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Designing Private Outdoor Spaces for Socio-Environmental Sustainability:

The case of Koya traditional housing

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Abstract: This study explores the potential of traditional outdoor spaces for the sustainable development of urban housing in Iraq, with a focus on socio-environmental values, namely: equality of privacy, safety, and environmental quality. Such values played a major role in forming private outdoor spaces in Iraq's traditional housing. Thus, the this study discusses possible designs of private outdoor spaces in terms of forms, locations, and components for achieving these values by designing private outdoor spaces based on socio-environmental sustainability. To do this, the old city of Koya in Iraq was chosen because it is rich in architectural heritage and still contains traditional houses inhabited at present. Five famous types of private outdoor design are chosen in terms of their relationship with the indoor; four types represent the yard approach in the courtyard houses, and one represents the strip approach in the individual houses. A questionnaire was also designed to determine the extent of the resident'sresidents' satisfaction with the external spaces of these houses. By comparing the types mentioned above, the benefits gained by the community from following the yard approach were identified as a recommended future strategy for housing design. Then, each form of the courtyard houses was analyzedanalysed to understand the possible uses of each one. The paper's main finding is to establish a guideline for achieving socio-environmental values in housing design. This approach can be a high-potential step for achieving sustainable development in Iraq. The main conclusion of the study sustains that different outdoor forms —U-shaped, O-shaped, L-shaped¸, and combined shapes of inner spaces —lead to different benefits that help achieve social and environmental sustainability in different uses, the most important of which are: achieving privacy, and safety, without affecting environmental quality, and in a simple manner.

1. INTRODUCTION

The need to build new housing units in Iraq increases every year to meet the population's growing need for housing (Al-Shaibani and Popov, 2019). Many of the implemented projects depend on adopting international housing

patterns that may not be directly related to the social and climatic milieu in Iraq because these do not pay much attention to the quality of the private outdoor spaces. Such spaces are attached to each housing unit and are considered a part of it. They are supposed to be open to the air, accessible from the inside of the house, and characterised by adequate proportions and shapes to facilitate daily use. Historically, Iraqi families depended on private outdoor space in their houses as a social place and climate modifier. It is an important part of the house, vital for daily activities that should not be separated from other indoor parts (Al-Thahab, A. A. L., 2021). Hence, there is a need to search for design approaches that are in line with the local environment and can meet the demand for healthy and affordable housing.

Finding good design strategies for outdoor spaces in residential areas is vital for fulfilling users' cultural needs, as many unplanned forms of outdoor spaces will be left over and not adequate for use (Bendjedidi, Bada et al., 2018). Private outdoor space in most residential areas plays an important role in the stability of communities and their consolidation (Abed and Al-Jokhadar, 2022). These spaces provide a direct relationship to cultural and social aspects, such as privacy and social contact. These aspects are affected by imported design themes and could change over time (Li and Li, 2023). Therefore, the design of the house must guarantee the use of housing types appropriate to the social and climatic environment of the region such that it increases the sense of belonging to the environment and improves the stability of society (Hussein, Barlet et al., 2010). Thus, the study of the relationship between outdoor spaces in housing design is a vital issue for residents' comfort (Chen and Ng, 2012). For that reason, this study aims to highlight the possibilities of sustainable private outdoor spaces to ensure adequate social coexistence for present and future generations. It is acknowledged that learning from traditional concepts is a possible way to reach sustainable housing (Itma, M, 2014; Karabag and Fellahi, 2017). Accordingly, the study tries to find suitable solutions in traditional housing in Iraq that assist in solving contemporary problems.

1.1 Overview of traditional private spaces in Iraq

The private spaces of houses used to have two typical approaches: the first is the form of strips around the individual house, which has been a common way of designing contemporary houses until now. The second approach is the inner space: the courtyard. A courtyard means a private space for the house that takes an important central position and is exposed to the sky (Abass, Ismail et al., 2016). In this kind of space, the rooms wrap around that void to form a strong relationship between all the rooms and the celestial void (Itma, MAF, 2019). This type of space was used in traditional Arab architecture in particular and in many other countries in general (Edwards, 2006). Today, the courtyard house is an effective way to reduce the total area used for residential buildings, as well as reduce construction materials, because it allows for wall-to-wall buildings (Abass, Ismail et al., 2016). Furthermore, this type creates a suitable environment for social life based on Arab and Islamic culture in residential areas (Soflaei, Shokouhian et al., 2017). For this reason, this type is common in many areas around the country, whether in vernacular or modern housing design.

The courtyard can be a main generator of the compact organization of Arab cities because each house represents an integrated unit of superimposed construction and urban space, which is built in successive stages to meet the

progressive needs of users (Hassan, Lee et al., 2016). It was an important organizational component that played an important role in the formation of the homogeneous fabric of ancient cities (Salat, 2010). Thus, the courtyard house obviates the presence of large central urban spaces in cities because it works to break the urban void and distribute it evenly among residential houses. The aggregation of these groups of houses can produce a great variety of compressed textures in the form of endless groups (Al-Ataabi and Hameed, 2020). In the form of compact clusters of low-rise agglomerations in vernacular residential areas, they play an important role in building coherence and unified articulation. These form the main parts of the residential areas because they include spaces for the complementary activities of the housing units in the middle space (courtyard), especially for social contact. Thus, these adequate outdoor spaces should ensure adequate social behaviour between members of the same family and increase their good affiliation with the place, maintaining the stability of their daily lives.

The courtyard is also a method of reinforcing people belonging to their lands. Therefore, many scholars investigated the potential of the courtyard to increase the social quality of the courtyard house in the contemporary living environment compared to single-family homes (Rapoport, 2007). Other scholars have focused on child safety while using indoor spaces in home planning (Whitzman, 2015). Additionally, these types of homes can be ideally designed to provide a group of residents with initial means of privacy in a neighbourhood (Abu-Gaueh, 1995). Moreover, the courtyard was a symbol of the need for privacy in public buildings. One of the important reasons for its use in traditional housing is to enhance the outdoor area for a group of residents without the need to create a separation in the urban fabric (Zawawi and Itma, 2023). It was also considered a common space for low-income and wealthy households. Due to both the difference in the courtyard area and the number of rooms around it, courtyards convey a strong message of privacy to residents through the use of small entrances, or giving the feeling that this area should not be seen by the eyes of strangers (Memarian and Brown, 2004; Ragette, 2003).

