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Editorial

Mehmet Topçu (Editor in-Chief)

JOURNAL of DESIGN for RESILIENCE in ARCHITECTURE and PLANNING (DRArch) is a multi-stakeholder independent organization with wide participation from different institutions. We are proud of to publish Volume 3 issue 1 with fresh ideas. The main topic of this issue is to discuss resilient design perspective, participatory design approach, ecological criteria, land value change, cultural landscape and archeological sites spanning from Anatolia to African Saha Desert.

Volume 3 Issue 1 begins with a study titled as “Mersin City-Lab: Co-creative and participatory design approach for a circular neighbourhood” a collaborative effort by seven different scientists. Nida Naycı, Ekim Tan, Hayriye Oya Saf, Mehmet Ali Mazmancı, Hüdaverdi Arslan, Hüdaverdi Arslan, Mehmet Ali Kurt focused on city laboratories in this study. City laboratories or urban living labs provide creative experimental platforms with participation of city actors to discuss urban sustainability issues before implementation of deep and structural urban changes for citizens. The paper starts with introduction of ‘city-gaming’ methodology and continues with discussions on stages of the case-study project through implementation of workshops. The paper concludes with impacts of City Labs approach and city-gaming methodology on decision-making process for real urban problems and urban settings.

The second article is multi-authored, and it is an adaptation of new conceptual approaches to fieldwork just like the first study. “Augmented experiences in archeological sites: Presentation of Alexandria Troas Podium Temple towards visitor experience” has been prepared by Hakan Anay, Ülkü Özten, Merve Ünal, Erhan Öztepe. Augmented Reality (AR) is a rapidly emerging but still quite a young field. This multidisciplinary study involves development and implementation of an AR application of a selected case: “Alexandria Troas Podium Temple,”. AR seems to have its own agenda, coming with unprecedented possibilities still to be appreciated and adopted, which in turn might help us to go beyond the conventional conceptions and modes of conservation of cultural heritage and presentation. Another conceptual approach is vulnerability assessments using the multi-Criteria Decision Making (MCDM) method. Selda Erdoğan and Fatih Terzi paper focuses on vulnerability assessments and presents a multi-criteria decision-making and earthquake-related vulnerability assessment method by using physical and socioeconomic parameters in the Historic Peninsula. The results of the method proposed in this study can be used as a basis for risk reduction studies. Another interesting paper titled as “Investigation of the Footprints of Ecological Criteria in The Historical Minority Mansion in Kayseri Talas” by comes from Zübeyde Özlem Parlak Biçer. This research deals with the concepts of ecology and sustainability from a different perspective and traces the ecological architecture through a residential building belonging to minorities that can be qualified as a historical cultural heritage and located in the Yukarı Talas locality of Talas district of Kayseri.

The fascinating piece of work comes from Guerrout Chouaib and Bahar Baser Kalyoncuoglu with the article titled “Understanding the cultural landscape value of traditional agrarian landscapes of African Sahara Desert: case of Timimoun, Algeria”. The paper aims to identification of cultural landscapes in the oasis and analyses transformation and change in cultural landscape and traditional green infrastructure elements by relying on a historical analysis of spatial images based on quantitative analysis using ArcGIS.

Somaiyeh Nasrollahzadeh contributed to this issue with the following article; “Comparative analysis of building large-scale projects in developing countries by emphasizing on land value changes: Case study: Tehran- Iran Mall versus Istanbul-Third Airport”. Meanwhile, the Tehran (Iran) and Istanbul (Turkey) cities, due to their location, economic and political conditions, have always been challenged to attract capital. Therefore, in recent decades, they have started to make investment capacities by developing large-scale projects. This study aims to verify two of the most challenging large-scale projects in these two cities.

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The term resilience has been examined in terms of ecological, economic, and cultural parameters specific to residential areas by Begüm Demiroğlu İzgi. In the first part of the research called “Resilience of rural settlement morphology dynamics: Example of Kargalı district (Village)”, the identity of the settlements and the resilience factor against change/transformation threats are explained according to the definitions in the literature. In the second part, the dynamics of rural settlement morphology are defined and the effect of rural resistance on the dynamics is presented. In the last part, a stratification analysis is made according to certain year intervals over the Kargalı district (village) of the Polatlı District of Ankara.

The last article which is entitled “Retrofit suggestions from resilient design perspective in educational buildings lighting systems” is at the building scale. Kasım Çelik has discussed the lighting arrangements of educational buildings. Within the framework of resilient design, certain suggestions have been developed in light of the current lighting standards in effect regarding the processes to be followed before the retrofit works to be performed in the lighting arrangements of the school buildings.

As the Drarch editorial team, our motivation is increasing with the interest of readers. As the editor-in-chief of DRArch, I would like to extend my deepest gratitude the intense interest of researchers and the care of our referees. Enjoy your reading, best regards...

Following names that provided valuable contribution as referees of articles in this issue are:

Özgün Arin (Assist. Prof. Dr.), İstanbul Okan University

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Cover photo: Image copyright © Sena Özfiliz, İstanbul Büyükada, (2018). The image on the left is detail " Taş Mektep Building (Old Büyükada Primary School) Cover and logo design: Mojtaba Karimnezhad

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DRArch's objectives are:

- to question how future building technologies are revolutionizing architectural design, city planning, urban design, landscape design, industrial design, interior design and education,

- to catalyze the processes that lean on interdisciplinary and collaborative design thinking, creating a resilient thinking culture,

- to improve the quality of built environment through encouraging greater sharing of academicians, analysts and specialists to share their experience and answer for issues in various areas, which distributes top-level work,

- to discover role of the designers and design disciplines -architecture, city planning, urban design, landscape design, industrial design, interior design, education and art in creating building and urban resilience,

- to retrofit the existing urban fabric to produce resilience appears and to support making and using technology within the building arts,

- to discuss academic issue about the digital life and its built-up environments, internet of space, digital in architecture, digital data in design, digital fabrication, software development in architecture, photogrammetry software, information technology in architecture, Archi-Walks, virtual design, cyber space, experiences through simulations, 3D technology in design, robotic construction, digital fabrication, parametric design and architecture, Building Information Management (BIM), extraterrestrial architecture, , artificial intelligence (AI) systems, Energy efficiency in buildings, digitization of human, the digitization of the construction, manufacturing, collaborative design, design integration, the accessibility of mobile devices and sensors, augmented reality apps, and GPS, emerging materials, new constructions techniques,

-to express new technology in architecture and planning for parametric urban design, real estate development and design, parametric smart planning (PSP), more human-centered products, sustainable development, sustainable cities, smart cities, vertical cities, urban morphology, urban aesthetics and townscape, urban structure and form, urban transformation, local and regional identity, design control and guidance, property development, practice and implementation.

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Editorial Team

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Research Article
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Mersin City-Lab: Co-creative and participatory design approach for a circular neighbourhood

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Abstract

While environmental, economical and social challenges that the world has been facing recently are increasing dramatically; cities have played critical role in generation many of these problems like negative impacts on environment and overconsumption of resources. Most of the cities today face severe sustainability challenges including sanitation, air pollution, environmental degradation, over population and lack of livability. However, cities may also raise answers to find solutions against many of such complex urban problems, since they are assumed as creative and innovative platforms for social ecosystem of ideas. In this sense, there is increasing interest in 'City Laboratories' or 'Urban Living Labs', which are established to provide creative experimental platforms with participation of city actors to discuss urban sustainability issues before implementation of deep and structural urban changes for citizens. They provide participatory, co-creative and experimental platforms for self-organizing cities. The aim of this paper is to discuss a collaborative City Laboratory approach -Mersin City Lab- to achieve sustainability principles during urban regeneration process for the selected case-study area located in Mersin. Mersin City Lab focuses on two aspects: Firstly, 'City Lab' approach, involves citizens and stakeholders into decision-making process. Secondly, it focuses on urban transformation process with circularity principles including water, mobility, energy, waste management, food and circular economy to achieve sustainable neighborhood development. The paper starts with introduction of 'city-gaming' methodology which has been adopted as the main structure of participation of multi-stakeholders. It continues with discussions on stages of the case-study project through implementation of workshops and game sessions by participation of multi stake-holders. Following, the results gathered from overall evaluations of participants' proposals regarding land-use, mobility and urban water management, local economy, urban development, urban agriculture and food strategies in neighborhood level are discussed. Finally, the paper concludes with impacts of City Labs approach and city-gaming methodology on decision-making process for real urban problems and urban settings.

Keywords: city lab, Mersin, city-gaming, circular city, neighbourhood.

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1. Introduction

Recent projections driven by UN Global Report on Human Settlements show that ratio of half of world's urban population passed for the first time the ratio of rural population in 2008. The ratio is projected to rise towards 70 % by 2050. Megacities with over 10 million population and hyper cities with over 20 million population will emerge during the following few decades (United Nations, 2009, p.4; Nevens et al., 2013, p.111). This situation also displays remarkable level of transition from production-oriented rural practices towards consumption-oriented urban living practices worldwide. Megacities with excessive population growth impose severe environmental risks such as large amount of carbon emissions due to heavy traffic, urban heat island affect, delimitation of underground water, degradation of forestry and agricultural lands, fragmentation of wildlife habitats, decrease in biodiversity. Cities play critical role with their negative impacts on environment and resource consumption. Most of them face severe sustainability challenges such as water and air pollution, sanitation problems, urbanization, and lack of livability (Von Wirt, et al. 2019, p.230). In addition to environmental problems, social and economic problems accumulated in these contexts cause severe urban development challenges for decision makers. But cities are also potential key factors to solve these problems since they are accepted as ecosystem of new ideas mainly open-minded and innovative (Nevens, et al. 2013, p.112; Von Wirt, et al. 2019, p.230). Fundamental principles of sustainable urban development goals include (i) environmental criteria integrating ecological constraints and mitigating adverse impacts of climate change, (ii) social criteria aiming to improve livability of communities, (iii) economic criteria empowering of self-sufficiency and wellbeing of citizens, and (iv) institutional criteria engagement of various stakeholders into planning and decision-making process (Wheeler, 2013, p.28; Sharifi, 2016, p.3).

1.1. Urban Living Labs: Co-Creative and Participatory Platforms

Although, cities are accepted as having potential role in sustainable development goals, there is still need for creative platforms to manage complex urban problems. Urban Living Lab approach is believed to close this gap by supporting inclusive medium for urban innovations (Steen and van Bueren, 2017b, p. 21; Hossain et al., 2019, p.977). Recently, there is an increasing interest in 'Urban Living Labs' (ULL) with high number of examples from different parts of the world[1]. ULL is derived from Living Lab phenomena, which has been developed a social innovative ecosystem to find solutions or products for a given problem. Steen and van Bueren (2017, p.11) classifies goals of ULLs as 'innovation'; to develop new products to find solutions for a given problem; 'knowledge development for replication' to exchange knowledge of existing products, 'increasing urban sustainability' to support local solutions. "Hub, incubator, makers space, city laboratory, urban lab, field lab" are other terms that are used for similar examples (Steen and van Bueren, 2017b, p.22).

