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Research Paper

The Study of Mixed Land-use and Social Capital in Different Districts of Kerman City
Case Study: Ganjalikhan, Shahr, 24 Azar, Ghadir, and Pansad Dastghah Districts

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Abstract
Land use characteristics affect social behavior and Social Capital (SC) among humans. Due to the different physical dimensions of the dense city neighborhoods, the type of ongoing social interactions in different locations will not be alike. In order to understand Kerman city's historical quarters, we must analyze the transitions that occurred in the past few decades, and the formation and reshaping of various neighborhoods. The question we must ask is: What is the relationship between mixed land-use (MLU) and Social Capital (SC) in older and newer neighborhoods? In order to answer this question, we must apply the Structural Equations Modeling (SEM) to determine the relationship between the variables, and to measure the amount of MLU and SC, the criteria of "Diversity and Accessibility"; and "Collaboration and Interaction, Neighborhood ties, Trust, Sense of belonging, Participation, Awareness". Based on the findings, the amount of SC and MLU is different in old and new neighborhoods. In all sample neighborhoods, the level of SC is lower than the theoretical average, and the new neighborhood of Pansad-Dastgah is at a higher level than other neighborhoods. In general, there is a causal relationship between SC and MLU in the surveyed neighborhoods. This relationship is direct and incremental in some indicators of "diversity and accessibility" criteria and it is reversed and decreasing in other indices. Also, with increasing MLU, the amount of SC in neighborhoods is amplified. To determine the relationship between LMU and SC, the length of time residents live in a neighborhood and its social context, as well as the assessment of SC, have been considered. The model of old Iranian neighborhoods that have more SC and MLU, and theories of urban planning with MLU in their set of principles, can be a good basis for planning/re-planning in new and existing neighborhoods.

Keywords: *Mixed land-use, Social capital, Diversity, Accessibility, Kerman city.*

1. INTRODUCTION

Throughout human history, most settlements have been multifunctional environments, with residents working close to home and accessing their daily needs on foot. But in the early twentieth century, the strategy of zoning and segregation of work centers, housing, and recreation became an integral part of urban planning, according to which the combination of uses was no longer acceptable as in the past. With the emergence of various issues resulting from the application of this strategy, the re-mixing and combination of land uses have become very important in the urban planning process, especially in connection with new urban planning approaches such as 'New Urbanism', 'Urban Village', transit-oriented

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development, and most importantly, sustainable development.

The locations of land usage as the core of the city planning system has a significant impact on various aspects of life in the city, the level of quality of life, and the efficiency of urban services and access, due to the different flows and activities in urban spaces formed from the connection between different land uses. Therefore, in a growing trend, especially from the prior decade, the study of the impact of mixed land use on various aspects of citizens' lives including health (Hosseini, 2021; Krefis et al., 2018), travel production (Siami & Khaliq, 2017), and housing prices (Wu et al., 2018; Yang et al., 2021) has been the focus of researchers.

Aside from the effects of land use mixing on the quality of life of citizens, the impact on other aspects of life in the city, including social sustainability, is also important. The social sustainability of a city or neighborhood is defined as "its persistent capability to provide the context for the long-term functioning of human interactions, communication, and cultural development" (Yoo & Lee, 2016). Experimentally, the relationship between social capital and social sustainability has been confirmed, as the people living in neighborhoods with high social capital are less likely to leave their neighborhoods (Kan, 2007; Yoo & Lee, 2015). Social capital, as part of the process of urban planning, reflects the mobility and dynamism of the social system, and is a factor affecting the spatial-physical dimension of the city and creating synergy among city residents. It increases the efficiency of urban planning and its significant impact on the realization of sustainable development (Nikpour et al., 2015).

At the neighborhood scale, social capital affects the collective and cooperative actions of residents, and through it, by creating social cohesion and social order, collective and public management in the neighborhood can be achieved and many social and physical problems of the neighborhood can be solved.

In our opinion, in the multidimensional model of sustainable neighborhood development (social, cultural, economic, physical, and environmental dimensions), mixed land-use is an aspect of the physical dimension and a provider of neighborhood physical sustainability; and social capital is an aspect of social dimension and a provider of its social sustainability. If the amount of mixed land-use in urban areas is directly related to the amount of social capital, the social sustainability of neighborhoods can be achieved through the planning of urban neighborhoods, in which the principle of mixed land-use is considered.

A systematic review indicated that there is a significant relationship between social capital and the structured environment, specifically between social cohesion and access to destinations/walkability. Positive relationships exist between social capital, design, and diversity (Mazumdar et al., 2018). Based on this, it can be said that research on the impact of mixed land use and the effect of the built environment on social capital in the world is gradually opening its place. Although, "We lack operational knowledge about the role of the nature of urban space on social capital" (Vilar & Cartes, 2016). What makes this research more important is that few studies in this field have been conducted in Iranian cities, despite its importance.

In the evolutionary process of growth and development of most of the old cities of Iran, including the city of Kerman, three distinct textures of old, middle and marginal (New) can be seen (Bastani Parizi & Daneshvar, 2009; Zangi Abadi et al., 2016). In addition, on a broader scale, they have a neighborhood structure where existing and new neighborhoods have been formed in accordance with the growth and expansion of cities.

The old neighborhoods of Kerman city have commercial uses (Bazaar), social and cultural uses (Mosque and Hosseinieh, etc.), health (Water storage, baths, etc.), services (Bakery and retail, etc.), and other day-to-day needs of the residents. Neighborhood affairs were also managed through existing popular social organizations (Yazdinejad & Mahdavi, 2016) However, presently the uses required for contemporary life are more or less formed in the neighborhoods.

The control and management by people, a very important feature in old Iranian neighborhoods, have lost their importance and function in the newer neighborhoods of Kerman (Hosseini & Soltani, 2018). New neighborhoods are generally associated with low density, zoning, and in some cases even the proximity of dissimilar land-uses which create long distances between the workplace and living place. The rapid urban sprawl and the forming of residential and dormitory neighborhoods on the outskirts of the city have created a mixture of old, traditional neighborhoods, with newer, planned ones.

Thus, considering the problem of changes in the nature of urban neighborhoods in Iran on the one hand, as well as confirming the impact of structured environmental characteristics, including how to combine land uses on the amount of social capital in global studies, on the other hand, the present study seeks to determine the situation of mixed land use and social capital, and the relationship between these two variables in five neighborhoods of the historic city of Kerman, which were formed in the different periods (From the Safavid dynasty to the present).

Because the study districts vary in terms of the date of establishment and the development of the urban mass, the case of confirming a significant relationship between mixed land-use and social capital in urban neighborhoods of Iran, urban planners and designers can boost social capital and sustainability by selecting, replacing, and developing mixed land-use strategy within the plans of creating new neighborhoods and the regeneration of existing neighborhoods. In addition, considering that new theories of urbanism, including Sustainable Development, New Urbanism, Smart Growth, etc., in planning new urban neighborhoods, an aim to increase people's social interactions and presence through their principles and rules, especially through creating mixed land-use, the results of this research can be an affirmation of their principles and rules.

2. DEFINITION OF MIXED LAND-US

Mixed land use, which refers to the relationship and proximity of lands and types of buildings with different applications (Nabil & Abd Eldayem, 2015), is the integration and relative proximity of a set of land uses such as residential, commercial, office, retail, recreation, training, and other uses within a specific area that can be horizontal, vertical, common mixed, and time mixed (Aurand, 2010; Esmaeelpour & Fakharzadeh, 2015; Ghahremani et al., 2020; Handy et al., 2002; Kananpur & Nazmzadeh, 2021).

