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A proposed model for evaluating social sustainability in gated communities in Egypt using the network analysis process: Madinaty case study

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Abstract

The concept of Gated Communities emerged globally in the 1960s. In Egypt, these communities appeared as complete residential suburbs for the wealthy classes on the outskirts of Cairo, such as Maadi, Garden City, and New Cairo, serving as communities for the upper classes. The rapid growth of these communities has been accompanied by the emergence of some drawbacks that negatively impact the social sustainability of these gated urban communities. Many studies have addressed this phenomenon and why individuals reside in such communities, but few have evaluated their social sustainability. This research paper focuses on assessing the social sustainability of gated communities within the context of the characteristics of closed urban complexes using an Analytic Network Process (ANP) model. Through this analysis, researchers could assign relative weights to the impact of closed community features on achieving social sustainability and analyze the dynamics of social behavior and its correlation with urban characteristics. The model was applied to a community called "Madinaty" assessing its social sustainability, with the results showing an achievement of 67% of the social sustainability requirements. The findings highlighted the robust communal features that contribute to enhancement, along with weak aspects that require support and improvement of efficiency.

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Keywords*:* Gated community, Egypt, Madinaty, Social sustainability.

1. INTRODUCTION

By the 1960s, gated communities emerged worldwide due to urbanization and economic liberalization, leading to the privatization of urban development policies. Typically located on city outskirts or in new towns, these communities provided the affluent with a refuge from urban decline, ensuring safety and prosperity [1]. Their expansion varied: driven by urban well-being in the U.S., seasonal tourism in Egypt and Latin America, crime protection in the Far East and South Africa, and war avoidance in Lebanon [2].

In Egypt, gated communities started as integrated suburbs but later became isolated, disconnected from society [3]. These communities expanded after the state withdrew from service provision, with urban development transferred to the private sector following the 2011 revolution [4]. In Greater Cairo, the rapid spread of these communities resulted in urban sprawl, with cities like New Cairo, Sheikh Zayed, and 6th of October seeing significant growth. Gated communities made up about 43% of Sheikh Zayed's urban mass in 2013 [5].

However, the rapid expansion of gated communities has led to negative social impacts, such as fragmented urban growth and isolation from surrounding areas, undermining social sustainability [3]. While many studies have examined community aspects like security, luxury amenities, and identity [6], the social sustainability aspect remains underexplored despite its crucial role in supporting their overall sustainability.

The ANP technique has the potential to address the problems posed during the assessment of social sustainability, and the various levels of assessment and elements associated with it, and influences skills at all levels. The strength of the approach lies in the link between the shared groups, established through a more reliable analysis, based on the inclusion of all relevant elements, tangible (economic), intangible (moral), and objective or subjective, which assist in decision-making, using the relative weight of all interactions and subtleties [7].

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This research aims to develop an innovative model for social sustainability by analyzing both internal (urban, environmental, social and administrative) and external connectivity, using the Analytical Network Prospects (ANP) technique to improve future optimization.

2. METHODOLOGY

This study relies on qualitative and quantitative data analysis. The qualitative part includes analysis of literature, government reports, and international institutions, while the quantitative part utilizes data analysis using the Analytic Network Process (ANP) technique. The study applies a case study methodology to evaluate and measure the success of the closed community in achieving social sustainability. A comprehensive literature review was initially conducted to identify and combine the critical factors and criteria for effective decision-making. Then, a collaborative approach was adopted, where brainstorming sessions were conducted involving experts, real estate developers, and researchers to add or exclude social sustainability criteria and the influential characteristics of closed communities in achieving social sustainability. Through several brainstorming sessions, the main groups and sub-criteria for social sustainability and the characteristics of closed communities were selected to build the proposed model and identify the network of relationships within the model for analysis using the ANP technique.

Also, through these sessions, Madinaty Compound was approved as a case study as it is one of the oldest compounds in Egypt and the most massive and diverse in housing types, making it ideal for evaluating social sustainability with the proposed model.

A first questionnaire was conducted by ten experts to assess the relative weights of the various criteria within the proposed model. A second questionnaire was conducted on a random sample of 400 residents from the target population within the Madinaty Compound to apply the model and assess the extent to which social sustainability was achieved within the case study. The target sample size was selected using the SPSS program and the Yamans equation.

The proposed model's results were analyzed using descriptive and correlation analysis to assess the significance of various factors and their interconnections. To ensure validity and accuracy, the findings were reviewed by five experts in a brainstorming session, compared with similar studies, and evaluated for logical consistency in representing the targeted closed community.

3. THEORETICAL AND LITERATURE REVIEW

3.1. Social Sustainability

The concept of sustainability, emerging in the late 1980s, encompasses four key dimensions: environmental, economic, social, and institutional. In Egypt, with the rapid expansion of gated communities on the outskirts of major cities and development axes, many studies have explored the reasons behind their growth, their positive and negative impacts, and their sustainability assessments. However, the social dimension of such communities has received the least attention despite growing concerns over their social consequences. Addressing these social impacts is crucial, as they could significantly contribute to achieving the desired sustainability for such communities.

Recently, the focus on social sustainability in developing countries has gained attention through the "Brown Agenda," which emphasizes social and urban dimensions over the environmental aspects of green cities [3]. Definitions of social sustainability have varied, depending on the perspective, whether philosophical, political, or urban. For example, Elmorshedy [8], in her study on residential neighborhoods, defined social sustainability as development that meets social needs while maintaining privacy and fostering social interaction. This is achieved by studying the relationships between residents and their urban environment to ensure it can meet their needs and desires. Hassan & Ibrahim, in their study on affordable housing [9], stated that social sustainability is crucial for urban sustainability, emphasizing community participation and the creation of a suitable living environment, improving social cohesion, safety, equality in accessing services, and promoting diversity.

In essence, the social sustainability of gated communities aims to create high-quality urban environments that meet the social and psychological needs of residents. It focuses on fostering positive social relationships, ensuring safety, promoting a sense of belonging, and enhancing equality and diversity. Additionally, it seeks to ensure connectivity with surrounding communities, contributing to their long-term sustainability and efficiency.

3.2. Social Sustainability Criteria and Indicators

Despite the crucial role of the social dimension in sustainable development, criteria and indicators for measuring social sustainability remain undefined, and a universally accepted measuring framework remains elusive, due to the complexity of the field. The United Nations' book "Methodologies and Indicators of Sustainable Framework and Development" lists 134 indicators for the social dimension of sustainability. Key indicators include social equality, public health, education, adequate housing, security (both social and crime prevention), and the relationship between population growth and sustainability [8].

Western Australian Council of Social Service (WACOSS) identified key social criteria, including social networks and community interaction, community participation, community stability, pride and attachment to place, safety, and security. Others proposed indicators such as social capital, social exclusion or marginalization, and social cohesion [10]. Some categorized the indicators into those specific to social quality (social interaction, sense of belonging) and others specific to urban quality (safety, community vitality, urban structure, and congestion)[11].