As for the climatic benefits of the courtyard, they are many. In ancient times, Arab people used to overcome the hot and humid weather in their countries by using outer space surrounded by buildings to provide shade (Dumper, 2007). This internal space is also able to provide a clean environment (Leng, Wang et al., 2020) as the air is purified from dust and unwanted soil as soon as it collides with the compact houses, so the courtyard works to create a suitable microclimate for the residents. In terms of thermal adaptation, the shade in the courtyards, which is reinforced with trees, reduce the heat in the summer, and cool air enters the house. On the other hand, there are water elements such as fountains in the courtyard to increase humidity and soften the atmosphere (Eissa, 2004). As a result, the residents had an outside space inside their homes, suitable for climatic adaptation on the one hand, and adaptation to customs and traditions on the other hand.

For all these benefits, courtyards were historically the main common spaces in Arab housing. They are used to carry out daily activities and social communication. The Iraqi family's demand for privacy within the home was able to control people's behaviour in choosing their living space (Al-Hafith, B K et al., 2017). However, privacy considerations are an essential human need that can conflict with other human needs such as the need for social interaction (Goldman, 1969). Iraqi families' pursuit of social interaction with family members and neighbours and the invitation of guests should aim to protect the privacy of their homes. Thus, the simultaneous search for privacy

and social interaction is a dilemma that has historically helped shape the built environment in Iraqi cities (Al-Thahab, A. A. L. J., 2022). Consequently, courtyards are likely to be the urban elements to solve this dilemma. Considering such traditional spaces in contemporary planning is believed to be a step towards sustainable communities (Itma, Mohammed and Monna, 2022).

1.2 Learning from traditional concepts and socio-environmental sustainability

Many countries searching for sustainable housing designs have realized the need to restore their vernacular concepts and work to integrate these concepts into their resident's contemporary lives. For this reason, extracting lessons from vernacular concepts is an important approach to reaching sustainability in contemporary housing (Tawayha, Braganca et al., 2019). In literary references, the sustainability of societies is classified as a pole for sustainable development. This is of interest to this study because there is limited research regarding other poles of sustainability in this context. Socio-environmental sustainability is the continuity of society having relevant relationships with the environment, while sustainability in general represents the ability to persist or continue for a long time (Musters, de Graaf et al., 1998).

Before proposing courtyards as a design approach for private spaces, it is essential to acknowledge the relationship between socio-environmental sustainability and the built environment (Mezerdi, Belakehal et al., 2022). Thus, all the components of the housing environment, such as physical components and cultural components, including houses and their services, will lead to different potentials for sustainability (Abed and Al-Jokhadar, 2022). The following will discuss most closely the literature on socio-environmental sustainability that is related to the interests of this study.

Hancock (1993) focuses on providing activities and services that constitute an environment conducive to social contact, and that constitutes the necessary foundation for social sustainability. Bramley and others argue that social sustainability is related to social justice as a main factor, which includes fairness between residents for reaching services and spaces. Another important factor is the sustainability of communities which includes belonging to the neighbourhood, social contact, environmental quality, security, indoor satisfaction, and participation in social activities (Bramley, Brown et al., 2010). Polèse, Stren et al. (2000) argue in their book Social Sustainability of Cities, that social sustainability is based on supporting the ecological relations with the social and cultural desires of groups, fostering the integration between members and improving daily life quality for all groups of the population. Another study addresses factors of socio-environmental sustainability namely: equity, safety, adaptability, and inclusion or social interaction (Ondabu, 2014).

From this standpoint, this study elicits three important values of designing outdoor spaces for socio-environmental sustainability that can improve housing design in many regions in Iraq: equality of privacy, safety, and environmental quality. This equality is suggested to build a comfortable environment such as equal reach to outdoor spaces, and sufficient elements to maintain the privacy and safety of the homes. This study maintains that the three mentioned values have been fostered by the traditional interior

courtyard in terms of its forms, locations, and components. Consequently, the main objective of this paper is to investigate to what extent the traditional courtyard can meet the needs of contemporary users of outdoor spaces in the modern era, and to what extent it can participate in the creation of communities living in a state of socio-environmental sustainability. It is assumed that the courtyard remains a potential approach to enhance socio-environmental sustainability because it provides the aforementioned values that must be found in housing design: privacy, safety, and environmental quality, which are fundamental and very necessary for the consideration of human needs in the design of houses (Itma, MOHAMMED, 2018; Salamati, 2001).

2. MATERIALS AND METHODS

The study combines two approaches to verify the sustainable design of outdoor spaces in Koya city: the first is the qualitative approach, based on architectural surveying of traditional courtyard houses and individual houses in the old city of Koya, to set an adequate classification of commonly used outdoor types followed by the selection of a group of houses to be analysed as examples; the second is the quantitative approach, which is based on surveying residents' opinions of living in different types of traditional houses within the old city of Koya. Consequently, this research was conducted across four main stages (see *Figure 1*):

1. Observation: The observation included several site visits to the old city of Koya and many of its houses with a focus on the design of outdoor spaces and courtyards. Observers stayed for different lengths of time at different times and took notes inside the dwellings. In addition, personal meetings with some of the residents of the old city were conducted to form a holistic and comprehensive idea of the traditional design. This step was essential to provide a comprehensive and more thorough understanding of the traditional design and resulted in the conclusion of the three values of traditional housing, which are the core of this study: equality of privacy, safety, and environmental quality.
2. Fieldwork Survey: A fieldwork survey was conducted aimed at producing the as-built plans, which was also important for exploring the current design and conditions of the selected houses to understand the current architectural characteristics of the traditional outdoor spaces. Additionally, the fieldwork tours resulted in archiving photographs and sketches that were used afterward for analysing the houses.
3. Interviews and Questionnaires: Interviews and questionnaires were distributed to find out the opinion of the residents on living in traditional housing. The questionnaire was used as a quantitative approach to measure people's satisfaction with living in different types and shapes of such houses.
4. Data Analysis: Data analysis was the last phase of the study; this phase included customization and data classification. The data collected from the questionnaires was analysed using an Excel program to extract the results. Finally, an output sheet was

produced to understand the final results and present them in the form of tables and charts.

