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**RESEARCH PAPER**

# A GIS Modeling for the Spatial Planning and Developmental Attraction of Land Use Land Cover Pattern in Cooperative Sukkur Society District Sukkur, Sindh

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**ABSTRACT**

A crucial requirement for making decisions about land management, development, and investment is mandatory to access the land information. For the purposes of land management, usage, and spatial planning, the distribution of land cover as represented by mapping data is essential. Geographic information systems (GIS) and remote sensing were utilized for this revision to examine the distribution of land cover pattern and the advantages of the society, in connection among anthropological burden on the terrestrial ground shown in Sukkur Cooperative Society which is located in the northern Sindh district of Sukkur, this project uses satellite imagery of 2023 specifically, quick bird imagery to illustrate the land cover pattern of the society. This community is a densely populated location with open areas, trees, reservoirs, railroad tracks, and some significant roadways. At the findings of the exploration the area is high built up in this association the GIS modules can be helpful in planning forward thinking initiatives like large-scale plans for the future development of Sukkur's society.

**KEYWORDS:** Features Distribution, GIS, Land cover pattern , Society Development

## Introduction

One of the most dramatic geographical events in human history, expansion is depicted by sets of two opposing viewpoints. On the one hand, sprawl is widely acknowledged for having greatly improved the socioeconomic status of the locals and serving a main part that shift away by the tradition of rustic economic factors, like physical and serviceable. In comparison to their rural counterparts, urban residents have access to superior housing frame plus amenities, societal welfare, as well as higher quality of life, according to the area. However, the benefits of cities in emerging nations were obscured by severe socioeconomic and ecological effects combined with an inadequate planning framework. (Weldu,2016)

The characteristics of Earth's land cover and human usage of it have a significant role in global change. Another revolution, the information revolution, has already completely overcome today's culture. This fundamentally changes how people live and opens up new avenues for pushing the bounds of previous revolution particularly in the mapping and resource monitoring of the planet. Due to both growing population demand and climate changes, the world's land use and land cover (LULC) have altered dramatically over the past few decades. (Mukherjee, 2009). Over the past thirty years, there has been a significant advancement in the technologies and techniques utilized in remote sensing. These technologies appear to be better suited to support land resource management programs that track changes at various spatial ranges and monitor land use and cover mapping (LULC mapping) based on the combination of modern remote sensing data and higher resolution from satellite platforms (Singh et al.2010).

With links to geographic information system (GIS) and global positioning system (GPS) data and potential modeling capabilities, remote sensing technology allows for the collecting and analysis of data from ground-based, space-based, and Earth-orbiting platforms (Franklin, 2001 and Thakur et al., 2010). Because of this, remote sensing is now useful for learning about land cover. Remote sensing is growing in importance as technology and information in both quantity and quality are required more and more in the future. As a result, the study concentrates on the problems and difficulties related to land cover mapping monitoring. Large areas of undeveloped country property, for instance, are quickly being used for urban purposes in the rural-urban fringe.

(Chen, 2002), at many different levels, economic, cultural, political, historical, and land tenure considerations all affect how land is used. The term "land use" refers to human activity and the range of uses that are performed on land. Natural plants, water features, rock or soil, artificial cover, and other features resulting from land alteration are all considered forms of land cover. Since land cover and contextual evidence are closely related and do not conflict, they can be used interchangeably. This is because the former is inferred from the latter. The use of remotely sensed data allowed for a quicker, more affordable, and more accurate analysis of the land cover pattern. Geoinformatics, which includes remote sensing and GIS, offers an effective way to analyze land use and planning.

