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RESEARCH PAPER

Integration of RS and GIS for Tracing the Rural Settlement Pattern and Household Characteristics Analysis of Mirokhan Town, District Kambe Shahdadkot, Sindh

[1] Naila Parveen Abbasi* [2]Quratulain Anmol Mangi [3]Ghazala Parveen Abbasi

1. Assistant Professor, Department of Geography, Shah Abdul Latif University Khairpur, Sindh, Pakistan
2. MS Scholar, Department of Geography, Shah Abdul Latif University Khairpur, Sindh, Pakistan
3. Assistant Professor, Department of Education, SMBBGC, Larkana, Sindh, Pakistan

***Corresponding Author:** proudtobeageographer@yahoo.com

ABSTRACT

The study's goal is to identify the settlement pattern, which reflect the socioeconomic features of the rural area. Mirokhan is one of the oldest tehsils Located in Sindh province's District Kamber Shahdadkot, The changes in the rural settlement pattern are a result of various social issues that are linked to the changes in this settlement. The research was on a survey based, a transect walk, and direct observation across the entire study region in several Muhallas. The Survey was done from January to March of 2024, 103 households were covered through questionnaire. GIS and RS used to observe settlement pattern. The primary causes of the changing environment are the reduced number of joint families, the availability of services, and the migration rate relative to neighboring rural parts of the city due to differences in income sources. The three distinct types of settlement patterns, dispersed, linear, and nucleated observed in study area. In the research area, the majority of the population resides in the nucleated pattern. While the state of the housing is moderate, the water quality is really bad. According to the research, the household's condition is 53.21% meaning that the study area's housing situation is moderate. Local government should monitor and plan the development of infrasturcture like roads, water supply system and sewage lines in rural culture in study area.

KEYWORDS GIS, Household Structure, Remote Sensing, Rural settlement Pattern

Introduction

A settlement is a human-made community or group of people. Humans have long since evolved to establish settlements according to their own needs. The phrase "characteristic groupings of population occupancy units together with the facilities in the form of house and street serve the inhabitants" is used to describe settlements. It analyzes the facilities created throughout the process of occupying the land and forming groups. Agriculture and a tiny cottage industry are the main industries in the rural community. Any settlement located in an area designated as rural by a government agency, such as the National Census Bureau, is referred to as a rural settlement in certain nations. Even small communities may fall under this (Mondal et al., 2020).

The primary economic activity in rural settlements is agriculture, and the pattern distribution characteristics of these settlements suggest knowledge of the villagers' natural surroundings as well as critical information about the level of civilization, social patterns, and shifts in regional characteristics (Zheng et al., 2023). Moreover, it is a social-ecological system (SES) with intricate relationships between the natural world and humans (Tong et al., 2023). In our nation, 86% of dwelling units are located in rural areas, and about 80% of the population resides in rural towns (Ferdous et al 2017). The arrangement of one building and home next to another is known as the settlement pattern. There are two types of patterns for settling on high land above the annual flood level: scattered and linear. The linear type is constructed along naturally occurring river embankments on high ground. Built on elevated terrain, these sporadic settlements are frequently scattered across the

landscape. By raising land, entire villages have expanded over time in the plains region, and new ones are still being established (Dewan, 1985).

The informal settlements established by refugees between 1947 and 1951 grew and became more densely populated as a result of the government's inability to house the migrants, many of whom came from Pakistan's rural areas. Squatter settlements known as katchi abadis (squatter settlements), were also established (Hasan, et al. 2002). Following the 1960s, research on rural settlements transitioned to a more quantitative phase, with an emphasis on combining qualitative and quantitative methods and paying particular attention to the influence of human decision-making behavior on formation and development. The rural settlement research paradigm started to give way to the socio-humanistic paradigm in the 1990s. Examining rural settlements from the viewpoints of settlement geography, sociology, ecology, economics, etc. has progressively gained traction. The primary research topics have progressively shifted to include rural communities, urban–rural relations, rural policies, population and settlements, and models of rural settlements (Zhang et al., 2023).

The center of rural human and land relations, rural settlements have garnered a lot of attention recently as the focal points of rural residents' activities. Theoretical components of rural geography, rural sociology, rural economics, and rural ecology comprise the core of the study of rural settlements. Furthermore, there has been a lot of attention paid to the Global Land Plan (GLP) project and other environmental issues, and a greater body of research has been done on the evolution simulation, the spatial and temporal patterns of rural settlements, and other related topics (Li et al.,2023).

The use of geographic information systems (GIS) and remote sensing (RS) has revolutionized residential land patterns over the last 20 years. However, the use of these tools is still in its early stages, having been proposed by Hodder and Orton in the early 1970s as rather complex and laborious models (Li et al., 2017). Along with the growth of cities and an expanding population, the use of GIS and remote sensing in assessing land for settlements is critically needed (Lasaiba et al., 2023). Because GIS makes multi-temporal data on the developments and patterns of LULC change available, it is helpful for mapping and analyzing these patterns (Rahman et al., 2022).