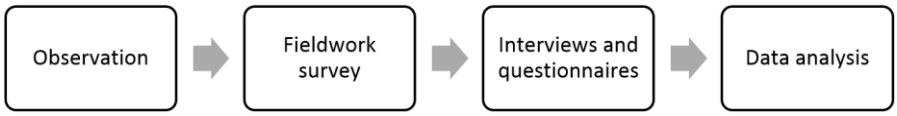


Figure 1. Diagram clarifies clarifying the stages of the study method

2.1 Study area

The old city of Koya was selected for analysis because it is acknowledged as one of the traditional cities in Iraq with two types of old residential houses, those with differing positions of the courtyard (Al Qaisi, 2013). In addition, its traditional houses are still occupied at present. The city is still full of cultural heritage and a unique urban fabric which represents local and regional heritage in its entirety. The residents of the old city have carried out numerous operations to restore traditional houses in an attempt to modernize them to adapt to the times, such as the expansion of water, electricity, telephone, and other networks, depending on the vernacular concept of restoration and maintenance operations. In this sense, those traditional houses are still preserved and vibrate in light of the high level of development that the country has experienced during the last century (Khoshnaw, Karim et al., 2019). This raises the question of how well these traditional types fit the contemporary needs of users. *Figure 2(a)* clarifies the location of Koya City, and *Figure 2(b)* clarifies the traditional fabric of Koya old city.

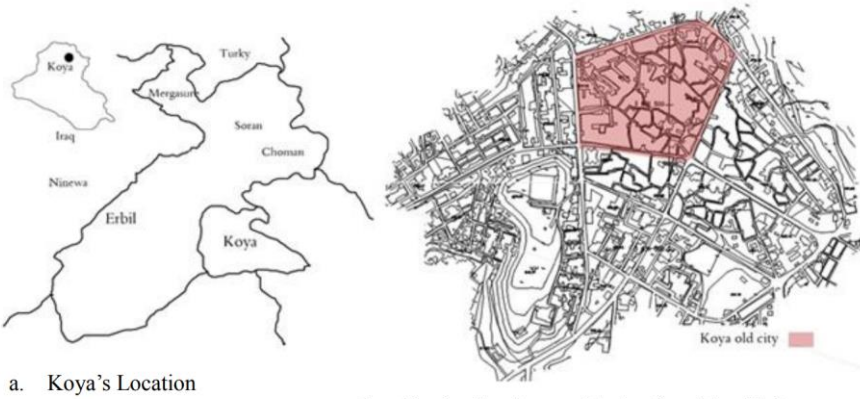


Figure 2. Koya city location, urban form, and the old city location

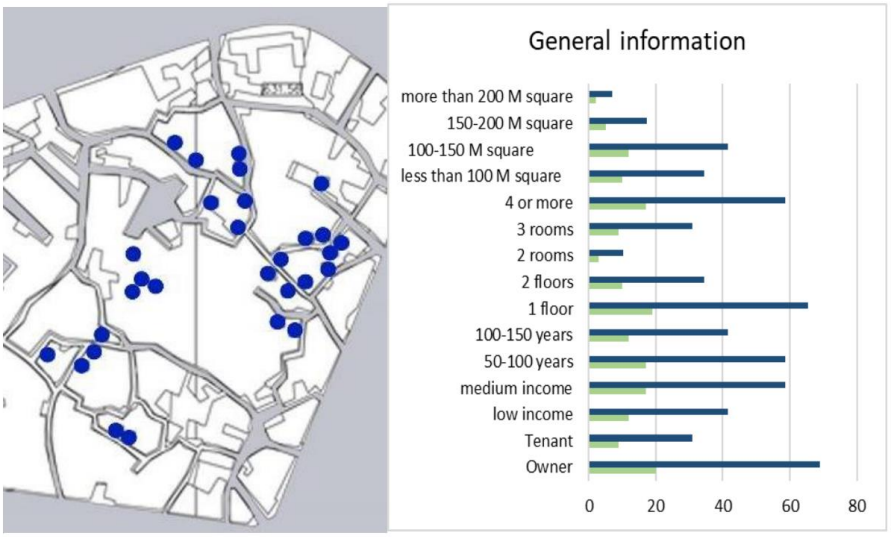
2.2 Survey design

The main objective of the field observation of residents' behaviour was to know how they respond to the different elements of the house relative to the outdoor spaces, as well as to what extent this architectural relationship affects social contact and privacy of the population, both in the outdoor and indoor spaces of the houses. During the survey, photographs and sketches were prepared and many notes were written. These tools informed design of

the interviews and questionnaire in the next stage. Five types of houses were chosen for the analyses: four courtyard houses and one individual house. 50 houses were selected, ten from each type, to complete the questionnaire. All chosen houses were in relatively good physical condition.

The questionnaire was written in a way that highlights the potential of courtyards to adapt to current residents' needs compared to individual-family houses in the old city of Koya. Privacy, safety, and environmental qualities were translated into several questions. The researchers attempted to adapt comprehensive and diverse criteria to select sample households. All surveyed dwellings were inhabited to obtain the most accurate results possible. However, selected homes vary in location and features such as the number of stories, building history, construction materials, area, opening types, and orientation. The sample of selected houses also differed in their characteristics of the households in terms of family characteristics, type of property, and income rates.