Basic knowledge of the different types of urban cover and their spatial distribution is required for many studies in the social and physical sciences as well as municipal planning. (Rahman et al, 2016). Various layers of information pertaining to a single location can be linked together using geographic information systems (GIS). They enable you to examine the interactions that are occurring as well as visually represent and intuitively comprehend a variety of data. With its ability to integrate materials from various data sources, including satellite imagery and core data, GIS is quickly becoming a crucial component of any successful environmental modeling. (Müller and Zeller, 2002)

**Literature Review**

The primary forces behind the subsequent urban process were the growing need for larger land parcels for the development of new projects as well as the renovation and industrialization of older urban infrastructures. The two main causes of high growth, however, people move by force for any cause in city resident's and other side the people who keep self-interest for migration, mainly for monetary development and for other factors (Li, 2003 and Sandeep, 2013). Understanding the processes involved and using appropriate physical planning are crucial to meeting the present and future needs of cities, as spatial patterning and change over time are essential. Nonetheless, trustworthy and accurate information about the urban area has drawn a lot of attention from the perspective of regional planning and decision-making and surely plays a crucial role in lowering the discrepancy between basic infrastructure supply and demand. City of province. (Weldu, 2016).

Unprecedented suburban sprawl has also resulted from recent decades' fast industrialization and population growth. In addition, even if topographical considerations like steeper slopes and flood-prone areas are ignored, the increasing demand for housing (Wondimu, 2011) even tends to push city inhabitants to move into new city corridors. Finding a suitable construction cooperative (Yeh, 1998) for housing construction can be crucial in meeting the demand of urban residents, as urbanization and population growth are unavoidable (Shalabi,2006 and Shenavr, 2014), In order to meet urban residents' demands for housing, it can be crucial to locate a suitable construction cooperative. (Weldu, 2016).

As a result, the social identification of integrated residential construction in the city is explicitly addressed by regional planning. It is still up for debate, though, how to

maintain both appropriate conservation measures for natural resources and effective urban planning (Joerin, 2001). Finding societies' potential for new residential construction in the study area was the main goal of this investigation. The study's output may serve as a support system for the regional decision-making process, which offers promising prospects for addressing the city's housing shortage and a swiftly expanding populace. (Weldu, 2016).

Figure: 1 Location of Study Area

The primary district of Sindh, Sukkur, is located at 27° 42' 50.1336'' N and 68° 50' 12.8364'' E. Due to its business location on the Indus River, it is also a large city in Sindh. The city, which is home to about 1.3 million people, is a significant social and cultural hub for the nation. It is a sizable industrial hub where numerous small businesses manufacture machinery, cotton and textiles, cement, pharmaceuticals, and a range of agricultural goods like tobacco and vegetables. Sukkur is a city in the Sindh province of Pakistan, situated next to the ancient Rohri city on the western bank of the Indus River.

After Karachi and Hyderabad, Sukkur is the third-biggest city in Sindh and, in terms of population, the fourteenth largest city in Pakistan. In the British era, New Sukkur was founded next to the Sukkur village. The hill of Sukkur and the hill on the river island of Bukkur together constitute what is sometimes referred to as the "Gate of Sindh." Sukkur Cooperative Society, located in Sukkur city at latitude 27.71802° or 27° 43' 5" north and longitude 68.82865° or 68° 49' 43" east, is the area that is being targeted. Sukkur Cooperative Housing Society is located adjacent to the villages of Abdul Sattar Maka and Professors Cooperative Housing Society. (Google, 2023).

**Table 01**
**Population of District Sukkur 1981-2023**

| Name | Population Census 1981 | Population Census 1998 | Population Census 2017 | Population Census 2023 |
|---|---|---|---|---|
| Sukkur | 575,962 | 931,387 | 1,488,372 | 1,639,897 |

**Source:** Pakistan Bureau of Statistics, U.S. Bureau of Census: Pakistan

Sukkur's population data from 1981 to 2023 is shown in Table 01 above. Sukkur had a population of 575,962 in 1981; by 2023, that number had increased to 1,639,897. Due to migration from the surrounding area and the city's business-friendly environment

as well as its easy access to city amenities compared to rural areas, Sukkur's population is predicted to grow by 2.15 percent in 2023.

**Population Structure 2017 Census**

**Table 2**
**Gender Disparity in Population of District Sukkur**

| | |
|---|---|
| Males | 776332 |
| Females | 711882 |
| Transgender | 158 |

The number of age and gender groups is shown in Table 2. In the 2017 census, there were 711882 women, 157 transgender people, and 776332 men. Children between the ages of 0 and 14 made up 646728, working adults between the ages of 15 and 64 made up 801920, and seniors made up 39724.