The study focuses on the key variables that affect how rural housing is altered as well as how people settle in rural areas. The goal of the study is to identify the most important variables influencing the shift in the housing and settlement patterns while also highlighting trends. Basically, the housing in rural areas differs from that in urban areas because of factors like income, culture, and material availability, which can sometimes put them in vulnerable situations. Additionally, the settlement pattern varies based on the inhabitants' culture, population density, and other factors. The primary focus of the study is on the dominant factors underlying the patterns of rural housing and settlement. 2022). (Ferdous et al, 2017).

Literature Review

According to (Song et al.2023), settlements represent the closest spatial and temporal units connecting humans to their surroundings. Rural settlements are thought of as a collection of places where people congregate, allow the majority of the population to live in rural areas, and act as hubs for the development of rural communities (Yao et al., 2023). The rural settlement is an essential component of the rural economy and society, serving as both the primary form of rural population settlement and the spatial unit of rural population activities. Important forms of rural land use are rural settlements, and global challenges in the urbanization process are rural reconstruction and transformation. Several viewpoints have been used in research on rural settlements. (Li et al, 2023), a rural settlement is a socio-ecological system (SES) made up of natural, socio-economic, morphological, and locational elements, among other systemic characteristics.

However, the intricate relationships between the subsystems of rural socio-ecological systems (RSES) have only been partially quantitatively revealed in a small number of prior studies. Third World countries' development cannot be completed without rural settlements. People living in rural areas are connected to larger regional and national markets through small urban centers and rural settlements (Richardson et al., 2022). It is very important for social succession, farmer livelihoods, and agricultural productivity. But the last few decades have seen a tremendous increase in urbanization, which has had a significant impact on rural settlements due to labor demands and capital growth (Tong et al., 2023). Studies on rural settlements are conducted worldwide and focus on the creation, location, purpose, and types of land use; they also highlight the approaches used by different disciplines and the effects of socioeconomic and cultural factors on the development of rural settlements (Li et al., 2023).

The housing condition and settlement pattern serve as the study's two fundamental criteria. In that instance, the housing conditions in these rural areas are determined by various housing structure types, dwelling types, roof types, wall and floor materials, room count, and housing tenancy (Hasan, 2000). Enhancing social justice, efficiency, equity, and resident dignity can all contribute to the development of a housing environment (Alam, 2016) Because of the diversity of the environment and climate, housing in rural areas varies. The housing is constructed in accordance with the regional characteristics, lifestyles, and ways of life (Alam, 2016). The social and economic standing of the household affects the housing situation. Conversely, there are primarily two forms of settlement on a homestead: scattered and linear settlement. Settlement forms are typically shaped by the topography of their surroundings (Dewan, 1985).

For government officials, experts in rural development, and planners at the local level, one of the biggest problems is the absence of spatial facts at the rustic plus region ranks. (Chen et al, 2023). A geographic information system (GIS) uses data associated with a rural area to analyze and display data that is geographically referenced. Geospatial analysis is the process of integrating image analysis with GIS data interpretation, exploration, and modeling. Fewer of the main uses of GIS in rustic growth include land-living plus resources map, combining native as well logical spatial facts, ecological managing, public-centered natural source supervision, natural threats, also expanse design. In order to support rural development and give people in these areas access to basic services, geospatial technology will undoubtedly play an ever-growing part for building structure in these zones (Chen et al., 2023).

Study Area

One of Sindh province's oldest tehsils, Mirokhan, is located in District Kamber Shahdadkot (previously, according to the 1998 census). District Kamber Shahdadkot was formerly a part of District Larkana before they were split apart in December 2005. Mirokhan, which has a land area of 796,095 km2, was founded in 1915. The shrine of renowned Islamic scholar and saint Mian Hamidullah Hazuri is the reason for Mirokhan's fame. The towns of Kamber, Sijawal, Shahdadkot, Ratodero, and Larkana are all connected by roads. It is located 27 km from Larkana and roughly 55 km from Mohen-jo-Daro, the most well-known location in the Indus valley. Latitude (27 46'0.120"N) and longitude (68 5'60.000"E) are the coordinates of Mirokhan. It is located in Sindh's northwest. Miro Khan is located in a monsoon climate zone. Summertime temperatures soar to 53 °C, while wintertime lows of -2 °C make for a somewhat chilly winter. Numerous individuals belonging to various castes reside in the city, some of the most well-known being Tunio, Bhatti, Chandio, Magsi, Brohi, Mangi, Shaikh, and others. The lush land that encircles Mirokhan is mostly used for the cultivation of rice, wheat, and numerous other vegetables. (Google,2024).