Ibrahim and Hamed [3] linked social sustainability dimensions (community acceptance and satisfaction, social relationships, and a sense of community identity) with urban sustainability dimensions (community security and safety, functional and service relationships, and spatial connection with surrounding communities). They classified social sustainability in gated communities in relation to the broader society into three standards: spatial connectivity (entry/ exit ease, number of entrances, and links with road networks), social relationships (resident bonds strength, social activities quality, security and safety, social connection with external communities), and functional relationships (services from surrounding areas, services to surrounding areas, employment opportunities, housing for workers, social acceptance of workers' housing).

Elmorshedy [8] divided social sustainability into moral and physical axes. The moral axis includes two criteria: Psychological criterion (with indicators: comfortable housing, privacy, living standards, affection, attachment to place, creativity, and spatial excellence); Social criterion (with indicators: belonging, safety, security, fairness, self-fulfillment and self-reliance, social networks, social interaction, and community participation). The physical axis includes three criteria: planning criterion (with indicators: location, neighborhood size, road design, land use, services, facilities, and property ownership); urban criterion (with indicators: general configuration, urban blocks, urban spaces, street facilitations); and architectural criterion (optimal performance, interior and exterior housing design).

Overall, this research classifies social sustainability into:

- Psychological criteria (related to individual needs within the community such as housing comfort, privacy, maintaining a decent standard of living, affection, spatial excellence, and housing safety)
- Social criteria (related to collective needs within the community such as a sense of belonging, pride, security, fairness among community members, self-fulfillment, social networks and interaction, and community participation).

The research assumes that achieving social sustainability for such gated communities must occur on both internal and external levels of the community. Therefore, the study of social sustainability criteria for gated communities (both psychological and social) can be conducted by examining their interrelationships with community features; both the internal physical features (with indicators such as: location, neighborhood size, traffic elements, urban spaces, housing, services, facilities, and the distinctive urban layout) and their relationships with the degree of external connectivity to surrounding urban communities (spatial, functional, and social), Figure 1.

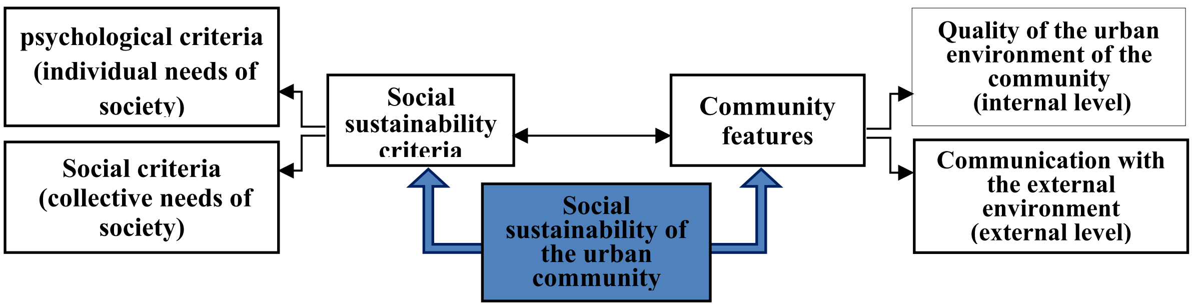


Fig. 1. Social Sustainability standards for gated urban communities

3.3. Analysis Network Process.

ANP is one of the multi-criteria decision-making (MCDM) methods, which can be categorized into two types: multi-objective decision-making (MODM) and multi-attribute decision-making (MADM), based on data nature [12]. MCDM uses mathematical modeling to optimize conflicting objectives with constraints and decision variables, while MADM focuses on comparing attributes and selecting alternatives to solve real-world problems. It encompasses fuzzy logic, utility systems, and preference modeling [13]. Standard methods in MADM include the Analytic Hierarchy Process (AHP) and ANP, with ANP better suited for addressing interconnected problems due decision element interdependencies.

In ANP, feedback occurs at different hierarchical levels, including the network level. Decision elements form networks of clusters and nodes [14]. ANP accounts for mutual relationships among groups and interrelated relationships among elements, allowing dependencies and feedback to determine relative element weights [15].

Unlike other methods, ANP handles complex interrelationships across decision levels, allowing interactions and feedback within and among groups (external and internal dependencies). Alternatives depend on criteria in a hierarchical sequence and on each other, enhancing accuracy for complex societal problems. It is an organized, analytical method for addressing a wide range of factors rather than relying solely on qualitative evaluations[16].

Each network within this system includes three matrices: the unweighted super matrix, containing priorities derived from pairwise comparisons; the weighted super matrix, results from multiplying the elements of the previous matrix by the weight of the corresponding cluster; and the limit super matrix, whose values represent the required priorities for the goal-related elements.

Real-world decision-making is complex, requiring feedback and interaction [17]. ANP effectively addresses social sustainability by handling interconnected criteria qualitatively. This study used pairwise comparisons on a one-to-nine scale, where one implies equal importance between the pairs, and nine implies that one pair is significantly more important than the other. These comparisons were then transformed into the matrices mentioned earlier, allowing for the assessment and analysis of various weights and relationships across all network levels.

3.4. Gated Communities.

Gated communities are upscale urban developments with high-end design, shared facilities, elements enclosed by fences, and controlled security access. They attract affluent social groups seeking better living conditions away from crowded/informal settlements [4]. Recent literature mostly dealt with the reasons for the emergence of such clusters and their attracting factors for residents, outlining their key features including social segregation, class filtration, and traffic safety [6], along with distinctive locations, luxury services, privacy, and elite status [18].

In Egypt, many gated communities have emerged nationwide, supported by real estate developers and government incentives. Examples include New Cairo, Madinaty, and Al Rehab in eastern Greater Cairo and Sheikh Zayed City in the west. Some provide full services, while smaller ones offer only essential commercial facilities [19].