The number of household members in the sample also varies from five to seven, with an average number of around six members for each household. The respondent was typically a female, 20-30 years old, born in Koya, and living with a nuclear family of 5-8 people at home. Beneficiaries were asked to fill in their answers about their attitude toward living in separate yards and houses in terms of their current environmental and social needs. *Figure 3* shows the location of the surveyed houses and the characteristics of the selected sample.



a. Study area and the surveyed houses

b. General information about the surveyed houses houses

Figure 3. The study area and household characteristics identified by respondents

The main tool for the survey was a questionnaire that explored the responses of the residents on satisfaction with privacy, safety, and environmental qualities in their private outdoor spaces. The questionnaire was divided into three topics: the first is in regard to the basic needs, which includes four questions that explore residents' satisfaction with infrastructure and physical conditions; the second is in regard to social aspects, with seven questions which explore the ability of houses' outdoor areas to satisfy privacy and safety needs; and the third is in regard to the environment, with six questions which examine the ability of the outdoors and the indoors to satisfy residents' need for climatic comfort. Recipients were asked to answer

questions using a Likert scale from 1 to 5 to set their satisfaction, where 5 is the highest degree of agreement and 1 is the lowest. The results of satisfaction were calculated as a percentage for all topics of the questionnaire as follows:

$$Percentage\ of\ satisfaction = \frac{Summation\ of\ scores}{Number\ of\ recipients * 5} * 100 \qquad (1)$$

3. RESULTS

The survey has revealed that, in general, traditional houses provide an adequate relationship between the indoors and outdoors due to the existence of sufficient outdoor space in most of them. Such spaces are suitable for increasing social contact between family members and guests from neighbours and have several advantages, the most important being the accessibility of the outdoor space from all rooms of the house being almost equal. The observation has also revealed that there is no overcrowding in the outdoor space during the day. Many outdoor spaces also contain elements that strengthen the social contact between neighbours, which is based on visual communication between the residents. However, there are also several houses in the form of individual and semi-attached types in the old city, these are houses that include outdoor spaces in the form of strips around the house. These types do not provide a good relationship between the indoors and outdoors due to their inadequate form. The use of such outdoor space is clarified in the following sections.

3.1 Strips-form of outdoor spaces

Figure 4 shows four common features of individual houses in the housing areas of Koya. The first is the lack of environmental features such as shading elements in many cases to expose outdoor spaces to direct sun and air, and the second is the presence of distances between buildings in the form of strips that can sometimes disrupt social contact between residents. It was noted that users of these spaces do not communicate comfortably or stay for a long time. The third is that individual houses open to the outside and not to the inside, which makes it possible to see their interior spaces from the street by some residents and visitors. This fact reduces the privacy and sense of safety of the residents of the place and suggests more formal relationships between neighbours. The fourth is the presence of cars scattered in the yards of individual houses, and cars may enter there, which occupy most of the space. Although accessibility by car can be beneficial for residents, it has been observed that many of these outdoor spaces around houses are not suitable for children to play freely. These characteristics of the house houses without courtyards conflict with social comfort in several termsaspects: privacy, social contact, and a feeling of safety.

Figure 4. A typical example of an individual house in Koya old city

To better understand the benefits of courtyards compared to this individual type, the study first surveyed several traditional courtyard houses to explore their social and environmental characteristics. The following is the result of the analysis of the sampled courtyard houses.

3.2 Yard form of outdoor spaces

The survey revealed that the courtyard houses of Koya City consist of three four parts: entrances, corridors, rooms, and yards. This sequence of rooms and yards makes the place suitable for social activities and the circulation of the inhabitants, both static and dynamic activities. The entrances of the houses open to the yards and sometimes to the interior corridors. The yards are surrounded by a series of rooms that spread over the ground and first floors. For houses that consist of two floors, the common services such as storage rooms and guest rooms are included on the ground floor, and bedrooms for families are usually found on the first floor. The size of the yards is affected by the number of floors that surround them; the higher the building is, the wider the yard becomes wider. Considering the surroundingsurroundings, the roads are narrow and shady because they are bounded by houses of two or three floors. In some cases, there may be wider roads to provide plenty of natural light.

There are many forms of courtyard houses in the old city of Koya in terms of their relationship with the outdoors. Most of the shapes of the houses are irregular due to the traditional methods of construction and the lack of prior plans for the house houses in most cases. However, the architectural analysis and surveying operations of the selected sample of houses concluded that the shape of the house and the outdoor yard can be classified based on its relationship with the yard into one of four main categories: U -shapeshaped, O -shapeshaped, L -shapeshaped, and combined shapes. These shapes can be found in many deferences ofdifferent sizes, the number of floors (usually one or two) may vary, and other components of houses like gardens and fountains may differ, but with common characteristics that can be summarized as follows:

1. The first form is the U-shaped house, in which three sides of the yard are bounded by the house and the fourth is bounded by a wall that forms the boundary with the neighbouring house, mainly being the rooms of

the other house and not their yard. Thus, yards of houses are not usually sited adjacent to each other. This wall is rarely cited in front of the street side as in modern designs. As shown in *Figure 5(a)*.

2. The second form is the O-shaped house, with a large central yard. This form is not common because it is for large houses that contain large yards. This is for maintaining the privacy of the yard using completely enclosed shapes for the inner space. As shown in *Figure 5(b)*.

3. The third is the L-shaped house with a simple form of yard, being L-shaped itself or square. This form is common because it allows for relatively small houses to have a good sized outdoor space. In this form, one of the walls that bound the yard is usually facing the street. As shown in *Figure 5(c)*.

4. The fourth is a combined shape house, with a central yard. This form can be found in large houses and sometimes in shared yards with more than one house. The form allows for a collective space that may contain shared entrances for the yard and some shared facilities like gardens, fountains, and so on. As shown in *Figure 5(d)*.