**Table 3**
**Literacy rate and urbanization in Rural Urban Population**

| **Urbanization** | | **Literacy** | |
|---|---|---|---|
| Rural | 767566 | Literate | 558889 |
| Urban | 720806 | Illiterate | 462370 |

Table 03 above displays the population and literacy rate by urban and rural areas. In 2017, Sukkur had 767566 rural residents and 720806 urban residents. There were 55889 educated people and 462370 illiterate people in the population.

**Material and Methods**

Effective geoinformatics techniques were applied in this study to capture the spatial variation in the pattern of land cover. These skills remain highly valuable for comprehending the dynamics of the ecosystem that are linked to changes in the distribution of land features. Remote sensing is the process of visualizing a thing, place, or phenomenon without having any connection to it. Remote sensing is the process of using a non-communicating device for the object, size, or phenomenon under study to conduct fact-finding investigations and collect data on almost any object, extent, or phenomenon. (Jenson, 2000).

Numerous channels are used to collect and process the data. The Google Earth map of the study area was obtained in 2023. Google Earth provided satellite imagery taken at a height of 2000 feet for this project. a set of images captured by the Sukkur Housing Cooperative Society that were then combined using Adobe Photoshop 8.0's mosaicing technique to create a single JPEG image. A mosaic for the study area was made using images from Google Earth Pro. The entire arrangement resulted in a seamless picture because the pictures were thoughtfully composed of small areas and the borders matched in certain places.

To determine the coordinates (latitudes and longitudes) of the study area, four place markers were added to various locations. Coordinates ranging from degree decimals to degrees minutes seconds. A Google Earth map of the research area is now included in the Arc GIS. 10.8 Click left and right to enter latitudes and longitudes in the x and y columns to add four points for georeferencing. Rectification and Geographic Coordinate System Properties. Different shapefiles and layers were created in Arc Catalogue. Once all of the shapefiles were imported into Arc GIS from the Arc Catalogue, each layer was digitalized by selecting feature classes such as polygon, polyline, and point. Google Earth is used to create maps of the study area. Arc GIS 10.8 is used to process the data and produce different land cover and use maps. The main application for Microsoft

Word is in research presentations. Images captured in various spectrums from the Quick Bird satellite. Maps and secondary data acquired from the Bureau of Statistics in Pakistan.

**On Screen Digitization**

Preserving each region's natural and cultural elements is one of the most significant uses of high-resolution satellite imagery. These images are of great assistance in recording the variations in the distribution of land cover in the research area. For this investigation, the author has examined the road structure, vegetation, and settlement pattern of the study area. That high-resolution data archive is also designed to allow manual selection of land, water, and utilize the land cover of the nearby extents. The land