4. BUILDING THE PROPOSED MODEL AND SELECTING CRITERIA

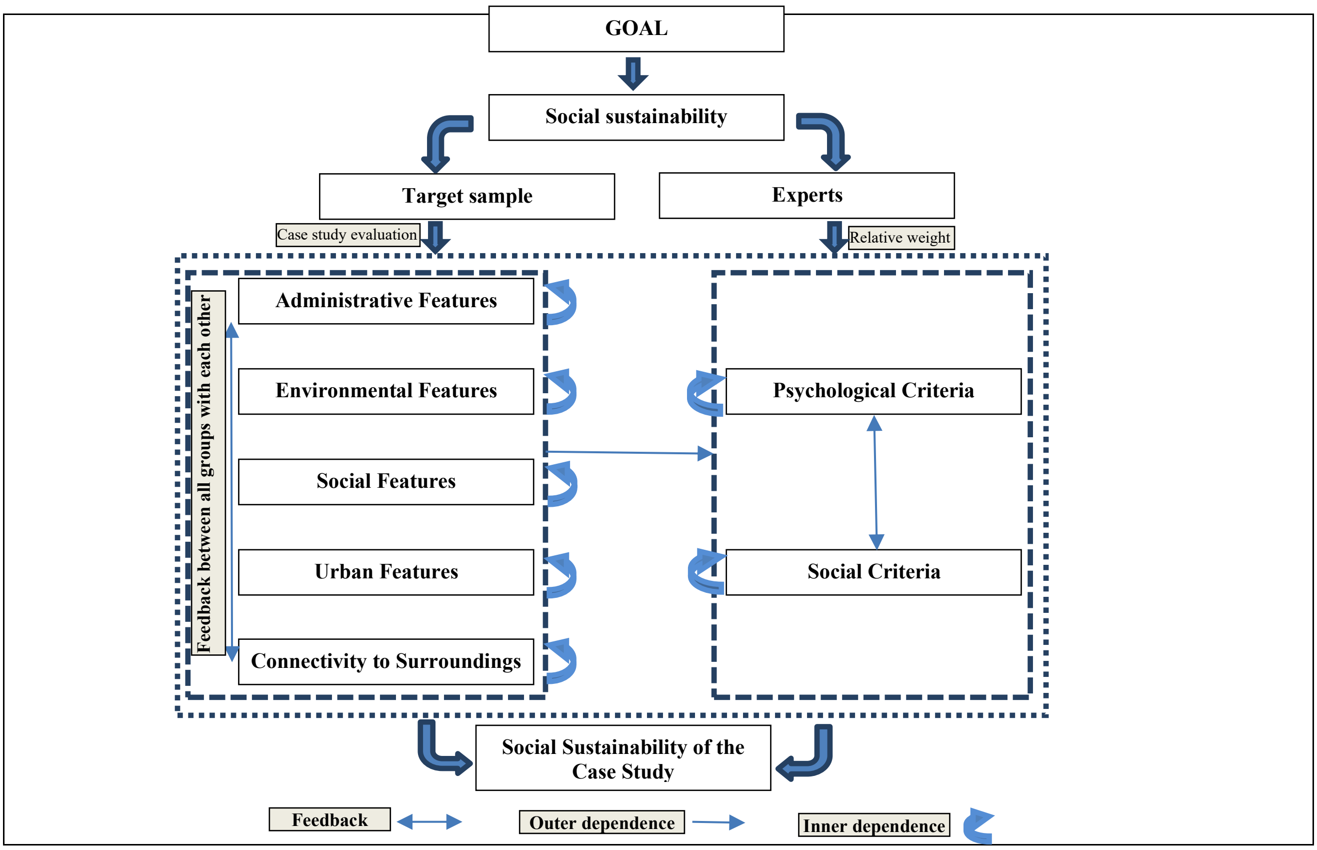


Fig. 2. The network of relationships within the proposed model

Researchers first identified criteria for measuring social sustainability and key features of closed communities based on prior studies. They then used brainstorming for data collection and validation, refined, ranked, and validated these criteria through multiple sessions with housing experts, real estate representatives, and architectural researchers, including the authors.

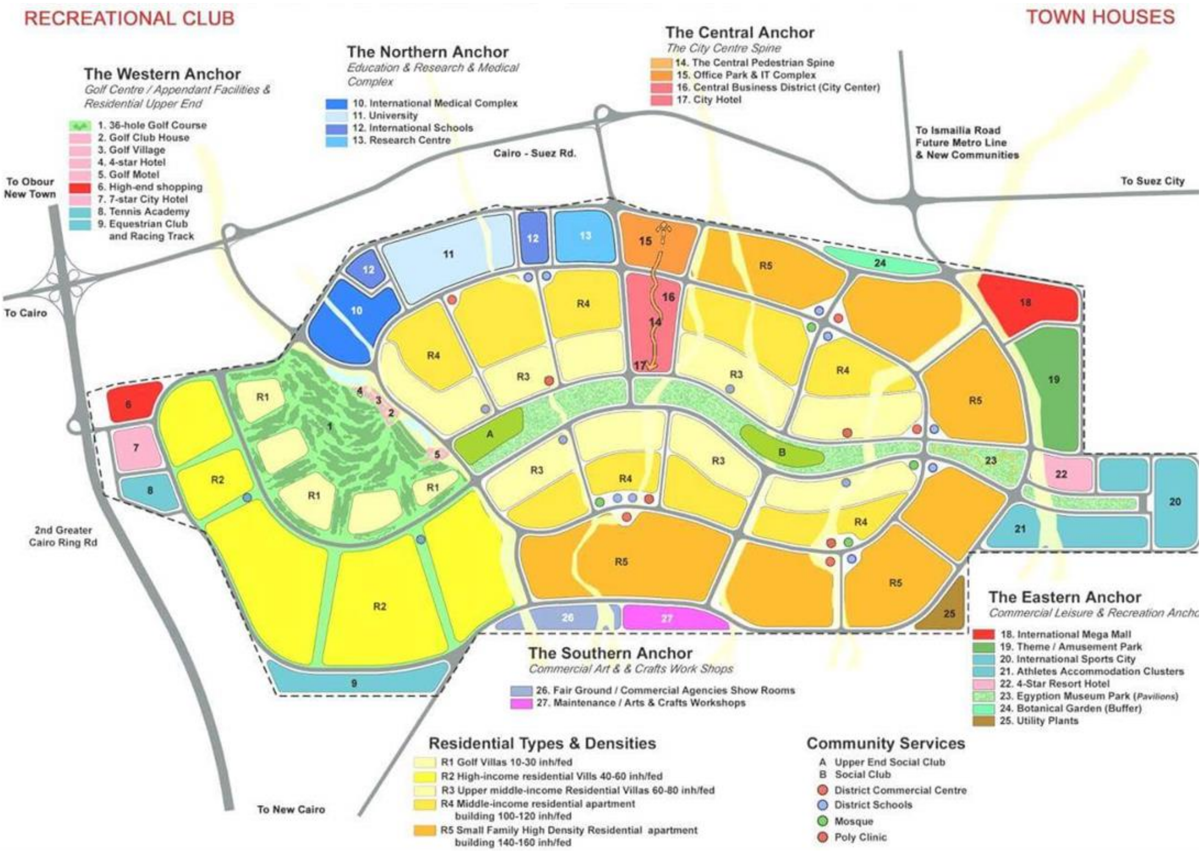
The meetings resulted in two main groups of social sustainability criteria, physiological and social, comprising 13 sub-criteria. Meanwhile, closed community characteristics were categorized into internal and external groups, with 5 main and 30 secondary criteria, representing the key features of closed communities in achieving social sustainability.