3. MEASURING MIXED LAND-USE

One of the most important issues related to mixed land-use is how to accurately measure it, especially as an independent variable that affects other aspects of human life in the city (Song, Merlin, & Rodriguez, 2013). They examined mathematical formulas (Entropy index, Atkinson index, Balance, Gini, Dissimilarity, etc.) and their conceptual contexts to measure mixed land-use, and simulated these formulas with data from the city of Monte Carlo (Song et al., 2013). They identified the limitations of these relationships and discussed how to implement them for this purpose. According to Javadi et al. (2013a), The Rolley model that is based on the characteristics of granularity, density and permeability, and the Hoppenbrouwe-Lou Model, by developing the Rolley model, which is based on the four dimensions of spatial, horizontal, vertical, and temporal commonalities are among the efficient models for evaluating mixed land-uses use (Javadi et al., 2013). The indicators for evaluating mixed land-use can be classified into 3 spatial categories including accessibility (Proximity), multiplicity (Density), and distribution pattern (Distribution mode) (See Figure 1). Balance and Gini indices are used to evaluate the mixing diversity of the two types, and Herfindahl, Hirschman, Entropy indices are used to evaluate the mixing diversity of more than two types of use, and Atkinson and Dissimilarity indices are used to assess the mixing diversity of both two types of use and more than two types of use (Javadi et al., 2013). The "diversity of use" and "accessibility" indicators, based on the amount of accessibility to different service spaces and the average length of streets, the width of the widest street in the study sample, and the width of the narrowest street in the study sample and transition way for different uses can be used as well (Nabil & Abd Eldayem, 2015).

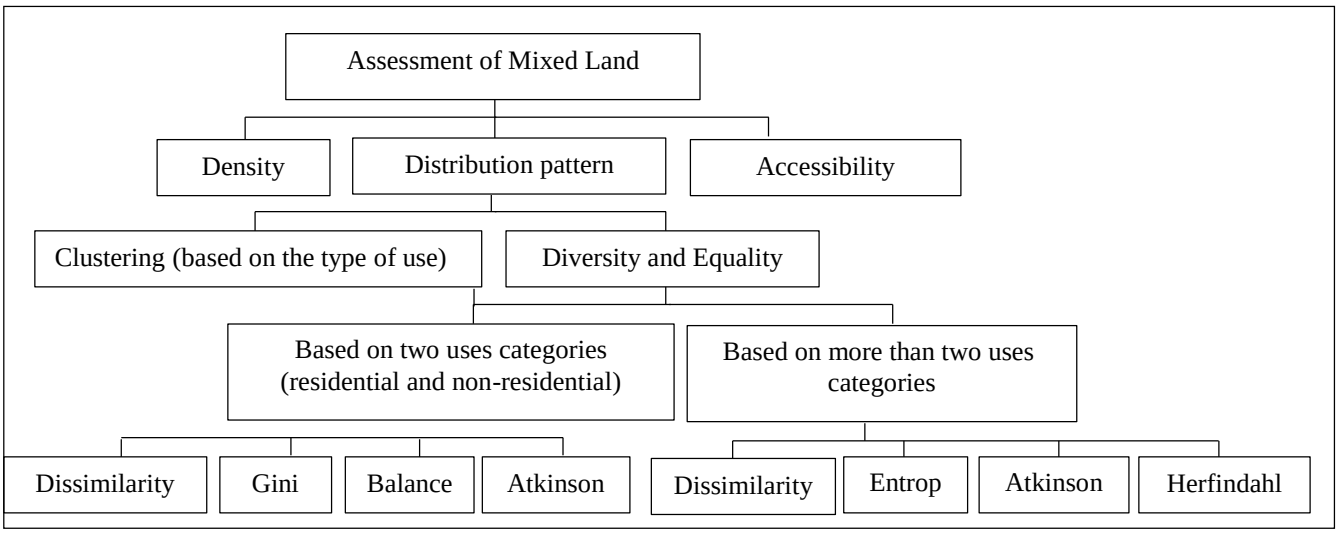


Fig 1. Methods for evaluating different indices for measuring mixed land use (Javadi et al., 2013[b])

Many researchers have used the Shannon Entropy Index for measuring mixed land (Bordoloi et al., 2013; Meshkini et al., 2018; Yamada et al., 2012; Zarafshan et al., 2020). Entropy generally quantifies the homogeneity of land use in a given area. Entropy expressed as equation 1:

$$Equation\ 1 \qquad Entropy = \sum_j p_j \frac{\ln(p_j)}{\ln(j)}$$ Where:

p_j = the proportion of the total land area of jth land-use category found in the tract being analyzed,

J = total land uses considered in the study area.

The entropy is normalized using the natural logarithm of the number of land uses and 0 represents homogenous land use, and 1 indicates the tract of land which is equally distributed across all land use types (Bordoloi et al., 2013). In the Dissimilarity Index (Equation 2), K is the number of developed lattice cells active in the census unit or urban parts, and X_{ik} is the number of land use classes in terms of neighboring cells (Bordoloi et al., 2013).

$$Equation\ 2 \qquad Dissmilitarity\ Index = \sum_k \frac{1}{k} \sum_{i=1}^{8} \frac{X_{ik}}{8}$$

Lawrence et al., proposed Equation 3 in which: LUM is the rate of mixed land-use, n is the number of uses types in the surveyed neighborhood, and Pi is the percentage of each use. Mixed land-use, in this equation, is a number between 0 and 1, and the closer the number is to 1, the higher will be the mixed land-use and the greater the balance in land use (Frank et al., 2004).

$$Equation\ 3 \qquad LUM = \frac{-\sum_{i=1}^{n} p_i \ln(p_i)}{\ln(n)}$$

Reviews of existing studies in this field indicate that:

Some have developed methods for measuring mixed land-use (Javadi et al., 2013, Bordoloi et al., 2013, Motieyan and Azmoodeh, 2021, Hosseini, 2020).

Many studies have only calculated mixed land-use rates on different scales (Esmaeelpour & Fakharzadeh, 2015; Esmailpour & Ghorbi, 2018; Javadi et al., 2013; Kananpur & Nazmzadeh, 2021; Meshkini et al., 2018), which is often varied in terms of the number and nature of the methods used, the diversity of criteria as well as the used indices/measurements.

In a few studies, in addition to determining the number of mixed land-uses, the method of distribution (Spatial changes) of mixed land-use in the city has been determined. Based on this, the amount of mixed land-use in different neighborhoods of the city is different from each other and in general. By distancing from the city center, its amount decreases (Pour Mohammadi et al., 2016).

A large number have also considered mixed land use as an independent variable and examined its impact on other aspects of life in the city such as travel production, health, social sustainability of urban neighborhoods, social capital, etc. (Christian et al., 2011; Ghorbani & TORKMAN, 2015; Hosseini, 2021; Khaksari & AZimi, 2018; Khaleh et al., 2022; Nabil & Abd Eldayem, 2015).

4. DEFINITION OF SOCIAL CAPITAL

Although there is no universal definition of social capital and the limits that all scholars agree on (Carrillo Álvarez & Riera Romaní, 2017; Claridge, 2018; Ievdokymov et al., 2020), some studies consider the resources available to individuals and groups through their membership in social networks (Carrillo Álvarez & Riera Romaní, 2017; Villalonga-Olives & Kawachi, 2015). Social capital is like capital embedded in the social structure (Lin, 2017). Like other forms of capital, it is productive and allows the achievement of certain goals that are not achievable in its absence (Putnam, 2001; Rezvani et al., 2021).

