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Modelling and Assessing Sustainable Urban Regeneration for Historic Urban Quarters via Analytical Hierarchy Process

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Abstract: The push for urban development and the rapid increase in population have left many historic urban cores vulnerable and subject to deterioration. SDG-11 is often mentioned as the goal in UNDP regeneration, revitalization, and preservation projects regarding historic urban sites around the globe. The goal emphasizes 10 targets that are complex in nature and require closer inspection regarding their interconnectedness when being utilized in real-world scenarios. The current study explores the complexities of the decision-making process in planning urban regeneration projects concerning targets of SDG-11. The study uses a Multi-Criteria Evaluation (MCE) method to investigate how and to what significance the targeted criteria were used in planning for two UNDP urban regeneration project zones in Cyprus. These cases have a complex cultural and socio-political dynamic and pose high contextual significance for the region; therefore, many of these targets are critical in achieving more sustainable regeneration projects. The data collection was done by critically examining the projects' documentation and conducting interviews with experts involved in the two projects. The data is controlled for internal consistency and anomalies. The study makes its case by comparing the different approaches implemented in these two projects and how effective they were in achieving SDG-11 targets.

Keywords: urban historic tissue; MCE; AHP; sustainable urban regeneration; SDG-11; UNDP; historic urban tissue; urban design; urban decision-making

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1. Introduction

The increasing population of the world and the influx of people into the cities make them central in planning for the future of humanity [1,2]. The United Nations proposed 17 goals within the framework of Agenda 2030 to make the development process more sustainable in the future [3]. Goal 11, perhaps the most spatial among these, directly targets various dimensions of cities. This goal aims to make cities more resilient, inclusive, safe, environmentally friendly, and protective of their heritage [4]. Nevertheless, keeping the balance between sustainable development and the preservation of heritage is a challenging endeavor that requires innovative methodological approaches capable of addressing the multifaceted nature of the problem from both perspectives [5].

The SDGs are often interconnected and cannot be achieved individually. The goals have an air of abstraction for the most part and lack an empirical action plan. They are often perceived as general guidelines or directions to move toward [6]. It seems that having a standardized metric to evaluate the success rate of moving toward the SDGs should be considered [7]. SDGs are general guidelines; thus, a significant problem associated with them is the lack of empirical solutions or, rather, ambiguities in how empirical solutions at a local scale can be achieved.

The influx of population makes planning for accommodation critical in urban settlements [8]; this often happens in three forms: new residential units, regeneration of existing

urban tissue, or informal settlements. In this regard, people's participation is an essential dimension of urban regeneration planning and policymaking [9]. Successful urban regeneration requires a balance between development and preservation [10]. Valencia et al. [11] state that "political will, coherent governance, and strong formal partnerships between the public sector, private sector, and civil society actors are key ingredients in achieving goals such as the SDGs." Bottom-up approaches that take into account the local residents' views and community-based frameworks are essential for sustainable and healthy regeneration practices [12]. The success of SDGs is dependent on the locality of their implementation strategies and how they affect the everyday lives of people [13]. This is especially critical as the vulnerable residential population is often most affected by regeneration plans that might have been designed with clear sustainability goals but without considering their needs [14]. The strive for sustainable development must not become a burden on lower social strata; instead, it needs to involve those people in the decision-making process [12].

Although Goal 11 targets cities and their attributes, the scholarly literature seems to be lacking in terms of addressing the interdisciplinary nature of urban regeneration with regard to the goal. It is evident that while tangible dimensions such as carbon emissions, materials, and climate have been thoroughly investigated [15], bottom-up urban design practices and the intrinsic socio-spatial quality of urban spaces seem not to be well defined within the framework of this goal. Many of these dimensions have been studied in urban design for decades outside the framework of SDGs, but moving toward seeing urban design frameworks through the lens of SDGs seems to be an inevitable necessity. The current paper focuses on the regeneration of historic urban quarters concerning Goal 11. The paper addresses the shortcomings of Goal 11 in providing tangible guidelines for the reality of urban design and planning practices. Furthermore, the relationship between local stakeholders and other institutional bodies is not well defined in Goal 11. The paper does not aim to address all indicators of Goal 11 targets, but rather explores contextual circumstances that might not fit within the overgeneralization of Goal 11 by including different involved parties. This process is conducted by superimposing the data associated with different targets and is often difficult to overlap. Therefore, the study aimed to utilize a Multi-Criteria Evaluation (AHP in this case) suitable for exploring a goal while addressing a multitude of data sources.

2. Material and Methods

Sustainable urban regeneration (SUR) is an intricate task for real-world project management and implementation. SDG-11 further adds to these complexities by introducing numerous long and short-term targets. Therefore, it seems critical to divide the goal into manageable criteria and sub-criteria relevant to the circumstances of the site and in line with the existing body of literature. Therefore, SUR can benefit from utilizing multi-criteria evaluation processes capable of addressing its natural intricacies. Additionally, this multi-criteria evaluation should be adopted for SDG-11 and targets historic urban quarters. Different case studies and literature reviews were realized, and criteria and sub-criteria packages were matched with targets (see Figure 1). Moreover, the lack of institutional transparency and urban data is one of the biggest obstacles when aiming for SDGs [16]; this is particularly problematic in less developed regions that are more in need of such approaches.

Urban regeneration programs are not mere spatial or physical interventions; they require the involvement of many different layers of data (e.g., social, cultural, economic, and historic). Furthermore, they require both top-down and bottom-up participation [17]. Accordingly, selecting a methodological approach that can receive input from different sources is critical. Multi-Criteria Evaluation (MCE) methods are strong tools in urban planning and regeneration, especially when the involvement of different parties, stakeholders, and data layers is required [18,19]. Utilization of MCE methods in approaching SDGs can potentially create a more comprehensive and successful empirical workflow [20]. MCE can be implemented in SUR to better understand the weights and priorities of intervening

criteria, especially when future planning requires active modification or when the transformation of local contextual attributes transforms the plan [21]. The novelty of the study is exploring a new approach by using AHP for SDG-11 goals and targets, constructing a hierarchy for modelling, and measuring the sustainability level of urban regeneration activities within historical and cultural urban environments (see Figure 2).

11 SUSTAINABLE CITIES AND COMMUNITIES	11.1	Adequate, safe and affordable housing and basic services
	11.2	Safe, affordable, inclusive and sustainable transport systems
	11.3	Sustainable urbanization/settlement, planning and management
	11.4	Protect and safeguard the world's cultural and natural heritage
	11.5	Resiliency against natural disasters, protecting the poor and people in vulnerable situations
	11.6	Reduce the adverse per capita environmental impact of cities, waste management
	11.7	Provide universal access to safe, inclusive and accessible, green and public spaces
	11.a	Economic, social and environmental links between urban, peri-urban and rural areas
	11.b	Increase the number of resilient and sustainable cities/ human settlements
	11.c	Support least developed countries

Figure 1. United Nations' Sustainable Development Goals.

