Bachal Shah Miyani', 'Araien', 'Larkana',  
'Karan Sharif', 'Qabalo', 'Garhi Yaseen', 'Khanpur', 'Jacobabad',  
'Kandhkot', 'Ghauspur', 'Thul', 'Municipal Committee Haripur',  
'Khalabat Township Haripur', None, 'Gulshan Iqbal', 'Nooriabad',  
'Goth Ramzan Wadero', 'Goth Chakar Khan', 'Bhigu Khan Mirjat',  
'Sindh University Employees Co-operative Housing', 'Jamshoro',  
'Hasham Dahri', 'Akrio', 'Nurpur', 'Sehwan Sharif', 'Dadu',  
'Bhan Saeedabad', 'Phulji', 'Piara Goth', 'Rahuja', 'Boreri',  
'Bali Shah', 'Radhan', 'Sihar', 'Badrah', 'Nasirabad', 'Naodero',  
'Ratodero', 'Darkhan', 'Shahdadkot', 'Kambar', 'Wagan',  
'Khairpur Nathanshah', 'Mehtar', 'Tando Adam', 'Tando Allahyar',  
'Mirpur Khas', 'Shahdadpur', 'Saidabad', 'Sakrand',  
'Tando Mohammad Khan', 'Matli', 'Hub Chowki', 'Nakka Karri', 'Wad',  
'Lajwari Kili', 'Qilla Abdullah', 'Chaman', 'Hassanabdal',  
'Rabwah', 'Jaranwala', 'Ú\`x840`Ú\`x86 Ú\`x86Ú\`x880±Ú\`x86Ú\`Ú\`x8c',  
'Ú\`x86Ú\`x8cÚ\`x84 Ú\`x86Ú\`x880±Ú\`x86Ú\`Ú\`x8c',  
'0-Ú\`x8cÚ\`x84 Ú\`x86Ú\`x880±Ú\`x86Ú\`Ú\`x8c',  
'0\`xad0³Ú\`x86 0\$0³Ú@Ú\`x880±', 'Khushab', 'Joharabad', 'Shahpur',  
'Jhawrian', 'Burhan M1 Interchange', 'Forte Manroe', 'D.G. Khan',  
'Muzaffargarh', 'Rajan Pur', 'Lilla M2 Interchange', 'I-8',  
'Swabi', 'Tapi', 'E-8 (Naval Complex)', 'I-16', 'I-14', 'G-13',  
'Barotha', 'Jhang', 'Attock', 'Nurpur Shahan', 'Rawat', 'Tarnol',  
'Naughazi', 'Dhok Minda', 'Qutbal', 'Garhi Hasu Khan', 'Hatar',  
'Cavalry Grounds', 'Charr', 'Peer Colony', 'Farooq colony',  
'Model Colony', 'Iqbal Park', 'Eden Cottage', 'Fort Villa',  
'Askari Flats', 'Keer', 'Qadri Colony', 'Chung Khurad',  
'Defence Housing Authority', 'Punjab Cooperative Housing Society',  
'Sultan Colony', 'Gadani', 'Uthal', 'Bela', 'Khuzdar', 'Ormara',  
'Pasni', 'Turbat', 'Jiwani', 'Dera Bugti', 'Bhag', 'Kalat',  
'Dalbandin', 'Nushki', 'Mastung', 'Sibi', 'Kohlu', 'Duki',  
'Harnai', 'Pishin', 'Barkhan', 'Gulmit', 'Passu', 'Sec FF Ph 4',  
'Nadara Abad', 'Police Lines', 'Askari Villas', 'Jollo',  
'Aamer Sidhu', 'Nishat Colony', 'Super Town', 'Ali View',  
'Noor Colony', 'Rehman Gardens', 'Rehman Villas', 'Naran',  
'Kaghan', 'Faizabad', 'Dhok Kala Khan', 'Gulshan Dadan Khan',  
'Shamsabad', 'Chah Sultan', 'Amarpura', 'Dhok Khabba',  
'Ghazi Abad', 'Tajpura', 'Skardu', 'Chilas', 'Shakargarh',  
'Kalan Mir', 'Safoora Goth', 'Dhok Girja',  
'Ghorghushti 0ºÚ\`x880±0º0´0«Ú\`x8a', 'Bagla', 'Bahria Town',  
'Fazal Town', 'Ú\`x860º0±0\$Ú\`x84', 'Mardan', 'Takht-e-Bhai',  
'Drosh', 'Ú@Ú\`x88Ú\`x810\$Ú¹', '0¨Ú\`x86Ú\`x88Úº', 'Panjgur',  
'Parachinar', 'Saidu Sharif', 'Ú\`x85Ú\`x8cÚ\`x86Ú\`Ú\`x880±Ú\`x81',  
'Sindhri', 'Jhang Sadar', 'Abdul Hakim', 'Arifwala', 'Shekhupura',  
'Kasur', 'Burewala', 'Hafizabad', 'Gojra', 'Mandi Bahaiddin',  
'Daska', 'Pakpattan', 'Bahawalnagar', 'Chishtian', 'Kamalia',  
'Kot Addu', 'Wazirabad', 'Taxila', 'Hasilpur', 'Mianwali',  
'Jalalpur Jattan', 'Bhakkar', 'Dipalpur', 'Layyah', 'Bhalwal',  
'Haroonabad', 'Farooqabad', 'Toba Tek Singh', 'Narowal', 'Haveli',  
'Sambrial', 'Shujaabad', 'Jampur', 'Mailsi', 'Hujra Shah Muqem',  
'Shaikh Wasil', 'Bahawal Khan', 'Ahmed Wal', 'Nok Kundi', 'Taftan',  
'Dadhar', 'Thatta', 'DHA Phase VIII', 'Alipur', 'Uch Sharif',  
'Jatoi Janubi', 'Shahr Sultan', 'Badin', 'Boat Basin',  
'P.E.C.H.S.', 'Nursery', 'North Nazimabad Town',