Among them, 'Urban Living Labs' (ULL) or 'City Labs' concentrate on real urban problems or development processes accepting the fact that all city actors have potential role for decision-making process for real-life contexts and territories. They are designed or managed to provide creative experimental platforms before implementation of deep and structural urban changes for citizens, who should be assumed as end users (Von Wirt, T. et all, 2019, p. 232). These platforms are especially enhanced for new approaches and ideas to increase urban sustainability since they help to foster new ideas among citizens before complex urban interventions and redevelopment process are implemented. So, the main idea of ULLs is to provide tangible or digital collaboration medium for multiple-stakeholders and citizens where they can share and discuss their ideas about a given urban theme. Its conceptual content is summarized by Steen and van Bueren (2017, p. 4) as "real-life research with its multiple stakeholders in a co-innovating inclusive setting". First essential

[1] There are around 90 Living Lab experiences only in Netherlands today as stated by (Steen and van Bueren, 2017,p.10). Habitat Norway, which has been established in 1988 has recently set up SLUM (Sustainable Living Urban Model) LAB initiative (URL 1).

criteria for ULL is the subject of the work; whether it is a product, system, technology or an urban context. Secondly, interaction of multiple stakeholders from different organizations is essential so that the focus of subject can be discussed or tested from different perspectives in advance. And lastly, a collaborative platform must be provided so that participants can share their ideas through a co-creating process to achieve the purposed goals (Steen and van Bueren, 2017, p. 4). Steen and van Bueren (2017b, p. 22) also discuss differences of ULLs from Living Labs according to their aims, activities, participants and context. Achieving urban sustainability is very essential for ULLs, so their content and activities should include development, co-creation and iteration motives (Steen and van Bueren, 2017b, p. 23). In order to call a process of a living lab as 'co-creative"; the participants should be involved in development or generation process. In particular to urban problems; the participants must be part of decision-making process. According to the results of survey conducted by Steen and van Bueren (2017b, p.12) regarding 90 place-based sustainable innovation projects in Amsterdam; they evaluated that only 12 of them qualify living lab experience. There can be different place-making methods to provide involvement of participants into development of urban solutions. For instance; in Buiksloterham Living Lab experience in Amsterdam, the former industrial zone have been converted into a residential area. The new residents of the neighborhood, decision-makers responsible from the planning of the site, related institutions have come together to define the roadmap of the district together. City-gaming methodology has been enhanced for the round-table discussions and all results have been transformed into a circular manifesto for the neighborhood. Since than; residents have started to settle down the district and build their houses according to this manifesto (Tan, 2017; URL 2).

1.2. Urban Living Labs/City Labs Enhanced for Urban Transformation Discussions in Neighborhood Level

Neighborhood and districts are smallest local planning units in city fabric. With the rise of sustainable development goals recently, there has been increasing interest in sustainable neighborhood level planning approaches again, since they are accepted to have remarkable impacts in achieving more sustainable and livable environments for citizens (Farr, 2008, p.44; Wheeler, 2013, p.294; Sharifi, 2016, p.2). Various planning theories and approaches have been developed for neighborhood planning from the beginning of 20. century: Garden City movement in the beginning of 20. century, Neighborhood Unit movement during 1920s, Traditional Neighborhood development during 1980s and Eco-Urbanism approaches since 2000s (Sharifi, 2016, p.3; Gülcan, Ünal & Erol, 2020, p.16). Each movement has contributed important impacts in neighborhood planning, while Eco-urbanism has more focus in climate-change adaptation and mitigation compared to previous ones (Sharifi, 2016, p.6,13). Besides, smart-growth principles also focus on compact city-cores with mixed-used neighboring units in walkability distance (Milosovicova, 2008). In result, "planning by neighborhood" model has been revived as "sustainable neighborhood" by contemporary sustainable urbanism theories (Mehaffy et al. 2014, p.12). While neighborhood level planning concerns more on livability standards of citizens; local level plannings aim to develop policies regarding affordable housing approaches for citizens as a basis for social rights, circular economy and self-sustaining fiscal models based on recycling potentials of the city, and its resilience against climate change (Wheeler, 2013, p.287). Therefore, involvement of city actors into urban transformation process is very important in every level to achieve good governance and to impact citizens' behaviors towards more sustainable way.

Since neighborhood level planning for sustainable development goals in cities is still in the center of discussions today; there are several ULL or City Lab examples which are structured in

neighborhood level[2]. ULLs or City Labs mainly concern with processes rather than single products or innovations. Very complex urban problems like urban transition process, new methods like participative planning tools, or integrated approaches such as neighborhood-level development with its inhabitants can be tested or simulated through these platforms. Moreover, they provide to test an idea, display alternative scenarios, or discuss multi-facet problems through an inclusive platform among multi-disciplinary professionals and interest groups before complex urban transformation solutions are implemented (Hoosain et al., 2019, p.980; Nevens et al., 2013, p.112). Besides, they help to foster urban transition process and principles among wider public and citizens. Such City Laboratories which particularly focus on management and governance of urban transition process in real-life context are conceptualized as 'Urban Transition Labs' by Nevens et all (2013, p.115). They state the need for such 'hybrid, flexible and transdisciplinary platform' to provide space and time for development of alternative solutions for multiple issues together such as energy, mobility, food, built environment. This is one of the smartest and most sustainable ways for discussing complex problems of cities (Nevens et all 2013, p.116). Von Wirt et all. (2019, p.229) also underline the need for 'experimentation process' for good governance of sustainable urban transitions since system innovation is evitable to achieve expected goals. Essential principles to achieve expected goals in ULLs especially during urban transformation process are stated by Steen and van Bueren (2017, p.5) as "real-life setting, representation of users/researchers from multi-disciplines and active collaboration". Since ULLs are good platforms for "participation, experimentation and learning"; utilization of participatory and co-creative methodologies in these platforms are very important. This raises the question of what kind of methodologies should be applied in ULLs. Real-world experiments, gaining knowledge, experience sharing should be included into their process management. The iterative process for such experimental approach provides "learning by doing, doing by learning" experience amongst their participants as underlined by Von Wirt, T. et all. (2019, p. 230).

2. Aim and Content of the Study

Similar to negative urbanization impacts aroused during past decades worldwide; Turkey faces unsustainable development challenges and urban sprawl problems due to migration from rural to urban areas. The ratio of urban population compared to population living in countryside increased from 25 % in 1950s up to 77 % by 2012 (T.C Çevre ve Şehircilik Bakanlığı, 2014, p.v). Such a rapid migration towards cities have caused severe urbanization challenges such as generation of slums and informal neighborhoods, low quality of infrastructural and sanitary conditions, poor housing conditions, social gaps amongst newcomers and existing residents, lack of access to adequate education and descent work opportunities. Ataöv and Osmay (2007, p.61) classifies urban transformation movements in Turkey into three periods as 1950-1980s; 1980-2000s and from 2000s up to present. Accordingly; the Governmental policies regarding economic growth and industrialization between 1950-1980s aroused migration from rural to urban areas. This resulted in development of slum areas in the peripheries of big cities, some of whose population is doubled or even tripled in such short time. A number of legislative arrangements has been conducted in order to deal with development of slum areas and informal settings in the cities such as 'Squatter Law act no 775' adopted in 1966 (URL 3). Due to the decentralization process of planning authority from State institutions to local municipalities after 1980s; approaches towards migration and urbanization problems have shifted as well. Urban transformations from informal housing constructions to low-rise apartments or legitimization of existing illegal constructions have become into the scene as result of local political relationships aroused between the newcomers and locally

[2] Buiksloterham Citylab -*also introduced as one of the participants in this paper*- is one of the neighborhood-level Citylab experiences in Amsterdam started after 2014.

elected mayors of cities (Görgülü, 2009, p.772). The planning tools developed during such phases were 'urban rehabilitation' or 'upgrading' approaches which aim to improve existing conditions of housing units, 'urban redevelopment' implementations which transform informal building stocks into multi-story buildings; or 'urban renewal' approach which relocate existing ownerships to reserved building lots in other parts of the city by private investment companies (Ataöv and Osmay, 2007, p. 63). Starting from 1980s, urban renewal projects based on demolishment of existing unhealthy building stocks and reconstruct new ones instead, have become the main central strategy of the Government to deal with housing needs in cities. Adoption of Mass Housing Act no 2985 in 1984 and establishment of The Mass Housing Development Agency (TOKI) were important institutional and legislative arrangements of this period (URL 4). Starting from 2000s, the scale of urban renewal projects has increased especially in metropolitan cities with the impact of public-private financial collaborations between the State and big construction companies as a result of neo-liberal economic policies of the period. TOKI has produced 640.000 housing units through urban redevelopment process and mass-housing projects throughout Turkey between 2002-2014 (T.C Çevre ve Şehircilik Bakanlığı, 2014, p.42). Despite the increase of urban transformation and mass-housing experiences during the past decades, they are highly criticized by scholars due to following issues (Anlı and Osmay, 2007, p.71; Görgülü, 2009, p.771):

- Urban transformation approach perceived and practiced as physical and spatial improvements focusing on real estate problematics,
- Social gentrification, degradation of natural and historical values during such large-scale transformation interventions,
- Loss of local architectural and townscape identities in newly developed areas,
- Lack of participatory decision-making process and long-term strategic policies.
- Urban transformation increases environmental problems such as water demand, noise, excessive air pollution, dust and waste heat.

Within the light of these discussions, the aim of this paper is to develop an inclusive and collaborative City Lab approach to achieve sustainability principles during urban regeneration process for the selected case-study area located in Mersin, which has been migrated since 1990s. "Mersin Citylab" Project[3] addresses two urgent aspects of city making: Firstly, "City Lab" concept aims to provide involvement of citizens into collaborative decision-making for sustainable urban transformation process. Providing open dialog among stakeholders, constant exchange of information, learning and negotiation are expected outcomes from the study. Secondly, Mersin Citylab proposes an academic refocus of city transformation process with circular systems of thinking including subjects related to water, mobility, energy, waste management, food and circular economy to achieve sustainable neighborhood development. Mersin CityLab is a research based process; which aims to test city-gaming methodology to achieve participation of stake-holders into decision-making process of a given urban problem. In practice; Turkey is very new to ULL or Living Lab experiences. Başakşehir Living Lab established by Başakşehir Municipality aims to support social innovation of individuals and create a collaborative ecosystem medium for citizens (URL 5). TAK Kartal and TAK Kadıköy leaded by Kentsel Strateji are two experiences, which aim to create a place making medium for citizens. They have developed several activities and approaches to increase

[3] "Mersin (Toroslar) City Lab: An Interactive Planning Process for Inclusive Urban Visions in Mersin" is granted by Government of Netherlands, Ministry of Education, Culture and Science, Creative Industries Fund for Open Call Grants for Turkey 2018-2019. Project participants and researchers are Ekim Tan, Nida Naycı, Mehmet Ali Mazmancı, H. Oya Saf, Mutlu Yalvaç, Hüdaverdi Arslan, Mehmet Ali Kurt, Ekim Tan, Irene Poortinga, Willem Velthoven, Cavidan Aksoy.

public awareness about participatory and co-creative planning approaches and to make them become active citizens about their city or districts (URL 6). In this point; Mersin CityLab experience is one of the first case focusing on urban transformation process, which is one of the complex and conflictive urban problematics of the city.

2.1. Definition of Case-Study Area: The Yumuktepe Mound, Müftü Stream and Informal Neighborhoods

Case-study area, which administratively comprises Demirtaş and Alsancak neighborhoods today, is located in Toroslar District of Mersin city. The site is bordered with the Müftü Stream and marked with the prehistoric Mound of Yumuktepe, which are important natural and historical landmarks of the city respectively. The Yumuktepe Mound, whose historical background dates to around 7000 BC, is the oldest settlement core of Mersin. Archaeological excavations in the Mound started in 1993 and have revealed historic significance of the site since then (Caneva, 2010). The Mound is located by the Müftü Stream (former name Efrenk), which connects springs of Bolkar Mountains to Mediterranean Coast along 100 km north-south direction while 10 km. of the stream passes through the urban areas (Çakmak, 2010, p.42). The geology and natural context had changed since then, while the Mound reached up to 23 m. and the stream had changed its original streambed in time.

Mersin city has flourished as a port town of Çukurova plain located on East Mediterranean Region after the second half of 19. century (Ünlü, 2007, p.426). The Müftü Stream remained as eastern boundary of the city until 1940s since the historic urban core developed around the port area. North sections of Müftü Stream including today's Demirtaş and Alsancak Districts were enhanced as cultivated fields and gardens of the city, while Yumuktepe Mound remained within agricultural vicinities of the city (Figure 1). The Mound and the River used to be enhanced as recreational destination of families coming from downtown[4]. Mersin city has faced rapid urban population growth due to migration moves especially from Central, Eastern and South-Eastern provinces of Turkey because of new economic investments in the city and development of Mersin International Port (Kaygalak, 1999; Tümtaş, 2009, p.116)[5]. Meanwhile, former agricultural lands located along the Müftü Stream and around Yumuktepe Mound became one of the focal points of this migration process. Former gardens were replaced with illegal constructions and the whole context were transformed into informal settlements of Demirtaş and Alsancak neighborhoods (Figure 2) with severe urban and infrastructural problems (Naycı, 2018, p.135).

[4] This information has been underlined by number of resource persons during interviews with local residents in the site and workshop sessions of the Project.