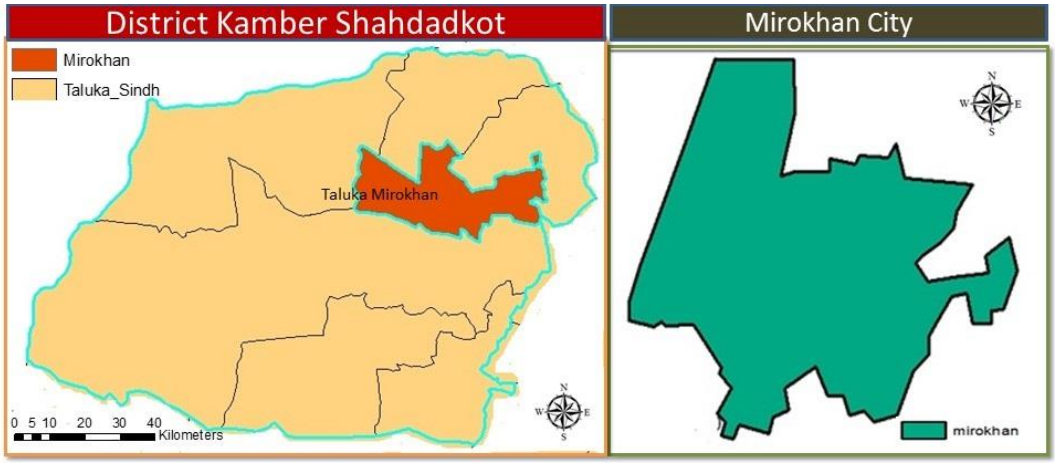

Figure: 1 Location of Mirokhan (Study Area)

Table 1
Population of Study Area in different years

Variation of Settlement population in different year	
Year	Population
1998	98,782
2017	157,934
2021	158,191

Martial and Methods

The primary methodology used in this study is field surveys. The idea behind survey methodology is to measure variables by asking people questions, and then to look at the relationships between the variables. Following the selection of the study's goal and topic, prior research on the subject was examined to determine the most effective approach for gathering data, which was then analyzed to produce the best possible outcome. For this study, two kinds of data are gathered from primary and secondary sources. Key informant and mapping, interviews, direct observation, questionnaire surveys, and structured questionnaire surveys are examples of primary sources. Direct observation of all significant activities involved simply strolling through the neighborhood, watching people go about their business, and gathering data about the resources in the research area.

The respondent is interviewed at home or in any other location to fill out the questionnaires. Using Google Earth imagery from January 2024 and geographic information systems (GIS), the settlement pattern for the year 2024 has been prepared. Secondary data gathered from the 1998 housing and population census. Both qualitative and quantitative surveys using questionnaires are used for data analysis. Reliable information from key informants and a transect walk across the survey area are also used. In 2017, (Ferdous et al.2017). Tools from geographic information systems (GIS) have been utilized to arrange the study. GIS software was used to create the maps, and GPS was used to obtain the coordinates of the Pacca and Katcha houses in the survey area. A significant amount of data about the study area is provided by the various maps that were created in a theme format using digital cartography techniques. These maps feature landmarks and basic infrastructure along settlement patterns.

Results and Discussion

The survey area is located in the Mirokhan town committee in the Kamber Shahdadkot district of Sindh, Pakistan. The study area's results are gathered from a variety of sources, including surveys, group discussions, census reports, and maps of settlement

patterns obtained from Google Earth in January 2024. The study area's settlement pattern in figure 2, is linear, dispersed, and nucleated. The majority of households in the study area have moderate conditions, as indicated by the household ration of average household condition, which is approximately 53.21%. According to the census report, the population of Mirokhan town is expected to be approximately 158,191 in 2021. In order to build living facilities for people residing in rural areas in accordance with federal requirements pertaining to permanent, semi-permanent, and temporary housing, those people and their families inhabit 75% of the study area in Pacca houses, 15% in semi-Pacca houses, roughly 5% in Katcha houses, and the remaining 5% in jhupries (squatter settlements).

The majority of Muhallas in the Mirokhan study area have undrinkable drinking water due to the poor quality of the water. The study area's residents travel to nearby locations to obtain water for their needs from various sources, such as hand pumps and tube wells. In the study area, the percentage of electricity is between 30 and 40% in the villages and between 70 and 80% in the city. The study area's streets are formed by the cement floor, and some of the roads are better built. Pacca is where the Mirokhan drainage system is being built.