'New Karachi Town', 'Hayatabad', 'Cape Monze', 'Peshawar',  
 'Hawkes Bay', 'Goth Mubarak Dadu', 'G.P.O', 'Bin Qasim Town',  
 'Gharo Town', 'Astola Island', 'Baba Island', 'Bhit Island',  
 'Darwesh', 'Mankarai', 'Meelum', 'Gov. Girls School',  
 'Mohallah Darwesh', 'Mohallah Qadeem', 'Mohallah Motiyan',  
 'Pandak', 'Talokar', 'Aalaman', 'Doyaan', 'Dhinda', 'Sarai Saleh',  
 'Jora Pind', 'Mohallah Koha', 'Moh. Choki Police',  
 'Mohallah Qateel Shafai', 'Panian', 'Bhuttri', 'Chattri',  
 'Kangra Township', 'Kotnajibullah', 'GHS for Boys', 'Mang',  
 'Pind Kamal Khan', 'Galhum', 'Abbas Brick Kiln', 'Ø-Ü\x8c',  
 'Haripur', 'Moh. Eidgah', 'Bagra', 'Shah Mahmud', 'Shinkari',  
 'Dhudial', 'Mohallah Sohah', 'Mohallah Session House',  
 'Qila Saifullah', 'Kuchlack', 'Nisai', 'Muslim Bagh', 'Khanozai',  
 'Ali Khan', 'Geher Khan', 'Lora Hazara', 'Noor Pur',  
 'Dhari Kayaala', 'Mohra Maira', 'Gorraki Mera', 'Jatti Pind',  
 'Lilloor', 'Teer', 'Raajoya', 'Balldher', 'POF Colony',  
 'Pakistan Ordinance Factory', 'Jaglot', 'Sassi', 'Shangash',  
 'Tube Well', 'Paidane', 'Jharee Kas', 'Shahiya', 'Sultanpur',  
 'Utmanabad', 'Sarai Gadahi', 'Khar Bara', 'Hamlet Colony',  
 'Dumrai', 'Gudwallian', 'Sri', 'Kalu Pind', 'Srikot',  
 'Chamba Pind', 'Dhingee', 'Koklian', 'Atharan Hazari',  
 'Ahmadpur Sial', 'Phase 4', 'Chapra', 'Shah Maqsood',  
 'Laban Bandi', 'Chajian', 'Khohi Kaman', 'Baghpur Dheri',  
 'Khan Pur', 'Tarnawa', 'Julian', 'Kamal Pur', 'Pind Muneem',  
 'Barila', 'Tramkan', 'Sarral', 'Chapprian', 'Dharra', 'Sari Bang',  
 'Dubran', 'Jabbri', 'Nalla Hazara', 'Chick Feed Factory', 'Akhori',  
 'Paharro', 'Doctors Hospital', 'WAPDA Town', 'PIA', 'NESPAC',  
 'Town Ship Industrial Estate', 'PECO Factory', 'Model Town Ext',  
 'Sui Gas Cop Society', 'Defence', 'Muslim Town', 'Rehman Pura',  
 'Ichara', 'Shadman', 'Riwaz Gaeden', 'Sanda', 'Krishan Naghar',  
 'Sanat Naghar', 'Bilal Ganj', 'Ravi Road', 'Sabzi Mandi',  
 'Misri Shah', 'Shad Bagh', 'SHAZO Lab', 'Baghban Pura',  
 'Sing Pura', 'Makhan Pura', 'Darogha Wala', 'Salamat Pura',  
 'Mughalpur', 'Harbanspura', 'PAF Colony', 'Bhata Chowk',  
 'Bank Officer Colony', 'Ladhar', 'State Life Housing Society',  
 'Kamahain', 'Ismaial Naghar', 'Ghawala Colony', 'Town Ship',  
 'Green Town', 'PECHS', 'EME DHA', 'Izmir Town', 'Niaz Baig',  
 'Canal View', 'TECH Society', 'Garden Town', 'Shah Jamal',  
 'Sodhi Wall', 'Gulshan-e-Ravi', 'Yateem Khana', 'Sabzazar',  
 'Dhoop Sari', 'Shadara', 'Rana Town', 'Gulberg', 'Mustafa Abad',  
 'Zaman Park', 'Ghari Shahu', 'Q Gujar Sing', 'Ghalwal Mandi',  
 'Urdu Bazar', 'Old Anarkli', 'Mustafa Town', 'Alama Iqbal Town',  
 'Wafaqi Colony', 'Qanchi', 'Multan', 'Mohallah Ramazani',  
 'Mohallah Upper Ramazani', 'Rehana', 'Moharra Muhammad',  
 'Mohallah Malikpura', 'Moh. Sherranwala Gate',  
 'Kathar Dilawar Khan', 'Nakota', 'Dheri Qasim',  
 'Thalarajwali Khan', 'Surakhi', 'Mohallah Ferozpura',  
 'Mohallah Asifabad', 'Mohallah Risaldarian', 'amb', 'chomukh',  
 'Banhal', 'Sakrana', 'Choha Kalsa', 'Gulistan Colony', 'Daroubala',  
 'Dalwaar', 'sandal', 'Ratta', 'Kailag', 'Thipra',  
 'Govt. Primary School', 'Govt. High School', 'Chak 5 Faiz',  
 'Chak 15 MR', 'Chak 21 MR', 'Makhdumpur', 'Chak 132', 'Chak 379',  
 'Chak 17 MR', 'Chak 3 Faiz', 'Chak 20 MR', 'Chak 16 MR',  
 'Chak 18 MR', 'Chak 12 MR', 'Chak 11 MR', 'Chak 9 MR',  
 'Chak 19 MR', 'Chak 13 MR', 'Laluwala', 'Nilwala', 'Lutabad',  
 'Bosan', 'Jharianwala', 'Surajkund', 'Nala muslimana', 'Doberan',  
 'Gujah', 'Para Kathar', 'Silyat', 'Burj', 'Balima', 'para Thara',  
 'Audit & Accounts Housing', 'Naz Town', 'Tariq Gardens',  
 'NFC Housing Society', 'IEP', 'Mari Khokhran',  
 'Rindheer Khokhran', 'Badaar', 'Kherli', 'Nawan', 'Sehnsa',  
 'Sibi District', 'SÄ\x81nghar District',  
 'NasÄ«rÄ\x81bÄ\x81d District', 'Khairpur District',