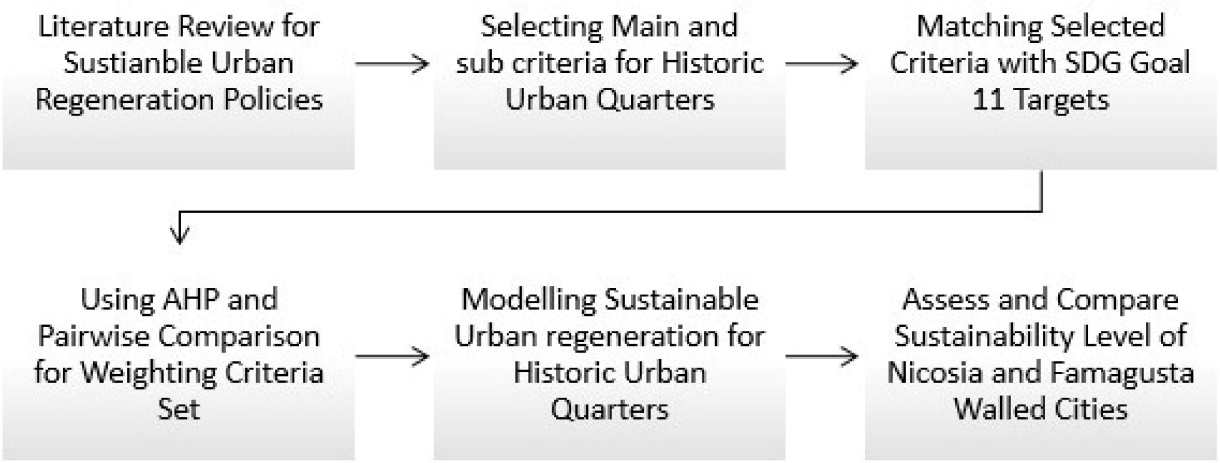


Figure 2. The framework of the paper.

Although SDG-11 has been used at the neighborhood level [22,23], urban regeneration policies and activities were not investigated within the SDG targets. The overlaying of different opinions and data layers generated by different parties is also a nuance of the current study.

2.1. Multi-Criteria Evaluation (MCE)

Multi-criteria evaluation methods (also known as multiple-criteria decision-making (MCDM)) are a set of methods designed to provide a logical workflow for decision-making when there are numerous (sometimes even conflicting) influential criteria [24]. MCE makes the process of decision-making in addressing problems of high complexity more informed and explicit [25,26].

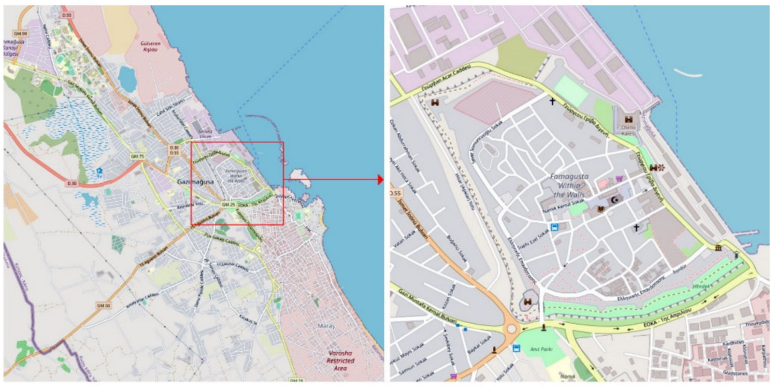
When complex interconnected factors are present, the integration of MCE methods within the GIS workflow allows for more comprehensive decision-making [27–29]. The implication of MCE methods for urban regeneration and decision-making has a strong precedent in the literature [30–32], and this is more evident for sites of cultural heritage [33–35]. The Analytic Hierarchy Process (AHP) is among the most utilized MCE methods, first introduced by Saaty. The model is constructed by defining a goal that aims to select the best alternatives from a set of possible outcomes, followed by identifying criteria and

possible sub-criteria. All criteria are then compared against one another using a pairwise matrix. Weighted criteria are then cross-referenced with the alternatives [36]. The pairwise comparison is usually done via a survey, but it can be achieved via other means of data analysis. The utilization of GIS in AHP modelling has been gaining traction and showing promising results [37,38]. Using GIS to support the weighing criteria is particularly useful in large urban settings due to the sheer number of influential criteria [39]. What is more, the fact-based nature of GIS might improve some shortcomings of surveys, such as a lack of consensus among experts or addressing a large number of evaluation criteria [40].

The process of conducting AHP analyses is often performed in five steps: setting up a goal, criteria, or sub-criteria, and an alternative, pair-wise comparison of criteria or sub-criteria with respect to the goal; constructing a comparison matrix; analyzing the weight of variables derived from the comparison matrix; and checking for potential inconsistencies via the measure of Consistency Ratio (CR). CR is calculated by using the Consistency Index/Random Index (CR: for more details, consult [41–43]).

2.2. Study Area

The paper explores two case studies: the walled city of Famagusta (also known as Gazimağusa, Figure 3a) and the walled city of Nicosia (also known as Lefkoşa, Figure 3b). Both cities have rich historic tissue, a large portion of which is located within the boundaries of the historic fortifications.



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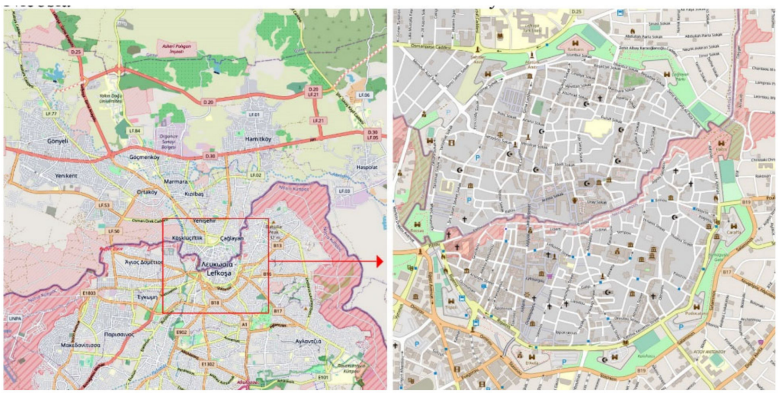


(**b**)

Figure 3. The city and walled city of Famagusta (**a**); The city and walled city of Nicosia (**b**).