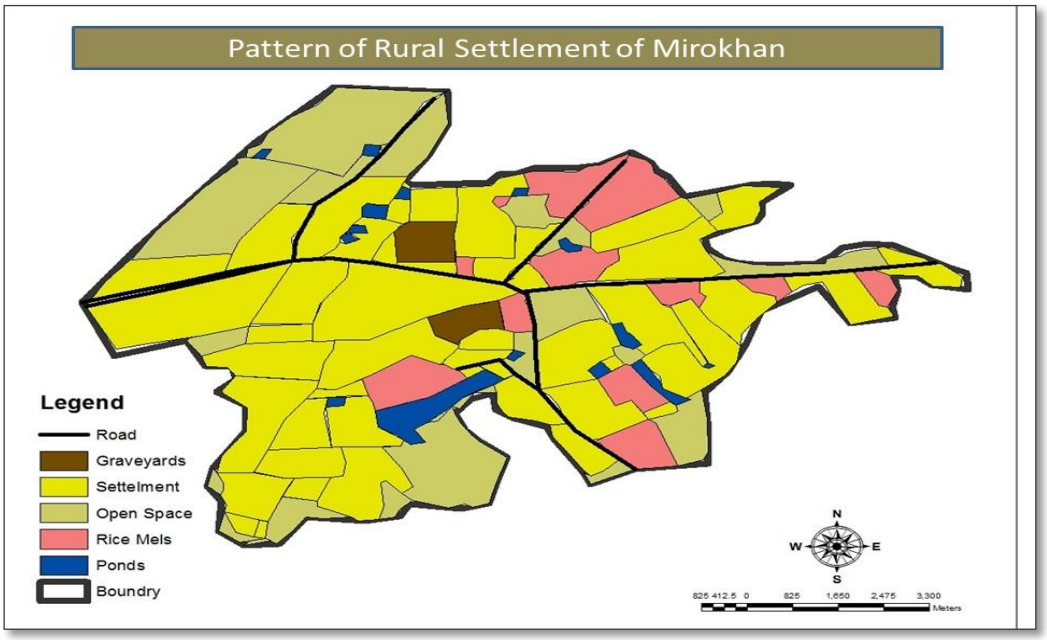

Figure: 2 Settlement Pattern in Study Area

Types of Rural Settlement in the Study Area

Settlement type is a component of rural settlement. A collection of homes that may be Nucleated, Dispersed, or Linear settlements that arise from the interaction of physical and cultural elements is referred to as a village. The term refers to the spatial relationship between settlements within a regional framework. This concept states that high resolution satellite images of the study area have shown the three types of settlements.

- Nucleated settlement
- Linear settlement
- Dispersed or sprinkled settlements.

Nucleated Settlement

Figure 3, shown the Consists of closely spaced buildings, usually grouped around a central location like a road intersection or river crossing. (Weebly (2024).

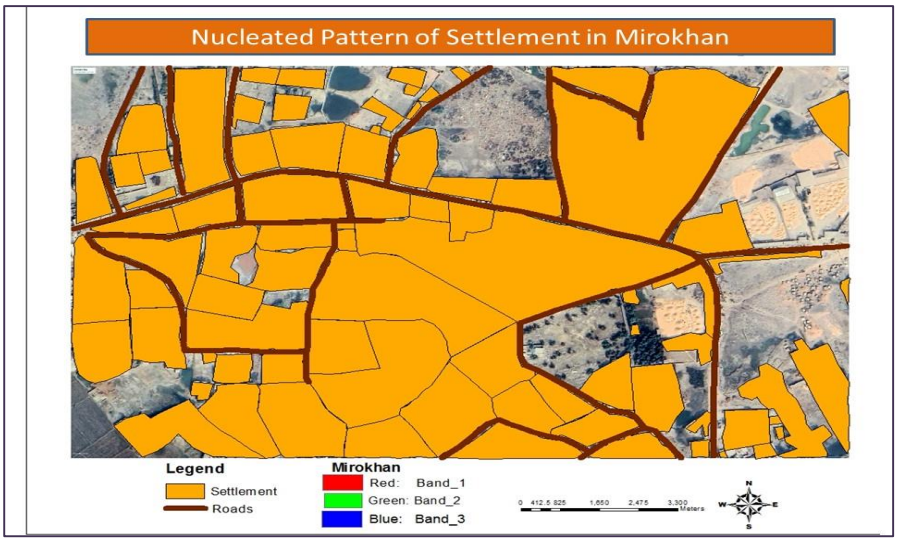

Figure 3: Nucleated pattern of Settlement in Mirokhan

Linear Settlement

A linear settlement is a long line of buildings that form a settlement, usually of modest to medium size. A lot of these communities are built along transportation corridors like roads, rivers, or canals. In figure 4, a linear settlement might not have a clear center. When a settlement is constructed alongside a transport route, the route existed before the settlement did, and the settlement then expanded along the route. (Weebly (2024).

Dispersed Rural Settlement type

As shown in figure 5, a scattered settlement is dispersed settlement. Another name for it is dispersed rural settlement. It illustrates how homes are dispersed throughout the area and are located far apart from one another because of fields and farms. Houses in this kind of settlement are relatively far apart, and there is a higher population density. These types of settlements are confined to a relatively small area, with a considerable distance between homes and a scattering of huts or homesteads throughout the village. (Weebly (2024).