[5] According to Turkish National Statistic Records; the urban population of Mersin raised from 221.861 in 1980, to 422.357 by 1990 and to 537.642 by 2000 (Tümtaş, 2009. 116).

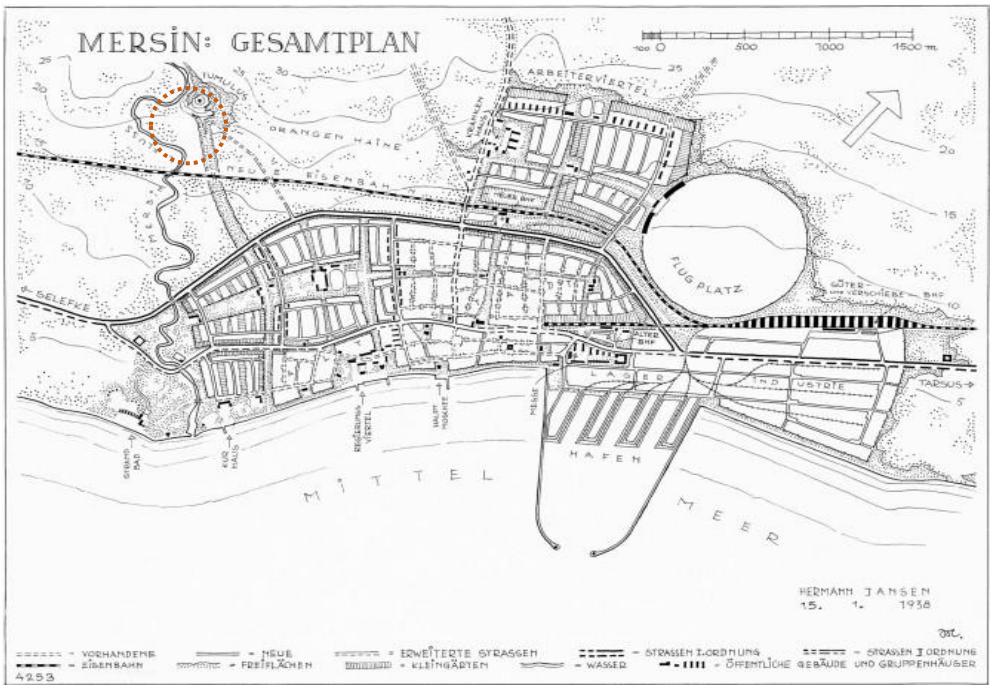

Figure 1 Müftü (Efrenk) Stream as western boundary and Yumuktepe Mound as important landmark of the city in Herman Jansen's plan for Mersin in 1938 (URL 7)

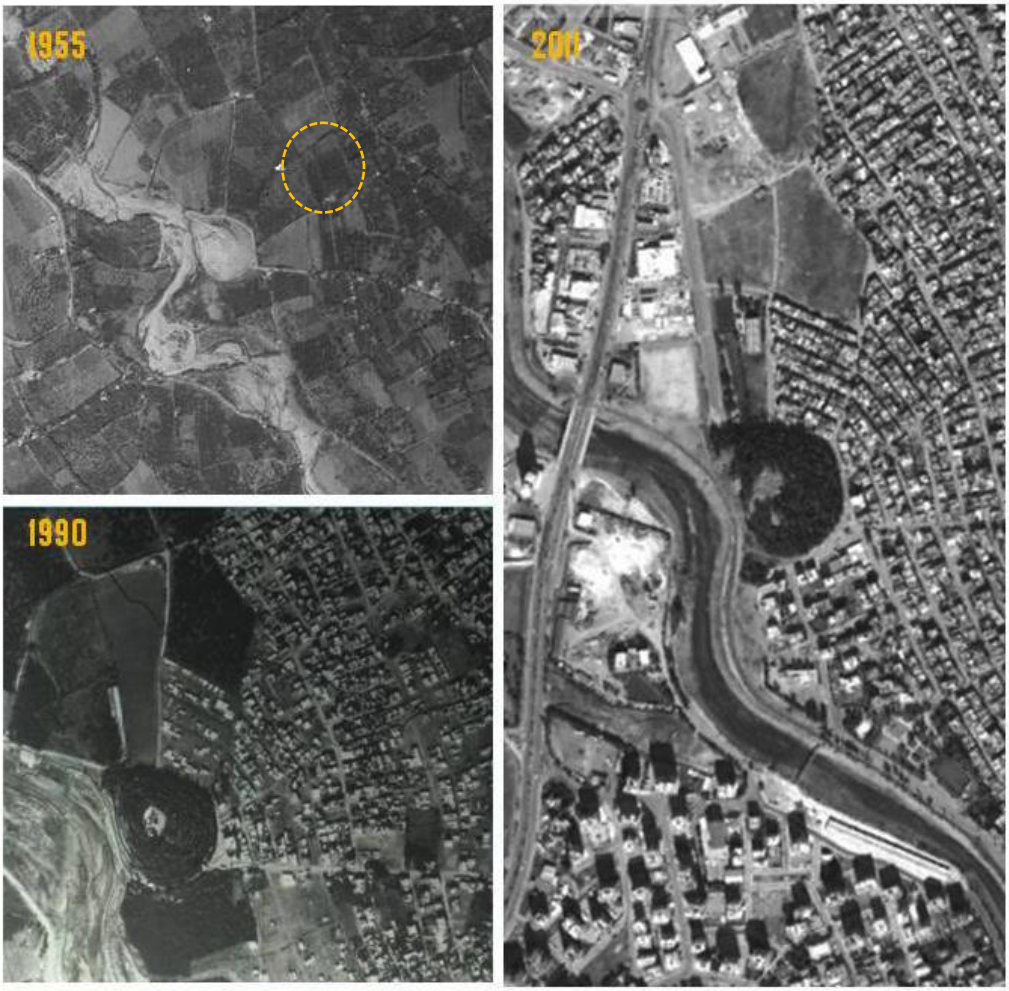

Figure 2 Urban development process around Yumuktepe Mound through 1955, 1990 and 2011 (Naycı, 2018)

The unsustainable development process of the region caused not only urbanization problems but also generated socially isolated immigrant neighborhoods. Gradually; integration of local inhabitants into socio-economical system the city stayed weak and public reputation of the area has become associated with crime and insecurity in time. In addition to social problems in terms of education, access to descent work and housing opportunities; local urbanization problems such as air pollution, sanitary and infrastructure have become important challenges stemming from its informal development background generated for the past three decades. Surrounded by unplanned urban context, significant potentials of the cultural heritage site of Yumuktepe Mound and potentials of Müftü Stream as green and blue corridor of the city has been neglected for a long time.

Another important aspect of the case-study area is administrative fragmentation in the planning and management context of the city. The Müftü Stream borders two administrative districts of Toroslar and Yenişehir Municipalities, each of which is responsible from urban development plans in their responsible areas. Besides; Metropolitan Municipality of Mersin is responsible from preparation of master plans including all districts in the city. Legitimization of low-quality informal settings within Toroslar district in time and recent planning decisions related to high-rise blocks across the river in Yenişehir area have been indicating an uncontrolled and fragmented urban transformation process in both sides of the Stream (Figure 3,4).

Figure 3 Housing constructions in the informal neighborhoods of Toroslar District

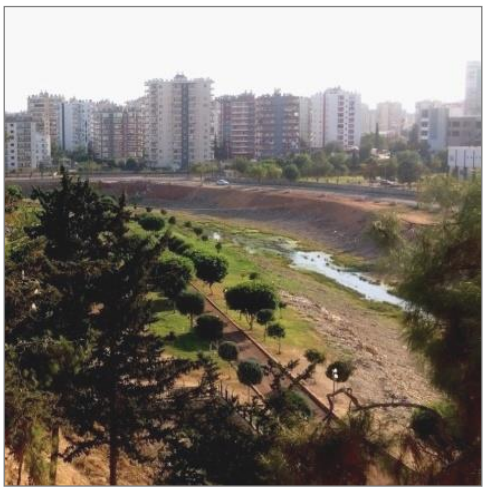

Figure 4 Changing urban silhouette with new construction in Yenişehir District

The mismatch between the local community and new residents living in high-rise buildings across the stream is only adding to socio-economic tensions in the city. In result, Müftü Stream

becomes a social boundary rather than single natural border separating inhabitants living on each side of the stream. Ecological degradation along the Müftü River and the historic and morphological protection required by the Yumuktepe archeological site add to the complexity of the local development challenge (Figure 5).

Figure 5 Changing urban silhouette with new constructions across *Müftü* Stream

During the past few years; Demirtaş and Alsancak neighborhoods have become subject to urban transformation discussions since the city grew towards north. Its close location to the city center; existence of Müftü Stream and prehistoric Yumuktepe Mound as significant landmarks of the city revalorized urban-land values of the context again. In order to overcome existing urbanization problems, existing Demirtaş and Alsancak neighborhoods have been designated as "Urban Transformation Zone", which delivered development planning authority to Mersin Metropolitian Municipality from district municipality. This situation has caused further speculative development and social gentrification pressures in the area. There is recently a number of local investments started in forms of high-rise residential and office blocks around the area. The ongoing developments disregarding local residents poses future social challenges as social gentrification or dislocation of existing residents. The new status of the area has induced a lot of rejections not only from the residents but also from various stakeholders since there is great doubt that proposed master plan will replace the existing urban tissue and historical morphological traces with a completely new urban layout. Besides, there is a high possibility of delivering this transformation process to big investment-contractor companies like occurred in similar examples in Turkey after 2000s.

Within the light of historical and urbanization developments stated above, the selected case-study area portrays a good 'city laboratory' to discuss sustainable urban transformation process with circular systems of thinking through an inclusive and participatory process with multiple stakeholders of the city. 'Mersin CityLab' Project aims to reveal following urban challenges and potentials of the case study area:

Historical and Geographical Context: The case-study area houses outstanding historical and geographical landmarks of city. Müftü Stream constitutes a very important green and blue ecosystem corridor potential passing through the city today. Similarly, prehistoric Yumuktepe Mound represents very important scientific and historic value along the stream. Signals of tourism potentials for developing the Mound as an open-air archaeological site or creating Müftü River waterfront projects have started.

Built-up Context: The study area now faces various urban challenges such as unsustainable urban development problems and informal settings generated in time. However, there is still 'neighborhood' identity in the site and there is strong awareness by the residents related to this.

Social Context: The multi-ethnical social structure of citizens immigrated in past few decades with different backgrounds accumulates very important potentials in means of social innovation resources and alternative local economy models for the city.

Administrative Context: Planning history of the case-study area portrays a local portion from urban migration problems and development challenges of Turkey that have been experienced since 1980s up to present. It provides good basis to discuss a self-organizing decision-making approach in relation with existing top-to-bottom planning regimes.

3. Methodology

Mersin CityLab project aims to practice a collaborative city planning methodology for thinking and strategizing city futures by providing a collaborative platform for formal and informal actors of city. The main principals regarding methodological approach of the project can be outlined as follows:

3.1. City Gaming as the Backbone of Mersin CityLab

City-gaming is the main method that has been adopted for integrating a dialog-based collaborative decision-making process in Mersin CityLab approach. City-gaming provide open-ended and dynamic simulation platform where different scenarios by various players can be discussed through game systems. Since Urban Living Labs and City Labs are claimed as 'conceptual laboratories' of cities, where various urban rules are tested, adapted and shaped through participatory sessions; city gaming becomes a strong and highly potential tool to discuss complex urban problems in city laboratories. It provides great opportunity for 'self-organizing' urban development process (Tan, 2017) where citizens and multiple stakeholders can take active role in development of their close environment, neighborhood, or any city context.