a. U-shaped house, three sided yard

b. O-shaped house, centred yard

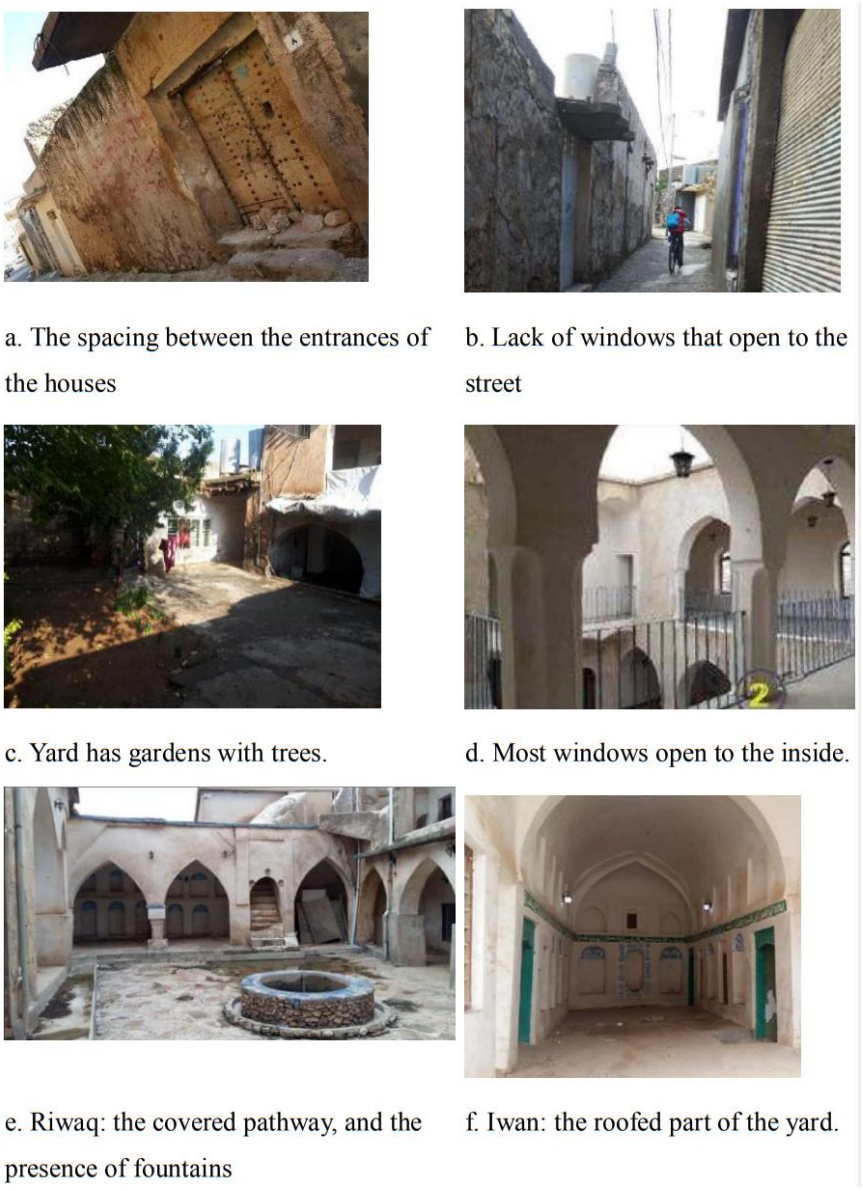
c. Simple L-shaped house

d. Combined shape house, central yard

Figure 5. Forms of traditional courtyard housing in Koya City in terms of their relation to the outdoors

3.3 Components of privacy, safety, and environmental qualities

Many design elements in the courtyards conserve the house's privacy and safety from outside streets. They encourage social contact inside houses compared to between individual houses, such as where house entrances are distributed and discourage interaction with others, increasing the privacy and safety of all houses (see *Figure 6(a)*). This facilitates the possibility for residents to maintain their privacy and keep their distance from other residents even in the same house. The access to the houses from the front on the sides of the street are designed to prevent exposing the house interior to the outside; a slight change in the door is enough to maintain the privacy of the house. Furthermore, none of the openings in each house look directly into the other private windows and yards. It is also noted that the windows on the ground floor to the street are small in size and limited, as shown in *Figure 6(b)*. The orientation of the houses towards their interior spaces (the yard) allows for social activities that maintain social relations as shown in *Figure 6(c)*. For example, children can play in the garden near a tree, keeping enough distance so as not to disturb parents in the paved area. Another example is that groups of men and women can be separated by adequate distance in the same yard as is appropriate for accommodating the traditions of Iraq. The opening inside the yard is another consideration for providing privacy from surrounding homes both visually and acoustically, as shown in *Figure 6(d)*. This allows for reducing the number of windows facing the street on the ground floor. However, first-floor openings to the street - if found - are also small and high compared to people's eye level. Hollow planks are also used to cover such windows or balconies. Other methods are used to maintain the privacy and safety of the houses from the public, such as raising the door level utilising stairs. Roofed parts of the courtyard, named "Iwan" and "Riwaq", are another method, as shown in *Figure 6(e)*, and *Figure 6(f)*.



a. The spacing between the entrances of the houses

b. Lack of windows that open to the street

c. Yard has gardens with trees.

d. Most windows open to the inside.

e. Riwaq: the covered pathway, and the presence of fountains

f. Iwan: the roofed part of the yard.

Figure 6. Components of privacy, safety, and environmental qualities in traditional courtyard houses

Some of the aforementioned components used to provide privacy and safety are the same used to enhance the environmental quality of the house and its external space: yard, Iwan, and Rewaq. This quality includes natural lighting, moderate heat in summer and winter, and good, clean ventilation. The yard, as shown in *Figure 6(c)* and *(e)* is one of the most important tools for providing these factors in the house because it provides an internal void open to the sky, but it is protected from the sides by the presence of the house being closely packed around it, which constitutes a natural insulator for the excess heat that can reach the yard from the side walls. In addition, the presence of trees and water elements (fountain) inside the yard, as shown in *Figure 6(e)* works to reduce the heat in the summer, moisturise the air and provide natural shade simply and inexpensively. The "Iwan," as shown in *Figure 6(f)*, is also the roofed extension of the yard that overlooks it directly and has a strong relationship with the fountain so that the residents can sit in the Iwan in moderate climatic conditions even during the hot summer. Windows are usually opened between the Iwan and the rooms so that cold

air can enter the house. As for the roofed corridors around the yard, "Rewaq," as shown in *Figure 6(d)* and *(e)*, they act as sun breakers that reduce the entry of the summer sun into the house but do not prevent the winter sun from entering, which is at a lower angle. In addition, Rewaq works in shading the external corridors for protection from various weather factors.

3.4 Comparison between concepts of private outdoor spaces

The previous results show two types of relationship between the internal and external spaces in the traditional houses of the city of Koya, which are the openness to the inside in the case of the courtyard house and the openness to the outside in the case of the individual house. The following is a comparison between the two ideas and the extent of their capabilities to meet the described standards of sustainable communities in the residential environment, namely: privacy, safety, and environmental quality, as shown in *Table 1*.