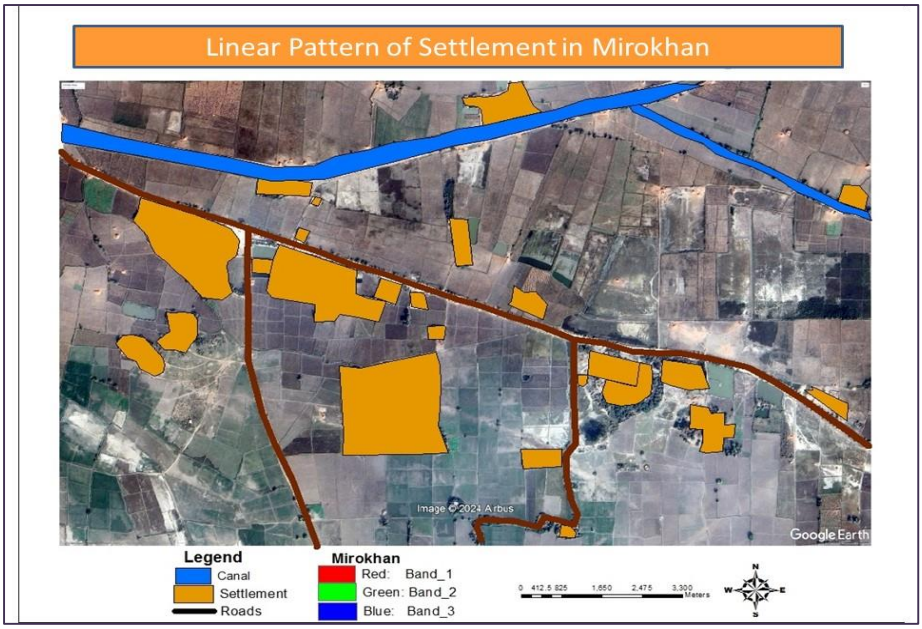

Figure 4: Linear pattern Settlement in Mirokhan.

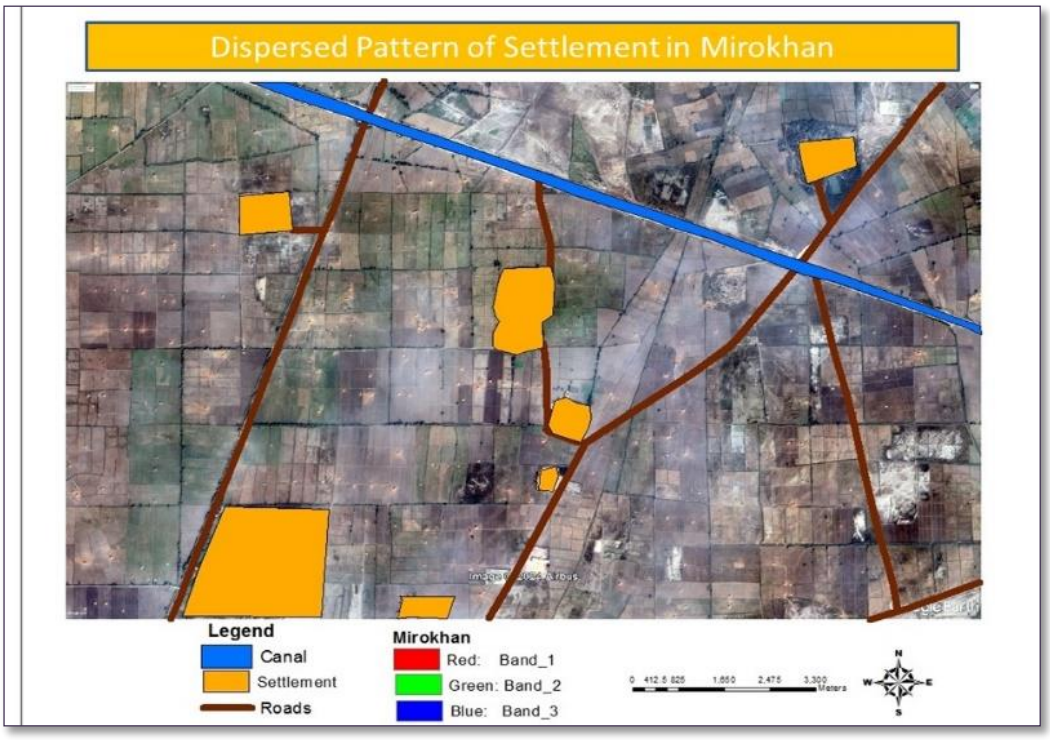

Figure 5: Dispersed pattern Settlement in Mirokhan

Table 2
Percentage of Area (Settlement Pattern)

Settlement pattern percentage of Area	
Settlement pattern	Percentage%
Nucleated	55%
Linear	20%%
Dispersed	25%

Type of Housing Structure

In figure 6, and 7 there is diversity in the types of building structures because only a small percentage roughly 75% are Pacca houses, 15% are semi-Pacca houses, and 5% are made of mud or katcha. Five percent are jhopries, or squatter settlements. In the research area, cement or a mixture of wood and cement was frequently used to build homes. Nowadays, financially secure individuals attempt to construct semi-permanent (more Pacca) homes in rural and suburban areas. Their walls are shared by the buildings next to them. This kind of construction typically has a rectangular plan shape, measuring between 20 and 30 feet long and 10 to 15 feet wide. The primary structural components of Mirokhan are the mud walls, which support the roofing. Many homes have front verandas that are open and have posts supporting the roof. According to the survey, household conditions are 53.21% moderate, 27.33% good, and 19.91% poor. (Ferdous et al, 2017).