The methodology and its tools utilized during Mersin CityLab project have been developed by Play the City[6]. 'City Gaming' facilitating knowledge exchange and required partnerships through multiple city game sessions have been previously tested in CityLab Buiksloterham since 2014[7]. In city-gaming, the goal or urban problematic that is in the focus of discussions are defined as 'game'. Participants whoever contribute to discussions like multiple stakeholders, professionals, citizens, representatives from administrations are called as 'players'. Numerous iterative discussions, which are conducted by participants until a consensus is achieved, concrete or satisfactory results are obtained, have been identified as 'game sessions'. These three pillars constitute general idea of game structure. The city-gaming methodology developed by Play the City (Figure 6.) includes seven stages (Tan, 2017, pp. 42-43). The process starts with defining the game challenge that is expected to display a real-life situation or urban problem. Secondly, the stakeholder network related with subject of discussions is prepared. Following, the data that will be utilized during design of game tools are gathered and processed. Similarly; physical, economic or social resources that will provide input data to the game process are defined. In the next level, game rules and conditions, which will help simulating multiple conditions by participants and moderators are defined. All the tools data and resources prepared to be utilized during game sessions should be bring together through physical or digital platform. This is called as game interface or game room. Having completed all the data, tools, sources and game medium that can be defined as preparation of game format; the game sessions become ready to be played and recorded (Tan, 2017).

[6]Play the City is an architectural and urban design company established in Amsterdam, who develops city-gaming methdology for city actors according to given urban design problem.

[7] By using city gaming method, various stakeholders joined the initiative to discuss future scenarios and co-created their neighborhood according to principles they obtained after these sessions.

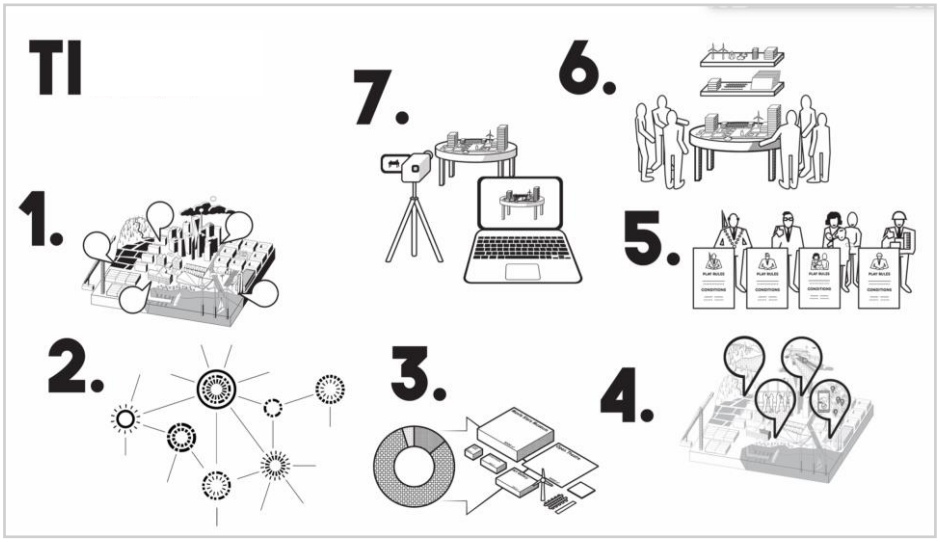

Figure 6 City-Gaming methodology applied during sessions (Tan, 2017)

3.2. Circular Systems as the Main Target for Sustainable and Livable Neighborhood

Circular thinking in cities is a systemic approach that integrates flow of energy, water, food, materials and people into sustainable urban development and transformation discussions. Mersin CityLab project aims to define a new dimension for the circular city where multicultural communities are valorized as crucial resources for the regeneration of the city. Beyond flows of water, energy and materials; migration potential of Mersin is assumed as main driver of urban transformation. The multicultural social structure of the city residents provides also great potential for determining social innovation as the key factor for local economy and urban environment. Thus, city-gaming methodology for Mersin CityLab is built on this holistic approach. Based on the input of the first game session, themes of mobility, water, urban agriculture and local economy has come to the forefront (see section 3.3.3); while each circular theme has been linked with workshops and game sessions.

3.3. Research and Implementation Stages of the Project

The project starts with literature research and site surveys related to physical, technical, and social capacity of the project area by the research team as well as existing legislative tools to understand circular system potentials of the neighborhoods. This stage has provided important basis for the content of discussions that will be moderated regarding urban transformation principles and define key actors that will join to workshops and game sessions. The project team has conducted physical surveys related to natural and built-up context, existing infrastructural conditions of the settlement, historical and planning background and social surveys through in-depth interviews with the residents in the site.

3.3.1. Identification and Engagement of Stakeholders:

Since the scope of Mersin CityLab has been defined as to facilitate an open dialogue and shared knowledge amongst stakeholders and citizens who feel responsible for the future of their city; focused workshops and game sessions were organized to ensure an open platform for new group of participants around the table each time (Figure 7). Each game iteration has brought citizens, local experts from professional associations and companies, representatives from local administrations and municipalities, academics and NGOs, as well as Dutch circularity experts from Amsterdam Rainproof, Mediamatic and Buiksloterham Citylab on the particular topic. While research team has provided local data related to existing land-use, urban agriculture, urban ecology, mobility, waste flows, and demographical data; all city stakeholders contributed to discussions with their experiences and future expectations from the site.

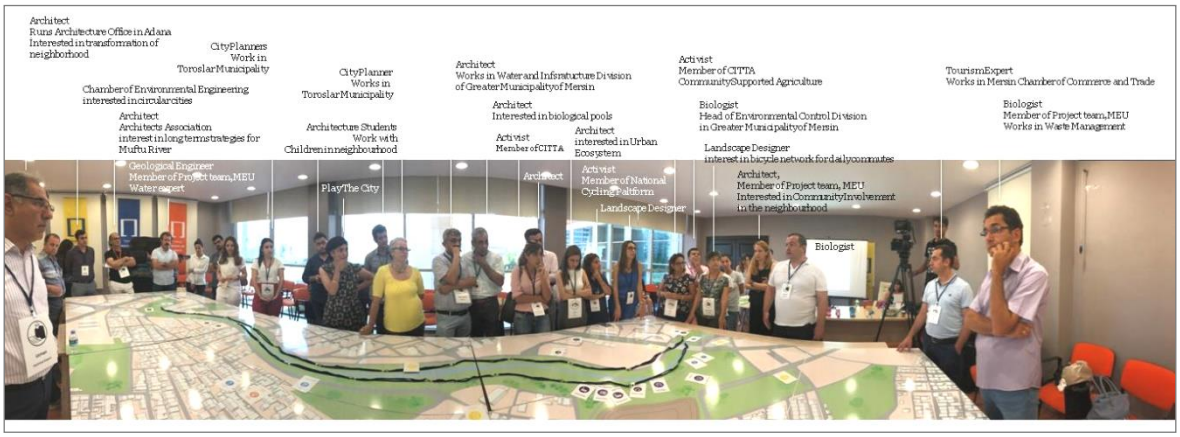

Figure 7 Participants in the first game session

3.3.2. Game Development and Focus of Sustainability:

Play the City team has iterated city gaming methodology during the workshops to support and moderate participants' decisions into city making process. Game utilities help to visualize principles (strategies) of circularity and their reflections on the built environment proposed by players during the discussions. All the collected data obtained during research and survey process have been transferred into the 'game board' that would be utilized as the base platform of discussions. Three groups of game utilities have been prepared for game sessions. 'Roleplay' cards represent actual role or profession of participants who attend the game sessions. 'Strategy cards' represent principles for each circularity concept including water, mobility, food, waste, energy and local economy (Figure 8). And finally building and land-use props represent functions of open and built-up such as types of buildings, housing typologies, blue and green land-use systems in cities (Figure 9). All the game utilities were prepared in 1:500 scales so that results of discussions could be transformed into realizable plans.

Figure 8 Strategy cards representing circular principles of mobility, water, energy food, waste and local economy

Figure 9 Utilization of all game utilities and props onto the game board during game sessions with participants

3.3.3. Multiple City-Game Sessions and Workshops:

Five city-game sessions and two workshops with participation of stakeholders were organized in Mersin. The first city-gaming session has provided initial think-tank discussion platform focusing on strategic and larger scale planning questions for the neighborhoods along the Müftü Stream: How to upgrade and preserve the natural riverbank? Which interventions are required for connecting neighborhoods? These fundamental questions provided to discuss future scenarios of Müftü Stream for its enhancement as blue and green ecosystem corridor through the city, circular development principles along the streambed and consider its linkages between the settlements. Participants' expressions onto the gameboard also displayed features for circularity principles and pointed out the focus of following game-sessions.

Workshops, which focused on sustainable mobility and urban agriculture topics, helped participants experience the case-study area and provided new inputs for the thematic game sessions afterwards (Figure 10,11).

Figures 10-11 Workshops and hand-on activities integrated with game sessions with participants

Each thematic game-session (Figure 12) was organized to discuss principles related to circular system thinking based on water, sustainable mobility, urban agriculture and local economy topics:

Urban Water Management: Clean water and sanitation has been stated as one of the important Sustainable Development Goals by UN (URL 8). Mersin is climatically subjected to hot and drought seasons during long summer periods and heavy rainfalls during short term winter seasons. So, principles related to sustainable urban water management issues such as preservation of Müftü Riverbank, flood risk zones, household and neighborhood level rainwater harvesting methods, grey water recycling methods, green roof systems were discussed during the game-session. The expected outcomes of this workshop have been identified to explore principles of sustainable urban water management systems that can be integrated into city planning process to achieve adaptation for climate-resilient strategies.

Figures 12 Game sessions conducted according to each urban theme

Sustainable Mobility: The role of sustainable transport systems to achieve SDGs was first stated in 1992 UN Earth Summit (URL 9). All levels of transportation systems based on fossil oil consumptions worldwide must be replaced with carbon-free and sustainable systems including mobility systems in cities. The main focus of mobility workshop was how to adapt our cities into more sustainable mobility principles with particular focus on neighborhood level implementations such as bicycle oriented and walkable environments.

Urban Agriculture and Food: The increasing ratio of world's urban population has raised the question of food security and sustainable food supply systems for cities. Public policies, structures and systems that will ensure resilience for good and quality food of communities living in the cities have become subject of sustainable urban development studies as well (Whittaker, J. et all, 2017, p. 7). Therefore, there is now a new role a waiting for planners to connect the food system with other urban systems. In this sense, urban agriculture is accepted as anew catalyst for urban food planning process (URL 10). Within the light of these discussions, the content of urban agriculture and food workshop was defined to discuss potentials of food-based planning system for case-study area. Topics related to reducing food waste, shortening local supply chains, improving infrastructure for safe food supply systems, alternative techniques to minimize environmental pollution on soil and water such as aquaponics systems were discussed during the workshop. Expected outcome of workshop has been defined as a holistic urban agriculture vision focused on the empty lands within the study area and along the Müftü Stream.

Table 1. Participation of Stake Holders during game sessions

STAKE HOLDERS \ GAME SESSIONS			Game Session # 1 Urban think-tank	Game Session # 2 Sustainable Mobility	Game Session # 3 Urban Water Management	Game Session # 4 Local Economy &	Game Session # 5 Urban Agriculture &
Municipalities	Toroslar Mun.	Planning & Development Unit,					
		Parks & Gardens Unit					
	Yenişehir Mun.	Planning & Development Unit,					
	Mersin Metropolitian Mun.	Enviromental Control Unit,					
		Urban Transformation Unit					
		Water Affairs Unit					
	Mezitli Mun.	Social Union					
Local Agency	State Agency for Water Affairs	Mersin Directorship					
NGOs	ÇITTA- Food Society						
	Sokak Bizim Derneği						
	Amsterdam Rainproof						
	Mediamatics						
	CityLab Buiksloterham						
	Roma Community Association						
	Tarsus Slowfood Union						
Citizens	Headsman from Neighborhood						
	Activists, artist, etc						
	Icel College (students and						
Represent.of Professional Organizations	Chamber of Architects						
	Chamb. Environmental Engineers						
	Chamb. Landscape Designers						
	Chamb. Commerce & Industry						
	Local Contractors Union						
Academia, Experts, Scientists	Project team members						
	Resource persons from MEU						
	Yumuktepe Res. Team						

Local Economy and Urban Development: The focus of local economy game session was to explore economic capacity of the neighborhood based on local resources; innovative and productive potentials of residents. Before the game session, participants conducted a site visit to visualize potentials of the site and understand loops of community skills, local economic activities such as basket weaving of Roma community, pottery-making atelier established for tourism potential of Yumuktepe. Development of existing local skills and establishment of new circular economy principles were discussed under this topic.