'PeshÄ\x81war Division', 'Upper DÄ«r District',  
'PanjgÄ«r District', 'AwÄ\x81rÄ\x81n District',  
'BahÄ\x81walpur Division', 'HyderÄ\x81bÄ\x81d Division',  
'Qila AbdullÄ\x81h District', 'Ü\x86Ø\$Øµ± Ø¢Ø`Ø\$Ø`',  
'LÄ\x81rkÄ\x81na District', 'RahÄ«myÄ\x81r KhÄ\x81n District',  
'Quetta Division', 'Khyber Agency', 'Lahore Division',  
'Ü\x82Ü\x84Ø\$Øª', 'KalÄ\x81t Division',  
'FaisalÄ\x81bÄ\x81d District', 'ChitrÄ\x81l District',  
'GwÄ\x81dar District', 'HazÄ\x81ra Division',  
'Qila SaifullÄ\x81h District', 'Mastung District',  
'Dera IsmÄ\x81Ä«l KhÄ\x81n Division', 'Muzaffargarh District',  
'DiÄ\x81mir District', 'Kurram Agency', 'ZiÄ\x81rat District',  
'Ø`Ø\$Ø±Ü@Ü%Ø\$Ü\x86', 'Kachhi District', 'KalÄ\x81t District',  
'Thar PÄ\x81rkar District', 'ShekhÄ«pura District',  
'Kohlu District', 'BahÄ\x81walpur District', 'KasÄ«r District',  
'MÄ\x81nsehra District', 'Nushki District', 'Jhal Magsi District',  
'Ø`Ü\x84Ü\x88Ü\x86Ø³Ø±Ø\$Ü\x86 (BalochistÄ\x81n)', 'Shangla',  
'Ø³Ø`Ü\x8c', 'SiÄ\x81lkot District', 'Ø¢Ü\x88Ø\$Ø±Ø\$Ü\x86',  
'MultÄ\x81n District', 'KohÄ\x81t District', 'Khairpur Division',  
'KhuzdÄ\x81r District', 'Jhang District', 'BolÄ\x81n District',  
'Sargodha Division', 'AbbottÄ\x81bÄ\x81d District',  
'Dera IsmÄ\x81Ä«l KhÄ\x81n District', 'SÄ\x81hÄ«wÄ\x81l District',  
'NawÄ\x81bshÄ\x81h District', 'WÄ\x81shuk District',  
'MÄ«sa Khel District', 'KhÄ\x81rÄ\x81n District',  
'IslÄ\x81mÄ\x81bÄ\x81d Capital Territory', 'VihÄ\x81ri District',  
'ShikÄ\x81rpur District', 'JacobÄ\x81bÄ\x81d District',  
'Malakand Agency', 'MakrÄ\x81n Division',  
'BÄ\x81rkhÄ\x81n District', 'Dera Bugti District',  
'SwÄ\x81t District', 'RÄ\x81walpindi Division',  
'MuzaffarÄ\x81bÄ\x81d District', 'GujrÄ\x81nwÄ\x81la District',  
'Loralai District', 'HyderÄ\x81bÄ\x81d District',  
'KohistÄ\x81n District', 'MiÄ\x81nwÄ\x81li District',  
'Lasbela District', 'North WazÄ«ristÄ\x81n Agency',  
'Mohmand Agency', 'Ü%Ü\x86Ø-Ø\$Ø`', 'Lahore District',  
'Kotli District', 'Sindh', 'Ü%Ø`Ü\x8cÜ\x86', 'MultÄ\x81n Division',  
'JÄ\x81farÄ\x81bÄ\x81d District', 'Ü@Ü\x8cÜ\x86',  
'Ü%Ü\x86Ø-Ü`Ü\x88Ø±', 'GujrÄ\x81nwÄ\x81la Division',  
'PÄ«nch District', 'Gilgit District', 'MÄ«rpur District', 'Hunza',  
'Bannu District', 'Orakzai Agency', 'Jhelum District',  
'MardÄ\x81n District', 'Malakand Division',  
'Ü\x82Ü\x84Ø¹Ü\x81 Ø¹Ø`Ø` Ø\$Ü\x84Ü\x84Ü\x87ä\x80\x8e',  
'RÄ\x81walpindi District', 'North-West Frontier Province',  
'Kech District', 'BahÄ\x81walnagar District', 'Attock District',  
'Zhob District', 'BaltistÄ\x81n District', 'Azad Kashmir',  
'ChÄ\x81gai District', 'GujrÄ\x81t District',  
'KarÄ\x81chi Division', 'PeshÄ\x81war District', 'Quetta District',  
'Sukkur District', 'Ø-Ø¹Ü\x81Ø± Ø¢Ø`Ø\$Ø`', 'DÄ\x81du District',  
'Thatta District', 'South WazÄ«ristÄ\x81n Agency',  
'Sargodha District', 'BadÄ«n District',  
'FaisalÄ\x81bÄ\x81d Division', 'BÄ\x81jaur Agency',  
'Federally Administered Tribal Areas', 'KarÄ\x81chi District',  
'PishÄ«n District', 'Ø`Ü\x88Ü\x84Ø\$Ü\x86',  
'Dera GhÄ\x81zi KhÄ\x81n Division', 'Ø®Ø\$Ø±Ø\$Ü\x86',  
'Northern Areas', 'Lower DÄ«r District', 'Fawara Chowk',  
'Jamia Masjid Block-1', 'Bari's Biryani House',  
'Centre of Excellence in Molecular Biology', 'Rustum Park',  
'Officers Colony', 'Askari 1', 'WAGHA BORDER', 'Raza Block',  
'Eden Lane Villas 2', 'Pidarak', 'Gulzar-i-Quaid', 'Pishukan',  
'AirPort Housing Society', 'Kund Malir', 'Khayaban-e-Amin',  
'DHA Rahbar Phase I', 'Nathiagali', 'Dongagali', 'Bhurban',  
'Daharki', 'University Town', 'Westridge 3', 'Qasae Chowk',  
'Dak Khana Chowk', 'Dheri Chowk', 'Tahlimoori Chowk',

```
'Chirah ( Tabariq Shaheed)', 'Mughal Town', 'Poori Koti',
'Kata Khat', 'Kandarkas', 'Dheri', 'Saidan Dheri', 'Dararri',
'Snote', 'Pipli', 'Ghanaire', 'Message Grammar School'],
dtype=object)
```