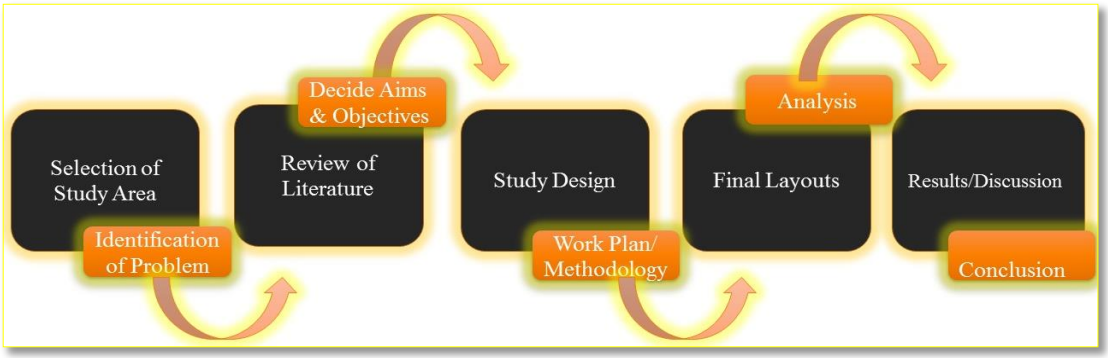



Figure: 2 Methodological Frame work

Cover set is described in conjunction with perceptual explanations, much like reflective sets of images do. For archives larger than 2000 feet, conventional on-display digitization is employed (Quick Bird) (Figure 1). It communicates the specifics of the overall overhead elements in a chosen area on a tiny standing that are not possible in such accuracy and swiftness on the planet. The work begins with the preparation of a base map using data that is readily available to assist with all administrative tasks, such as land use mapping, thematic mapping, road mapping, and water line mapping. To analyze the financial, taxable, and other incomes to the municipal corporation, adding desired attributes can be useful. The created maps can be useful for planning the city's future growth and for analyzing the services that are needed. The study demonstrates the advantages of the GIS environment for planning infrastructure. (Waghmare, 2015).

**Results and Discussion**

This study highlights the many benefits of mapping land cover using satellite remote sensing. Quick Bird data and other high resolution satellite data can provide accurate information. The prior year's shift in land use was primarily brought about by population growth, land conversion, and underuse of potential land. Overall, 41.3% of the land cover in the built-up area is currently accurate. Based on the analysis of changes in land cover and use, some corrective measures are suggested. In addition to preventing more detrimental and deteriorating changes in land use, these measures are essential for optimizing and sustainably using land resources. One of the main components of land cover is the land-cover map that was examined from a 2023 satellite image. The land cover of the Sukkur cooperative housing society is ordered such as cultivated area, residential, plain acreage, shrubs, as well as crop growing area. The review is also discussed about, open spaces are allotted to facilitate the construction of new homes, whereas the built-up area is larger due to its previous development. (Weldu, 2016).

Low yields can be avoided and the land's potential can be increased with the addition of vegetation. Depending on how well the soil suits the plants, trees could be planted to enhance the human environment. The center of West Sukkur is home to

Sukkur society. The vegetable market in the north, Sukkur IBA University in the west, the Dadu, Rice, and Kheerthar canals in the south, and the Friends Cooperative Society in the east are some of its neighbors. These canals are among the many significant distributaries of the well-known Indus River.

**Table 4**
**Distribution of Land cover Categories**

| S.No | Land cover categories | Year 2023 | Percentage |
|---|---|---|---|
| 1 | Buildings | 400 | 41.3 |
| 2 | Open spaces | 100 | 10 |
| 3 | Roads | 12 | 1.2 |
| 4 | Streets | 22 | 2.3 |
| 5 | Railway track | 1 | 0.1 |
| 6 | Vegetation | 5 | 0.5 |
| 7 | Trees | 425 | 43.5 |
| 8 | Reservoirs | 2 | 0.2 |
| 9 | Ditches | 8 | 0.8 |

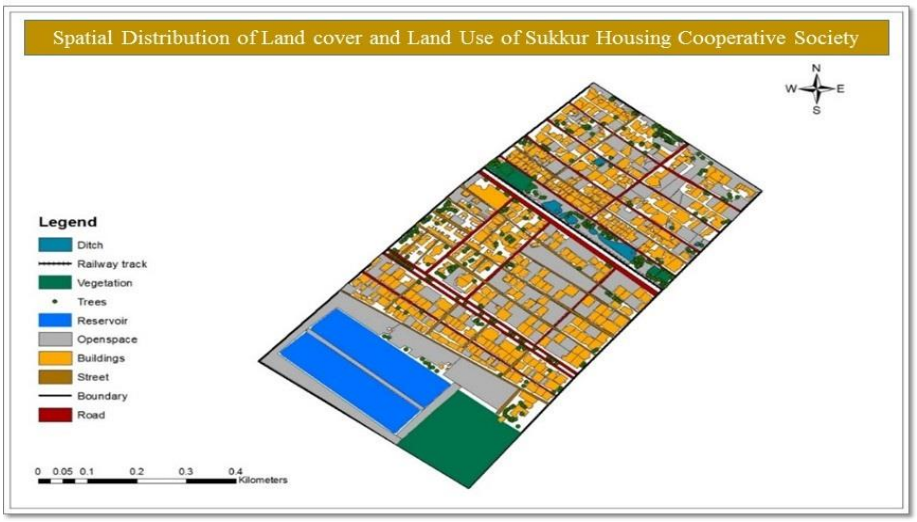



Figure: 3 Spatial Distribution of Land cover Land Use of Study Area

Accessibility to roads is a critical component of a sited area that fosters connectivity and mobility among the settlement spots (Yeh, 1998). Thus, it is crucial to consider how accessible public infrastructure is in terms of how far it is from a given location using a particular mode of transportation when selecting a community for housing (Meng, 2011). Road accessibility is, in any event, the most important factor to take into account, in addition to at all the accommodation developmental plan need to contain inside a range of one to five kilometers (Shalabi, 2006 and Seid, 2007).