Table 1. A comparison between traditional types in terms of outdoor qualities

Item	Sub-item	Socio-environmental Factors	Open to the Inside (Yards)	Open to the Outside (Strips)
Social aspects	Privacy potential	Relevancy for women and men	x	
		Relevancy for social activities	x	
		Relevancy for children playing	x	
		Waste of space – unused outdoor spaces	x	
		Provision for multi-use space	x	
	Safety of the houses from their surrounding	Provision of defences and walls between properties		x
		Decreased window exposure to the street	x	
		Provision for acoustic privacy	x	
		Provision for visual privacy	x	
Environmental	Environmental	Good, clean ventilation	x	
		Natural lighting	x	x

Item	Sub-item	Socio-environmental Factors	Open to the Inside (Yards)	Open to the Outside (Strips)
aspects	characteristics of the outdoor space	Provision for environmental architectural elements: fountains	x	
		Provision for environmental architectural elements: gardens, trees	x	x
		Provision for designed environmental components: yard, Riwaq, Iwan	x	
		Accessibility for most rooms to the outdoors	x	x
		Shading- sunshine with simple tools	x	
	Environmental characteristics of the neighbourhood	Provision for future densification	x	
		The ability to decrease land lot area	x	
		The ability to decrease the built area of the house	x	x
		The ability for compactness between units	x	

Table 1 shows the possibilities provided for by opening the house to the interior courtyards, in the outdoor space of the house, compared to opening to the strips outdoor strip spaces of the individual houses. All potential qualities related to privacy, safety, and environmental qualities are covered by the yardscourtyards. Nevertheless, most of these qualities are not completely coveredfully addressed by the strips, such as relevancyallowance for social activities, because ofdue to their inconvenienceinconvenient shapes, and the lack of safety because ofresulting from their direct relationship with the streets. For that reason, strips may costincur many expenses compared to courtyards for solving these problems like, such as the cost of constructing surrounding walls and consuming much land for providingto provide adequate shapes of outdoor spaces. The following explores the resident'sresidents' opinions in terms of private outdoor qualities.

3.5 Satisfaction with traditional outdoor spaces

The satisfaction of the residents with the private outdoor spaces provided by the yards and their elements that stimulate privacy, safety, and environmental qualities was determined. The comparison of courtyard

houses with the residents of individual houses was the approach used to investigate the degree of satisfaction of the residents with the two types of housing.

Table 2 shows the results of the questionnaire regarding the residents' satisfaction with living in traditional houses in terms of basic needs, privacy, safety, and environmental qualities. The residents were asked at the beginning of the questionnaire about their satisfaction with the basic needs in the house, such as electricity, water installations, sanitary and other utilities, as shown in *Table 2,* sections 1.1 and 1.2. This was to identify the extent to which the satisfaction of the residents with basic needs affects their answers in the other branches of the questionnaire. The results show that there is a lower-than-acceptable level of satisfaction in both the courtyard and individual house types, about 40% in each in terms of basic needs. This is due to the low quality of those in the old houses that need renovation. It is expected that this percentage will affect the general satisfaction with housing in the old houses. Nevertheless, logical results can be reached by comparing the satisfaction of the residents in the two traditional types mentioned because the level of satisfaction of the residents on both types is the same concerning basic needs.

The second part of *Table 2* shows that satisfaction with privacy is higher in houses with yards than in single houses in all sections of the four questions, regarding entrances, privacy from the street, acoustic, and visual privacy, with a variation of the gap between each question (8%-12%) as shown in *Table 1*. It is also noted that the average significant difference in respondent satisfaction between the two types in the privacy hierarchy is 9% (30% in individual houses and 39% in courtyard houses). This gap indicates the importance of preserving the privacy of the residential area as a whole, from the public and semi-private to private areas, as well as the importance of preserving the privacy of the houses from the street. Although individual houses may have been located directly on streets wider than yards, however, they did not offer a satisfactory environment for their inhabitants. Perhaps this is because residents seek more privacy in their outdoor spaces.

Table 2. Satisfaction with outdoor spaces in traditional housing

Item	Sub- item	Socio-environmental Aspects	Courtyard House	Individual House
1. Basic needs	1.1. Infrastructure	Satisfaction with electricity	34%	37%
		Satisfaction with water	37%	33%
		Satisfaction with sanitation	36%	36%
	1.2. Interior	Satisfaction with utilities	49%	52%
2. Social aspects	2.1. Privacy	Satisfaction with the entrance	47%	39%
		Satisfaction with privacy from the public	39%	27%
		Satisfaction with acoustic privacy	37%	29%

Item	Sub- item	Socio-environmental Aspects	Courtyard House	Individual House
		Satisfaction with visual privacy	33%	24%
	2.2. Safety	Satisfaction with safety inside the house	43%	32%
		Satisfaction with children playing	51%	44%
		Satisfaction with safety from street	37%	31%
3. Environmental aspects	3.1. Indoor space	Satisfaction with natural lighting in the indoor space	33%	36%
		Satisfaction with natural cooling/ heating in the indoor space	66%	27%
	3.2. Outdoor space	Satisfaction with natural lighting in the outdoor space	31%	44%
		Satisfaction with natural cooling/ heating in the outdoor space	44%	32%
Overall satisfaction			**41%**	**35%**

The second part of *Table 2* is based on three questions which measure the extent of satisfaction with safety inside the house from outdoor factors such as strangers, cars, etc. The questions covered three main components of safety: the general feeling of safety inside the house, the safety of places for children to play, and safety from the street. The results show higher satisfaction with the courtyard houses in all aspects of safety with a lower gap of 6% regarding the safety of the street, a moderate 7% gap regarding the safety of children playing and a higher 11% gap regarding the safety inside the house. These gaps show that there is a hierarchy of feeling safe in the courtyard houses between the indoors and outdoors. Accordingly, people's sense of safety in courtyard houses increases as they approach the interior spaces and move away from the entrance and the main street.