The first game session was enhanced as a triggering level for the following city-gaming sessions. So, 38 participants from different professions and institutions have been attended to first workshop (Table 1). According to results of first game-session; four sessions themed with mobility, water, urban transformation and local economy; urban agriculture and food are organized respectively. Thus, the participants of following workshops have been defined according to subject of each session. By this, 93 participants in total have been attended to the four sessions defined for the whole process.

4. Findings

Having completed five city-game sessions and two workshops with participation of stakeholders; results and evaluations game sessions have been translated into realizable plans and a circular manifesto has been reached according to collaborative discussions of participants. Suggestions generated related to sustainable urban transformation process for Demirtaş and Alsancak neighborhoods can be summarized with reference to circularity principles as in the follows:

4.1. Sustainable mobility:

During the in-situ workshops and mobility game sessions; integrated sustainable mobility solutions such as [electric] bikes, public transport systems, pedestrian zones were discussed. Participants pointed out existing problems and threats that prevent cyclists and pedestrians commuting safely through the site. Accelerated traffic passing along the Stream, traffic jam occurring in the school junction, unregulated vehicle flows through the neighborhood, lack of parking areas were some examples portrayed during the discussions. With the moderation of 'Sokak Bizim Derneği'; participants presented their proposals to overcome these problems and provide sustainable mobility principles in the neighborhood such as new suggestions for vehicle transportation routes, improvements for pedestrian zones, declaration of 'Bike to School' hours, establishment of cycling NGOs in the neighborhood. Accessibility from different parts of the city, greenery of the riverside, significant monument of Yumuktepe Mound increases recreational potentials of the site as one of the attractive destinations in the city. Thus, proposals to integrate biking potentials of the site with the rest of the city are also discussed by participants (Figure 13).

Figure 13 Cycling and experiencing the site before Sustainable Mobility game session

Figure 14 Game session on sustainable urban water management

4.2. Urban Water Management:

Sustainable urban water management has been one of the intensely discussed game-sessions with stakeholders. Contribution of Dutch and Turkish experts from Amsterdam Rainproof, Mersin

Directorate of State Agency for Water Affairs and Water Network of Mersin Metropolitan Municipality provided comparative evaluation on recent impacts of climate change on Amsterdam and Mersin, which are threatened by intense rainfalls and flood risks recently (Figure 14). In particular to the study-area; participants have drawn attention to drought summer seasons and heavy rainfalls during winter times. Müftü Streambed has been designated as 'flood risk zone' into the current master plans. Within the light of these discussions; urban design principles and strategies in neighborhood level related to rain harvesting methods such as rain gardens and parks with collective reservoirs, street fountains, permeable streets directed towards the stream and rain gardens were developed. Additionally, building scale interventions such as green and blue roof systems to collect and direct roof water towards the street scale collective systems have been proposed. By this way, integrated approach to link building, street and neighborhood scale design principles to collect and reuse of clean water sources through rainwater harvesting methods were discussed. These strategies would provide a more resilient urban water management system for drought seasons of the city. Second group of proposals included ecosystem strategies related to flexible water level control and habitat sustainability along the streambed. During the long and heavy rainy seasons; the water level of Müftü Stream raises and causes flood risk for the buildings along the riverbed. Participants proposed a green belt along the riverbed to provide controlled flood sections managed with appropriate landscape elements. This approach also increases publicity and accessibility of the stream as a recreational zone by the residents and wider users from the city (Figure 15).

Availability of water and mobility experts simultaneously made it possible to integrate ideas for pedestrian and cycle routes and creative use of parking areas along with the water systems. This provided generation of linked ideas from the water and mobility teams; for example, soft parking grounds along the streambed that can be flooded during rainy season.

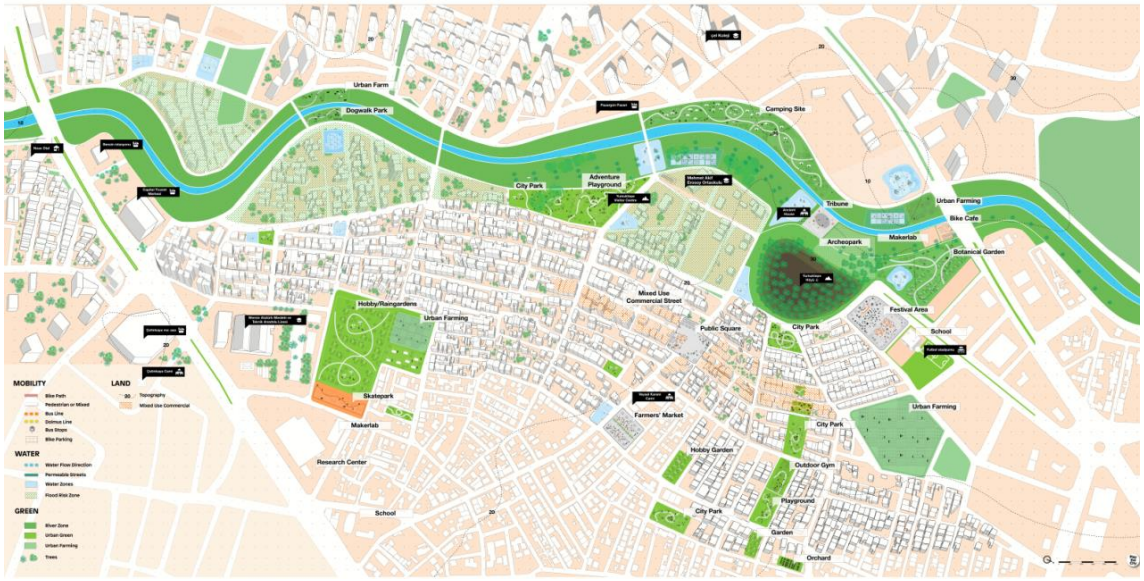

Figure 15 Results of participants' proposals related to land-use, mobility and urban water management strategies in neighborhood scale

4.3. Local Economy and Urban Development:

One of the main aspects of the case-study area are its close location to the central business district of the city. Tourism potential of Yumuktepe Mound, recreational potential of Müftü streambed, existing local markets on each side of the stream, local handicrafts produced in the neighborhood provide important potentials for development of alternative and innovative small-scale business models for local people. Thus, participants developed proposals related to

strengthen socio-economic structure of the neighborhood in relation with new land-use zonings such as culture and tourism areas, recreational axes, and commercial streets.

The study area preserved its 'neighborhood' characteristics, which has been defined as 'positive' by the residents. Although existing housing conditions are very poor and needs urgent improvements; their satisfaction levels from their neighborhood are very high (Naycı, 2018)[8]. They feel connected to their neighbors and expect to preserve their existing lifestyles provided within their neighborhood context. Within the light of these discussions, participants suggested on alternative housing models that would fit circular principles and sustainable goals such as rainwater collection, green/blue roof systems, waste recycle, sustainable building materials; but also would provide collective sharing mediums amongst the neighbors such as parks and gardens, terraced roofs, courtyards within the blocks.

With the contribution of city planners, architects, and environmental engineers in the participants; master plan strategies that would integrate environmental data such as micro-climatic conditions, sun orientation, constant winds, underground water, stream hydrology and topography into land-use zonings and height control of building blocks were proposed (Figure 16). The integration of the neighborhood with the rest of the city in macro-level such as urban transportation and city economy have also been discussed and proposals related to new commercial and mixed-used zones, traffic circulation axis were developed.

Figure 16 Proposals regarding urban redevelopment strategies onto the game board

4.4. Urban Agriculture and Food:

Game session about Urban Agriculture and Food was integrated with workshop activities conducted by contribution of Dutch experts from Mediamatics in Amsterdam and Turkish experts from Tarsus Slowfood Union. Participants shared their experiences related to alternative food production techniques such as aquaponics and community-supported local farming systems during the workshop (Figure 17). During the session, valuable knowledge related to practice of the residents who produce edible vegetables and flowers on green roofs and in their backyards were pointed out. Agricultural sites are present within the newly developed areas especially in northern

[8] In-depth interviews conducted in the case-study area. The results of this social research is analyzed and discussed in another paper (Naycı, 2018, p.142)

sections along the Stream. Although animal husbandry within the city is banned due to current urban laws, the practice still continues. Volunteer groups supporting local farmers and safe food production are increasing each day. In the framework of these inputs, participants developed proposals such as circular farm models, alternative food production systems in aquaponics, community gardens, collective compost systems to be located in neighborhood food markets to increase existing food production and farming activities along the Müftü streambed and in the neighborhood; and their transformation into more sustainable urban agricultural lands (Figure 18). By this way, an alternative economy can be created for local residents while accessibility of citizens to good and fair food is achieved at the same time.

Figure 17 Aquaponic workshop before game-session on urban agriculture and food

Figure 18 Urban agriculture proposals during game-session

4.5. Development of the Circular Manifest for a Liveable Neighborhood:

Based on the outcomes obtained during the game sessions and workshops spreading over one-and-half year; the project team conceptualized the content generated collaboratively by the stakeholders all through this process into a realizable plan (Figure 19). Altogether evaluation of collaborative debates, decision-making game sessions and research conducted in the neighborhood provided to develop a set of comprehensive proposals, which offer complementary design, policy, planning and strategic interventions for future development of the study area. Some of the results provided tangible and concrete design interventions that can be implemented by the local agencies, residents or civil society organizations; whereas some proposals include long-term visions which needs change of mindsets towards more circular systemsof thinking by policy makers.

Figure 19 Realization of stake holders' proposals developed during game sessions

5. Conclusion

Citylabs can be conceptualized as "an autonomous platform where both formal and informal parties can meet for exchanging knowledge and ideas and plan the future of their city". They create a relatively neutral, collaborative and open-ground platforms outside existing formal institutions. Being the smallest planning unit in cities; neighborhood-level development and regeneration processes are complex urban problems, which necessitate long-term and participatory decision-making process to achieve environmental, social, cultural and economic pillars of sustainable development goals. In this sense, Urban Living Labs and City Labs provide a co-creative planning and design process with contributions of its residents, multi-disciplinary professionals, and responsible authorities. Testing an idea, displaying alternative scenarios are possible before large scale urban interventions are implemented. In this sense, it supports flexible and reversible decision-making process which also makes it more resilient and adaptive against unpredictable changing conditions.

Since Mersin CityLab experience has a research-based target rather than real-life or institutionalized Urban Livin Lab or Citylab establishment; its main purpose is to evaluate its participatory impact on citizens. Therefore, the game sessions and workshops organized during Mersin CityLab process have provided to monitor stakeholders' participation levels into game sessions and workshops (Table 1) and to understand variety, motivation and collaborative capacity of city actors.

The Mersin CityLab experience has shown that participants are open to share their knowledge with others while they also welcome new ideas in such inclusive and collaborative platforms. The scope for reaching 'common goods' by the consensus of multiple stakeholders increase motivation of individuals to be a part of solution as well. Secondly, managing multi-facet discussions needs transformation of complex and technical data into an understandable platform by all participants and moderation of discussions by experts so that concrete and applicable results can be achieved in the final. In this sense; city-gaming method which has been prepared and moderated on real data gathered from the case-study area increased motivation of participants and efficiency of results gained in the result (Table 2). Besides, hand-on activities provide participants "learning by doing" opportunities, which accelerates spread of new information, techniques or skills amongst people. For this purpose; defining appropriate methodological approaches in City Laboratories are so important as increasing number of these platforms in cities.