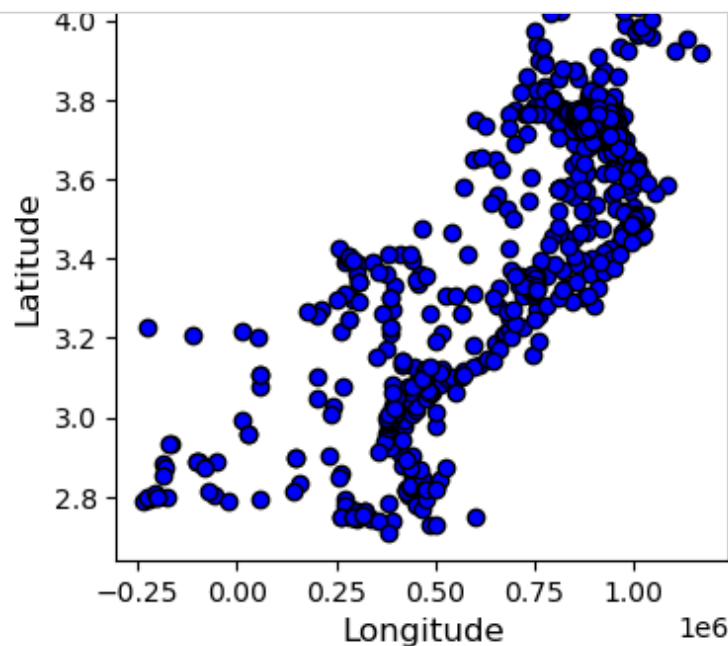
In [11]: `df.describe().T`

Out[11]:

	count	mean	std	min	25%	50%
osm_id	1057.0	2.627187e+08	7.061840e+07	16175031.0	243495215.0	279109654.0
population	1057.0	3.797820e+05	6.127434e+06	0.0	0.0	0.0