The third part of *Table 2*, sections 3.1 and 3.2, reflects the four questions that were designed to measure satisfaction with environmental qualities, which relate to the environmental qualities of the indoor and outdoor spaces. The results show lower satisfaction with natural lighting in the courtyard houses, which may be due to one of two reasons: the first is the possibility that some small yards of the surveyed sample do not have adequate room orientation, while the individual house can provide four aspects exposed to the outdoors, which may not affect the orientation of the house; the second is the deterioration of the courtyard houses which are older and need maintenance, including the painting of walls which may increase the

reflection of daylight. However, the second question shows high satisfaction with the cooling/ heating inside the courtyard houses with a gap of 39%, which is the highest gap of the table. This highlights the efficiency of yards in terms of energy-saving. In terms of environmental qualities of the outdoors, the individual houses also have a higher score of satisfaction in terms of natural light outdoors, which is surprising but can be understood as a result of the old materials outside the house which may decrease the reflection of natural lights. However, the satisfaction of naturally cool and hot outdoor areas increases again in the courtyard house which sustains the previously discussed advantages of the yard, Iwan, and Rewaq in modifying the atmosphere. As a result, the satisfaction of residents on social aspects and environmental aspects is higher in courtyard houses compared to individual houses, while satisfaction with basic needs is almost the same in both types, as shown in *Figure 7*.

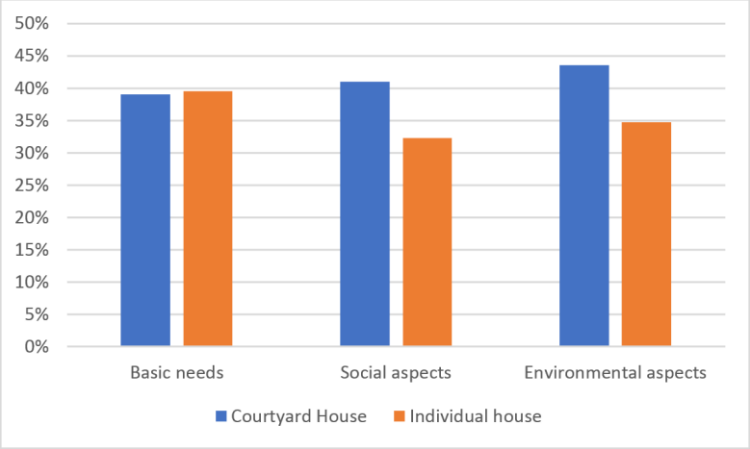


Figure 7. A comparison between courtyard houses and individual houses in terms of the basic needs, social aspects, and environmental aspects.

Although all the items discussed items in *Table 2* showed a good degree of resident satisfaction of residents inwith the yard compared to strip spaces. However, there is still an opportunity to increase the resident satisfaction rate through some design improvements. Personal interviews and observations with residents revealed several aspects that reduce resident satisfaction with outdoor spaces due to the need for modernization, prompting many residents to leave the Old City and live inmove to modern housing in the city. They are looking forseek the modern meansamenities that these housing units provide, such as parking lots, modern building materials, and new infrastructure. This indicates that the ideaconcept of designing outdoor spaces as a concept is not the sole reason for some residents to move to modern houses. From this standpoint, the study concludes that designingconceptualizing a yard as a concept for strengtheningdesign approach to strengthen the outdoor-indoor relationship in contemporary housing will more likely increase the current residents' satisfaction at a very good level.

4. DISCUSSION: A GUIDELINE FOR DESIGNING SUSTAINABLE HOUSING IN IRAQ

The results of the questionnaire have validated the hypothesis discussed in the INTRODUCTION, and analysed in *Table 1*, that yards have the

potential for maintaining a convenient atmosphere in residential areas based on socio-environmental sustainability. The results also confirm the need for having adequate private outdoor spaces in residential areas in terms of shapes, locations, and sizes. Most families prefer to have such outdoor spaces in their houses to practice their daily social activities comfortably. Yards can successfully achieve the necessary balance between privacy, safety, and environmental qualities in the house. The social satisfaction with yards sustains this conclusion.

In modern times, and after centuries of adapting the concept of yards to organize homes around them, this type of outdoor space has the potential to satisfy all users, assisting them to relax away from crowded public areas as discussed in section 1.1. The yards also help to create a strong society by suggesting good relations between residents inside houses based on good relations with the outdoors, in addition to its social and environmental values as discussed in section 1.2. As a result, the yard is a very potent approach for designing housing in Iraq and can play an important role in achieving social and environmental sustainability for future generations. The following goes further to propose a guide for designing private outdoor spaces based on learning from traditional architecture.

The residential area can be designed using more than one form of the relationship between the inside and the outside and drawing inspiration from the four traditional forms that were studied in traditional housing in Koya. The following analysis goes further in exploring the differences between the previously discussed types of outdoor spaces in the courtyard houses found in Koya city: U-shaped, O-shaped, L-shaped, and combined shape.

1. U-shaped house, as shown in *Figure 5 (a)*. This shape can be used to design medium and large homes, so it is not expected that this type will constitute a large percentage, but it can exist to meet the needs of some families for large internal spaces or where the number of rooms is more than three.

2. O-shaped house, as shown in *Figure 5(b)*. This type can be used when there is a need to completely enclose the yard, and this is expected to meet the functions of housing to a small extent, but it may be preferable design for other functional buildings in the residential area that accommodate services such as clinics, schools, and places of prayer.

3. L-shaped house, as shown in *Figure 5(c)*. It is recommended that this type constitutes the most used house because it enhances the relationship between the inside and outside of the house without consuming large areas. Part of the yard can be used for future construction so that the shape of the house may become like the first type, U-shaped, in case of need.

4. Combined shape house, as shown in *Figure 5(d)*. This style is suitable for the design of housing for low-income people and social housing, as it saves on used outdoor spaces and increases social cohesion between neighbours. *Figure 8* clarifies the proposed guideline for designing sustainable housing in Iraq based on the private outdoor shape.