Table 2 Feedbacks from participants in Game Session # 1

"Provides interactive information sharing, arouses new and different ideas" (Environmental Engineer)
"visual and catchy, experimental so it is easy to see gaps and revise proposals" (City Planner)
"Efficient method, especially local municipalities should use this method in urban design processes" (member of Mersin Chamber of Commerce and Industry)
"Helps to visualize different urban issues altogether" (Expert from Toroslar Municipality)
"unites all participants and their ideas" (Expert from Water Affairs of Mersin Metropolitian Municiaplity)
"increases participation" (Agriculture Engineer, Flowerist)
"fast and useful flow of information" (City Planner, Toroslar Municipality)
"enjoyful, we could develop common solutions without knowing each other before" (Architect)
"interdisciplinary medium, easily exchange ideas with others" (Landscape Designer)
"generation of tangible and collective ideas" (Manager in Agency Company)

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Augmented experiences in archeological sites: Presentation of Alexandria Troas Podium Temple to visitor experience

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Abstract

Set aside the issues concerning their excavation, documentation, and conservation, as far as their presentation to the public experience is concerned, Archaeological sites represent a special case of cultural heritage that come with distinctive set of conditions and demands, posing a problem situation deserving a special treatment. Problem is manifold: The presentation should be informative, entertaining, and educational, all accomplished through an active corporeal and mental participation where interactivity and immersion must be the key. The setting must provide a holistic, comprehensible experience by completing "missing parts and layers," and contextualizing it, perhaps through a story, a theme, or a background. Any intervention must be non-invasive, reversible and updateable; alternatives and different layers must be presented, preferably, synchronously. Above all, final setting should be subordinate to the primacies of "conservation of cultural heritage," while providing an intellectually and physically accessible and sustainable overall historical environment. This has been an age-old issue for the scholars, a genuine challenge due to the ill-defined nature of the problem situation itself. The present study departs from the proposition that, Augmented Reality (AR), by definition, has a potential to contribute to such a problem situation. AR is a combination of real and virtual worlds, where "virtual" could complement what was missing in the real and new objects and layers might be woven together, into one new reality where active bodily and mental participation and interaction is possible. Though it might seem implied in the definition, the proposition still needs a rigorous investigation since AR is a rapidly emerging but still quite a young field that has a long way to go; and since, research on AR's specific adoption to presentation of archaeological sites, apart from few examples, is still an unbeaten path. The present multidisciplinary study aims to take a step towards such an investigation. Established upon a detailed investigation and analysis of examples, the present study involves development of an AR application of a selected case: "Alexandria Troas Podium Temple," followed by a field study. In the present report, we share our experience and observations of the process and the implementation. In conclusion, we propose that AR is a serious candidate to be a considerable asset for the presentation of archaeological sites for the visitor experience, without compromising the universal norms of conservation of cultural heritage. We also argue that AR seems to have its own agenda, coming with unprecedented possibilities still to be appreciated and adopted, which in turn might help us to go beyond the conventional conceptions and modes of conservation of cultural heritage and presentation.

Keywords: Alexandria Troas, archaeology, architectural (Re)presentation, Augmented Reality (AR), visitor experience in archaeological sites.

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1. Introduction

Archaeological sites represent a special case of cultural heritage that come with distinctive set of conditions and demands as far as their conservation and presentation is concerned. On the one side of the equation resides the scientific studies, typically involving survey, excavation, documentation, analysis and interpretation, and conservation of these sites. These studies typically do not seek for knowledge towards practical application (as in applied sciences), and typically there might not be a chance to (re)evaluate remains economically, i.e. for refunctioning or adaptive reuse. Main objective and benefit here is towards understanding and explaining and for the production and dissemination of knowledge; and of course above all, ensuring a sustainable life for the cultural heritage. Scientific studies concerning archeological sites have their own methods and processes as well as codes of conduct, rules and principles.

The other side of the equation, the presentation of archeological sites towards visitor experience comes with a different agenda that does not always confront with the norms and privileges of the abovementioned framework. Here, typically, the emphasis seems to be on entertainment and recreation of a visitor, but through these, there is always dissemination of information and knowledge involved, delimiting the educational aspects of such experiences. Learning from built environments and artifacts is a special type of experience since these are not only infused with knowledge operational in their making, to be deciphered, but also investigation of them might give ideas about the contexts and environments (whether cultural, social or physical) within which they were embedded.

Spatial artifacts such as architectural pieces and built environments (including archaeological sites) demand a spatial experience, involving a full corporeal presence and movement in space. Of course, in any genuine experience, corporeal presence must be incorporated by “mental” or “spiritual” presence. What leads such a presence might be a professional interest, a pure curiosity, empathy(or sympathy), a sense of belonging, cultural affiliation, memory, or perhaps a mere urge towards being a part of a community or, saying “I was there.” It must be noted that “mental” or “spiritual” presence is not directly associated with physical and spatial being of an artifact. Through “one’s horizon of expectations,” such a presence gets involved with issues like spirit of a place, life and people, the artifact’s history and story, as well as its meaning and symbolism. A “full immersion” and a holistic meaningful experience further demands consolidation of “spatial” and “mental” presence with active participation and interaction operational at both levels.

Apparently, such a framework poses quite a number of issues for the presentation of archaeological sites. Typically, archaeological sites present a two dimensional (flat), and incomplete environments that hamper a satisfying spatial experience. It is a matter of missing physical context, making orientation and corporeal integration to the environment difficult. Lack of physical context and incompleteness make artifacts (i.e. buildings or built sites) lose their scale, as well as their integration to whole, and the overall sense of unity both within and without themselves. Incompleteness not only concern missing physical parts or layers, or the physical context. It is the social and cultural context that gives a place its meaning, soul and vibe. Archaeological sites on the contrary, are mostly “dead” environments devoid of life and people. They are barren, not only in the physical sense: their story might be forgotten, they might belong to a distant culture and society, the meanings and symbolism they carry once might be either lost or represent a mismatch with the present one. Element of surprise could only carry the visitor to a point (if such a thing exists), and it is not sustainable: such a place should reproduce itself and the experiences it provide.

If we are to treat the abovementioned missing layers to augment the site towards making a meaningful and holistic visitor experience possible, we should apply the questions such as “what, how and to what degree,” to the whole setting, to each layer and to each part. Generally, such built environments are not entities emerged, finalized and frozen at certain point of history, but rather they are a product of time that span a period in history and as such, involve process. It is quite a challenge to present a phenomenon that differentiates and undergoes various changes over time,

and thus having multiple layers those should be treated both diachronically and synchronically. Every (re)presentation is an interpretation if not speculation, and no interpretation in such a setting could be static, unique, final or flawless. There may be equally plausible interpretations, there will always be missing parts and missing information; and of course, as far as data and interpretation is concerned, there is always an issue of reliability. Archeology itself is a process and basically operate on hermeneutics: There will always be new findings and new data, followed new interpretations that could lead to either refinement of existing conjectures, or production of the new; sometimes even elimination of the old ones. Therefore, any intervention or proposal whether it is towards conservation or (re)presentation, must be compatible, honest, non-invasive, reversible and updateable; alternatives and different layers must be presented, preferably, synchronously. Above all, final setting should be subordinate to the primacies of "conservation of cultural heritage" while providing an intellectually and physically accessible and sustainable overall historical environment.

The situation summarized here has been an age-old issue for the scholars, posing a genuine challenge due to the ill-defined nature of the problem situation itself.

The present study departs from the proposition that, Augmented Reality (AR), by definition, has a potential to contribute to such a problem situation.

AR could be interpreted as a synthesized "environment" produced out of digital (ly generated) objects simultaneously transmitted together with the real world. It consists of layers of virtual and the real, weaved together into a new reality, as such presenting an unprecedented potential that could be possible neither in real nor in virtual worlds alone. Interactivity and immersion are the two key features of AR: Beyond being in a state of passive "observer," created environments present the user a world they could be a part of and where, an active, two-way corporeal and mental engagement is possible. Especially, when "augmentation" is considered as that "virtual" layer complementing what was missing in the real, AR seems to be an objective opportunity for the presentation of archaeological sites. However, the situation requires an interpretation going beyond this simple view, and the initial proposition still needs a rigorous investigation. This is so since AR is a rapidly emerging but still quite a young field that has a long way to go; and since, research on AR's specific adoption to presentation of archaeological sites, apart from a number of examples, is still an unbeaten path.

Embedded within the abovementioned framework, the present multidisciplinary study aims to take a step towards such an investigation. As a departure, it presents a concise review of AR, particularly in its application to presentation of archaeological sites. This stage is followed by development and implementation of an AR application of a selected case: "Alexandria Troas Podium Temple." As a conclusion, we share our experience and the observations about the process and of the implementation.[1]

2. Augmented Reality: A brief Introduction and About its Adoption for the (Re)Presentation of Archaeological Sites

Literature typically date practical studies concerning AR back to late 50s and 60s. Its conceptualization and contextualization however, come about in 90s. Thomas Caudell and David Mizell (1992) first coined the term. Pierre Wellner, Wendy Mackay and Rich Gold (1993) put AR on the opposite of Virtual Reality, by stating that unlike VR, AR does not cut human beings off from the real world but establishes an unprecedented set of relations with it. Then in 1994 comes Paul Milgram and Fumio Kishino's (1994) famous Reality–virtuality continuum where anything concerning both the real and the virtual were conceptualized as a "mixed reality." In this continuum, they located AR closer to real environment (Figure 1).

[1] The study is a part of the thesis titled "Augmented Reality Applications in Architecture: Presentation of Podium Temple at Alexandria Troas as a Case for the User Experience" and is supported by the ESOGÜ BAP coordination unit as 202015A114.

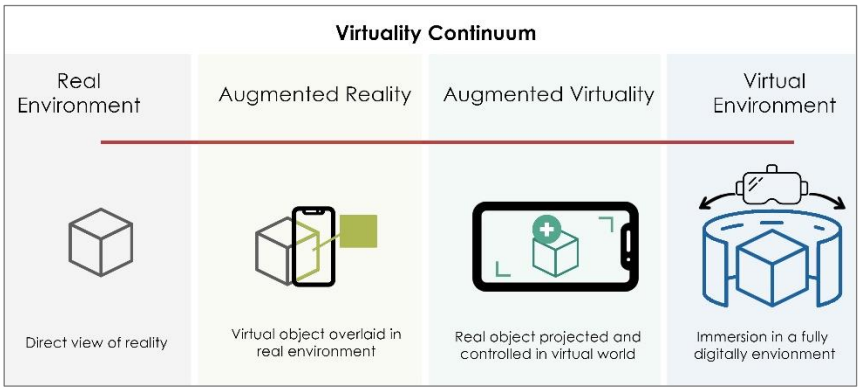

Figure 1 Reality-Virtuality continuum. Authors after Milgram and Kishino (1994).

In 1997, Roland Azuma (1997) defined AR a combination of real and the virtual, while introducing real-time interactivity and three dimensionality as its essential aspects. Studies towards conceptualizing and theorizing AR was parallel to its practical applications, and about the beginning of 2000s, AR started to become a well-defined research field. While, to this date, AR seems to be serving primarily for industry, i.e. aviation, military, etc., especially after 2010s, it started to extend and expand across other fields, such as commerce, advertisement, gaming, and started to be more available for mainstream utilization. Perhaps one of the important shifts concerning AR's lifeline is the development of tablets and smartphones that made AR widely utilized for various purposes and accessible for all.

As expected, AR provided a considerable set of opportunities for the field of architecture, and therefore known to be utilized for various ends: Design conceptualization, representation and collaboration, design education, building (site) management and for the conservation and (re)presentation of cultural heritage (sites) and architectural works. An instance of the last category, AR's use for the (re)presentation of archaeological sites, is of particular interest here.

Before going into a detailed analysis of a number of relevant cases, we could argue that first set of examples (the pioneers) required heavy and complex hardware sets and specialized equipment. Moreover, almost now readily available aspects such as plane detection, object placement, overlapping and projection of virtual and real layers, interaction, and such had to be addressed individually and almost an ad-hoc manner, where each requiring a specialized hardware and expertise. The use was not so practical at all (Figure 2).

Figure 2 Actual use of ARCheoguide (Vlahakis et al. 2002).

Second set of examples are after the introduction of Smartphones and Tablets relied upon these devices' interactive screens, processing and graphic capabilities, cameras, GPS (Global Positioning System), sensors, gyroscopes, magnetometers, and such already built-in aspects, as well as connectivity capabilities such as WI-FI and Bluetooth, almost tailored to fit the needs of an AR application. We could easily say that combined with the already developed expertise coming from smartphone industry (including hardware and software), and already developed familiarity (and dependence) of society upon these devices, led to a paradigm shift in AR's evolution and made it available, accessible, and mainstream.

2.1. Summary of the Case Reviews

Before formulating the study a review of the existing studies concerning AR's adoption for the (re)presentation of archaeological sites were held. Methodologically, above all, the contribution of two major components, namely virtual and the real layers, to the overall augmented experience, and the nature of that contribution were examined. This is followed by further investigation of virtual layer(s), such as buildings, building parts, natural elements, life, themes, scenarios, and information of sorts. We particularly questioned the issues of interactivity, immersion, corporeal and mental presence in relation to all these. Only a number of examples are summarized here for the limitations and convenience.