Nevertheless, (Zewdu, 2011), discovered that the road distance within the study area might not have a big effect. For example, because there are transportation options nearby, residential buildings are more likely to be appropriate in areas closer to the street. Additionally, (Seid, 2007) suggested that housing be situated 200 meters on the space by line of railway track in order towards the reduce sound disruption also guarantee the shelter for occupants. (Weldu, 2016).

The current regional roads in the area are given priority when adding new rural and urban road links to the primary and secondary road system. The link could follow either the existing paths or tracks in the area or a completely different route for the roads. Since the road network data for the study area did not include the alignments of the existing paths and tracks, they are not included in this case study. The maximum

accessibility network established by this process includes the social roads and streets that intersect in the study area. (Waghmare, 2015).

Roadways, railroad tracks, and streets Imdad Ali Awan Road, popularly referred to as the "100 feet road," Canal Road, Nisar Ahmed Siddiqui Road, and Shikarpur Road are the four main thoroughfares in Sukkur society. This urban road network will therefore prove to be more economical in the long run. A railway line called the Sukkur-Shikarpur track also passes through the Sukkur cooperative society. Additionally, figure 4 shows a few streets. The distance from a developed zone remained take out by the terrestrial-usages and included for exploration. New city expansion for the aim of accommodation must be positioned nearer towards the standing residential areas in order for reduce the city extension plus build consistency within predeveloped areas. Built-up areas within cities were therefore taken into account. As a result, it is far preferable to construct residential real estate adjacent to an existing built-up area. (Weldu, 2016).

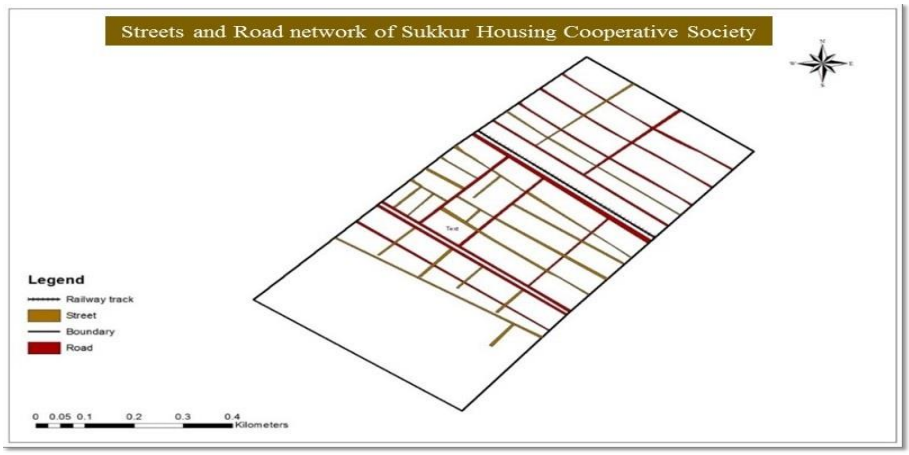



Figure: 4 Streets and Road network of Study Area

Figure 5, displayed a high buildup society is the Sukkur Cooperative Society. There weren't many built homes in this community before 2010, but there are now about 400, and a sizable population lives there. The vast majority of those living in this society are wealthy and part of the elite class. Because of its well-built homes, well-maintained roads, and lack of pollution, this society is well-known. Additionally, there is planned fresh water below ground in this region. Educational establishments such as Sukkur IBA University, School of Excellence, and Hira Public School are situated in close proximity to this community, providing easy access to higher education for their children.