## Plotting the Shape File

In [93]: `fig, ax = plt.subplots(figsize=(4, 4))
df.plot(ax=ax, color='blue', edgecolor='black')
ax.set_title('Spatial Data Visualization', fontsize=15)
ax.set_xlabel('Longitude', fontsize=12)
ax.set_ylabel('Latitude', fontsize=12)`



## Basic Exploration

```
In [57]: ► print(df.head())
print(['type'].value_counts())
```

	osm_id	name	type	population	geometry
\					
0	16175031	Islamabad	city	0	POINT (876663.915 3735721.400)
1	16175073	Lahore	city	0	POINT (1005476.883 3504221.395)
2	30670223	Rawala Kot	city	0	POINT (942713.350 3759336.681)
3	58568637	Gilgit	city	0	POINT (979638.535 3988239.263)
4	58744442	Rawalpindi	city	3000000	POINT (877105.489 3724909.105)

	area	perimeter
0	0.0	0.0
1	0.0	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	0.0

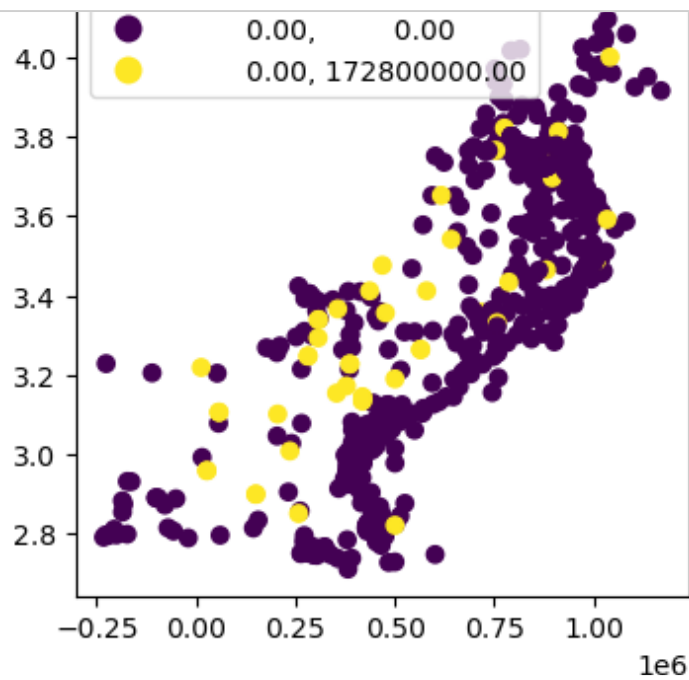
```
type
village      379
town         279
suburb       130
county       103
city         89
historical_divis  18
hamlet       13
locality     8
state        8
Haripur      5
island       3
Hattar Industria  2
Havellian    1
historical_state  1
Colony       1
Hospital     1
NS Palace    1
Research Institu  1
Rawalpindi   1
Mohallah Kund  1
Sultanpur    1
Kotnajibullah  1
NADRA Office Har  1
Police Station H  1
Mohallah Gojar M  1
HARipur      1
Noor Colony   1
Lahore       1
country      1
airport      1
Lahore Airport  1
School       1
Name: count, dtype: int64
```

```
In [ ]: ►
```

## Create a Choropleth Map for Population

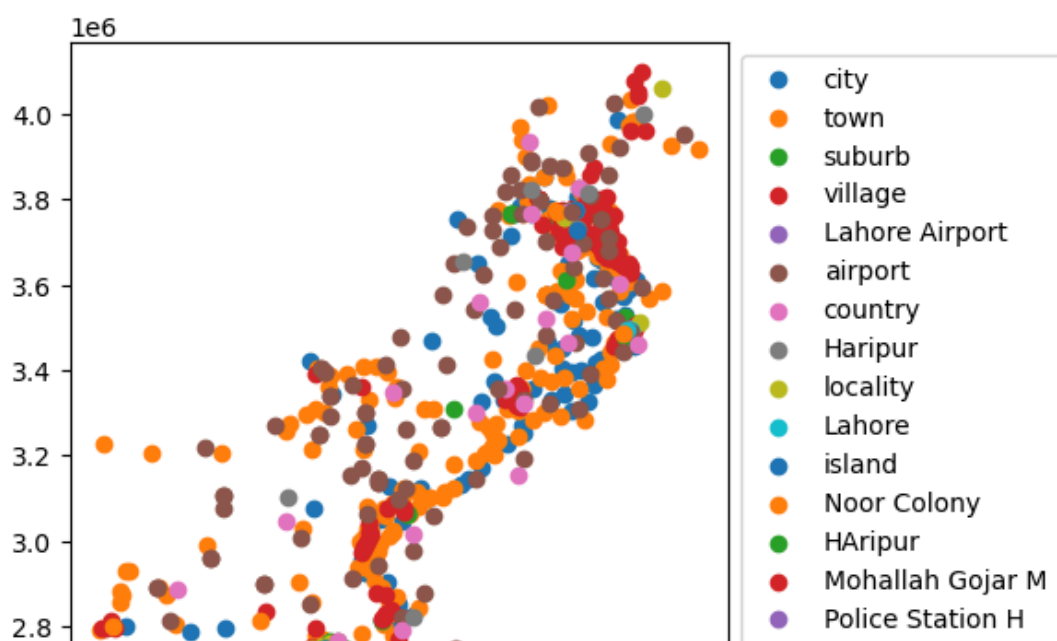


```
In [92]: df.plot(column='population', scheme="quantiles", figsize=(4, 4), legend=True)
```