Perhaps one of the earliest of such applications is AR-cheoguide prepared for Ancient Olympian city of Greece (Vlahakis et al. 2002). In the study, reconstruction of Temple of Hera is embedded into the existing remains of the building. The experience is planned to work interchangeably, i.e. it is possible to turn the augmented layer off to see the existing situation of the site. Virtual reconstruction A building is not the only augmentation the project provides: Audio, 3D models, 2D pictures and informational texts are also given as a part of the virtual layer. In this way, users can get information that could be provided neither by the remains of the site nor the virtually completed buildings.

Perhaps one of the important components of this study is the introduction of intangible cultural heritage as a complementary part: The life of the city. Visitors in the stadium area can experience ancient virtual athletes competing with each other. It illustrates the Olympic Games together with the built environment it takes place in and makes it possible for visitors to have an enhanced unprecedented immersion and experience (Figure 3).

Figure 3 Athletes competing in Olympia (Karigiannis & Stricker, 2002).

Another example Ancient Pompeii (Papagiannakis et al. 2005), as the name suggests, is prepared for the ancient city of Pompeii. As a case, it is different from the AR-cheoguide where its motivation is not towards the virtual reconstruction of the built environment and the buildings, but rather towards the revitalization of the life, possibly due to fact that the remains in this example are already rather intact. Departing from the depictions in existing murals, life of the past was reconstructed as the augmentation layer by using the storytelling technique. Towards this, virtual-human characters have been created and these characters acted according to a certain story and a scenario. For example, visitors observed an ancient woman preparing food in the thermopolium as once before (Figure 4). This particular application promotes the use of AR for the revitalization of one of the layers of intangible cultural heritage as a part of the built environment and puts a particular emphasis on the spatial characteristics of ancient architecture (rather than the external form) and their use. Frescoes are also utilized for the reconstruction of flora and fauna, later presented as an augmented layer.

Figure 4 Thermopolium, AR character preparing food (Papagiannakis et al. 2005)

AR project of Aurelian Wall at Castra Praetoria in Rome (Canciani & Saccone, 2016), provided the full process including the studies prior to the development of AR application, such as historical research, documentation (surveying), and restitution. It provides mobile AR experience (Figure 5).

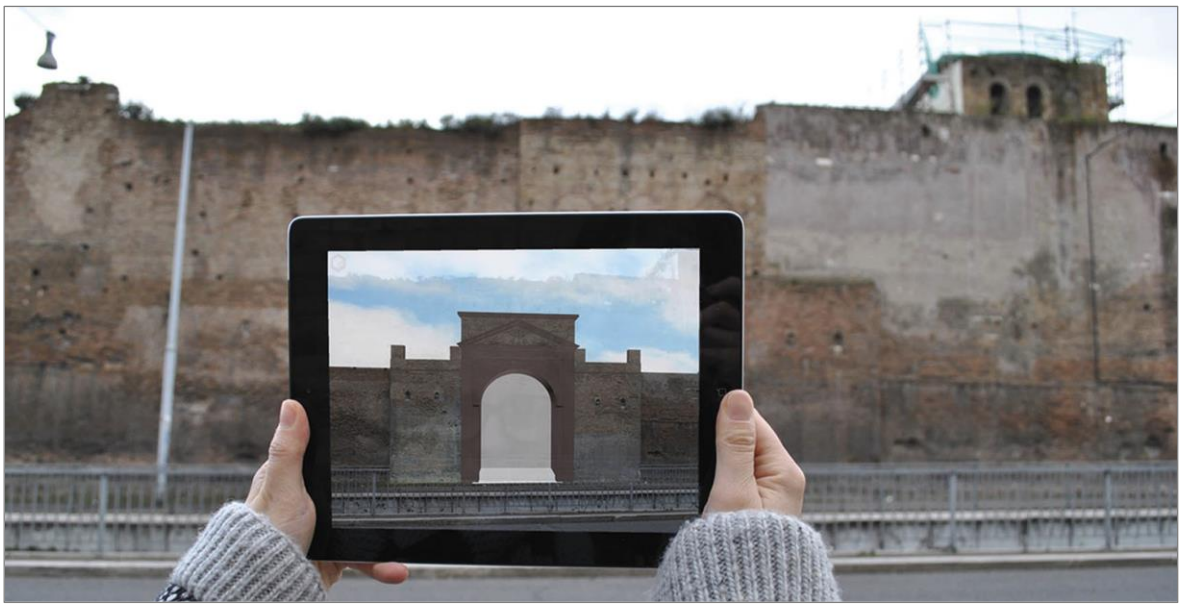

Figure 5 Early Examples of Mobile AR (Canciani & Saccone, 2016)

Another study is about a Roman Villa located in Valladolid (Finat et al. 2015). One of the final products of the study is a virtual model of the villa but the process itself particularly has unique characteristics. The problem was the complex stratigraphic layers and partial excavations, demanding a special treatment and interpretation. One of the intentions was to present visitors an interactive navigation while showing various layers and giving a certain interpretation of the site (Figure 1). Further interactivity was added by asking some simple questions and assigning minor tasks and puzzles. This example also presents documentation and restitution process prior to the AR application.

Figure 6 Layers of Different Periods (Finat et al. 2015).

AR project of Parthenon Temple (Liestøl, 2011) carries AR to another level. Here, documentation and restitution is not the issue. Although it seems to be intact, many details of the temple, i.e. friezes carried to the nearby museum, were missing. Another problem was the limited accessibility, due to the confrontations of conservation that made access within cella impossible. As such, a contextual holistic experience would not be possible. The project provided the missing details, even the statue of Athena, as an augmented layer. What is particularly important here was the use of interactivity. Visitor could made the outer shell transparent, to various degrees, and as such without losing the sense of unity, observe what was inside the cella (Figure 7). Also "zooming" certain parts of the buildings made possible, to observe the details. A further interactive layer is also provided to give information about the building and the details, and for contributing them. Particularly in this study, we see an emphasis on "mobile" devices as primary devices for AR.

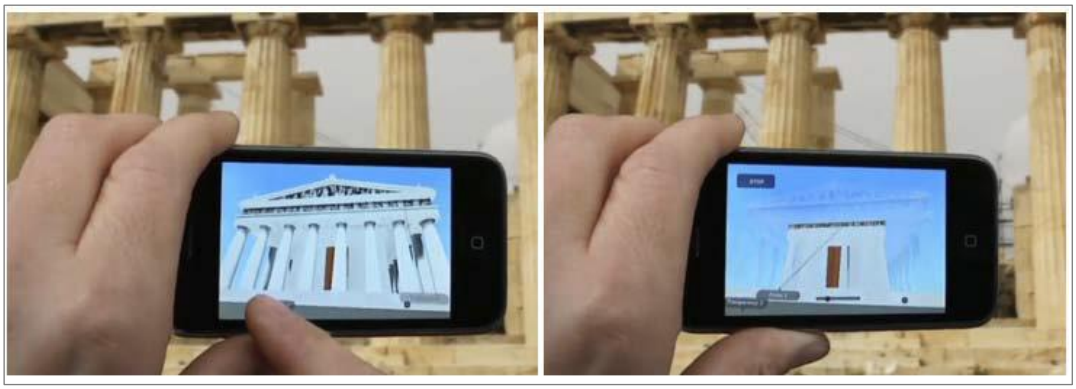

Figure 7 Parthenon Temple, Zooming-in and Transparency in AR (Liestøl, 2011).

Another example is Temple of Deified Julius Caesar (Liestøl, 2011). Here the virtual reconstruction of a building is not the primary issue. As the visitor approaches the temple, the application asks, "if they want to experience the events that led up to the building of the altar and

the temple." Then it rolls back time to the death of Julius Caesar, 44 B.C., and start to tell the story through a set of animated scenes and situations (Figure 8). Here augmentation involves the "time" dimension, manipulated in two ways, and also there is a cinematographic narrative as an augmentation. Nature of immersion and experience here is particularly unprecedented; it makes the visitor a part of history.

Figure 8 Roll-back in time. Crowd, Mark Antony's Speech (Liestøl, 2011).

3. The Case Study: Designing an AR Experience for the Podium Temple of Alexandria Troas

Selected case, Alexandria Troas, is a city, initially established in 311 BC, by Antigonos Monopthalmos. First, it was called Antigoneia, later Lysimakhos renamed it as "Alexandria Troas," after the Ipsos war. It was governed under Seleukos between 281-226 BC, and it was known to remain as an independent state until 65 BC (Ricl, 1997), (Öztepe, 2012), reports that, during the reign of Emperor Augustus, the city reached its heyday, as a colony of Rome; "Colonia Augusta Troadensis." It was an important port city throughout its Roman period, and the city is known to be an important exporter of monumental monolithic columns, "marmor troadense," to all around Mediterranean (Feuser, 2009), (Feuser, 2011), (Öztepe, 2019). In 1st century AD, during his second travels, St. Paul visits the city, and sails towards Europe to disseminate the essentials of Christianity to Europe, first time in history (Acts16:6-8), (Körpe, 2015).He revisits the city during his third missionary travels and stayed awhile, after which the city became an episcopal center (Acts 20:6-12), (Glavic, 2014), (Wilson, 2020)The city is known to lose its economic power after the Goth invasion, together with its port losing much of its functionality by time. In 4th century AD, it was one of the capital candidates of Roman Empire, but lost to Constantinople, and the city lost its importance and started to decay. Recent studies show that settlement in the city remains until the Middle Age, but it was quite insignificant. In Ottoman times, it was called "Eski İstanbulluk" by Piri Reis. Perhaps one of the important and ill-fated periods in city's history is 17th century when many of the buildings were dismantled down to their foundations and taken to Istanbul to be used in the construction of new buildings (Cook, 1973).

Today a few remains of buildings such as Doric and Podium temples, Odeon, baths, stadion, nymphaeum, main street (Decumanus), theater, waterway, port and some of the city walls are more or less above the ground and observable, but mostly all in very bad condition. At its present stage, the focus of the visitors is mostly the forum area (Aside the Herodes Atticus Baths to East) defined and surrounded by a number of architectural and urbanistic elements, where at the core, the Podium Temple is situated. However, most of the remains are either not unearthed or unearthed ones were stripped to the bare foundations, thus neither giving a holistic idea of themselves, nor about the forum itself as whole.

3.1. Investigation of Problems and Conditions Concerning the Presentation of the Forum: a summary

Before going into designing an AR experience, we analyzed the patterns of behavior and use by the visitors. Access to site was always through the car park area to the East, since the existing road did not permit pedestrian access otherwise. Generally, people pass through with only gazing the remains. If they decide to stop, they enter the archaeological site from the Northeast corner where

they first get a glimpse of the major building remains: to the left is Odeon, remains of a dodecagon building, to the right resides partially excavated Decumanus and a row of shops, and axially located are the remains of the Temple and the fountain. Generally, it was observed that people right away proceed by the Temple and at the Northeast corner of it, stop and read the information panel about the building. After a while, after taking a few photos, they go on and walk along the North edge, and reach the end of the forum while also checking out the findings under the porch to the North. In many cases, the visit ends there, and people go back to parking area and leave since there seems no more worth to visit. Often, it becomes a fast-paced endeavor that could not be interpreted as a satisfactory experience. Dodecagon building and sculpture hall to the North is almost always passed by since their primary spatial aspects of them are not shown. A number of situations are observed to be changing or slowing down this course: First, as it was stated, due to the written and graphical information about the findings, i.e. the info panel at the Northeast corner of the temple. Second, if there was an expert at the site (professors, archeologists, guides), the experience turns into a dialog, missing parts and pieces together with the informational and historical layers, sometimes stories completed by the expert make the visit longer and more satisfactory. The dialog often develops in two-ways, by questions and answers. Third, pre-informed visitors might go on to seek the attraction points. The source of pre-information was generally mass or digital-social media, and people seek for popular places or go towards re-experiencing other people's "shared" previous experiences. Forth, if people see other people going around and checking out other things, or archaeologists working, in case of any crowd and movement, they just tend to follow. It is observed that this also helps to catch people passing through by car. If the site is crowded, people tend to stop.