Table 1 presents social sustainability criteria horizontally, and closed community features vertically. Validation involved a brainstorming session with five experts, who confirmed the results as accurate and reasonable. Figure 2 shows the network of relationships within the proposed model.

5. CASE STUDY (MADINATY)

"Madinaty," an extension of New Cairo on the Cairo-Suez Road at kilometer 33, spans 10 km in length and 4.5 km in depth at 270 meters above sea level. It is developed, by the Talaat Moustafa Group since 2006, as a self-sufficient, fenced urban community within Greater Cairo, planned to house 600,000 residents. Its development occurs in stages, covering 33.6 million square meters, each linked by arterial and ring roads, Figure 3 (a). Each stage is surrounded by arterial roads connecting to the surrounding external roads. Two ring roads also link these stages within the city. Residential areas occupy 27.3 million square meters, with villas, apartments, green spaces, and amenities, while 6.3 million square meters are designated for central services to serve the residents of the city, as well as the population of Greater Cairo and neighboring cities [19, 20].

Madinaty's residential areas are divided into villa and apartment zones, each centred around green spaces with pedestrian pathways leading to service areas, ensuring a safe and pollution-free environment. Apartments come in various designs (42m²–324m²), with elevators, private gardens, and multiple orientations for sunlight and airflow. Commercial activities are prohibited in residential buildings, and designated parking is provided. Villas offer scenic views of green spaces, golf areas, and lakes, with sizes ranging from 259m² to 660m² and land areas from 330m² to 1556m², including private gardens as needed, Figure 3 (b & c).



(a) Master plan of Madinaty located as an extension of New Cairo City

(b) Images of Apartment buildings

(c) Images of Villas and golfparks

Fig. 3. Master plan and images of residential areas of Madinaty

6. RESULTS AND DISCUSSION

Table 1 presents the results of the proposed model for assessing social sustainability. It illustrates the relative weights and rankings for the sub-criteria (Nods) of the closed community features in achieving each sub-criterion (Nods) of social sustainability standards/criteria in closed communities. Meanwhile, Table 2 shows the relative weights and rankings for the main groups (Clusters) of community features in achieving each group (Clusters) of social sustainability in closed communities. Table 3 displays the relative weights and rankings for the sub-criteria (Nods) of closed community features within the decision network and each group (Cluster). Table 4 provides the relative weights and rankings for the two social sustainability groups (Clusters) and the criteria falling under them (Nods). The first horizontal group (achieving social sustainability) demonstrates these weights in achieving social sustainability in general. In contrast, the second horizontal group (achieving community social sustainability) indicates the groups' relative weight, ranking, and criteria for achieving social sustainability in "Madinaty."

TABLE 1: RELATIVE WEIGHTS AND RANKING OF THE IMPACT OF THE SUB-CRITERIA (NODS) OF THE CHARACTERISTICS OF CLOSED COMMUNITIES ON ACHIEVING EACH SUB-CRITERIA (NODS) OF THE SOCIAL SUSTAINABILITY STANDARDS

Community Features	Main Cluster	Social Sustainability Criteria	Social Sustainability																									
			Psychological Criteria												Social Criteria													
			Affection intimacy		Belonging and loyalty		decent living		privacy		rest		safety		Equality and justice		Freedom and participation		Homogeneity & interdependence		respect cultural diversity		security		social interaction		social protection	
			weight	priority	weight	priority	weight	priority	weight	priority	weight	priority	weight	priority	weight	priority	weight	priority	weight	priority	weight	priority	weight	priority	weight	priority	weight	priority
Internal	Administrative	Internal management	0.010	28	0.032	10	0.025	16	0.026	25	0.023	23	0.048	9	0.017	30	0.036	15	0.049	3	0.021	24	0.081	2	0.009	25	0.022	24
		maintenance	0.008	30	0.023	19	0.051	1	0.007	30	0.040	2	0.035	16	0.023	23	0.030	23	0.016	27	0.046	3	0.096	1	0.009	26	0.014	28

Exter	Internal Community Features																					
Conn	Urban Features												Social Features					Environmental				
Exchange of utilization of services	Urban Spaces	type of tenure	roads	public facilities	population density	location distinguishes	Housing characteristics	Housing area	gates and fencing	footpaths / crossing points	availability of services	accessibility	**Status/ social uniqueness**	**social autonomy**	**social activities**	**neighbourly relations**	**length of stay**	**pollution**	**Orientation of buildings &urban spaces**	**environmental quality**	**social control**	**regulatory restrictions**
0.027	0.027	0.018	0.019	0.039	0.044	0.011	0.013	0.025	0.011	0.015	0.027	0.012	0.016	0.036	0.035	0.019	0.017	0.030	0.014	0.022	0.027	0.009
7	12	17	16	2	1	25	23	13	26	20	11	24	19	3	4	15	18	5	21	14	6	29
0.027	0.029	0.034	0.012	0.032	0.032	0.022	0.014	0.009	0.015	0.015	0.027	0.011	0.013	0.039	0.039	0.035	0.039	0.051	0.011	0.047	0.027	0.026
13	11	7	26	8	9	20	23	29	21	22	17	28	25	3	5	6	4	1	27	2	12	18
0.027	0.022	0.010	0.011	0.017	0.041	0.014	0.026	0.025	0.017	0.016	0.027	0.033	0.032	0.039	0.024	0.024	0.018	0.023	0.022	0.033	0.027	0.026
8	20	30	29	25	2	28	14	15	26	27	12	4	6	3	18	17	24	19	22	5	7	13
0.027	0.036	0.009	0.036	0.018	0.009	0.042	0.069	0.047	0.053	0.030	0.027	0.039	0.053	0.035	0.025	0.048	0.050	0.026	0.071	0.026	0.027	0.026
17	13	29	12	27	28	9	2	7	4	15	21	10	3	14	26	6	5	24	1	23	16	22
0.027	0.032	0.039	0.037	0.032	0.026	0.034	0.026	0.046	0.012	0.030	0.027	0.023	0.014	0.021	0.019	0.021	0.018	0.026	0.028	0.025	0.027	0.026
13	9	3	6	8	20	7	18	1	30	10	17	24	29	26	27	25	28	21	11	22	12	19
0.027	0.016	0.053	0.046	0.023	0.009	0.038	0.014	0.009	0.053	0.057	0.027	0.044	0.068	0.026	0.055	0.048	0.056	0.026	0.036	0.029	0.027	0.049
19	27	6	10	26	29	14	28	30	5	2	23	11	1	24	4	8	3	25	15	17	18	7
0.047	0.056	0.040	0.028	0.041	0.032	0.032	0.026	0.032	0.019	0.021	0.032	0.023	0.022	0.024	0.023	0.021	0.021	0.032	0.030	0.053	0.057	0.050
7	4	10	18	9	15	11	19	13	29	27	14	24	25	20	21	26	28	12	17	5	3	6
0.068	0.000	0.020	0.031	0.045	0.036	0.031	0.040	0.032	0.041	0.034	0.052	0.041	0.041	0.043	0.035	0.021	0.029	0.032	0.080	0.034	0.024	0.028
5	30	28	21	8	14	22	13	20	12	17	6	11	10	9	16	27	24	19	3	18	26	25
0.026	0.056	0.028	0.028	0.025	0.032	0.031	0.027	0.032	0.010	0.021	0.026	0.025	0.022	0.027	0.029	0.028	0.029	0.032	0.060	0.026	0.029	0.014
19	2	14	13	20	7	8	15	6	30	24	18	21	22	16	11	12	10	5	1	17	9	28
0.028	0.000	0.038	0.028	0.025	0.032	0.026	0.025	0.032	0.027	0.033	0.027	0.028	0.041	0.036	0.025	0.031	0.025	0.032	0.019	0.026	0.031	0.017
14	30	5	13	23	10	18	22	9	17	7	16	15	4	6	21	11	20	8	26	19	12	27
0.014	0.056	0.031	0.047	0.022	0.029	0.039	0.040	0.032	0.054	0.041	0.024	0.048	0.025	0.025	0.031	0.031	0.025	0.032	0.017	0.026	0.048	0.075
28	4	14	8	25	18	11	10	13	5	9	24	7	21	22	15	16	23	12	26	20	6	3
0.016	0.000	0.029	0.028	0.037	0.032	0.031	0.022	0.032	0.042	0.037	0.035	0.028	0.022	0.024	0.032	0.031	0.038	0.032	0.000	0.031	0.014	0.015
22	30	15	16	4	10	12	21	9	1	5	6	17	20	18	7	13	2	8	29	11	24	23
0.026	0.056	0.037	0.031	0.028	0.032	0.031	0.042	0.032	0.031	0.037	0.027	0.031	0.025	0.022	0.026	0.038	0.034	0.032	0.016	0.026	0.031	0.037
21	1	6	12	17	11	14	2	10	16	4	18	15	22	25	20	3	7	9	27	19	13	5