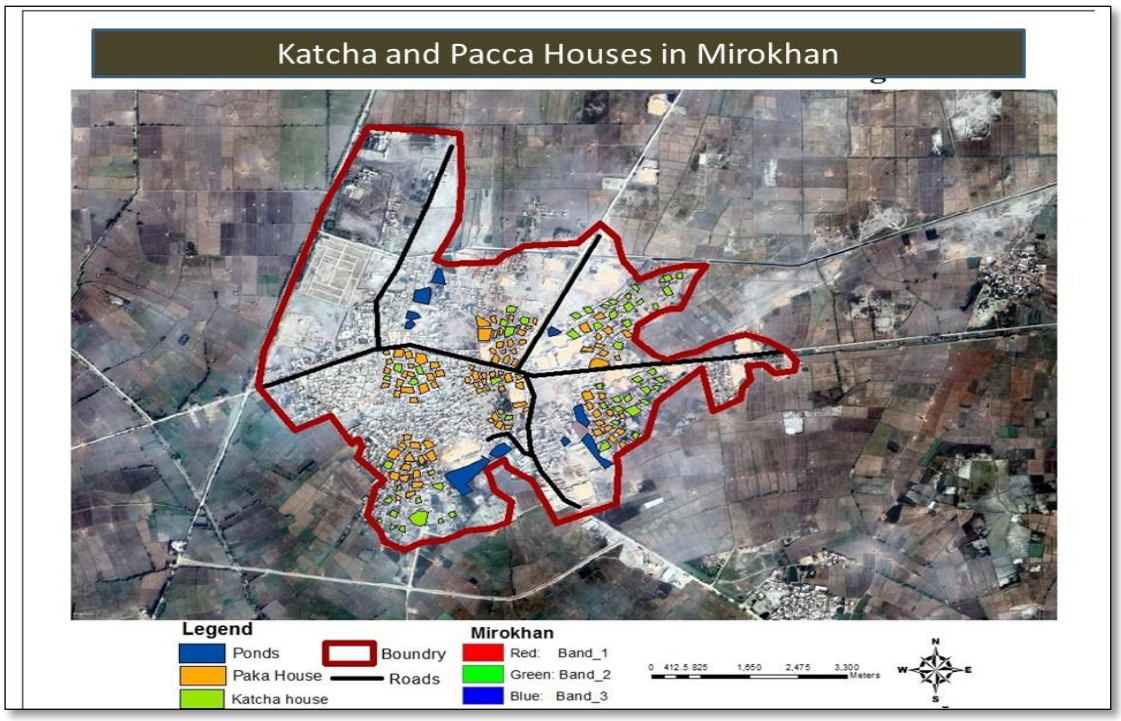

Figure 6: Housing Structure in Mirokhan

Table: 3 Building construction (material) and Rooms in Houses in Mirokhan

Type of House	Number of Houses%	Number of Rooms	Total Houses%
Katcha House	5	2	5
Semi Pacca	15	2	15
Pacca House	75	2&3	75
Jopries/Squatter Settlement	5	1	5

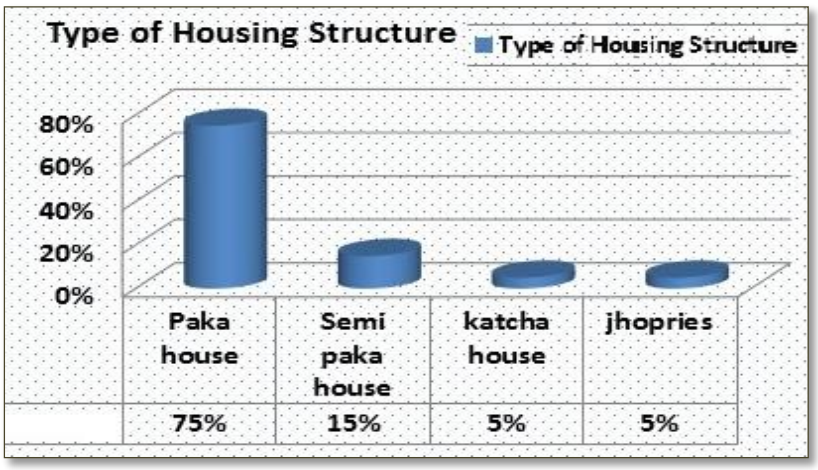

Figure 7: Percentage of Different Types of Household

Household Characteristics of Mirokhan

Everywhere there are differences in the environment and the household characteristics of the houses where people live. In Mirokhan town, for example in figure 7, sown about , 75% of the houses have two or three rooms, 15% have two rooms, and 5% of the houses have two rooms in common.

Table 4
Houses Construction period and Bathroom Table per House in Mirokhan

Period of Construction	Number of Houses%	Categories	Total Houses%
Less than 5 years	16	Bathrooms	39
5-10 years	18	Toilet	41
10+above	59	Attach washrooms	17
Under construction	7	Bathroom/Toilet	5

The variation in time that transpired during the building of the houses. According to the results of table 4, about, 59% of the houses have been built for more than ten years, and only a small percentage were still under construction. There is a moderate variation in the facilities for bathrooms, toilets, and washrooms in the summary data. During the survey, 41% of the interested area's bathrooms and 39% of its toilets were discovered; of these, 17% had attached bathrooms, and the remaining 3% of homes were still under construction.