2.2.1. Famagusta

The growth of Famagusta has been influenced by a variety of social, economic, and cultural intervening factors. The conflict of 1974, which bordered a significant part of the city, and the establishment of the Eastern Mediterranean University motivated the growth

of the city toward the university campus and away from the walled city [44,45]; these circumstances have left the walled city less connected to the rest of the urban grid and prone to deterioration [46]. Original regeneration strategies proposed for the historic walled city followed the traditional sustainability triad of economic, social, and environmental factors [44,47]. Nevertheless, the integration of Agenda 2030 and the SDGs has not been fully explored in these renewal processes.

2.2.2. Nicosia

The walled city of Nicosia, similarly, has a rich history and has evolved and expanded over time [48]. Similar to Famagusta, the city has been divided after the conflict of 1974, with the buffer zone (or green line) cutting through the middle of the historic walled city. Nevertheless, the city has a master plan that was produced by both sides after 1977 [49] and finalized in 1981 as a conjoined official document [50]. Preservation, regeneration, and rehabilitation of historic tissue were central to the development of the Nicosia master plan, taking into account the complex intricacies of the two parts' economic, political, and cultural divides [51]. According to Tsolaki et al. [52], the Nicosia master plan regards regeneration strategies aiming to achieve social, economic, and architectural objectives. Although the master plan is a great undertaking, it has some shortcomings in considering administrative, environmental, and local stakeholders.

2.3. Selection of Criteria/Alternatives

The current study explores the multidimensional complexity of establishing a comprehensive practice for sustainable urban regeneration in areas with historic tissue. Accordingly, the goal of the study was to determine a more successful site in terms of "sustainable urban regeneration in historic urban quarters." The alternatives in this study refer to the two cases, the walled cities of Nicosia (northern section) and Famagusta, respectively.

Selection of the criteria and sub-criteria is often conducted by addressing the relevant body of literature and the circumstances of the sites [53]. There exist numerous approaches regarding the selection of criteria concerning the preservation and regeneration of historic environments [5,54–56]. The current study approached the topic from the main criteria for sustainable development (economic, social, and environmental); the administrative/legal dimension was added later because it has a significant contextual impact on how the other three dimensions can be realistically implemented [57,58]. The selection process of the associated sub-criteria was motivated first by the targets of SDG-11, the existing literature, and contextual circumstances of the site (see Figure 4). Each sub-criterion is corresponding to one of the targets of Goal 11. Targets 11.b and 11.c are not included due to their international scope that cannot be addressed within the scale of the current case studies.

2.4. Evaluation of Criteria Weights

After the criteria are set, implementing pairwise comparisons with experts related to the topic is required. Experts from town planning, municipalities, antiquities, universities, and chambers were selected to fill the comparison tables for the main and sub-criteria. The target group included architects, urban planners, academicians, and managers, who compared the given criteria by using the model proposed by Saaty [26]. The weights were calculated for each criterion (Table 1). Consistency Ratio (CR) values were also controlled for each comparison and are within the acceptable threshold (<0.05).

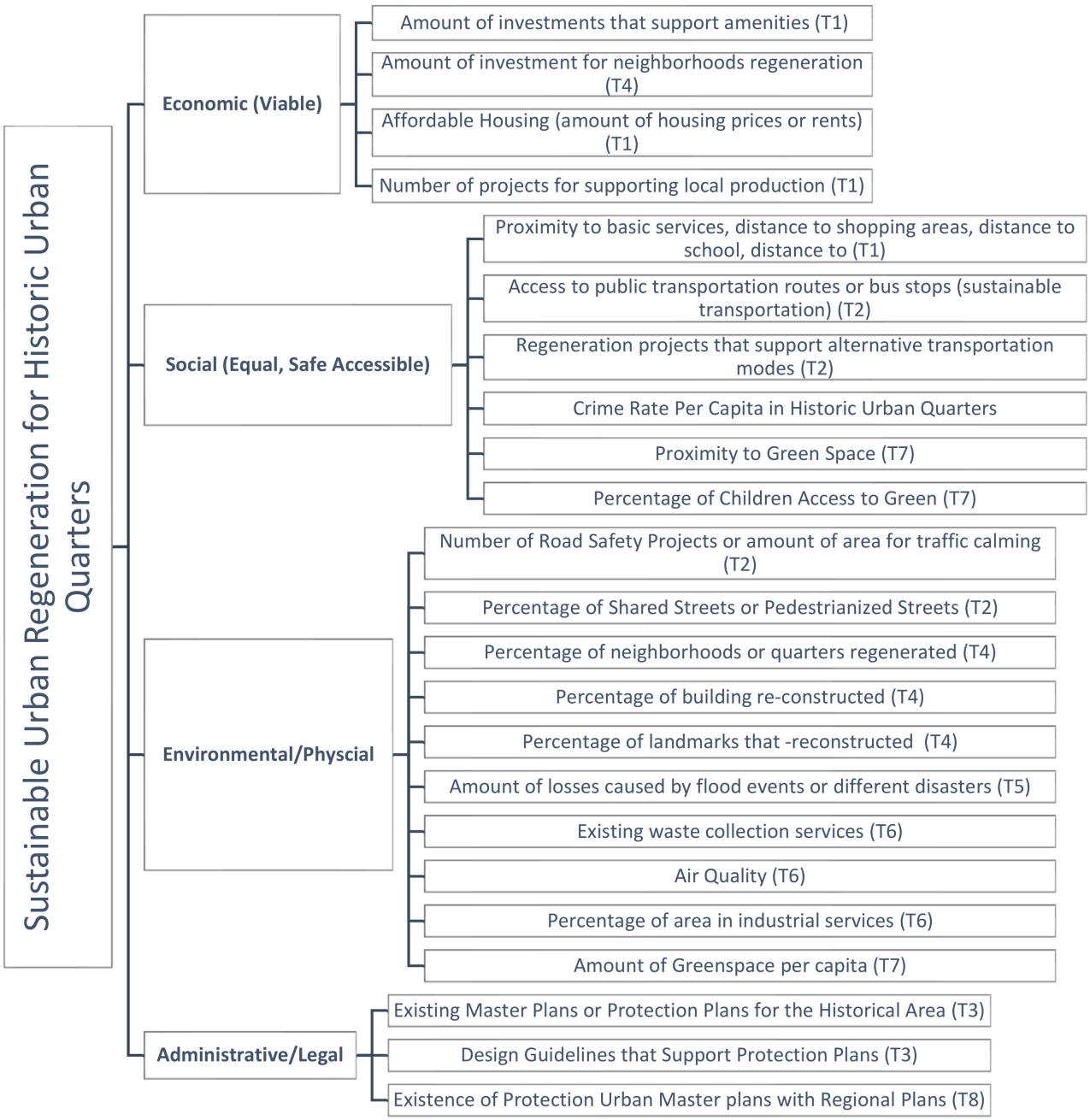


Figure 4. Hierarchy for Sustainable Urban Regeneration for Historic Urban Quarters.