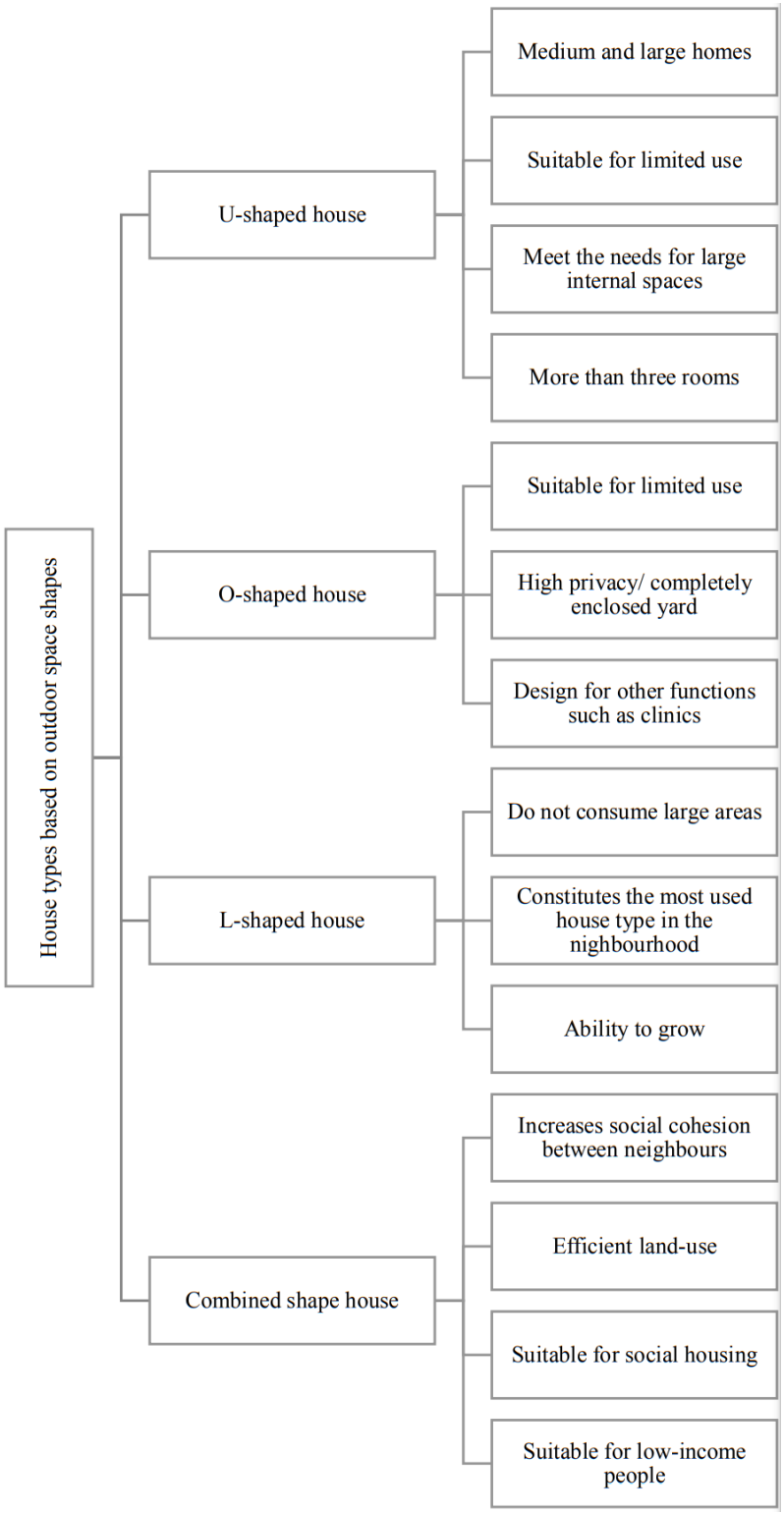


Figure 8. The proposed guideline for designing sustainable housing in Iraq

5. CONCLUSIONS

This study develops a guideline for designing private outdoor spaces in terms of forms, locations, and components based on socio-environmental sustainability. Hence, three related values of sustainability are examined:

privacy, safety, and environmental quality. Each value was discussed in detail in the literature review and in analysing the case study. Through the analysis, two main types of private outdoor spaces in Iraq were examined to explore the sustainability value potentials in each type of outdoor space: first, the strips around the houses, and second, the central yard. The survey supported the paper's hypothesis and demonstrated the positive effects of yards on residents' satisfaction compared to strips. The results of the study sustain many potentials of the yard approach for designing private outdoor spaces in contemporary housing, offering successful adaptation to the socio-environmental needs of residents. Moreover, courtyards can enhance the housing environment with other sustainable values on the neighbourhood level, mainly wall-to-wall buildings and densification.

The results of the study show that the yard is still in line with current social needs because it maintains the three values that promote socio-environmental sustainability: equality of providing privacy, safety, and environmental quality. Yards maintain these values through their relationship with the surrounding rooms: the central location facilitates accessibility from all rooms to the outdoors and also facilitates designing socio-environmental components like Iwan and Rewaq. Therefore, the study's understanding of the outdoors was verified, and the comparison between yards and strips was the method of this verification.

The research looks at the importance of designing convenient outdoor spaces, which is based on a balance between choosing spatial forms, locations, and components and fulfilling socio-environmental values. This fulfilment should be conducted simply; we suggest that designing for privacy, safety, and environmental quality will work to reduce the cost of living in housing accessible by people with a limited income. This study tried to learn from traditional housing for designing sustainable private outdoor spaces.

Finally, this study has discussed one factor for improving housing in Iraq, which is designing private outdoor spaces for socio-environmental sustainability. Other factors that enhance housing qualities are also recommended to be studied, such as housing services, neighbourhood planning, and sustainable building materials. Encouraging improved housing can provide many economic, social, and environmental benefits to Iraqis in the future. As a result, it is recommended that further research be conducted by learning from traditional housing to improve contemporary housing design, towards housing that fosters environmentally and socially sustainable communities. Thus, further studies are recommended for comparing this type of outdoor space with other types in other cultures and for studying other aspects of housing design like spatial design and building materials, to achieve greater learning benefits.

AUTHOR CONTRIBUTIONS

Conceptualization, M.I. and T.K.; methodology, M.I. and T.K.; software, M.I.; investigation, T.K.; resources, M.I., and T.K.; data curation, M.I.; writing—original draft preparation, M.I.; writing—review and editing, M.I. and T.K.; supervision, M.I. All authors have read and agreed to the published version of the manuscript.

ETHICS DECLARATION

The authors declare that they have no conflicts of interest regarding the publication of the paper.

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