		Proximity to work	0.027	8	0.027	14	0.027	9	0.027	18	0.027	14	0.027	20	0.061	2	0.047	7	0.021	23	0.021	25	0.028	19	0.023	19	0.023	23
		Restriction on visitors	0.027	9	0.027	15	0.027	10	0.027	19	0.027	15	0.027	21	0.023	22	0.071	4	0.016	26	0.059	1	0.009	30	0.037	3	0.008	30
		social activities participation	0.027	10	0.027	16	0.027	11	0.027	20	0.027	16	0.027	22	0.047	8	0.082	2	0.014	29	0.017	28	0.016	27	0.031	14	0.018	26
		Social interaction with surrounding	0.011	27	0.008	30	0.022	21	0.043	8	0.038	4	0.041	13	0.031	16	0.095	1	0.019	25	0.055	2	0.011	29	0.000	27	0.013	29
		transportation	0.013	22	0.013	24	0.019	23	0.038	11	0.037	5	0.042	12	0.127	1	0.000	29	0.035	4	0.000	29	0.030	17	0.000	28	0.032	8

Figure 4 graphically represents the main research result, which is achieving a 67% of social sustainability score in the case study of "Madinaty."

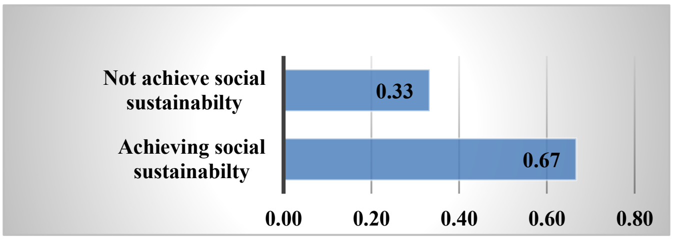


Fig. 4. weight of Social sustainability criteria

Table 1 highlights the priority of key criteria for closed community features that impact social sustainability. Firstly, the "Psychological criteria", such as "Affection intimacy" is primarily influenced by population density, then public facilities, and social autonomy. "Belonging and loyalty" depend on pollution, then environmental quality, and social autonomy. "Decent living" standard is influenced firstly by maintenance, then population density, and social autonomy. "Privacy" is affected by building orientation, then housing characteristics, and status/social uniqueness. The standard of "Rest" is influenced by housing area, maintenance, and tenure type. Finally, "Rest" standard is primarily influenced by status/social uniqueness, followed by footpaths/crossing points, then length of stay.

On the other hand, for "Social criteria", "Equality and justice" are influenced mainly by transportation, then work proximity, and social control. "Freedom and community participation" are shaped by social interaction with surrounding neighborhoods, social activities participation, building orientation, and urban spaces. "Homogeneity and interdependence" rely on building orientation, urban spaces, and internal management. "Respect cultural diversity" is influenced by visitors' restrictions, social interaction with surrounding neighborhoods, and maintenance. "Security" is affected firstly by maintenance, internal management, then regulatory restrictions. "Social interaction" depends on gates and fencing, followed by the length of stay, then restrictions on visitors. And "Social protection" is shaped by urban spaces, then housing characteristics, and neighborly relations.

In general, the descriptive analysis indicates that factor averages range between 0.02 and 0.04, reflecting a relatively uniform distribution. Standard deviations suggest some variability, but data dispersion is not extreme and data not widely scattered. The graphical representation of factor distribution reveals key insights, as many factors show a symmetrical distribution around the median, while some lean towards higher or lower values. The concentration of values around a specific mean is evident, highlighting patterns in data distribution. Additionally, dispersion levels vary, with some factors displaying greater variability than others.

The correlation matrix, Figure 5, reveals relationships between factors. High correlation values (close to 1 or -1) indicate a strong relationship, with positive values showing a direct correlation and negative values showing an inverse correlation Medium and low correlation values suggest weaker or no significant correlation between factors. This matrix identifies factors with strong correlations, offering insights into their dynamics. While both positive and negative relationships exist, no robust correlations were found, suggesting that factors, though somewhat connected, maintain a degree of independence. For instance, the criteria of "Affection intimacy" and "Belonging and loyalty" have a strong positive correlation but a negative correlation with "Safety" and "Privacy," respectively. "Freedom and community participation" and "Respect cultural diversity" exhibit weaker positive correlations but strong negative correlations with "Social interaction." Overall, no clear correlations exist between physiological and social criteria.