Table 1. Comparison and weight results for the selected criteria set.

Main-Criteria	Weight	CR	Sub-Criteria	Weight	CR
(A) Economic	0.29	0.01	Amount of investments that support amenities (T1)	0.190	0.02
			Amount of investment for neighborhoods regeneration (T4)	0.185	
			Affordable Housing (amount of housing prices or rents) (T1)	0.273	
			Number of projects for supporting local production (T1)	0.352	
(B) Social	0.26		Proximity to basic services, distance to shopping areas, distance to school (T1).	0.162	0.02
			Access to public transportation routes or bus stops (sustainable transportation) (T2)	0.221	
			Regeneration projects that support alternative transportation modes (T2)	0.208	
			Crime Rate Per Capita in Historic Urban Quarters	0.131	
			Proximity to Green Space (T7)	0.118	
			Percentage of Children Access to Green (T7)	0.160	
(C) Environmental	0.30		Percentage of Road Safety Projects or amount of area for traffic calming (T2)	0.094	0.01
			Percentage of Shared Streets or Pedestrianized Streets (T2)	0.087	
			Percentage of neighborhoods or quarters regenerated (T4)	0.100	
			Percentage of building re-constructed (T4)	0.072	
			Percentage of landmarks that were reconstructed (T4)	0.060	
			Number of losses caused by flood events or different disasters (T5)	0.120	
			Existing waste collection services (T6)	0.163	
			Air Quality? (T6)	0.101	
			Amount of area in industrial services/total area(T6)	0.061	
			Amount of Greenspace per capita (T7)	0.140	
(D) Administrative Legal	0.15		Existing Master Plans or Protection Plans for the Historical Area (T3)	0.367	0
			Design Guidelines that Support Protection Plans (T3)	0.340	
			Existence of Protection Urban Master plans with Regional Plans (T8)	0.293	

3. Data Collection and Results

One of the most challenging aspects of the current study was the scope of data collection. Whereas in many regions public and transparent data on issues such as spending, occupation, taxes, subsidies, crime rates, and funded projects are available, in this case, similar to many other parts of the region, accessing detailed economic data is not feasible [59]. Even when available, the data are very general and lack necessary details suitable for AHP analysis. The current data sets addressing 24 sub-criteria for two alternatives were collected using police department reports, UNDP, municipalities, the antiquities department, the environment department, the town planning department, available GIS data, Open Street Map (OSM), existing literature, master plans, and housing market websites. It must be noted that AHP is especially helpful in these cases when the influencing factors are numerous, intricate, interrelated, from different sources, or even at odds with one another. [24,42,60]. This approach, coupled with the expert evaluation, ensures that the results address the intrinsic complexity of the topic from multiple perspectives.

3.1. Economic Dimension

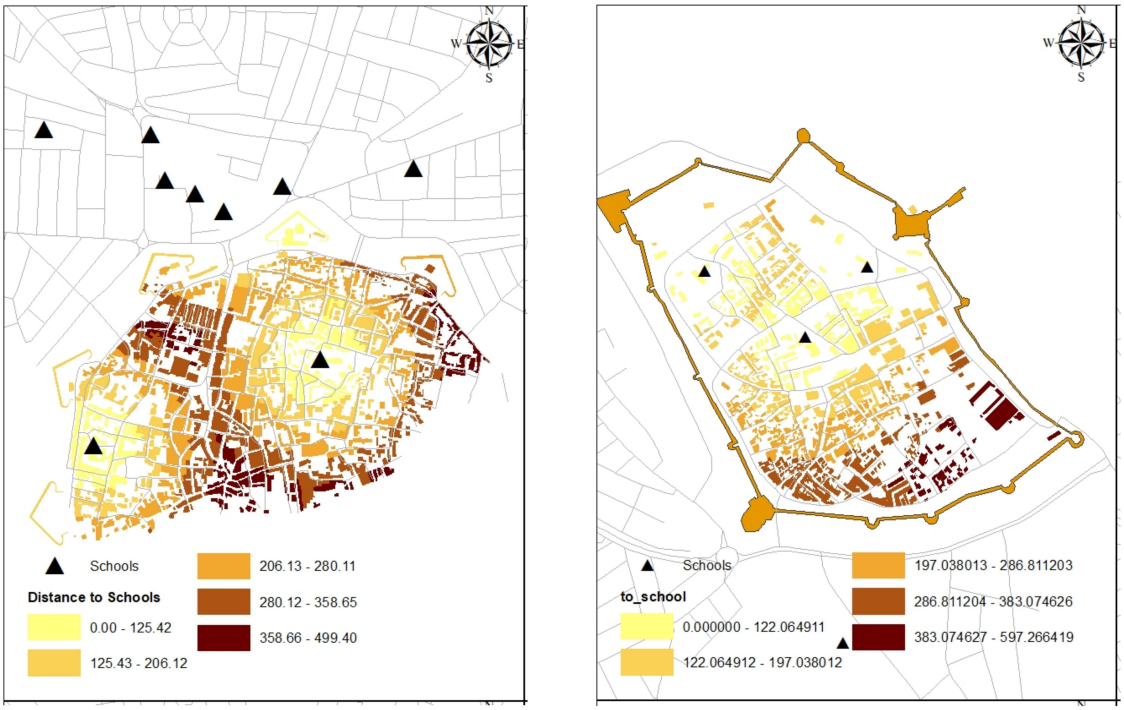
Amount of investments that support amenities (T1): The economic sub-criteria were evaluated using different data collection methods. The amenities were evaluated based on their frequency as displayed on the Open Street Map (OSM) platform. OSM has proven to be a reasonably reliable image of the region's public amenities [46]. The numbers were first adjusted for the area in each case before conducting a pairwise comparison. Northern Nicosia, due to its administrative dimension and centrality, contains more public amenities compared with Famagusta. Nevertheless, these amenities are not equally distributed across the area and are more focused on central parts and tourist attractions.

Amount of investment for neighborhood regeneration (T4): Neighborhood regeneration investments are more numerous in Northern Nicosia. Many neighborhood regeneration plans have been proposed and implemented over the last two decades within the framework of the Nicosia Master Plan, which is an ongoing effort to preserve Nicosia's urban and architectural heritage regardless of its borders [49,51]. These projects in northern Nicosia included housing rehabilitation programs in Arabahmet, Samanbahce, and Selimiye [61]. Famagusta, on the other hand, has seen very limited investment for neighborhood regeneration, and the majority of the focus has been oriented toward more significant historical buildings and monuments [62]. Although small social housing units have been constructed on the northern side of the walled city by the municipality, the area lacks a clear plan for investing in neighborhood regeneration.