In fact, some researchers have defined social capital based on the combination of the two words capital and social with the help of the word capital. Other experts have also mentioned how it is formed or introduced its constituent elements when defining it. For example, social capital that is formed through social interactions (Yoo & Jeong, 2017), people's participation in social networks (Eriksson, 2010), and social relations and value creation (Chen et al., 2017). Social capital consists of social networks and norms, social interaction, social trust, social participation, cohesion, social security, and social awareness that improve the efficiency of society by facilitating coordinated actions (Arjmand et al.; Gorriz-Mifsud et al., 2017; Putnam, 2001).

From another perspective, social capital is an effective source for local community development and can be considered for the sustainable growth of communities and coming generations (Vilar & Cartes, 2016) and (Gorriz-Mifsud et al., 2017), unlike other forms of capital, social capital does not emerge without the presence and cooperation of citizens. Social capital is born or produced only when human beings are together in a given community and a relationship is formed (Putman, 2002). Social capital is created in the neighborhood, society, and in the space between individuals and social structure (Hamdan et al., 2014). Therefore, it is necessary to determine its nature, factors, as well as elements and components depending on the place and scale. In the definition of social capital, which is always associated with the social suffix, factors such as social composition, neighborhood orientation, the rule of informal power institutions in each neighborhood and

the neighborhood structure of urban neighborhoods, etc., are used. The factors affect the formation, amount and function of social capital. However, in the definitions of social capital, the role of these factors has not been given much attention.

On the other hand, the situation of social capital in urban areas is not limited to the role of social factors. Physical factors and the built environment also play a role. The combination of land usage and characteristics of the artificial environment, through increasing the sense of belonging to the neighborhood and the creation of equal opportunities to increase the interaction of residents with each other, can affect the amount of social capital in various ways locally.

5. MEASURING SOCIAL CAPITAL

Social Capital has been understood and measured at various levels: Macro (e.g., Countries), Meso (e.g., Neighborhoods and groups), and Micro (e.g., Smaller groups and individuals) (Ehsan et al., 2019).

To measure the amount of social capital on the scale of urban neighborhoods, the components of connection to groups and networks, trust, collective action and cooperation, cohesion and social capacity, local people participation, neighborhood links, belonging to a place, common social norms, and social security, are used while defining the indicators related to each component (Arjmand et al., 2016; Hamdan et al., 2014; Hosseini, 2021; Nabil & Abd Eldayem, 2015; Soltanzadeh Zarandi, 2020).

Summing up the research reviews in the field of measuring social capital, it can be said that:

Most of them have only determined the amount of social capital in cities and urban neighborhoods. However, in general, the measurement of social capital in different countries and in Iran is not the same.

A large part of the research has evaluated the effects of social capital amount on social sustainability and also on the urban quality of life in various dimensions and aspects.

6. THE RELATIONSHIP BETWEEN MIXED LAND-USE AND SOCIAL CAPITAL

Spatial differences in social capital in relation to physical factors, and in particular, its relationship to mixed land use, have been an issue for the past decade.

In investigating the effect of mixed land use on social capital in Cairo neighborhoods, (Nabil & Abd Eldayem, 2015) it was found that the higher the mixed land-use ratio, the higher the social capital. The authors measured mixed land use by a great number of diversity indices, building mix, accessibility to commercial centers, accessibility to kindergartens and elementary schools, accessibility to secondary school, accessibility to parks, average length of streets, width of the widest street in the study sample, width of the narrowest street in study sample, and transitions of the way for different uses. They say that these indices were chosen and the focus was centered on them due to their close correlation and direct influence on realizing social capital (Yoo & Lee, 2016).

The causal relationship between social capital and social sustainability with the built environment on the neighborhood scale has also been investigated. Yoo & Lee (2016) used "network, trust and reciprocity" indices to measure social capital and accessibility to parks and public sports facilities, characteristics of residential, land use diversity, neighborhood socioeconomic status to measure the state of the built environment. In their opinion, conclusively, neighborhood-built environments directly affect social capital. This study suggested an integrated model of the built environment, social capital and social sustainability, which also looked to empirically examine and investigate the causal relationships by SEM, based on the precedent theory that the built environment affects social capital and that social capital can contribute to social sustainability.

Based on the findings of Vilar and Cartes (2016), the diversity of mixed uses around the pedestrian axes helps to form spontaneous visits, commercial mobility, and dynamism in the neighborhood, and allows for greater socio-cultural mobility and diversity. Urban design, as a multidisciplinary and place-making process, has provided an opportunity for social interactions in this neighborhood. This encourages people to have more civic behaviors and promotes more networks and collective action, as well as civic and political participation.

Urban structures are decisive for the probability of social interaction (chances for people to socialize) and learning (based on social interaction), and thus critical for stimulating the formation of social capital that is crucial for local community-based response capacities. The formation of social capital as a resource is influenced by the quality and number of places to meet within neighborhoods. The spatial distribution, quantity, and quality of public meeting places (informal meeting places, small street food stands, small street shops/kiosks, religious places, parks, playgrounds, etc.) influence formal or informal social encounters among user groups that give rise to the cultivated form of social capital (Bott et al., 2019). In the association of urban form and social capital formation in the metropolitan cities of Indonesia, by

the multilevel logistic regression, it has been has determined that: 1) Individuals in high residential density areas were less likely to know their neighbors, and had lower levels of bridging trust, and were less involved in the community's activities; 2) Street connectivity appeared to have a positive association with bridging trust (or the higher the degree of street connectivity, the higher the level of bridging trust), but negatively related to social networks. In this way, areas with high connectivity would provide a more walkable environment that could increase the likelihood for people to accidentally meet each other and have a spontaneous face-to-face interaction; 3) The land use mix did not seem to be significantly associated with any social capital variables (Muzayanah et al., 2020). But this is not the conclusion of Cabrera and Nagarian's research in which an association between spatial bridging ties and the use of mixed-use amenities was found, suggesting that mixed-use amenities (e.g., Local shops and restaurants) may be facilitating spatial bridging ties between residents in new urbanist subdivision (NUS) communities (Cabrera & Najarian, 2015).

Urban renewal can affect the dynamics of social capital in urban neighborhoods. Du et al. (2020) evaluated the relationship between the dynamics of social capital (social connectedness, neighborhood attachment, reciprocity, social trust, eviction and gentrification, community participation, and efficacy and cohesion) in six urban renewal projects in different stages in the center of Chongqing, China. The results show that three particular factors, namely social connectedness, social trust, and reciprocity appeared to have a significant contribution to the dynamics of social capital amid urban renewal.

Summing up the research reviews in the field of the relationship between mixed land-use and social capital, it can be said that:

1- Although several studies have been conducted in the field of measuring the two variables of mixed land-use and social capital, as well as the effects of each of these two variables on aspects of life in cities (see section 2.2 and 2.4), there has been little research in the field in particular on the relationship between the two variables. However, no research has been conducted in Iran to this point. As mentioned in the introduction, in fact, "we lack operational knowledge about the role of the nature of urban space on social capital" (Vilar & Cartes, 2016).

2- In general, the results of the existing research indicate a positive relationship between the two variables, although the details of the results are different.

Since there are few investigations in this field, the present study hopes to complete the relevant shortcomings. First, the conceptual framework of research (Figure 2) examines the existing theory that the built environment has an effect on social capital, and to do this, it uses several criteria and metrics for variables. Second, there is a relationship between mixed land use and social capital by utilizing SEM, which has been rarely applied in previous studies.