The results from Table 2 show that the most influential groups (clusters) in achieving social sustainability are the ones that are defined as (Psychological criteria – Social criteria). The 'Psychological' criteria group is primarily influenced by "social features", followed by "environmental features", while the ‘Social’ criteria group is influenced by "administrative features" followed by "connectivity to surroundings". This highlights the significant affecting role of "management" and" external communication" factors on ‘Social’ aspects while "social" and "environmental" features most influence on ‘Physiological’ aspects within closed communities. Additionally, ‘Physiological’ criteria show high average weights, emphasizing their importance in social sustainability. Meanwhile, ‘Social’ criteria maintain consistent weights, indicating their balanced significance in the model. Considering the standard deviations of values, the low standard deviations for "environmental" and "social" features indicate stability in their estimated importance.

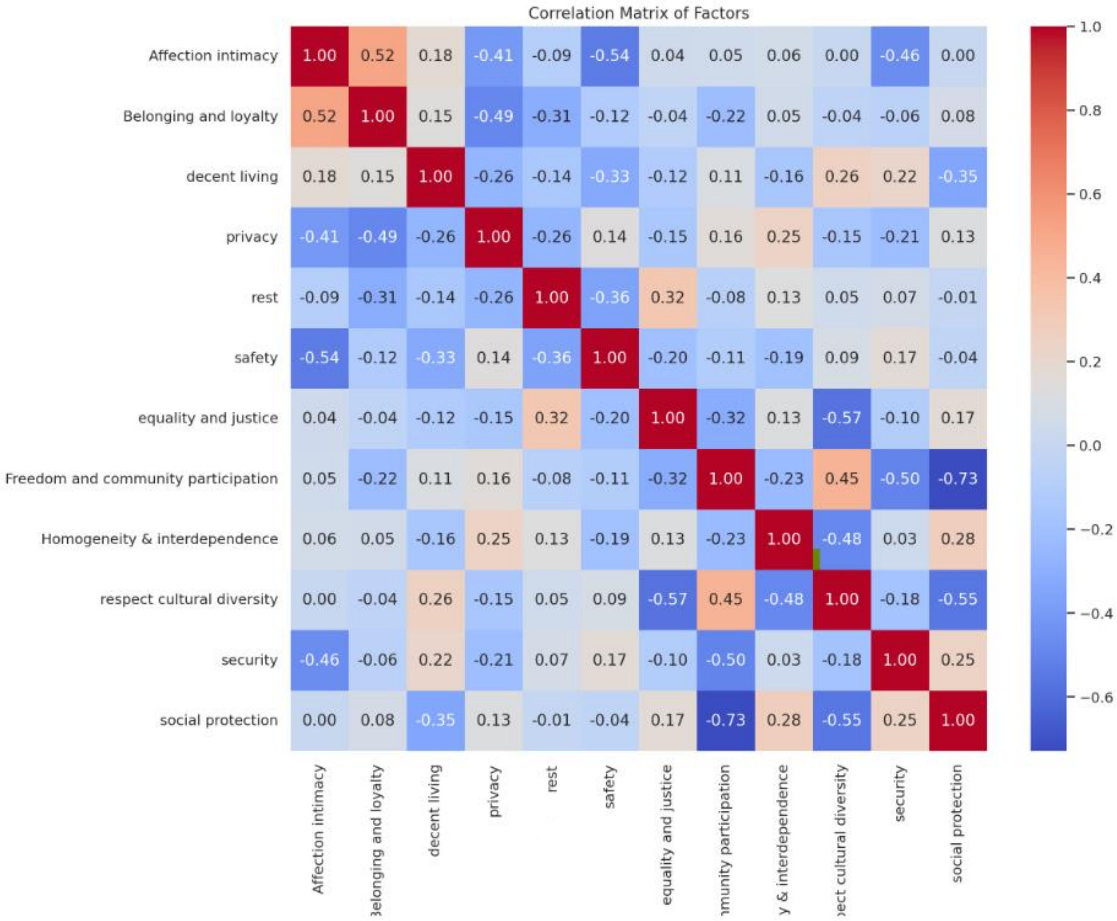


Fig. 5. Correlation of factors

TABLE 2: RELATIVE WEIGHTS AND RANKING OF THE EFFECT OF MAIN GROUPS (CLUSTERS) OF THE FEATURES OF CLOSED COMMUNITIES ON THE ACHIEVEMENT OF EACH GROUP (CLUSTERS) OF SOCIAL SUSTAINABILITY CRITERIA

			Community Features					Social Sustainability	
			Internal Features				External Features		
	Main Clusters		Administrative Features	Environmental Features	Social Features	Urban Features	Connectivity to Surrounding	Psychological Criteria	Social Criteria
Social Sustainability	Psychological Criteria	weight	0.163	0.182	0.196	0.162	0.163	0.231	0.25
		priority	5	4	3	7	6	2	1
	Social Criteria	weight	0.235	0.223	0.201	0.223	0.224	0.462	0.25
		priority	3	5	7	6	4	1	2

Table 3 shows that most influential factors (nodes) in the proposed model's decision network are social criteria, with "Freedom and community participation" ranking highest, followed by "Respect cultural diversity," "Equality and justice," and "Social protection." Conversely, urban features are the least influential in the proposed model, with "Footpaths/crossing points," "Type of tenure," "Housing Characteristics," and "Housing area" ranking lowest

(42, 43, 44, and 45 respectively). These findings highlight that social criteria play the most significant role in achieving social sustainability, while planning characteristics contribute minimally (Figures 6 and 7).

TABLE3: RELATIVE WEIGHT AND RANKING OF THE SUB-CRITERIA (NODS) FOR THE ATTRIBUTES OF CLOSED COMMUNITIES WITHIN THE OVERALL DECISION NETWORK (SYSTEM) AND WITHIN EACH GROUP (CLUSTER)