Affordable Housing (amount of housing prices or rents) (T1) and Number of projects for supporting local production (T1): Housing affordability was measured by exploring all available sales and rental options on the two major websites that are widely used in the region (23 cases in Nicosia and 14 cases in Famagusta). The collected prices were adjusted by area, and the averages were used for the comparison. The average price of housing is relatively higher in Famagusta (GBP 1029 per m2) compared to Nicosia (GBP 788 per m2), but the range of prices is much wider in Northern Nicosia (GBP 2228-246 per m2) compared to Famagusta (GBP 1400-418 per m2). What is more, the physical condition of housing in Northern Nicosia varies from neighborhood to neighborhood. For the criterion addressing local production, the number of workshops, shops, and non-governmental organizations supporting local production were counted and compared (adjusted for population). Nicosia, due to its centrality, higher tourist numbers, and its closeness to the border, has more activities associated with local production. Supporting local production and local involvement, which is an intrinsic dimension of Target 1, is a critical aspect of resilient neighborhood regeneration. Putting emphasis on mere physical improvement can create undesirable social side effects such as gentrification and unintentional displacement of the local population. Therefore, exploring the success of a regeneration plan needs to include intentions for the future stability of the social fabric.

3.2. Social Dimensions

As with the economic dimension, each social sub-criteria value was obtained from different resources. Accessibility to basic services and green spaces was analyzed in a GIS environment by using the near distance tool. Within the historical environments, the distances from schools, markets, and green spaces were calculated (see Figure 5) and the average distance from each house was added to evaluation Table 3. According to the local municipalities, regeneration projects that support alternative transportation modes are very limited. There are only a few pedestrianized roads in the historical environment. The percentage of crime values was generated with population data, and total crime values were obtained from local police and planning. In addition, the case area's proximity to green space and the percentage of children's access to green spaces were investigated.



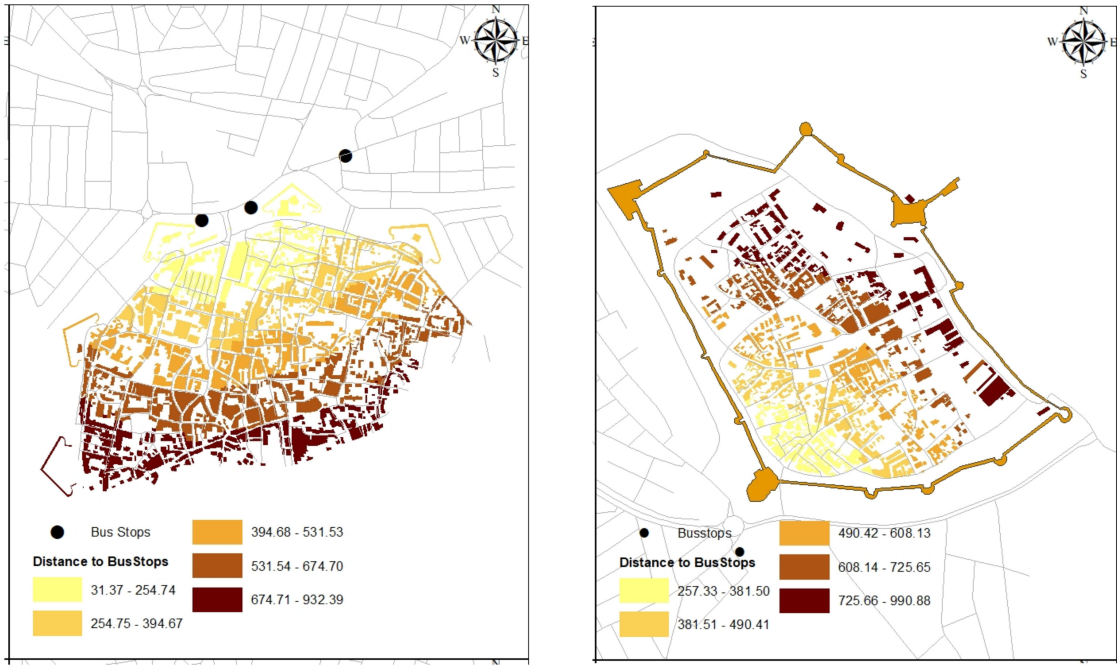
(**a**) (**b**)

Figure 5. Accessibility to Schools in Nicosia (**a**) and Famagusta (**b**) Walled Cities.

Proximity to basic services, distance to shopping areas, and distance to school (T1): Accessibility to basic services is one of the essential dimensions of sustainable urban development. This is particularly critical regarding local accessibility because it would reduce the necessity for vehicular traffic [63]. Local accessibility improvement would allow people to conduct many activities of their daily lives within their neighborhoods [64] and has a direct impact on their quality of life [65]. The sub-criteria, in this case, were measured by averaging the distance from all residential units to the local government schools. Both cases contain schools within the walls, and the network structure is relatively similar in both cases (Figure 5). Therefore, both cases, although isolated from the city to some extent, show high internal accessibility, which is expected from organically developed historic urban tissues (see [66]).

Access to public transportation routes or bus stops (sustainable transportation) (T2): Public transportation plays a key role in developing cities that are less car-dependent and more sustainable [67]. Having a bus stop within walking distance has a significant impact on residents' mode of transportation, which reduces traffic and pollution while encouraging walking [68]. Equal access to public transportation for all residents is a social necessity for sustainable development [69]. In this case, the two cities are highly dependent on cars, and

public transportation remains limited to the services provided by the universities [70]. The buses do not enter the walled city and are not permitted to do so due to their weight and size. Furthermore, there is no support for smaller shuttle buses that can supplement the existing system. Accordingly, all bus stops and routes are directly connected to the gates and are not highly accessible (Figure 6), especially considering the peak climate conditions, which might make walking to the bus stops undesirable.



(**a**) (**b**)

Figure 6. Accessibility to Bus Stops in Nicosia (**a**) and Famagusta (**b**) Walled Cities.

Regeneration projects that support alternative transportation modes (T2): There is very limited access to alternative transportation modes in both cases. There are some private bicycle stands supported by local mobile phone companies, but these facilities are often oriented toward touristic activities and not usable by the local residents. What is more, there are no dedicated bicycle lines that encourage locals to use alternative modes of transportation. Sustainable transportation in this regard is highly influenced by the way people imagine and think about it in terms of their daily routines [71]. Therefore, it could be assumed that the degree of availability of infrastructure supporting alternative transportation modes would impact people's attitudes toward them. Alternative transportation models in this sense can be considered a socio-cultural phenomenon where even the norms of what constitutes normal—or even acceptable—transportation vary from context to context [72]. Moreover, a combination of alternative and public transportation would have a much stronger positive environmental impact [73].