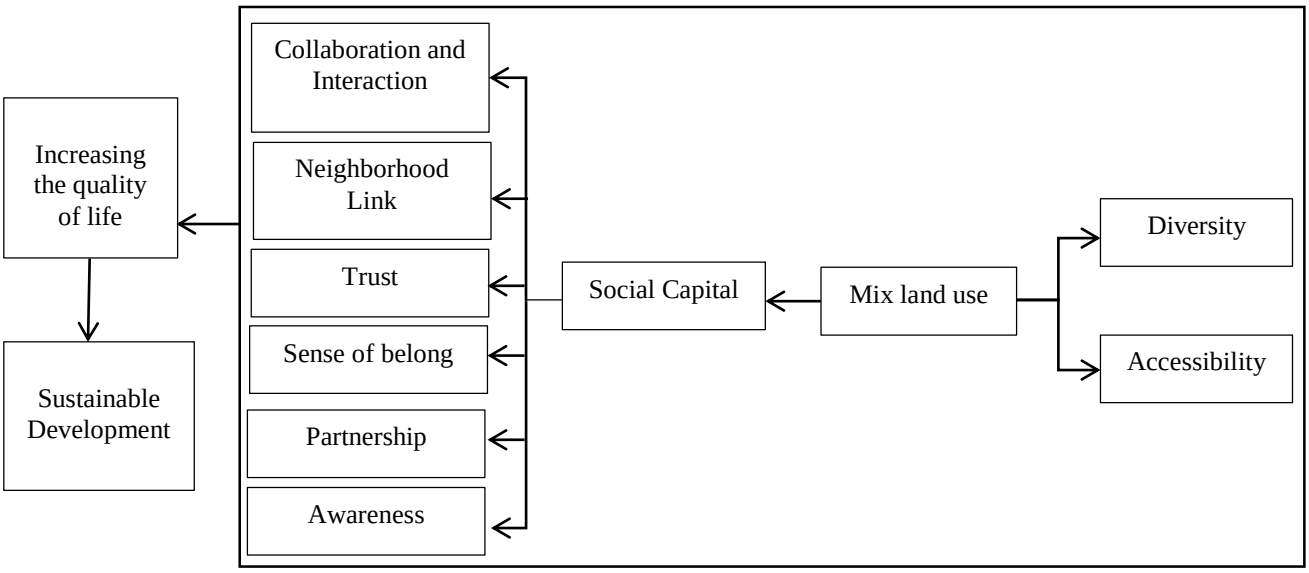


Fig 2. The conceptual model of research

7. CONCEPTUAL MODEL AND RESEARCH QUESTIONS

Few studies conducted by researchers such as Nabil and Abd Eldayem (2015), Yoo and Lee (2016), Vilar and Cartes (2016), and Soltanzadeh Zarandi (2020) show the importance of mixed land-use in urban life and its impact on social factors such as trust, cooperation, sense of belonging, awareness, links and networks and in a word social capital. These studies confirm the existence of a significant relationship between the two variables of mixed land-use and social capital. By increasing the amount of the two important criteria of mixed land-use (i.e. diversity and accessibility), people's satisfaction with their living environment increases, as well as increasing their cooperation, trust, sense of belonging and sense of closeness and connection with the environment improve. The stronger and more sustainable this relationship becomes, the stronger and more meaningful the relationship between mixed land-use and social capital, and thus ultimately, will lead to sustainable development and social sustainability. Figure 2 shows the conceptual model of the research.

Research questions include:

1. What is the situation of mixed land-use and social capital in the sample neighborhoods?
2. Is the situation of mixed land-use and social capital different in the neighborhoods of the city (old and new)?
3. What is the relationship between mixed land-use and social capital in these neighborhoods?

8. METHODOLOGY AND ANALYSIS OF RESEARCH FINDINGS

8.1. Area of the Research

As mentioned before, the research field includes five neighborhoods located in the old part of the city (The core of the city), the middle part of the city and the new part of the city (surrounding) of Kerman, which have been formed in different historical periods. The criteria for selecting neighborhoods is the historical period of their formation and their location in the city of Kerman. The selection was made of the neighborhoods in the old part of the city. The neighborhoods adjacent to the bazaar are very different from other neighborhoods in terms of their value (Without market focus), formation time, their vitality, and dynamism. Two neighborhoods were selected from this context: One is the historical neighborhood of Ganjali Khan and the other was the old neighborhood of the city. The history of the formation of the Ganjali Khan Neighborhood dates back to the Safavid era, and it was built by the ruler of Kerman at that time. This neighborhood was chosen as the neighborhood adjacent to the bazaar. This neighborhood is influenced by the historical complex of Ganjali Khan (including baths, water storage, caravanserai, Saqakhaneh, and mosques), which contributed to the completion of the Kerman Bazaar. However, the old part of the city is located a short distance from Kerman Bazaar. The 24th of Azar neighborhood is located in the middle part of Kerman city, which was created with the arrival of the wave of modernism in Iran, and has an almost irregular geometric shape and was created by Kerman City Development Plan. The neighborhood has relatively good access to transportation networks due to its location between the old and new textures. Finally, two neighborhoods were selected in the new context that had formed in recent decades on the outskirts of the city. One is the Ghadir Neighborhood, which was linked to the development of the city and is planned. And the other is the neighborhood of Pansad-Dastgah, which was built after the Iraq-Iran war and by the migration of evacuees, and formed as a town on the outskirts of the city of Kerman. Figure 3 shows the location of the sample neighborhoods in relation to the city of Kerman.

8.2. Measurement of Mixed Land-use in Sample Neighborhoods

In this study, a descriptive method was used to express the rate of mixed land-use (independent variable) and the amount of social capital of residents (dependent variable) in the sample neighborhoods.

In order to measure the variable of mixed land-use inspired by the research of (Nabil & Abd Eldayem, 2015), (Javadi et al., 2013) and (Javadi et al., 2013) the two main criteria (i.e. diversity and accessibility) were used, each of which includes different and multiple indices (Table 1).

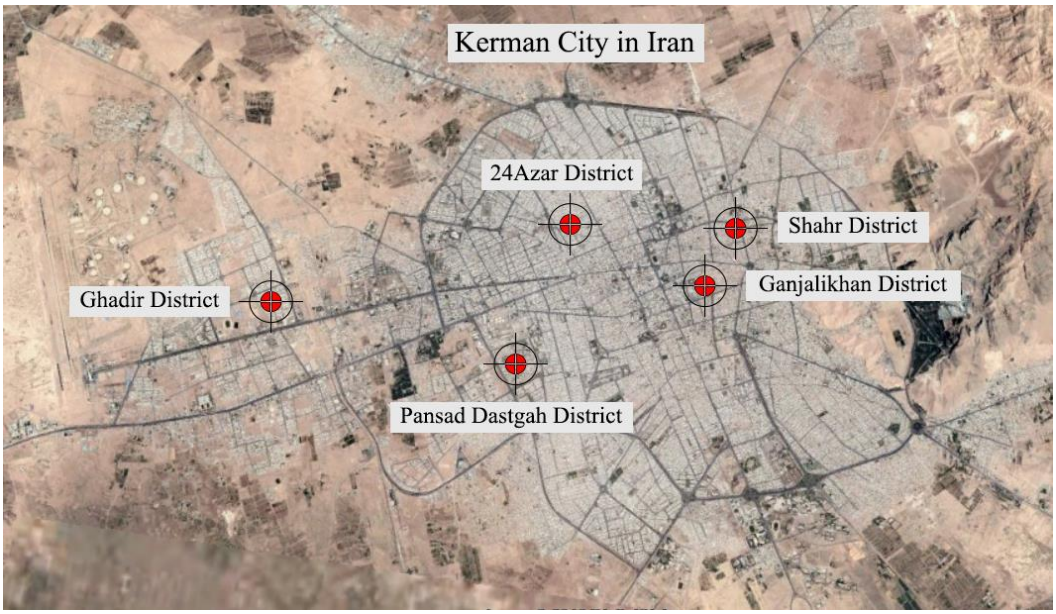


Fig 3. Location of the studied neighborhoods in Kerman

Table 1. Criteria and indices for measuring mixed land use (independent variable)