## Visualize Place Types

```
In [89]: fig, ax = plt.subplots(1, 1, figsize=(6, 8))
for place_type in df['type'].unique():
    sub_df = df[df['type'] == place_type]
    sub_df.plot(ax=ax, label=place_type)
plt.legend(loc='upper left', bbox_to_anchor=(1, 1))
plt.tight_layout()
plt.show()
```



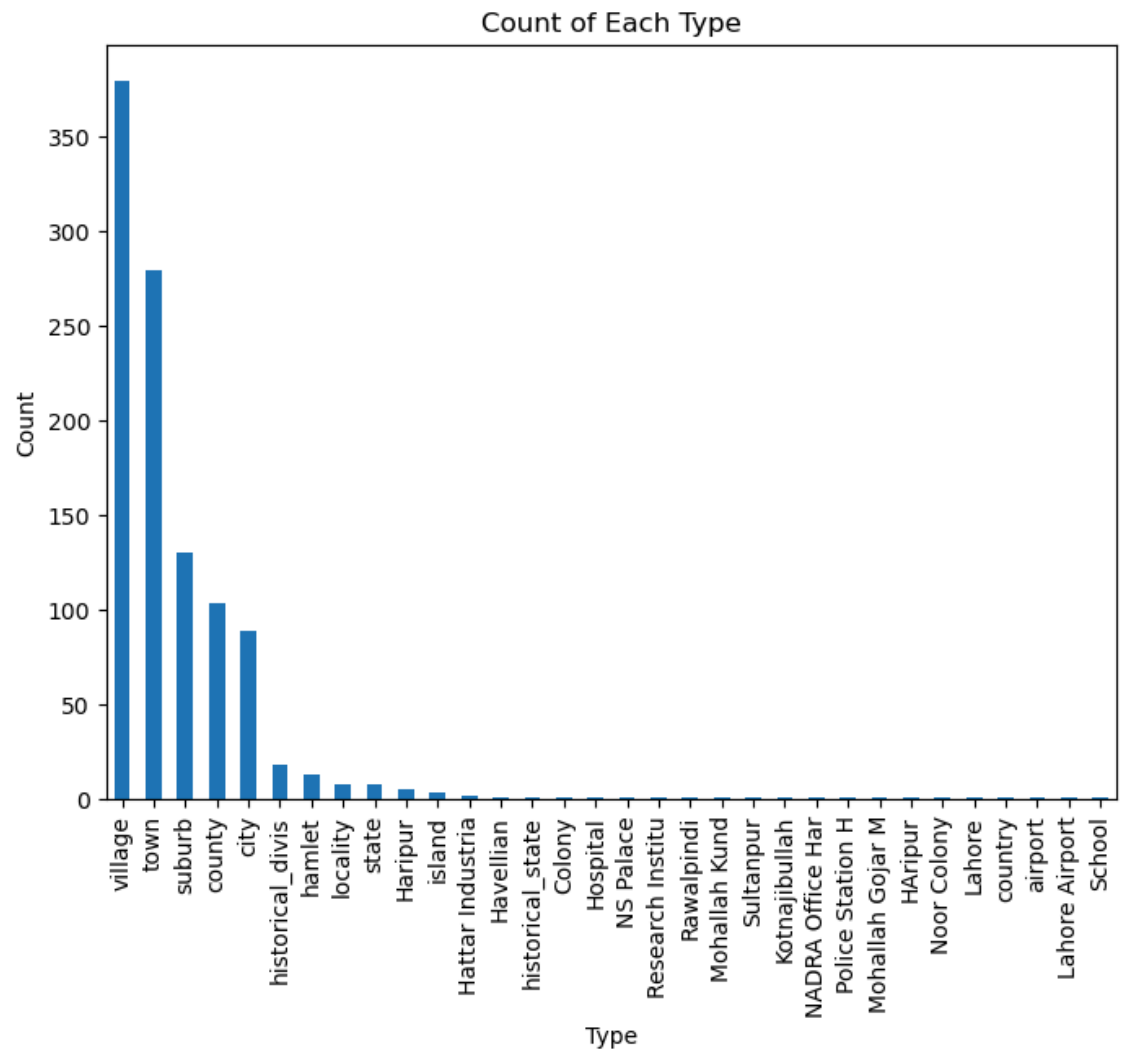
## Count the Occurrence of Each Type

```
In [65]: type_counts = df['type'].value_counts()
type_counts
```