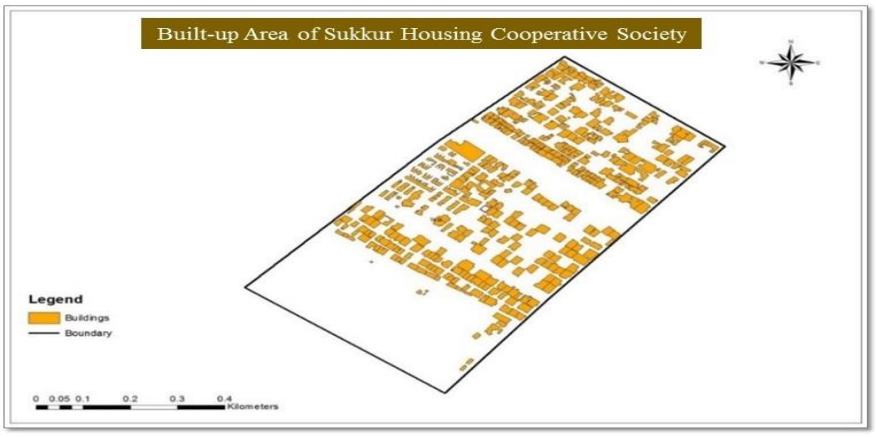



Figure: 5 Built-up Region of Study Area

This society's high commercial rates are related to its geographical location. There are still about 100 unbuilt plots; this may be due to plots being resold or other factors, but the majority of people in this society started living in proper homes in 2010. Figure 6 shows all of the available spaces. The review defines a sustainable development as one that advances the welfare of both the environment and people. The people and environment of a development area are the two main stakeholders who have shaped it and will continue to do so.

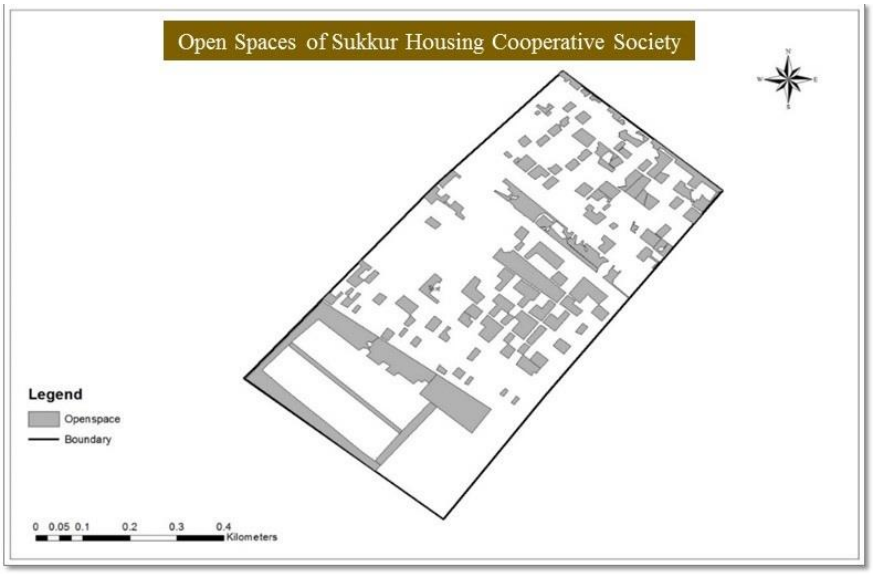
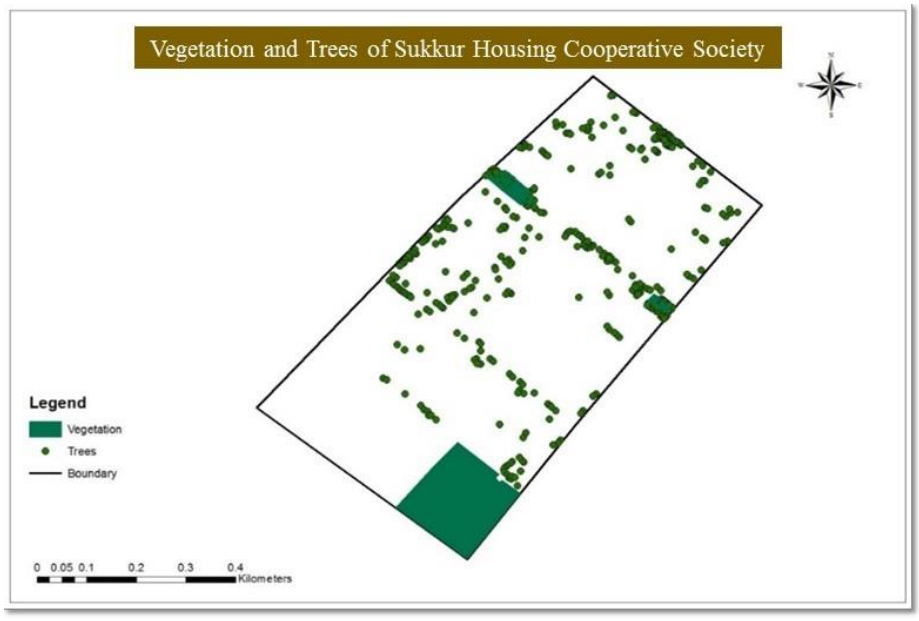