Criteria	Index	The way of measuring the amount of index and data collection
diversity	Number of land uses	Counting number of uses in the neighborhood (Observing and Checklist completion)
	land use diversity	$H = \frac{-\sum_{i=1}^{s} p_i \ln p_i}{\ln(s)}$ / (Observing and Checklist completion)
	Housing diversity	Counting number of housing types (detached house, apartment, residential complex) / Measured by GIS
	Distance to the commercial center	median distance to the nearest commercial center distant less distant, better access/ Measured by GIS
	Distance to park	median distance to the nearest park, less distance, better access/ Measured by GIS
	Distance to religious institution	median distance to the nearest religious institution less distance, better access/ Measured by GIS
	Distance to kindergarten	median distance to the nearest kindergarten, less distance, better access/ Measured by GIS
	Average width of street	Measured by GIS
	Narrowest width of street	Measured by GIS
	Widest width of street	Measured by GIS

Resource: adapted Nabil and Eldayem, 2015, Javadi et al., 2013[a] and Javadi et al., 2013[b]

In this table, the data in the third column are collected in two ways; one is to use GIS software and the other is to view and complete the checklist. In addition, to measure mixed land-use, a suitable radius for each house (in the neighborhood scale) in which the questionnaire related to social capital was filled was 250 meters (Habibi, 2000).

In order to measure mixed land-use in the sample neighborhoods, the status of each of the indices was examined (Figure 4). According to the data in this table, the maximum and a minimum number of uses in the radius of 250 meters for each house for which the checklist was filled, respectively, which belonged to Ganjali Khan and Ghadir neighborhoods. This indicates that the neighborhoods located in the historical context have more plural uses, and this plurality makes access to services more desirable for residents, while in new texture neighborhoods, applications have not yet been sufficiently and optimally formed.

In relation to the index of housing diversity, four types of single-family, multi-family, apartment, and residential complexes were examined in the sample neighborhoods, in which all neighborhoods except Ganjali Khan, have three types of single-family villas, multi-family villas, and apartments. As such, the

greater the variety of housing, the better the mixed land-use.

In relation to the access criteria, the indices of distance to commercial, religious, kindergarten and park centers, with a radius of 250 meters for each house for which the questionnaire was filled were calculated. The lower the distance to uses, the greater amount of mixed land-use. The indices of the average length of the street, the width of the widest street, and the width of the narrowest street, indicate accessibility and permeability of the district also indicate ease of access and permeability in the neighborhood, and the results can be seen in Figure 4.

Thus, the neighborhoods located in the historical texture (Ganjali Khan and Shahr) have more mixed use according to the studied criteria and their indices. The Ghadir neighborhood, which is located in the new texture and has a development plan influenced by blueprint plans and use zoning, has the least mixed use.

8.3 Measuring Social Capital in Sample Neighborhoods

To measure the variable of social capital, there are 6 common criteria in existing studies including collaboration and interaction, neighborhood ties, trust, sense of belonging, participation, and awareness. For each of these six criteria, several items were defined separately in the form of an anonymous questionnaire. In this questionnaire, respondents were able to express their views on the items based on the five-point Likert Scale (values 1 to 5). To ensure the validity of the questionnaires, the Delphi method was used. To investigate the internal reliability of the questionnaire, a pre-examination was utilized on 30 statistical samples, the internal reliability of the questionnaire was calculated using Cronbach's alpha. And given that Cronbach's Alpha values for each of the criteria were higher than 0.7, the internal reliability of the questionnaire was also confirmed.

Considering that the Structural Equation Modeling was used to examine the relationship between mixed land-use and social capital, the sample size was considered to be 10 times greater than the number of model parameters (Westland, 2010). Thus, the sample size was 750 people. However, with the probability of a 5% drop in samples (i.e. the probability that some respondents will not submit questionnaires), the number of samples increased to 780 samples.

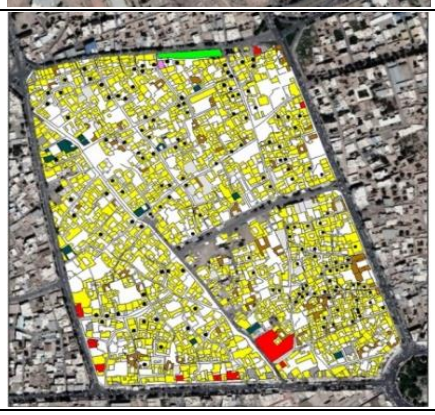
Therefore, 780 questionnaires were distributed to 5 neighborhoods by a random sampling-class-proportional method, and finally the 745 completed questionnaires returned to us were the basis of our statistical analysis. To distribute the questionnaires to the residents of the neighborhoods, the homes in each neighborhood were first numbered on the map. Then, in proportion to the percentage of the population in each neighborhood and the total population of the sample neighborhoods, the questionnaires were distributed randomly by simple random sampling among the sample homes selected.

Due to the fact that a one-way t-test was used to measure the social capital of the sample neighborhoods, in the questionnaires, the scores of 1 and 5 indicate the minimum and maximum importance of each item respectively, and the score 3 is the theoretical mean of the answers were selected in the Likert Scale. Thus, if the score obtained is higher than the theoretical value, it can be said that the level of the criterion considered in the social capital variable is desirable.

Based on the descriptive results of the completed questionnaires, out of 745 samples, 53.4% of the respondents were men and 46.6% were women. Also, 70.5% of respondents were married couples. In terms of length of residence, the longest habitation in the neighborhood is 1-5 years. Most respondents with a frequency of 20.7% are in the age group of 25-30 years. The highest frequency of respondents' education is bachelor’s degree holders with 31.5%.

Descriptive statistics on the social capital variable, including the mean, minimum, and maximum values, is presented in Table 2.

Table 2 shows us that the criterion of the sense of belonging belongs to the highest, and the criterion of awareness has the least effect on the creation of social capital in the studied neighborhoods. On the other hand, in all neighborhoods, the number of criteria of social capital variable is lower than the theoretical average. In other words, from the respondents' point of view, collaboration and interaction, neighborhood ties, trust, participation, awareness, and social capital variables in the surveyed neighborhoods have not been able to reach the minimum desired utility.

case	Land use Map	Variable	Mean	Min	Max
Pansad Dastagh (n=150)		Number of land uses	3.40	1.00	5.00
		land use diversity	0.10	0.04	0.74
		Housing diversity	2.92	0.00	3.00
		Distance to the commercial center	147.92	31.50	240.00
		Distance to park	169.96	57.00	250.00
		Distance to religious institution	164.24	55.00	244.00
		Distance to kindergarten	197.26	41.00	250.00
		Average width of street	141.35	21.12	168.39
		Narrowest width of street	6.90	3.10	80.00
		Widest width of street	28.67	13.00	42.00
24 Azar(n=195)		Number of land uses	2.08	0.00	3.00
		land use diversity	0.08	0.05	0.15
		Housing diversity	2.68	2.00	3.00
		Distance to the commercial center	134.41	33.00	249.00
		Distance to park	161.61	33.00	250.00
		Distance to religious institution	86.03	21.00	181.00
		Distance to kindergarten	-	-	-
		Average width of street	141.81	58.04	210.75
		Narrowest width of street	7.21	4.50	13.00
		Widest width of street	18.72	10.00	27.00
ghadir(n=150)		Number of land uses	2.06	1.00	3.00
		land use diversity	0.16	0.11	0.23
		Housing diversity	2.98	2.00	3.00
		Distance to the commercial center	124.78	41.00	218.50
		Distance to park	-	-	-
		Distance to religious institution	-	-	-
		Distance to kindergarten	97.33	5.00	197.00
		Average width of street	79.20	72.80	110.78
		Narrowest width of street	10.46	8.00	12.00
		Widest width of street	17.39	12.00	20.00
Shahr (n=150)		Number of land uses	3.63	2.00	5.00
		land use diversity	0.06	0.04	0.10
		Housing diversity	169.11	3.00	3.00
		Distance to the commercial center	140.49	68.00	250.00
		Distance to park	140.49	11.00	237.00
		Distance to religious institution	158.29	24.00	250.00
		Distance to kindergarten	-	-	-
		Average width of street	94.87	72.00	114.50
		Narrowest width of street	1.63	1.50	1.79
		Widest width of street	13.93	9.50	17.00