Kitchen Table and Home/house Category

The kitchens used by joined families in a single residence are combined. The variation shown in table 5, in the number of attached, detached, or non-attached kitchens in Mirokhan homes 34% of kitchens are combined and 52% of kitchens are separate. One-fourth of homes lack a kitchen. While some people in the study area rent their homes, the majority of residents have owned homes for a considerable amount of time. 43% of people rent their homes, while 57% of people own their own. Owned homes therefore have more configurations than rented ones.

Table 5
Kitchen Table and Home/house Category

Type of Kitchen	Number of Houses%	House Category %	No of People%
Separate 16	52	Owned	57
Combine 18	34	Rented	43
No availability of kitchen	14		

Residential Segregation

Figure 8 and 9, shown several households were surveyed for the study, and their opinions on common segregation in the home are presented. The majority of people in the study area are Muslims, but there are not as many non-Muslims. The way the study area is segregated is similar to how different caste groups create their own paras or muhallas, such as Tunia Muhalla, Bhatti Muhalla, Abra Muhalla, Yousif Colony, Gulshan Abad, etc.

Although the town area has a lot of amenities, the environment still needs to be improved. The map indicates that the majority of the households forming the settlement on various road sides were constructed parallel to the road, and in certain instances, they formed groups. There are also a very small number of nucleated settlements. Despite this, the settlement was constructed in an orderly manner alongside the road, and it in no way impedes agricultural fields. However, as the settlement grows from both sides of the roads, it is evident that both linear and nucleated settlements are present. There are more houses because there are more people living in them.

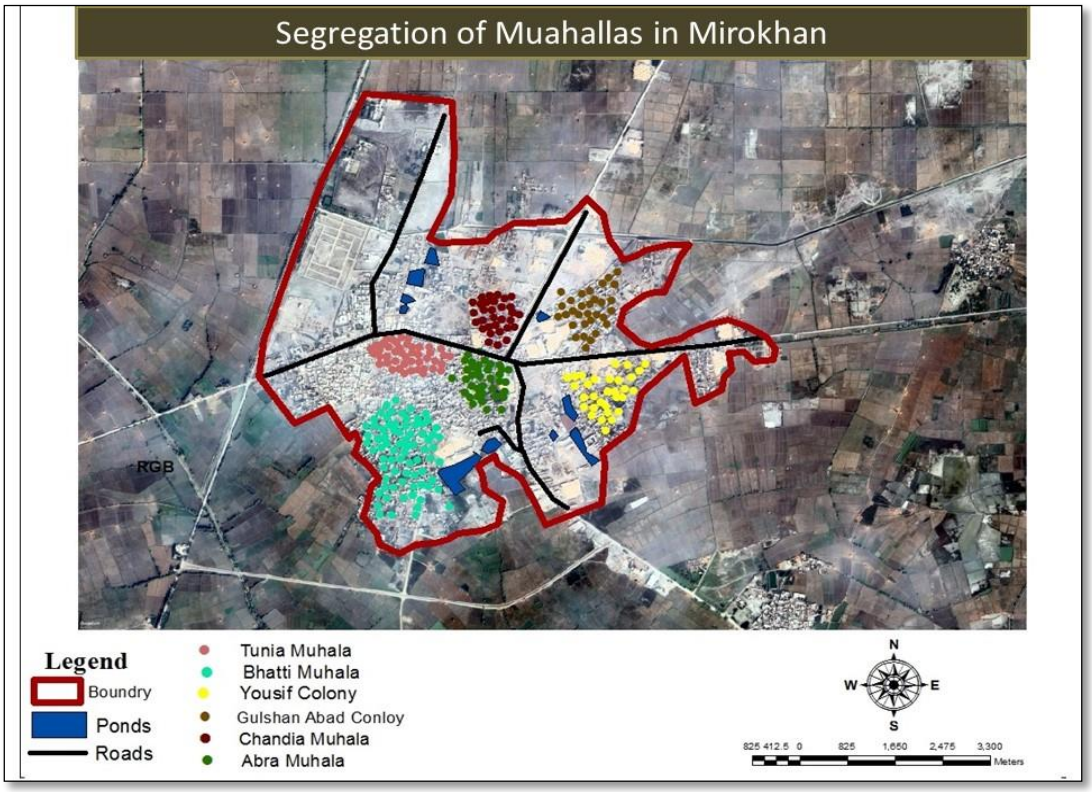

Figure 8: Segregation of different Muhalla's in Mirokhan

According to the aerial survey, more and more homes are expanding in a more planned manner than in the past (Ferdous et al.2017). The majority of the study area's drainage issues are related to the fact that most of the water that comes from the supply source is contaminated because it comes from the canals where drainage water is dumped. Since these places are known to be hotspots for the spread of illnesses like hepatitis, malaria, and the dingy virus, people should avoid passing through them when traveling. This is especially true in areas where bad stag rent water is stored. There is not a working drinking water line in the study area. The town of Mirokhan is traversed by the Warah Canal, and the same water is used for irrigation as well as drinking. There are only two higher secondary schools for boys and girls in the study area, in addition to numerous private schools and a degree college. As a result, the government ought to provide the means for the establishment of additional higher secondary schools so that future generations can receive a better education.