Figure: 6 Open Spaces of Study Area




A city's quality of life affects its socioeconomic level even though socioeconomic status and population are directly connected. The ecological health and environmental management of a city are inextricably linked to the state of its environment. (Ahmad, 2014). There are trees and other vegetation in this society shown in figure 7, but their numbers are restricted because of the densely populated and highly constructed area. This community has 417 planted trees, which contribute to environmental preservation and cleanliness. They are also essential for maintaining the freshness of the surrounding area and supplying oxygen.Figure: 7 Vegetation and Trees of Study Area

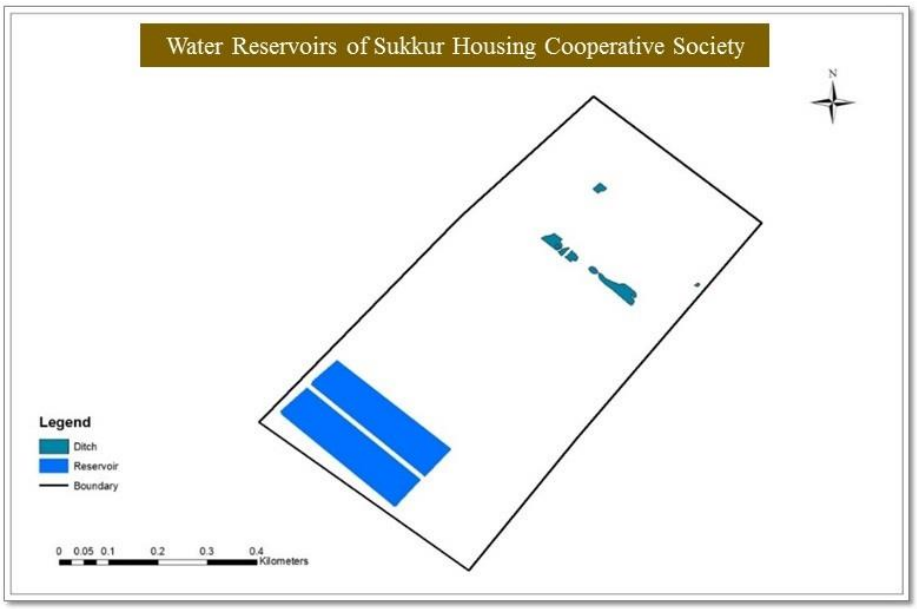



Figure: 8 Water Reservoirs of Study Area

Cities offer a range of underground infrastructures that support improved living conditions and the delivery of essential services. The water line network is one of the most important structures among them. This should only be done with drinkable water. In this case, there is not enough drinkable water available due to infrastructure limitations in society. (Waghmare, 2015). Water is stored for fields and vegetation in two reservoirs in the area. Additionally, there are some ditches where drainage water sits stagnant due to unconstructed plots which shown in figure 8. However, more work is needed for the chosen estimation of water line properties from surface parameters. (Waghmare, 2015).