Source: researchers

Fig 4. Descriptive Statistic of mixed land use

Table 2. Descriptive Statistics of social capital (Dependent variable) in sample neighborhoods

Criteria	Case	n	Mean	Min	Max	statistic
Cooperation	Pansad-Dastagh	150	2.47	1.00	4.40	10.545**
	24 Azar	195	2.46	1.00	4.20	
	ghadir	150	2.38	1.00	4.40	
	Shahr	150	2.55	1.00	4.20	
	GhanjaliKhan	100	2.49	1.00	4.20	
Neighborhood ties	Pansad-Dastagh	150	2.84	1.63	3.63	6.509**
	24 Azar	195	2.58	1.13	4.00	
	ghadir	150	2.67	1.38	3.63	
	Shahr	150	2.73	1.88	4.38	
	GhanjaliKhan	100	2.70	1.63	3.88	
Trust	Pansad-Dastagh	150	2.71	1.25	4.25	11.864**
	24 Azar	195	2.50	1.00	3.88	
	Ghadir	150	2.56	1.13	3.88	
	Shahr	150	2.61	1..38	3.88	
	GhanjaliKhan	100	2.69	1.50	4.38	
Participation	Pansad-Dastagh	150	2.47	1.00	4.40	1.253**
	24 Azar	195	2.46	1.00	4.20	
	ghadir	150	2.38	1.00	4.40	
	Shahr	150	2.55	1.00	4.20	
	GhanjaliKhan	100	2.49	1.00	4.20	
Sense of belonging	Pansad-Dastagh	150	3.26	1.00	5.00	6.851**
	24 Azar	195	2.77	1.00	5.00	
	ghadir	150	3.02	1.00	5.00	
	Shahr	150	3.15	1.00	5.00	
	GhanjaliKhan	100	3.32	1.00	5.00	
Awareness	Pansad-Dastagh	150	1.84	1.00	3.67	15.711**
	24 Azar	195	1.44	1.00	3.67	
	ghadir	150	1.43	1.00	3.00	
	Shahr	150	1.64	1.00	3.67	
	GhanjaliKhan	100	1.53	1.00	3.33	
Social Capital Variable	Pansad-Dastagh	150	2.80	1.53	4.06	10.632**
	24 Azar	195	2.50	1.44	3.76	
	ghadir	150	2.40	1.53	3.59	
	Shahr	150	2.62	1.85	3.85	
	GhanjaliKhan	100	2.65	1.65	3.82	

**significant at the level of 0.05
Source: researchers

Only the value of the sense of belonging in the sample neighborhoods (except the new neighborhood located in 24-Azar) is higher than the theoretical average. Since the sense of belonging to the neighborhood increases with the increase of the history of living in each neighborhood, it is natural that with the increase of the antiquity of the neighborhood, the sense of belonging of its residents also increase.

The results of the one-way analysis of variance test showed that in general, the level of social capital in 5 neighborhoods was not the same and the new neighborhood of Pansad-Dastgah and then the historical neighborhood of Ganjali Khan in terms of social capital are higher than other neighborhoods. The planned neighborhood Ghadir, which was formed during the spread of modernism in Iran and the dominance of the idea of use zoning resulted from blueprint projects, also has the minimum social capital ($P < 0.05$). Thus, the old neighborhood of Ganjali Khan with maximum mixed land-use (see section 4-2) also has high social capital and the Ghadir neighborhood with the lowest mixed land-use (see section 4-2) has the lowest amount of social capital. In this case, the new neighborhood of Pansad-Dastgah located on the outskirts of Kerman is an exception. This new neighborhood was formed in the 70's after the war between Iran and Iraq and by war immigrants from southern Iran to the city of Kerman on the outskirts of this city. Since ethnic ties play an important role in the formation of social capital, in this neighborhood, the ethnic solidarity of immigrants has been able to help increase social capital, and the promotion of the neighborhood to the top in terms of social capital, as compared to other sample neighborhoods.

8.4. How is the Relationship between Mixed Land-use and Social Capital in Sample Neighborhoods?

In this section, using the structural equation modeling, the relationship between independent and dependent variables of research based on the conceptual model of the research (Figure 1) has been investigated.

As shown in Figure 2, the model proposes a particular casual flow from a set of independent variables (mixed land use indices including the number of land uses, land use diversity, housing diversity, distance to the commercial center, distance to a park, distance to religious institutions, distance to kindergartens, the average width of street, the narrowest width of street, the widest width of the street) to a dependent variable (social capital). We tested a model with a path analysis which is appropriate and often employed as a technique for testing the fit between such a model and the observed set of correlations between variables in the model.

Multivariate analysis is one of the strongest and most appropriate methods of analysis in the research of behavioral sciences and social sciences. Because the nature of such issues is multivariate, they cannot be solved by a two-variable method, given only one independent variable with one dependent variable. The path analysis method is a generalization of ordinary regression that is able to show not only direct effects or indirect effects, but also the overall effect of each independent variable on the dependent variables and with logical expression, to interpret the observed relationships and correlations observed between them. The goal of structural equation modeling analysis is to determine to what extent theoretical models are supported by sample data (Kline, 2015).

One of the main goals in using structural equation modeling is to identify the degree of consistency between experimental data and conceptual and theoretical models. Indicators and indices are used to identify the degree of consistency, which are called model good fitness indicators. In the Structural Equation Modeling, different indicators are used to ensure the good fit of the model. If the collected data support the conceptual model of the research, then the fit criteria of the model show the desired situation. There are several ways to estimate the goodness of a pattern fit with the observed data. In this study, the evaluation of the good fit by the following indicators has been employed using Root Mean Squared Error of Approximation (RMSEA), Normed Chi-Square (CMIN/ DF), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Comparative Fit Index (CFI), Normed Fit Index (NFI), Tucker-Lewis Index (TLI) and Incremental Fit Index (IFI) and Software Output. They indicate the appropriateness of the research conceptual model (Tables 3 & 4).

The t-value statistic is used to check the significance of the relationship between the variables. Because the significance is investigated at the error level of 0.05, the relationship is not significant if the observed t-value is less than 1.96 or greater than 1.96. The path coefficient indicates the existence of a linear causal relationship and the intensity and direction of this relationship between the two variables. The coefficient of the path in the standard case is a numerical integer (-1,+1) which, if equal to zero, indicates the absence of a causal relationship between the two variables, and if its value is close to -1 or +1, indicates the strong relationship between the two variables.