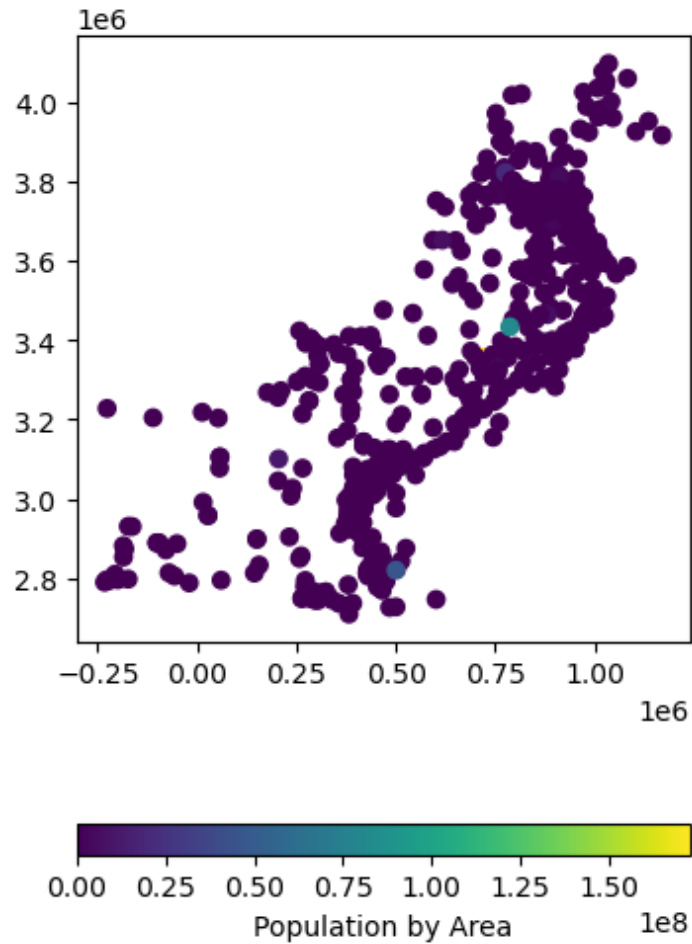
```
Out[65]: type
village      379
town         279
suburb       130
county       103
city         89
historical_divis  18
hamlet       13
locality      8
state         8
Haripur       5
island        3
Hattar Industria  2
Havellian     1
historical_state  1
Colony        1
Hospital      1
NS Palace     1
Research Institu  1
```

## Plot the Counts

```
In [87]: ▶ type_counts.plot(kind='bar', figsize=(8, 6))
plt.xlabel('Type')
plt.ylabel('Count')
plt.title('Count of Each Type')
plt.show()
```



```
In [84]: ▶ df['population'] = pd.to_numeric(df['population'], errors='coerce')
fig, ax = plt.subplots(1, 1, figsize=(4, 8))
df.plot(column='population', ax=ax, legend=True,
        legend_kwds={'label': "Population by Area",
                      'orientation': "horizontal"},
        cmap='viridis')
plt.show()
```