**Advantages of Cooperative Housing Society**

Establishing a cooperative society is comparatively easier than forming other types of business organizations. Any ten adults can get together to form a cooperative society. The process of registering a cooperative society is very simple. It is possible to establish a cooperative society without adhering to any official legal requirements. The liabilities of members of a society are usually limited to the capital they have contributed. They can now rest easy knowing that their personal belongings won't be taken in case society suffers financial setbacks.

Better products and services are provided at reasonable prices to members of a cooperative society. The society also provides financial assistance at discounted rates to its members. It supports the development of production facilities and the marketing of agricultural products produced by small farmers and enterprises. The cooperative society is governed by its elected members both inside and outside. In addition to having equal rights and one vote, each member can actively influence the policies that the society adopts. As a result, each individual is equally important to the community.

The permanent incapacity, insanity, or death of its members cannot bring an end to a cooperative society. Because of its stable life, it is able to endure for a longer period of time. Its existence on its own is lawful. Until every member of the society decides to dissolve it, it does not end. Existing members may depart, and new ones may join. Operations in the cooperative society are more cost-effective since there are no longer any middlemen involved. Community members charge the lowest possible price for the services of middlemen.

There are relatively few ongoing and one-time costs in a cooperative society. Additionally, the economies of scale whether in production or purchase automatically lower the cost of acquiring the goods, which lowers the selling price. The society makes a small profit on the products it sells to its members. The society does sell goods to outsiders occasionally. The profit is used to cover the society's daily administrative expenses. Based on these purchases, the profit-sharing mechanism reserves a portion of the surplus, distributes dividends to members, and dedicates another portion to member welfare. In order for societies to effectively achieve their objectives, the government provides additional assistance. Consequently, the societies receive financial lo at discounted rates. In order to support cooperative societies' long-term financial stability and sustainable growth, the government also offers them a range of subsidies.

**Conclusion**

With 1,639,897 residents living there as of the 2023 census, Sukkur is the third-largest city in Sindh after Hyderabad and Karachi. It occupies an area of 5,165 km^. Situated between 68° 50'12.8364'' N and 27° 42' 50.1336'' N. E. is where the city is located. Sukkur society is concentrated in the western part of the city. The Friends Cooperative Society is located in the east of the society, Sukkur IBA University is located in the west, and three major canals are located in the south. The vegetable market is situated in the north of the society. This community is well-known for its clean environment, well-built structures and roads, and fresh water that is subterranean. It is conveniently close to hospitals and educational facilities. It is also secure because there is a police station nearby, and several judicial and administrative buildings are located there. It also has healthcare facilities, such as clinics and hospitals. GIS and remote sensing techniques have been used in this research project. They provided precise information about the land cover and use. The 2023 satellite images display the various land use classes in this. The study's conclusions not only demonstrate the usefulness of centered GIS multi-measures valuation of technical base, but they also work for a geographical choice which support the structure for reduce ambiguity near to the that wherever new residential developments would be situated to build within cities. Furthermore, it can be a useful tool for decision support, offering recommendations for mitigating new environmental risks and encouraging policymakers to employ GIS platforms to promote sustainable urban land-use management. (Weldu, 2016).

**Recommendations**

For run the best system of a cooperative society as a number of adding factors which can be the main elements towards the supportive to cooperative act. Planned formation, memberships' involvement, social wealth, organizational plus interpersonal resources stand amongst the recognized aspects as a result of previous works. As a solid business strategy that meets customer needs, extensive planning and budgeting. Participant's commitment to the predetermined goals, plans, and processes. Capable supervision and a responsible board can be important for its development, it is also based on the core values, which include social responsibility, honesty, transparency, and consideration for others. Interdependence that is constructive is the cornerstone of cooperative projects. Among other things, must be provide more develop housing system, credit, utilities, medical care, transportation, and technology. Cooperatives benefit both sides by advancing their shared goals. For enhancing the better system construct new water plant for safe drinking water. There must be the parks for family and children for heathy and fresh environment around the society. For managing the system the city owner must be involve to encourage the community for more develop and manage the society in study area.

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