Number of Crime/Crime Rate Per Capita in Historic Urban Quarters (2011–2020): The region is known to have a very low crime rate, especially regarding violent crimes [74]. This is evident from the nine years of data that are presented here. The crime rate data were collected from the police departments of both cities. In this case, instances of crime have been recorded with street names but do not provide exact coordinates (Table 2). The majority of these crimes are shoplifting and petty theft, which shows the concentration of these activities around commercial areas. However, even a trivial crime rate indicates the presence of inequality, social stratification, poverty, and crime rate as interconnected topics [75]. The relationship between crime and neighborhood regeneration is complex [76] and goes beyond the scope of this study. In general, reducing crime rates is essential to achieving sustainable neighborhood regeneration; nonetheless, neighborhood regeneration

can decrease the crime rate by creating new opportunities [77,78]. In both cases, it is evident that the crime rate is higher in areas that have undergone some renovation and are tourist destinations, which makes them more vital and vibrant with microeconomic activities and consequently more prevalent for the aforementioned type of crime that occurs in the city.

Table 2. Crime Analysis in Nicosia and Famagusta Walled Cities.

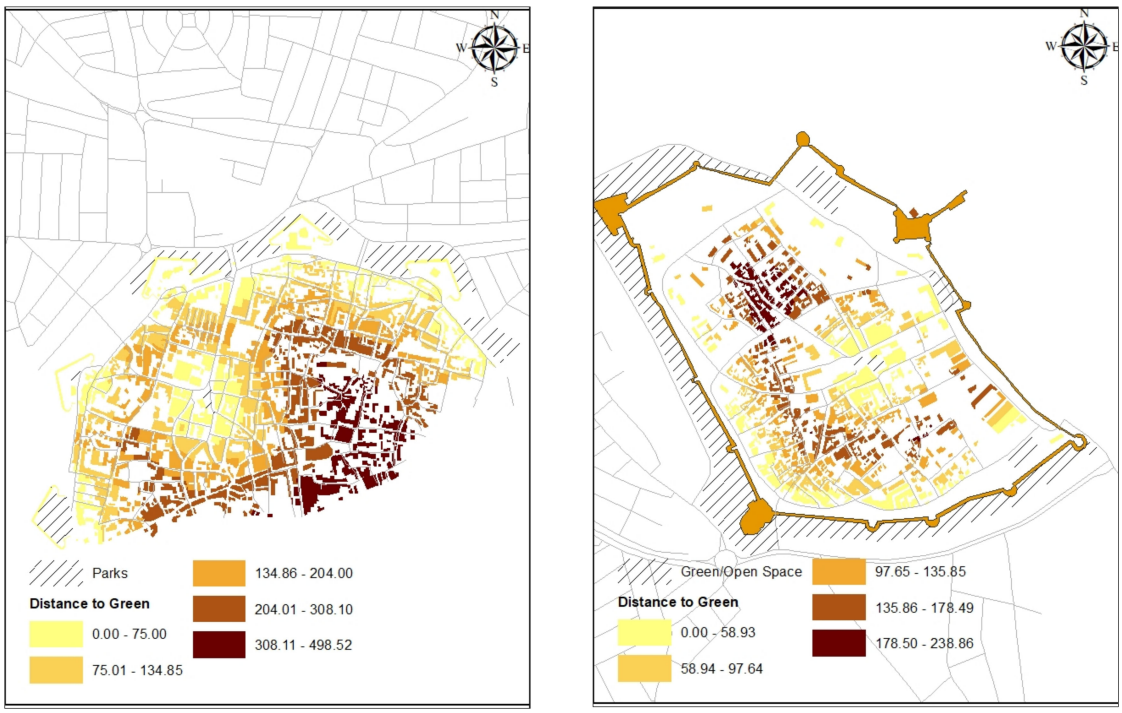
	Nicosia			Famagusta		
Years	**Population**	**Amount**	**Ratio**	**Population**	**Amount**	**Ratio**
2011	6800	298	0.04	1476	3	0.00
2012	6815	343	0.05	1472	2	0.00
2013	6835	321	0.05	1462	9	0.01
2014	6888	274	0.04	1459	32	0.02
2015	6956	211	0.03	1459	33	0.02
2016	6950	216	0.03	1443	59	0.04
2017	6958	204	0.03	1430	35	0.02
2018	7087	236	0.03	1442	58	0.04
2019	7181	262	0.04	1447	22	0.02
2020	7152	215	0.03	1427	31	0.02
		OVERALL	0.04			0.02

Proximity to Green Space (T7) and Percentage of Children's Access to Green (T7): Providing just and proper distribution of green spaces throughout the city is a critical dimension of regeneration planning [79]. Both cases are dense organic urban tissues with walls and moats; accordingly, the largest green space for both cases is the moat. This historic defensive element now serves as a green pedestrianized path in both cases, albeit access to this space is limited through the gates of the walled cities. The central public spaces of both cities present open public spaces with some greenery, although this is more prominent in the case of Famagusta. Children's access to green spaces was determined by proximity to parks with designated areas for playgrounds—albeit at a smaller proxy. Famagusta has a slight edge over Nicosia regarding this criterion; with a children's playground located at the heart of the city, it provides better and more accessible green areas for children (see Figure 7).

3.3. Environmental/Physical Dimensions

The targets regarding the physical and environmental aspects of cities are very versatile within the framework of SDG-11. In this case, ten criteria were used to evaluate the two alternatives (addressing targets 2, 4, 5, 6, and 7). Screening UNDP project documentation, publicly shared information made available by municipalities, the LIPA 2019 socio-economic survey for the Gazimağusa Iskele and Yeniboğaziçi Master Plan, the Environment Department, and the Town Planning Department were used to collect the data. Some criteria were evaluated using analysis conducted on GIS maps of the region.

Number of Road Safety Projects or amount of area for traffic calming (T2): Road safety projects can significantly reduce the number of accidents [80], and they play a significant role in the success of urban regeneration projects [81]. In this case, the instances of road safety measures and their locations were collected from musicality maps. Both cities utilize measures such as speed control cameras, raised curbs, speed bumps, road textures, mirrors for sharp turns, and active police patrols. The entrance to both walled cities is limited by the weight and size of the vehicle. Although both cities have reasonable road safety features, Nicosia performs better. This is most likely due to its centrality, resources, and budget.



(**a**) (**b**)

Figure 7. Accessibility to Green Space in Nicosia (**a**) and Famagusta (**b**) Walled Cities.

Percentage of Shared Streets or Pedestrianized Streets (T2): The impact of pedestrian movement on the quality of life in cities is well documented in the literature (see [82]). The comparison was conducted using data collected from the municipalities of the two cities. Nicosia has seen much more development in terms of road safety projects and pedestrianization efforts in line with its comprehensive master plan. Both cities include pedestrianized segments mainly around historic landmarks, but the efforts are more spread out and regulated in Nicosia. In this case, the comparison was conducted via the volume of pedestrianized space relative to the size of the walled cities.