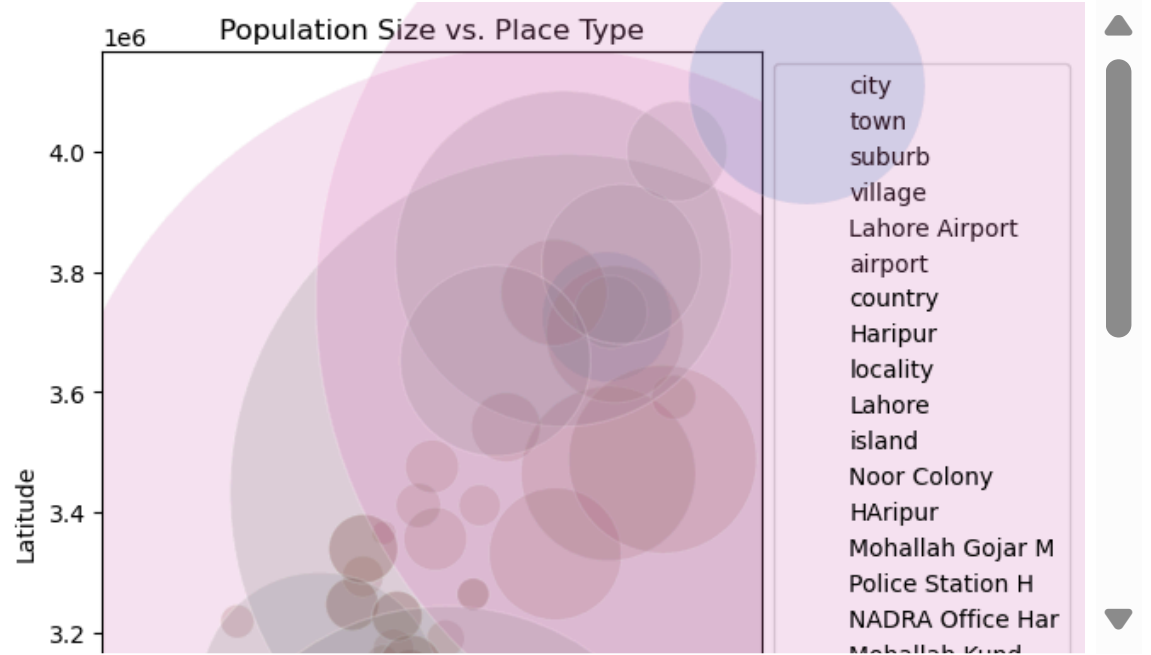


## Population Size vs. Place Type

```
In [83]: ▶ df['population'] = pd.to_numeric(df['population'], errors='coerce')
df['x'] = df.geometry.centroid.x
df['y'] = df.geometry.centroid.y
fig, ax = plt.subplots(figsize=(5, 7))

for place_type in df['type'].unique():
    subset = df[df['type'] == place_type]
    ax.scatter(subset['x'], subset['y'], s=subset['population']/1000, label=place_type)

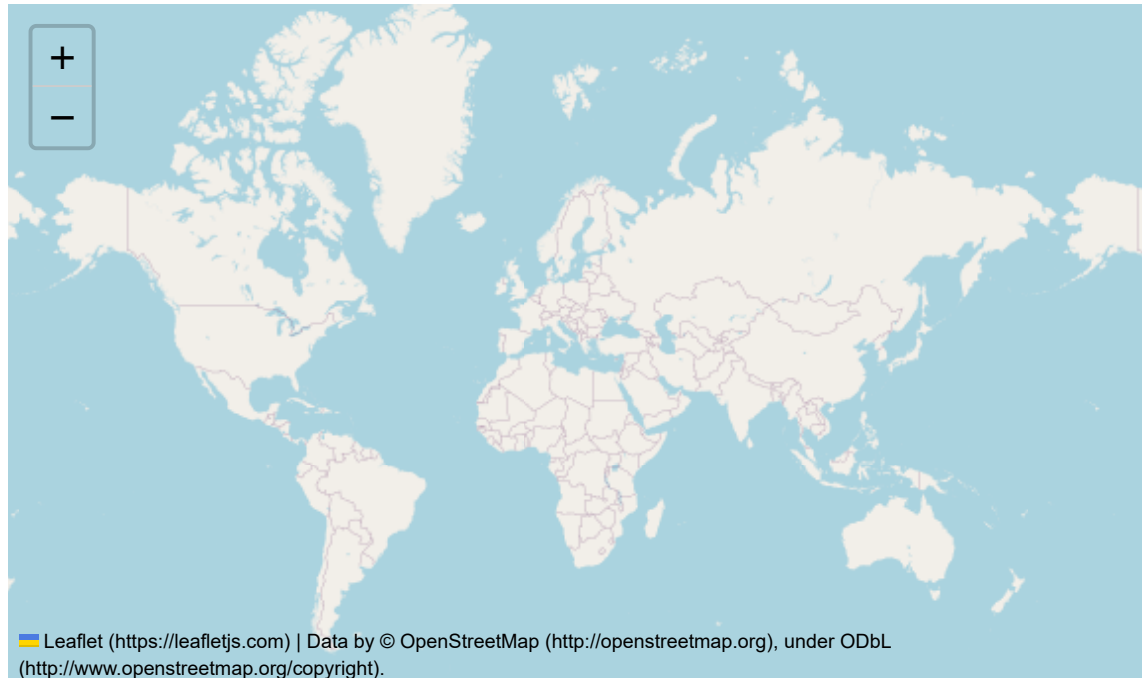
ax.legend(loc='upper left', bbox_to_anchor=(1, 1))
ax.set_xlabel('Longitude')
ax.set_ylabel('Latitude')
ax.set_title('Population Size vs. Place Type')
plt.show()
```



## Hotspot Analysis

```
In [81]: ► import folium
from folium.plugins import HeatMap
base_location = [df['y'].mean(), df['x'].mean()]
m = folium.Map(location=base_location, zoom_start=5)
heat_data = [[row['y'], row['x'], row['population']] for index, row in df.i
HeatMap(heat_data).add_to(m)
m
```

Out[81]:



```
In [23]: ► print(df.crs)
```

EPSG:4326

**Reproject to UTM zone 42N for western Pakistan (EPSG:32642). If your area of interest is more towards the east, consider using EPSG:32643 instead.**

```
In [32]: ► df_projected = df.to_crs(epsg=32642, inplace=True)
```

```
In [27]: ► print(df.crs)
```

EPSG:32642

```
In [ ]: ►
```