		In Cluster		In System	
		weight	priority	weight	priority
Administrative Features	Internal management	0.3338	1	0.0065	13
	Maintenance	0.1837	4	0.0036	31
	Regulatory restrictions	0.2470	2	0.0048	23
	Social control	0.2355	3	0.0046	25
	Transportation	0.2231	3	0.0057	26
Environmental Features	Environmental quality	0.4092	2	0.0052	27
	Orientation of buildings &urban spaces	0.1867	3	0.0024	32
	Pollution	0.4041	1	0.0051	22
Psychological Criteria	Affection & intimacy	0.1420	4	0.0375	17
	Belonging and loyalty	0.1818	3	0.0480	12
	Decent living	0.1166	6	0.0308	19
	Privacy	0.1913	2	0.0506	11
	Rest	0.1276	5	0.0337	18
	Safety	0.2408	1	0.0636	10
Social Criteria	Equality and justice	0.1517	3	0.0536	3
	Freedom and community participation	0.1777	1	0.0628	1
	Homogeneity & interdependence	0.1289	6	0.0455	5
	Respect cultural diversity	0.1614	2	0.0570	2
	Security	0.1317	4	0.0465	6
	Social interaction	0.1188	7	0.0420	7
	Social protection	0.1299	5	0.0459	4
Social Features	Length of stay	0.5941	1	0.0282	8
	Neighborly relations	0.0787	5	0.0037	30
	Social activities	0.1022	2	0.0049	14
	Social autonomy	0.1061	4	0.0050	24
	Status/ social uniqueness	0.1188	3	0.0056	15
Urban Features	Accessibility	0.1204	3	0.0017	36
	Availability of services	0.1020	4	0.0014	37
	Footpaths / crossing points	0.0611	9	0.0009	42
	Gates and fencing	0.1148	2	0.0016	35
	Housing area	0.0374	12	0.0005	45
	Housing characteristics	0.0515	11	0.0007	44
	Location distinguishes	0.0842	8	0.0012	41
	Population density	0.0995	1	0.0014	34
	Public facilities	0.0894	6	0.0013	39
	Roads	0.0750	7	0.0011	40
	Type of tenure	0.0800	10	0.0011	43
	Urban spaces	0.0849	5	0.0012	38
Connectivity to Surrounding	Exchange of utilization of services	0.1869	2	0.0048	21
	Proximity to work	0.1067	6	0.0027	33
	Restrictions on visitors	0.1942	1	0.0050	20
	social activities participation	0.1509	4	0.0039	28
	Social interaction with surroundings	0.1382	5	0.0035	29
	Exchange of utilization of services	0.1869	2	0.0048	21

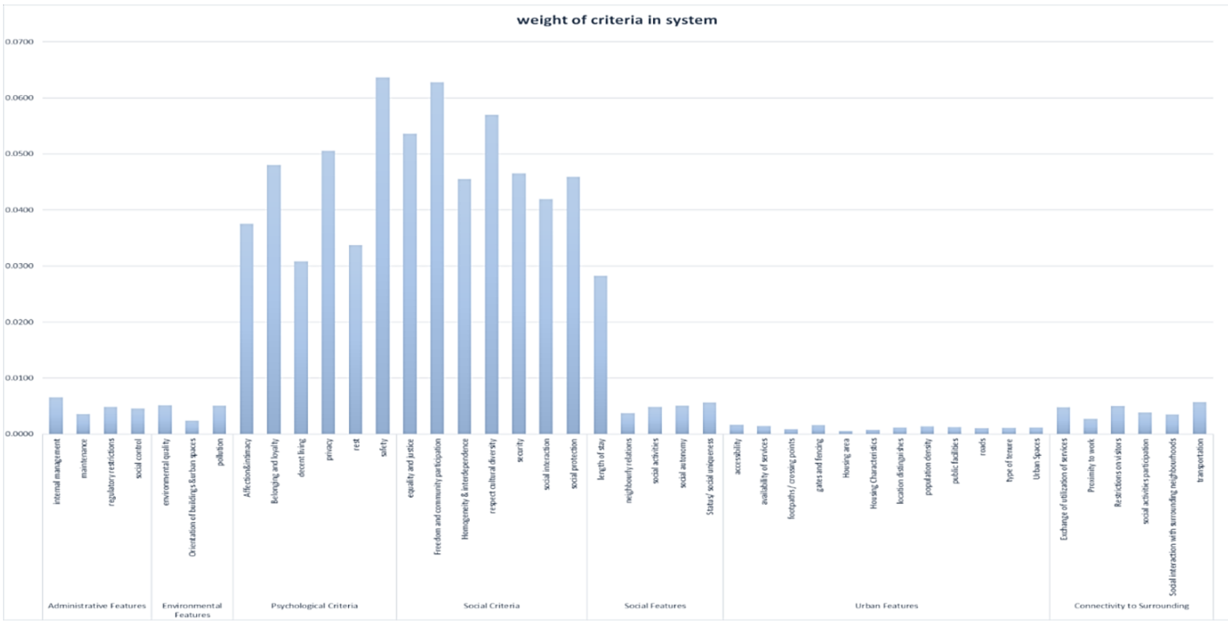


Fig. 6. Weight of criteria in cluster

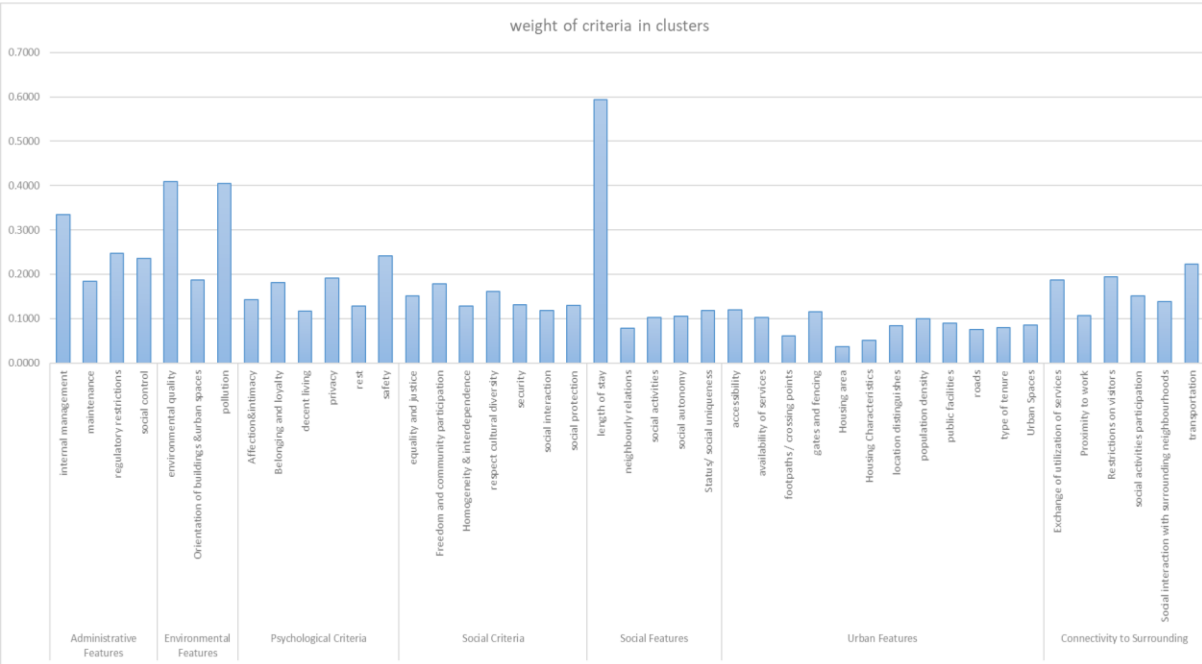


Fig. 7. Weight of criteria in the system

Table 4 illustrates the relative weights and rankings for the two social sustainability groups. The first horizontal group, "Achieving Social Sustainability," indicates the weights for achieving overall social sustainability. Meanwhile, the second horizontal group, "Achieving Community Social Sustainability," specifies groups' relative weights and rankings and criteria for achieving social sustainability within "Community City."