A higher standard of living is the result of both economic and natural factors. Because Mirokhan City is more developed than the nearby villages and has access to educational facilities, the city's education level is good. A survey that was conducted indicates that the literacy rate in Mirokhan is roughly 61.2% for both genders. The state, kind, material, drainage, drinking water, latrine, etc. of housing. These elements affect the kind and arrangement of homes.

The presence of utilities such as stores, ponds, and dictionaries can occasionally affect where homes are located. A small number of farmers, in particular, use the ponds to wash their crops. The majority of households (nearly 63.38%) do not have any migrants. Two people migrate in 24.62% of the remaining 36.6% of households, out of which one person migrates. Despite being low, the rate of migration is rising daily.

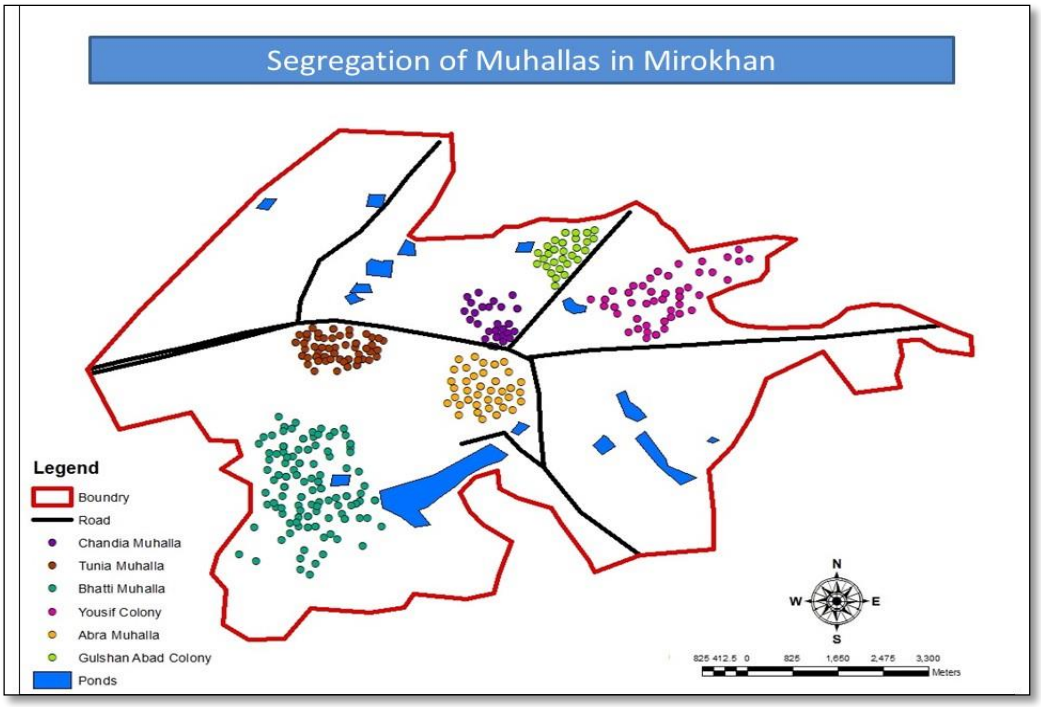

Figure 9: Segregation of different Muhalla's in Mirokhan

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The primary driver of migration is the pursuit of improved job prospects, educational opportunities, and financial resources. Because fewer people are living in joint families and more people are living alone, the number of housing units is growing daily. As lone families construct their own homes. The houses were situated outside of Mirokhan town's centre, close to their agricultural land. The majority of families used to be joint families. Because the urban area is influencing the rural area, there are more and more Pacca houses every day. The study area is more accessible to the growth centres due to the availability of facilities and transportation. Improvement of the general state of affairs through population migration, income growth, and improvements in the agriculture sector. (Ferdous et al, 2017).

Conclusion

This study examines the housing types, settlement patterns, and amenities available to local residents in the study area. Additionally, it is examined that the study area contains three different types of settlement patterns: scattered, nucleated, and linear. The majority of the households in the area are Pacca, meaning they live near the town and have semi-pacca houses, while others live outside the town and have katcha houses and jhopries (squatter settlements). In the study, in table 2, the nucleated settlement pattern is most prevalent at roughly 55%. The social structure and residential segregation are to blame for the deteriorating rural housing conditions. With the help of this study, it will be ensured that any new construction in a rural area won't have a negative effect on nearby homes or the land's environmental values. (Ferdous et al, 2017).

Recommendations

The study area's water quality is so bad that the government needs to take action to improve it by installing water filter plants. The government also needs to take action to improve the road infrastructure in the various Muhallas within the study area. Both governmental and non-governmental organizations involved in rural development should work to improve the state of the houses that require it. Further research on this type of topic can aid in observing the current rural area overview to the general public and issues would assist the government in improving the situation in any rural geographic area. (Ferdous et al, 2017).

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