Table 3. Indicators for fit of research conceptual

Index	Confirmed Range	Reported Rate
Normed Chi-Square (CMIN/DF)	Equal or smaller than 3	4.975
Root Mean Squared Error of Approximation (RMSEA)	Equal or smaller than 0.08	0.063
Goodness of Fit Index (GFI)	Equal or bigger than 0.9	0.911
Adjusted Goodness of Fit Index (AGFI)	Equal or bigger than 0.9	0.805
Normed Fit Index (NFI)	Equal or bigger than 0.9	0.923
Incremental Fit Index (IFI)	Equal or bigger than 0.9	0.933
Tucker-Lewis Index (TLI)	Equal or bigger than 0.9	0.821
Comparative Fit Index (CFI)	Equal or bigger than 0.9	0.932

Source: researchers

Table 4. Indicators of the conceptual model fit

Index	RMSEA	CMIN/DF	GFI	AGFI	CFI	NFI	TLI	IFI
Criteria	≤0.08	≤3	≥0.9	≥0.9	≥0.9	≥0.9	≥0.9	≥0.9
Model	0.063	4.975	0.911	0.805	0.923	0.933	0.812	0.932

Source: researchers

Based on the results presented in Table 5:

Regarding the criterion of diversity, all three indices of the number of uses, diversity of use, and diversity of housing have a direct and significant effect on social capital ($p < 0.05$). Of course, it should be noted that in the new neighborhood of Pansad-Dastgah, there is no significant relationship between the use diversity and social capital. Also, in relation to the accessibility criterion, the indices of distance to the commercial centers, distance to the religious centers, distance to the kindergartens and the average width-based have an indirect and significant effect on social capital. In other words, as the distance from these centers increases and so does the average width of street and the amount of social capital decreases ($p < 0.05$). Of course, according to statistical results, in the Ganjali Khan historical neighborhood, there is no significant relationship between social capital and distance to religious centers, despite the multiplicity of religious spaces ($p < 0.05$).

Also, a direct and significant relationship between the narrowest and the widest width of the street index with social capital is confirmed ($p < 0.05$). In addition, there is no statistically significant relationship between the narrowest width of the street and social capital in the neighborhoods of the city in 24 Azar, Pansad-Dastgah and Ghadir districts, and this relationship is directly and increasingly in the historical context of Ganjali Khan neighborhood in the historical context, while the Bazaar is in the center. This can be attributed to the small width of passages and alleys within the texture, and the lack of proper management and attention to their problems in modern urban life have created many problems for residents. There was no statistically significant relationship between the distance to the park and the amount of social capital in any of the sample sites ($p < 0.05$).

Figure 5 shows the output of the application of the SEM model in the software for the conceptual research model, based on which it can be said that:

- In general, with the increase of diversity (due to the increase in the number of uses, diversity of uses, and diversity of housing species) in all urban neighborhoods of the sample (from old to new) the amount of social capital also increases.
- In general, with the declining availability of neighborhood residents for public uses, the amount of social capital in all neighborhoods (from old to new) is decreasing.
- In general, in all neighborhoods (from old to new), reducing the availability of residents due to the low average width of existing streets will also reduce their social capital.

Table 5. Path coefficients and its significance, and the analysis of conceptual model in main path analysis

Neighborhood	Hypothesis	Path coefficient	t value
Pansad Dastagh	Number of land uses →social capital	0.314	6.922**
	land use diversity →social capital	0.030	0.667
	Housing diversity →social capital	0.561	12.394**
	Distance to the commercial center →social capital	-0.374	-8.261**
	Distance to park →social capital	-0.042	-0.919
	Distance to religious institution →social capital	-0.189	-4.165**
	Distance to kindergarten →social capital	-0.257	-5.664**
	Average width of street →social capital	-0.144	-3.182**
	Narrowest width of street →social capital	0.074	1.624
	Widest width of street →social capital	0.098	2.174**
24 Azar	Number of land uses →social capital	0.351	7.465**
	land use diversity →social capital	0.116	2.477**
	Housing diversity →social capital	0.544	11.589**
	Distance to the commercial center →social capital	-0.162	-3.444**
	Distance to park →social capital	-0.014	-0.300
	Distance to religious institution →social capital	-0.153	-3.249**
	Distance to kindergarten →social capital	-0.207	-4.405**
	Average width of street →social capital	-0.171	-3.650**
	Narrowest width of street →social capital	0.052	1.104
	Widest width of street →social capital	0.122	2.606**
Ghadir	Number of land uses →social capital	0.235	4.805**
	land use diversity →social capital	0.115	2.352**

Neighborhood	Hypothesis	Path coefficient	t value
	Housing diversity →social capital	0.455	9.314**
	Distance to the commercial center →social capital	-0.346	-7.081**
	Distance to park →social capital	0.008	0.166
	Distance to religious institution →social capital	-0.128	-2.622**
	Distance to kindergarten →social capital	-0.365	-7.476**
	Average width of street →social capital	-0.287	-5.890**
	Narrowest width of street →social capital	0.070	1.428
	Widest width of street →social capital	0.113	2.316**
Shahr	Number of land uses →social capital	0.262	5.452**
	land use diversity →social capital	0.154	3.208**
	Housing diversity →social capital	0.520	10.824**
	Distance to the commercial center →social capital	-0.225	-4.695**
	Distance to park →social capital	0.030	0.629
	Distance to religious institution →social capital	-0.153	-3.178**
	Distance to kindergarten →social capital	-0.346	-7.209**
	Average width of street →social capital	-0.262	-5.457**
	Narrowest width of street →social capital	-0.016	-0.324
	Widest width of street →social capital	0.174	3.619**
GhanjaliKhan	Number of land uses →social capital	0.199	3.320**
	land use diversity →social capital	0.103	1.710*
	Housing diversity →social capital	0.700	11.662**
	Distance to the commercial center →social capital	-0.181	-3.014**
	Distance to park →social capital	0.033	0.556
	Distance to religious institution →social capital	0.052	0.870
	Distance to kindergarten →social capital	-0.154	-2.563**
	Average width of street →social capital	-0.108	-1.803*
	Narrowest width of street →social capital	0.105	1.742*
	Widest width of street →social capital	0.134	2.230**
Total	Number of land uses →social capital	0.285	12.612**
	land use diversity →social capital	0.097	4.293**
	Housing diversity →social capital	0.565	25.052**
	Distance to the commercial center →social capital	-0.259	-11.471**
	Distance to park →social capital	-0.018	-0.813
	Distance to religious institution →social capital	-0.123	-5.432**
	Distance to kindergarten →social capital	-0.267	-11.840**
	Average width of street →social capital	-0.199	-8.838**
	Narrowest width of street →social capital	0.055	2.438**
	Widest width of street →social capital	0.125	5.539**