Percentage of neighborhoods or quarters regenerated (T4): As mentioned before, only Nicosia hosts officially regenerated neighborhoods, namely, the housing rehabilitation programs in Arabahmet, Samanbahce, and Selimiye [61]. In Famagusta, neighborhood regeneration efforts are mainly limited to personal investments. The criteria weights here were generated by comparing the relative areas of residential neighborhoods that have gone through some regeneration.

Percentage of buildings (listed) reconstructed (T4), and Percentage of landmarks that reconstructed (T4): Within the framework of target 4 of SDG-11, the protection, rehabilitation, regeneration, and reconstruction of historic buildings and landmarks are highlighted [83]. The capital investments required for these protection plans need to be secured via multiple levels of government, including local communities, local administrations, the private sector, national governments, and global institutions—especially as outlined in indicator 11.4.1 [84]. Accordingly, the extent of these efforts illustrates the level of attention that exists surrounding a historic site from different perspectives. In this case, information was gathered through UNDP, municipalities, and the Antiquities Department. In terms of landmarks and more significant urban heritage, both cities have a good track record due to findings secured via UNDP programs. Nevertheless, urban tissues, residential buildings, and less-significant built heritage are less visible in these plans. These buildings require more engagement from private and local stakeholders. Examples of private investments in this regard can be seen in the rehabilitation of many residential buildings into cafes, shops, and tourist gift shops. It is necessary to note that, in accordance with all regeneration

charters, preservation of the context is as critical as the landmarks. This requires more attention in both cases.

Number of losses caused by flood events or different disasters (T5): Target 5 addresses issues related to the prevention of loss of life, particularly those associated with preventable causes. In this case, there are no recorded losses of life in the contemporary histories of the two cities caused by natural disasters, famine, or economic despair. The only real neural phenomenon that causes some problems is flooding, which is not severe and has not caused any loss of life.

Existing waste collection services (T6): A robust waste management system is vital for sustainable and resilient urban regeneration efforts [85]. Data were collected from the municipalities, and from a survey that was conducted by LIPA in 2019 addressing the occupancy evaluation of waste management systems. Waste management was ranked as the most important environmental sub-criterion by the experts (see Table 1). Although there are efforts for systematic separation of waste by material and recycling, these efforts are still very limited, and most collected waste finds its way into landfills [28]. Nevertheless, both cities are kept relatively clean. The sewage system, however, is lacking, and the majority of houses use septic tanks. Due to the historic layering of the city, the realization of an underground sewage system seems to be harmful.

Air Quality (T6) and Ratio of areas in industrial services (T6): These factors correspond to Target 6. Both cities have very low air pollution, and they are very similar in this regard; however, Famagusta's proximity to the cargo port might be a cause for concern for air pollution. In both cases, the industrial functions are located outside the walls, and very small areas are occupied by industrial land use (some car repair shops).

3.4. Administrative Dimensions

The administrative criterion was assessed using three sub-criteria, which primarily addressed Targets 3 and 8 of SDG-11: existing master plans or protection plans for the historical area (T3), design guidelines that support protection plans or policies (T3), and the existence of protection urban master plans with regional plans (T8). Accordingly, if a corresponding official document for each criterion was extant in both cases, it was marked as equal; otherwise, the city where those conditions were met was evaluated higher. Nicosia has a comprehensive master plan compared to Famagusta, which does not have an officially published master plan. It must be noted that Famagusta, a walled city, has a revitalization plan, but it is not officially published and is referred to more as a general guideline. The revitalization plan for Famagusta has a set of design policies and protection targets for regeneration and upgrading the historic cultural environment. The National Physical Plan (2015) also has goals and targets for Famagusta, but it does not have any economic, social, or physical items for the historic walled city.

Criteria values and resources which data were collected is shown in Table 3.

After obtaining the criteria values for the case areas, AHP-generated weights and criteria values were combined using the Simple Additive Weighting (SAW) formula (see Equation (1)). SAW is a multi-attribute procedure based on the concept of a weighted summation:

$$f(x) = \sum_{j=1}^{n} (W_j \cdot X_{nij}) \quad (1)$$

where W_j is the relative importance weight of criteria j, X_{ij} is the standardizing value of area i under criterion j, and n is the number of criteria. Each criterion was summed for the calculation of the main criteria values by using the formula. As can be seen from Figure 8, Nicosia's walled city (North) is more sustainable than Famagusta in economic and administrative terms. Physically and socially, they are very close (see Figure 8).

Table 3. Evaluation of the Criteria and Sub-Criteria for the case areas.

	Criteria/Case Area	Nicosia Walled City (North)	Famagusta Walled City	Resources
Economic	Amount of investments that support amenities (T1)	0.131	0.059	Authors: Open Street Map
	Amount of investment for neighborhoods regeneration (T4)	0.69	0.31	UNDP, Municipalities Antiquities Dept.
	Affordable Housing (amount of housing prices or rents) (T1)	0.155	0.118	Authors: local real estate services
	Number of projects for supporting local production (T1)	0.211	0.141	Authors: Open Street Maps
Social	Proximity to basic services, distance to shopping areas, distance to school, distance to (T1)	0.757	0.787	Authors: GIS
	Access to public transportation routes or bus stops (sustainable transportation) (T2)	0.527	0.45	Authors: GIS
	Regeneration projects that support alternative transportation modes (T2)	0	0	UNDP, Municipalities Antiquities Dept.
	Number of Crime/Crime Rate Per Capita in Historic Urban Quarters (2011-2020)	0.04	0.02	Police Dept.
	Proximity to Green Space (T7)	0.767	0.889	Authors: GIS
	Percentage of Children Access to Green (T7)	0.767	0.889	Authors: GIS
Environmental/Physical	Number of Road Safety Projects or amount of area for traffic calming (T2)	0.50	0.25	UNDP, Municipalities Antiquities Dept.
	Percentage of Shared Streets or Pedestrianized Streets (T2)	0.13	0.07	UNDP, Municipalities
	Percentage of neighborhoods or quarters regenerated (T4)	0.21	0.03	UNDP, Municipalities Antiquities Dept.
	Percentage of building(listed) reconstructed (T4)	-	-	UNDP, Municipalities Antiquities Dept.
	Percentage of landmarks that were reconstructed (T4)	0.28	0.25	UNDP, Municipalities Antiquities Dept.
	Number of losses caused by flood events or different disasters (T5)	0	0	Municipalities
	Existing waste collection services (T6)	0.75	0.77	Municipalities, LIPA (2019)
	Air Quality? (T6)	-	-	Environment Dept.
	Ratio of industrial services to total area(T6)	0.03	0.01	Town Planning
	Amount of Greenspace per capita (T7)	0.18	0.90	Authors: GIS
Administrative	Existing Master Plans or Protection Plans for the Historical Area (T3)	1	0	Town Planning
	Design Guidelines that Support Protection Plans or Policies (T3)	1	1	Town Planning
	Existence of Protection Urban Master plans with Regional Plans (T8)	1	0	Town Planning