TABLE4: RELATIVE WEIGHTS AND RANKINGS FOR THE TWO SOCIAL SUSTAINABILITY GROUPS (CLUSTERS) AND THE CRITERIA THEY FALL UNDER (NODS)

		Psychological Criteria						Social criteria						
	Criteria	**Affection & intimacy**	**Belonging and loyalty**	**Decent living**	**Privacy**	**Rest**	**Safety**	**Equality and justice**	**Freedom and community participation**	**Homogeneity & interdependence**	**Respect cultural diversity**	**Security**	**Social interaction**	**Social protection**
Achieving Social Sustainability	**Weight**	0.051	0.082	0.036	0.141	0.051	0.141	0.056	0.100	0.050	0.100	0.046	0.100	0.050
	Priority	8	6	13	1	9	2	7	3	10	4	12	5	11
	Weight	0.50						0.50						
Achieving Community Social Sustainability	**Weight**	0.231	0.264	0.246	0.205	0.256	0.231	0.278	0.200	0.250	0.250	0.083	0.111	0.111
	Priority	7	2	6	9	3	8	1	10	4	5	13	11	12
	Weight	0.308						0.25						

The results of "Achieving Social Sustainability" show that the most vital criteria for achieving social sustainability are "Privacy", followed by "safety" and "Freedom and Community Participation", aligning with the requirements of closed communities. On the other hand, the two groups, "Psychological" criteria and "Social" criteria, have an equal impact on achieving social sustainability within closed communities.

Regarding "Achieving Community Social Sustainability," the factors contributing most to sustainability within a "Community City" are "Equality and Justice", followed by "Belonging and Loyalty", "Rest", and "Homogeneity and interdependence". Additionally, it appears that the "Psychological" criteria group achieves higher sustainability within "Community City" compared to the "Social" criteria group, as illustrated in Figures 8and 9.

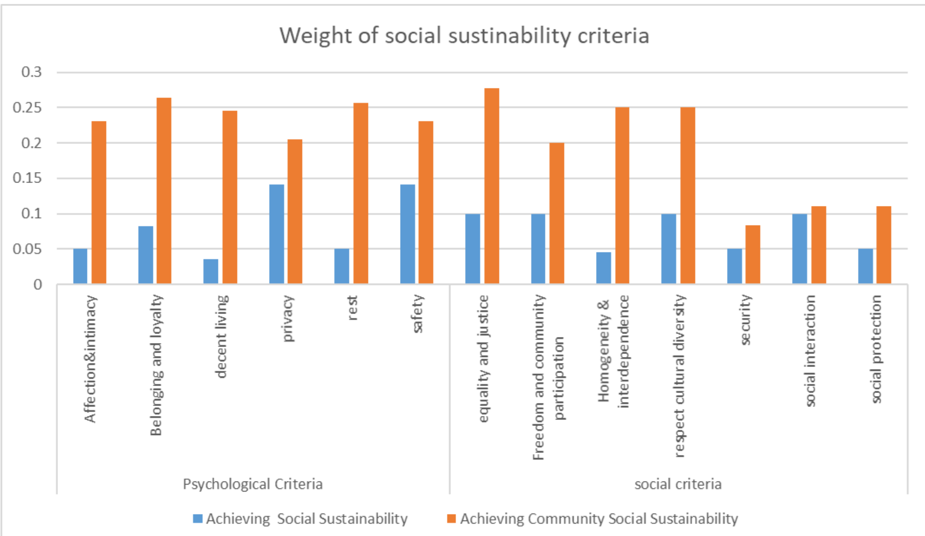


Fig. 8. Weight of Social sustainability criteria

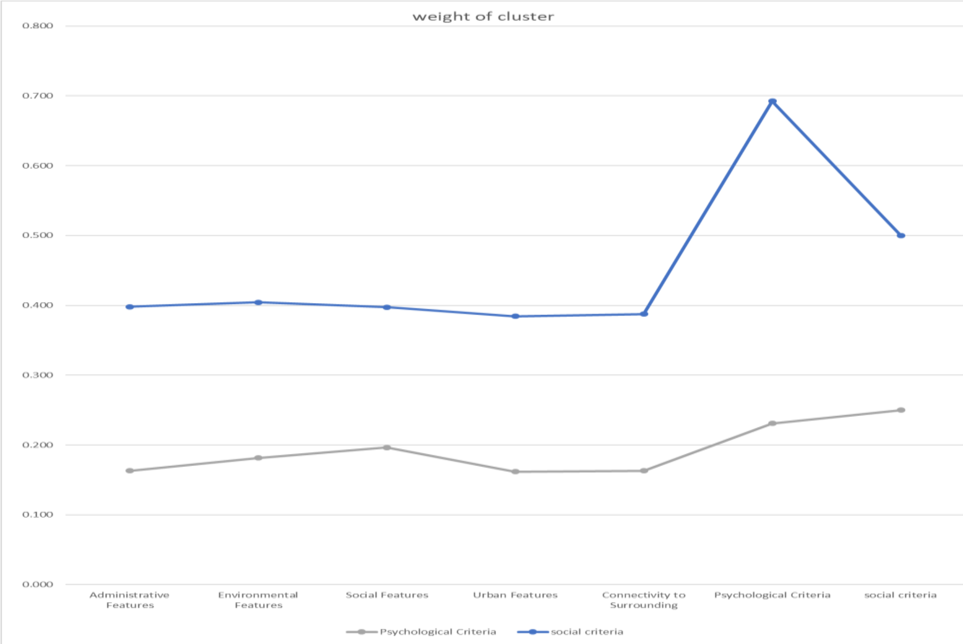


Fig. 8. Weight of Social sustainability criteria

7. CONCLUSION

The proposed model demonstrates the ability to analyze the impact of urban community characteristics on achieving social sustainability, providing a deeper understanding of social and cultural dynamics within these communities. By analyzing various criteria and their interrelations, the findings can be utilized to develop policies and programs that enhance safety, equality, and social integration.

The Analytic Network Process (ANP) was applied to the "Madinaty" community to assess the impact of environmental, social, and administrative factors on achieving social sustainability. The results indicate that the community meets 67% of social sustainability criteria, with psychological and social factors playing a dominant role, while some urban aspects had a relatively lower impact.

The analysis revealed a strong relationship between gated community design and social interaction, where green spaces and service management enhance security and a sense of belonging, whereas spatial isolation limits integration with surrounding areas. The study also emphasized the importance of promoting social justice and community participation to improve sustainability within these residential environments.

Based on these findings, the study recommends adopting more integrated planning and administrative strategies that balance privacy with community engagement, strengthen connections with surrounding areas, and improve public service quality. The proposed analytical model can also be applied in future studies to evaluate gated communities in different contexts, contributing to the development of urban policies that support broader social sustainability.

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