**Significance at level 0.05, *Significance at level 0.1

Source: researchers

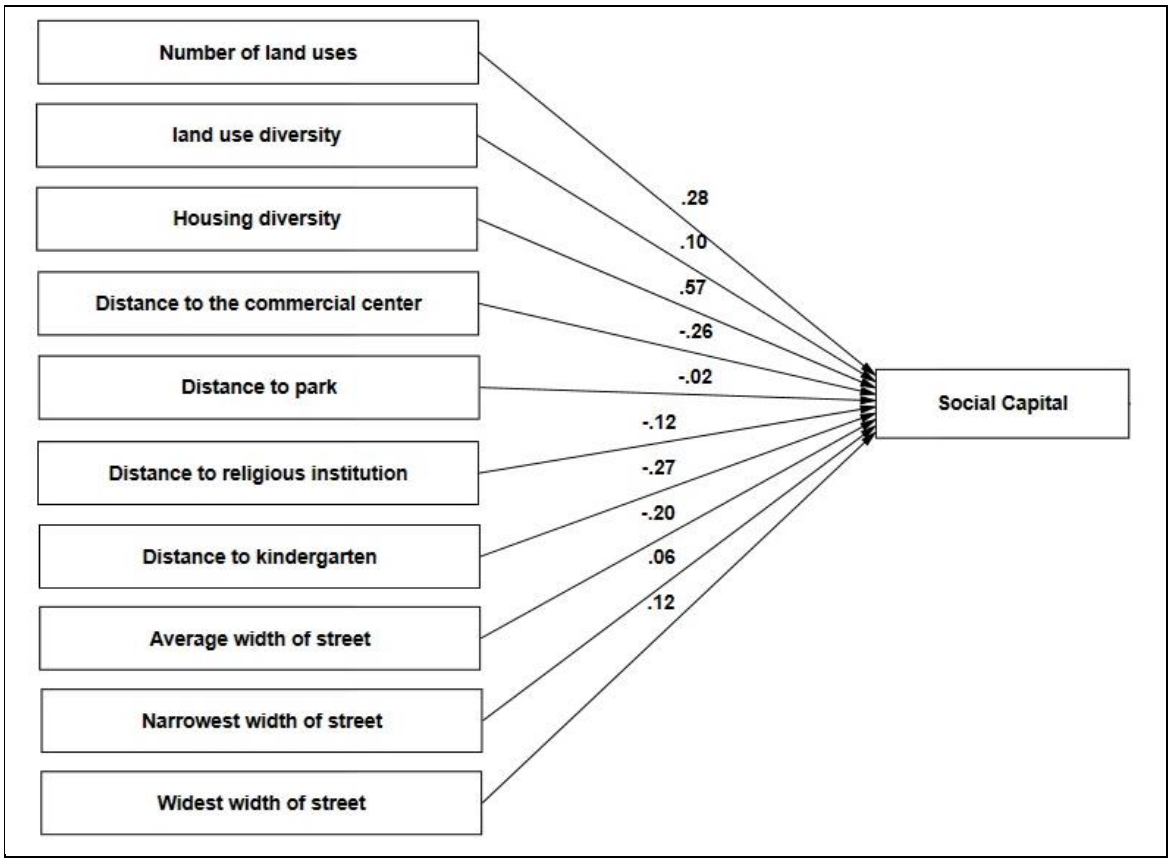


Fig 5. Result of the structural equation model

9. CONCLUSION

Mixed land-use in urban neighborhoods has been widespread in urban planning literature for several years and is an important mainstay in the literature on the compact city, new urbanism, smart growth, and so on. Social capital, meanwhile, is a multidimensional concept in the social sciences and influential in many aspects of the society, and has found a special place in development-related literature, with some call it the missing link in development. In this study, by examining the relationship between mixed land-use and social capital, an attempt has been made to measure the relationship between these two concepts so that with proper planning in urban neighborhoods that have been formed in different periods, a proper balance can be created according to residents' needs.

Regarding the first and second questions of the research, this research has concluded that the amount of social capital and mixed land-use in the studied neighborhoods are different from each other. The Ganjali Khan's old neighborhood, next to the old bazaar of Kerman city and the collection of historical elements of Ganjali Khan (located in the city center), has the most mixed land-use. The Ghadir new and planned neighborhood (located on the periphery of the city) has the least amount of mixed land-use. Based on this, the amount of mixed land-use in different neighborhoods of the city is different from each other and in general, by distancing from the city center, its amount decreases. The result is in proportion with the research of Pour Mohammadi et al. (2016).

In conclusion, the social capital of the surveyed neighborhoods is less than the theoretical average. The largest social capital in the surveyed neighborhoods belongs to the neighborhood of Pansad-Dastgah in the new texture on the outskirts of the city, which can be attributed to the deep ethnic ties between its residents, who are all Arab immigrants in the southwest of Iran. Since ethnic ties play an important role in shaping social capital, in this neighborhood, the ethnic solidarity of immigrants has been able to help increase social capital in this new and marginal neighborhood.

The high level of social capital in the Ganjali Khan neighborhood is in the old context with the focus on the market that has the most social capital, which can be attributed to the long history of the neighborhood. The spatial distribution, quantity, and quality of public meeting places in the traditional neighborhoods in the core of Iranian historical cities (such as Religious places, historical squares, baths, water storage, caravanserai, Saqakhaneh, etc.) helps to form spontaneous and informal visits and commercial mobility and dynamism in the neighborhood and

allows for greater socio-cultural mobility and formation of social capital in the neighborhood. On the one hand, in the traditional neighborhoods of Iranian cities, including Kerman, due to the long history of the residents and their neighborhood structure, over the years have been able to achieve a greater social capital. According to Bott et al.'s opinion, urban structures are decisive for the probability of social interaction (chances for people to meet) and thus critical for stimulating the formation of social capital. In addition to the low level of mixing, the new Ghadir neighborhood has the lowest level of social capital. The results of this question are in line with the research of Yoo & Lee (2016), Rastegar et al. (2017), Hamdan et al. (2014), and Nikpour et al. (2015).

A closer look at the status of constructive criteria for mixed land-use in the neighborhoods in question can be concluded that the diversity criteria of the old neighborhoods are better than in those the new neighborhoods. In other words, the role of diversity in traditional neighborhoods is more crucial in creating mixed land-use than in new neighborhoods. The role of the accessibility criteria in relation to distance indices from service centers (including parks, commercial, kindergartens, and religious) in creating mixed land-use in all neighborhoods is relatively equal. In relation to the permeability criterion of the passages (Indices of the average width of street and the narrowest and the widest width of street), in the neighborhoods of the new texture, this criterion has a more decisive role in increasing their mixed land-use rate.

Regarding the third question of the research that deals with the relationship between mixed land-use and social capital, the results showed that there is a direct and significant relationship between mixed land-use and social capital, in other words, social capital increases with increasing mixed land-use. This result is in line with the research of Nabil and Abd Eldayem (2015), Nikpour et al. (2015), and Bordoloi et al. (2013).

Finally, the following results can be derived from this research:

• The rate of mixed land-use and social capital in the historical sites formed in different periods of Kerman city differs from each other.

• There is a direct relationship between mixed land-use and social capital.

• The antiquity of the neighborhood, its historical background, ethnic characteristics and social networks, as well as its development, directly affect the relationship between mixed land-use and social capital. The pattern of old Iranian neighborhoods with more mixed land-use and social capital, and new urban planning theories that incorporate the principle of mixed land-use into their set of principles and rules, can be good bases for planning new urban communities or re-planning existing neighborhoods.

• Increasing social capital is recognized as an important source of sustainable social development. Based on the fact that mixed land-use increases social capital, it can be said that in the formation of new urban neighborhoods as well as regeneration of existing neighborhoods, increasing mixed land-use can increase social capital and of course can promote social sustainability in urban neighborhoods.

This study also showed that the physical environment might have a significant impact on the development of social capital. Overall, this study suggests that the formation of social capital is not only related to the individual's attributes but might also be influenced by urban form elements. Therefore, this study would still suggest that urban policymakers, urban planners, and urban designers should be mindful to consider the role of urban form features in urban planning since they might bring impact on the stimulation of social capital development.

It is also suggested for future research that the factor of the length of time that residents live in the neighborhood and social context, be seen as an intervening variable to determine its impact on the amount of social capital, is clearly not latent. Thus, in defining social capital, in addition to the common criteria in previous research, two criteria should be considered: The duration of living in the neighborhood and the existence of ethnic ties.

DATA AVAILABILITY STATEMENT

Some or all data, models, or code generated or used during the study are available in a repository online in accordance with funder data retention policies (Providing full citations that include URLS or DOIs). URL:https://www.dropbox.com/sh/0ijkjo6ukn6gg3u/AABfv0EAlUeB_3aGLiXo8wv7a?dl=0

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