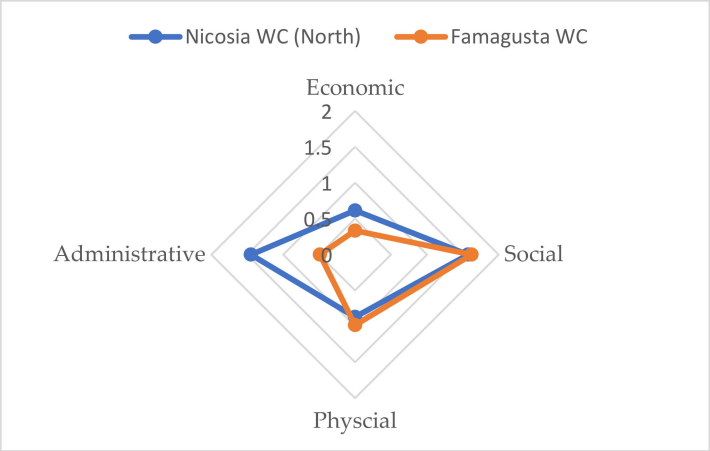


Figure 8. Comparison of Main Criteria Results for the case areas.

4. Discussion and Conclusion

In this study, urban renovation in historical and cultural heritage areas was evaluated within the scope of the sustainable urban development goal and targets. First, the SDG-11 target and sub-targets were examined, and a list of criteria for these objectives was created corresponding to the relative circumstances of the two case studies. The weights of these criteria have been demonstrated by experts using the AHP method. After the determination of relative weights, all criteria were analyzed, and the values found were normalized in the range of 0–1. After this stage, all data related to the Nicosia Walled City and Famagusta Walled City regions were collected, and the basic criteria and sub-criteria for sustainability were compared with criteria weights.

The United Nations' sustainable development goals, even when explored individually, are highly complex and interconnected concepts. Contextual preferences add an extra layer of complexity to projects aiming for tangible progress toward the SDGs. This is more apparent in urban regeneration plans, which are highly contextual and correspond to different layers of local populations and stakeholders [86]. Complexity is an intrinsic quality of cities [87], which makes approaching Goal 11—sustainable cities and communities—that includes a multitude of criteria more challenging. What is more, the data associated with different dimensions of an urban regeneration project can come from a multitude of sources. Superimposing these data layers requires methodological innovations and interdisciplinary explorations. Thus, decision-making encapsulates these challenges, requiring a method that can address different criteria at once. AHP was used in this study to highlight a methodological possibility for addressing these complexities with regard to multiple data sources while hearing the voices of local experts. What is more, the involvement of stakeholders in regeneration plans is essential to moving toward the SDGs [20], and AHP can provide a framework for different voices to be heard. Future studies can further explore the comparison of criteria weights generated by the different parties involved. This is critical as the image of neighborhood regeneration can differ from the viewpoint of local communities and governing bodies [88]. The current method aims not to remain merely top-down or bottom-up; rather, it aims to utilize both. What is more, the diversity of supporting data sources makes the approach more comprehensive. In this case, the outcome did not merely reflect the point of view of experts, the department of antiquities, or the municipalities, for instance, but rather a combination of them.

The experts, in this case, evaluated economic, social, and environmental criteria as almost equally important, followed by the administrative criterion. The weighting of sub-criteria was a much more complicated process consisting of a multitude of data layers from different sources in two cases. The results show that each city has unique strengths and shortcomings in its regeneration approach when aiming for SDG-11. Northern Nicosia scores higher in most sub-criteria because it has a clear master plan, some neighborhood

regeneration projects, better road safety, affordable housing, and pedestrianization schemes. This might be attributed to the centrality of the city, its population, and the flow of capital through it, which makes many of these projects feasible in the eyes of stakeholders. Famagusta, on the other hand, only excels in terms of the amount of green or open space per capita. In general, walkability and accessibility seem to be highly influential dimensions of sustainable regeneration efforts.

The importance of proper planning for land use in a growing, conflicted city is a concern. In both cases, the Cyprus conflict has left its mark, slowing regeneration efforts and especially international investments. Making a meaningful connection with the tourism sector by highlighting local culture and contextual values in the regeneration plan would make Nicosia's regeneration plans more resilient [89]. Within the context of Nicosia, Atun [48] argues that regeneration plans should be a link between the past and future of the city. As one of the rare communal efforts between the north and south sides, these urban master plans could serve to create a more sustainable future for the cities. Savvides [90] shows the critical importance of accounting for residential and housing rehabilitation within the framework of the regeneration of Nicosia. In a regeneration plan, the housing sector is the seed for improving the economy and local job market. Although the administrative criterion was evaluated lower than the main pillars of suitability, it encapsulates and guides those criteria if conducted properly. It could be argued that the reason why Northern Nicosia scores higher across sub-criteria concerning SDG-11 is its masterplan, which is lacking in the case of Famagusta.

One of the current study's findings was the apparent lack of attention paid to urban residential tissue when compared to well-known historic buildings. Affordable and socially inclusive housing is an essential component of sustainable urban regeneration planning and policies [91]. Thus, regeneration efforts targeting long-term sustainability need to pay closer attention to the residential tissue that is associated with the everyday life of the city. This is particularly important as both sites are points of interest for UNDP, so it could be argued that a more comprehensive approach that does not solely focus on the physical restoration of structures needs to be implemented. Furthermore, it cannot be denied that economic issues are the most central in terms of immediate impact on sustainable urban regeneration plans [92]; therefore, the micro-economy that empowers local production, involvement, and investigation is critical. This is critical as lack of attention to the local population can lead to displacement (intentional, incremental, or as a side effect of the economic transformation), transformation of the social fabric, and gentrification in some cases; these are well-known phenomena that occur when the planning parties are disconnected from the setting [88,93]. Therefore, the involvement of the local communities in the decision-making process is critical in achieving more sustainable and resilient future neighborhoods that aim for regeneration without displacement [93]. In this regard, AHP provides a methodological possibility for the involvement of different parties together with various secondary data sources.

In the end, it must be noted that this study was not without limitations. Many dimensions such as cultural heritage, social neighborhood structures, place attachment, and identity are influential elements of planning for urban regeneration [94], which are not investigated in this paper. Nevertheless, the methodological novelty of the study indicates the possibility of creating more inclusive and complex AHP models. Accordingly, future studies are required to expand on the list of criteria and to include other SDGs in the model.

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