Therefore, first targets towards its presentation should be to make the site more attractive at first sight and make it more accessible. Then second would be to go on and support the initial attraction by providing continuity between points of interest. Such a fluid flow needs slowing down or delay at some points where main events take place. Towards a satisfactory experience, missing parts and layers should be augmented by various means: not only physically, but also by providing people and life, through a theme, a scenario or a story. Finally, as we have emphasized earlier, visits must be more interactive.

3.2. A scenario for Alexandria Troas Forum: Towards a montage of attractions

After analyzing the patterns of behavior and use by the visitors, we investigated the site, and points of attraction, starting from the entrance while numbering them as reference "scenes." The aim was to identify the nature of the existing material at hand, and draw a sketch of a visitor experience accordingly. Here our main intellectual reference was Sergei Eisenstein's, early theories on film, i.e. "montage of attractions" (Eisenstein & Gerould, 1974) and his readings and interpretation of experience of Acropolis in his "Montage and Architecture" (Eisenstein, 1989) where he interprets acropolis from a cinematic point of view. We also refer to an emerging design field "experience design" as our conceptual and theoretical source.[2]

The sequence of Scenes are diachronic, later to be montaged to provide a holistic AR experience (Figure 9).

[2] For example see (Dewey, 1980)(Hassenzahl et al. 2013) (Shedroff, 2001) (Benz, 2015) (Anay, Özten, & Özten Anay, 2014) (Özten, 2019).

Figure 9 Visitor Experience Sequence of Scenes.

Scene 1-2: Approaching from parking area (P) North of the entrance (E) is dodecagon building and so-called sculpture hall (Scene 2). They are fully unearthed, but upper structures are incomplete, and they do not give idea about their overall form. These buildings are important for their spatial characteristics, and the things to be presented inside them, rather than their outer form. Dodecagon building has its mosaics, inner ornamentations, and sculpture hall has its sculptures presented on a podium, therefore both should be experienced from inside. At their present stage, none of these assets is on-site, and replacing them through AR is an opportunity.

Scene 3: To the West of entrance, it is the Decumanus (Figure 10). A number of cells (shops) lay along its South border. It is partially excavated, but giving a sketchy idea about its scale, orientation, construction technique, etc. Visitors sometimes wonder the street towards West. To the West end of the street is the remains of a Roman Arch that is neither visible nor accessible from this point. Street as a linear element could be best experienced by movement, by being inside, by walking through it, or watching people doing things and walking around. Virtually augmenting Roman arch and completing the shops would contextualize it and bring it its lost spatial characteristics. What is missing here is not things, but the life and people. We decided to tell a story about an important event in time in the city's history here as an augmented layer. It is about reanimation of one of the visits of St.Paul (Acts 16:6-8) (Texier, 2002) in history, walking from the ancient harbor, along the decumanus. During experience one of the apostles come towards the visitor and tell the story about the event.

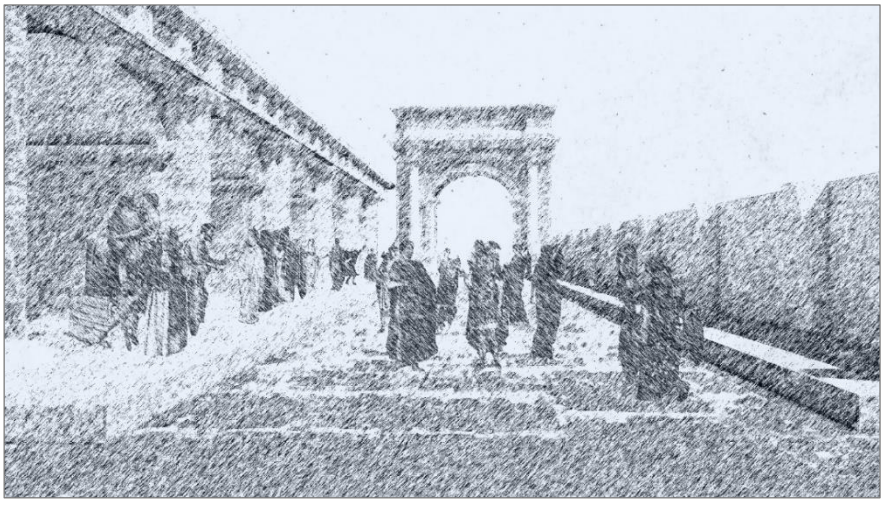

Figure 10 Scene 3: Thematic Reanimation of Decumanus.

Scene 4: Passing through these scenes, visitors are now inside the forum, where to the Southeast corner of it, adjacent to the dodecagon building and the sculpture hall, resides the Odeon. It is only partially excavated and giving us a trace information. No rows of Odeon and no scaenae exist at its present stage. Here aside the building parts and the overall external form, missing layers are the people and the acts, where crowd, movement, sound, etc. should be involved. We also decided to tell a visual story about an important event in time in the city's history here. The story is inscribed on a stone and it is about a musician from Lesbos who was commended for his exceptional performance in a competition that take place in the Odeon (Schwerteim, 2002). We decided to reanimate the performance and through AR, make visitors to sit on the slopes of the Odeon and watch the performance, where the forum, temple and Tenedos is at the background.

Scene 5: At the center of the forum is the podium temple, together with a fountain to its East, and an altar to its West (Figure 11). These three should be considered as a whole. All three are fully excavated but what is left is only the foundations and giving no idea about their overall form. All these are important in the sense of their missing sculpturesque characteristics (external form) and must be primarily augmented in this sense. The fountain and the altar are also complementary elements to the overall composition of Temple. Podium Temple is the heart and soul of the forum, the main attraction in the site. Apart from completing the missing architecture of it, the life around it is particularly important, especially together with the altar. We decided to present a ritualistic ceremony, where temple and the forum at the background, and there is crowd involved.

Figure 11 Scene 5: Thematic Reanimation of Podium Temple and the Altar.

3.3. The Case: Scene 5, Podium Temple

In such a context, we selected the temple as the first scene to work on. First, since it is already the visitors' main point of attraction, it is convenient to present it through AR and then test it. Second, it might be a departure point, a trial to learn from for a more comprehensive and inclusive study. Third, there is almost nothing left from it except the foundations to give a three-dimensional holistic idea about it, and there is nothing to do about this in conventional means.

So-called podium temple is dated as early imperial and the remains led researchers to decide it was built in Corinthian order (Görkay, 2002). Apart from the conjecture that it was a podium temple (referring to the traces of foundations), it would be hard and quite speculative to tell anything else about its main layout, elements, form, and style. Although there is as attempt towards its restitution, as such, it is almost impossible to do something towards its representation to visitors, at its present stage by the conventional means. AR on the other hand might be a feasible option, since it permits speculation, and it is essentially non-invasive.

Following the traces of the foundations, using Gorkay's (2002). existing study as a departure point, and after a number of interviews, we decided to develop our AR model upon three distinct restitutions of the temple based on three likely probable layouts: prostylos, peripteros, and pseudo-

peripteros (Figure 12). After this decision, we conducted studies towards restitution of the variations. Proposals then were modeled in ArchiCAD.[3]

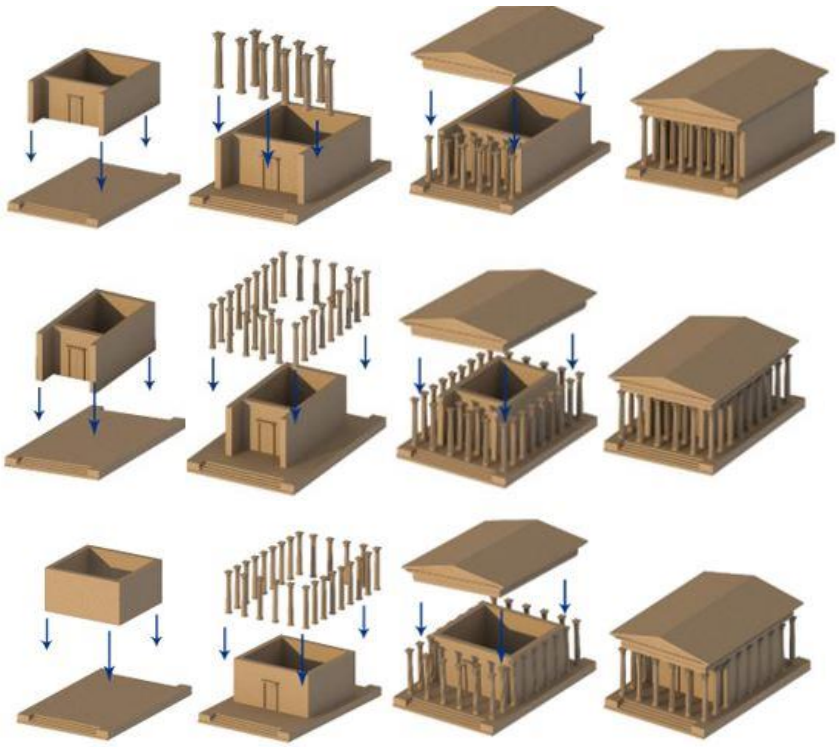

Figure 12 3 Temple Alternatives.

3.4. Developing and Testing an AR Application

During the study, we tested two distinct approaches: GPS placement and manual placement. It is about the question how virtual, and the real layers are woven together successfully. Typically, AR applications use hardware's in-build capabilities such as Cameras, GPS, Gyroscope and Accelerometer. In addition, the means of locating the virtual layer might be by using GPS, recognizing a Marker, or manually. We tried both the GPS and the manual placement methods. GPS would be a logical and practical solution since placement is automatically made by the application. However, GPS provided unprecise results since the signal is always distorted and precision is roughly 2 meters max. Manual placement was also feasible, but placement needed a manual labor just before the experience begins. It was not the aim of the study to evaluate and/or compare the capabilities of hardware. But we observed that it is a part of the equation, a very important one. We used a state-of the art version of an IOS (IPAD operating system) based tabled. Even if so, the machine did not support the virtual model fully. Frame-per second, an important indicator was well below the acceptable standards, if texture and light were to be included. There were aspects without which an immersive precise experience would not be so possible. Optimization might be key but still, we thought that hardware capabilities are yet to advance to support rigorous AR applications. As far as development of the application is concerned, there were two major paths to follow. One is Android (Google's Mobile Operating System based on Linux) the other IOS as the development platforms. As far as the capabilities of both are concerned, ARkit[4] and ARCore[5] provide

[3] To our experience, Archicad is not the optimal choice in this sense. Rendering capabilities of smartphones and tablets are way behind the capabilities of a graphic-card supported system, i.e. desktops and laptops. Therefore, one should seek low-polygon models and textures accordingly. There are a number of choices in this sense such as MAYA, 3DS, Blender for general purpose modelling, and architecturally Sketchup provides a relatively viable option.

[4] ARKit is Apple's framework and software development kit that developers use to create augmented reality games and tools. (https://appleinsider.com/inside/arkit)

[5] ARCore is Google's platform for building augmented reality experiences. (https://developers.google.com/ar/develop)

almost identical opportunities for the developer and the user. A cross–platform development perhaps would be a better choice. For example through Unity[6], and ARfoundation[7] or Vuforia[8] it is only a matter of compilation.

In its present stage AR goggles are barely available/accessible for the ordinary end-user. This option would perhaps might lead to solutions that are more rigorous since they are designed solely for this purpose. The second option is wearables, handheld tablets and cellular smart phones that present a great opportunity. These are already embedded within people's daily life and people are used to them as visual devices. They also have connectivity. We traced this objective opportunity.

We developed our application for IOS, and consequently used ARKit library under Unity as our development environment. Object placement, when the virtual layer is calibrated and overlapped with the real have had a particular importance here. Typically, the device first have to analyze the environment through its camera and sensors and establish a virtual model of the real within itself. Then virtual layer has to be "placed" onto the real by various means such as GPS, manual placement, and placement by image recognition. We used first two and decided to go on with manual placement (Figure 13). Since there were three alternative versions of the temple, we utilized click gestures to browse through them (Figure 14). After all the visitor is free to do whatever she likes, go around, get close to the temple, or get back to have a better overall view. During this process, the initial model had to be optimized and some aspects such as lighting, and textures had to be removed for the sake of achieving a plausible performance.

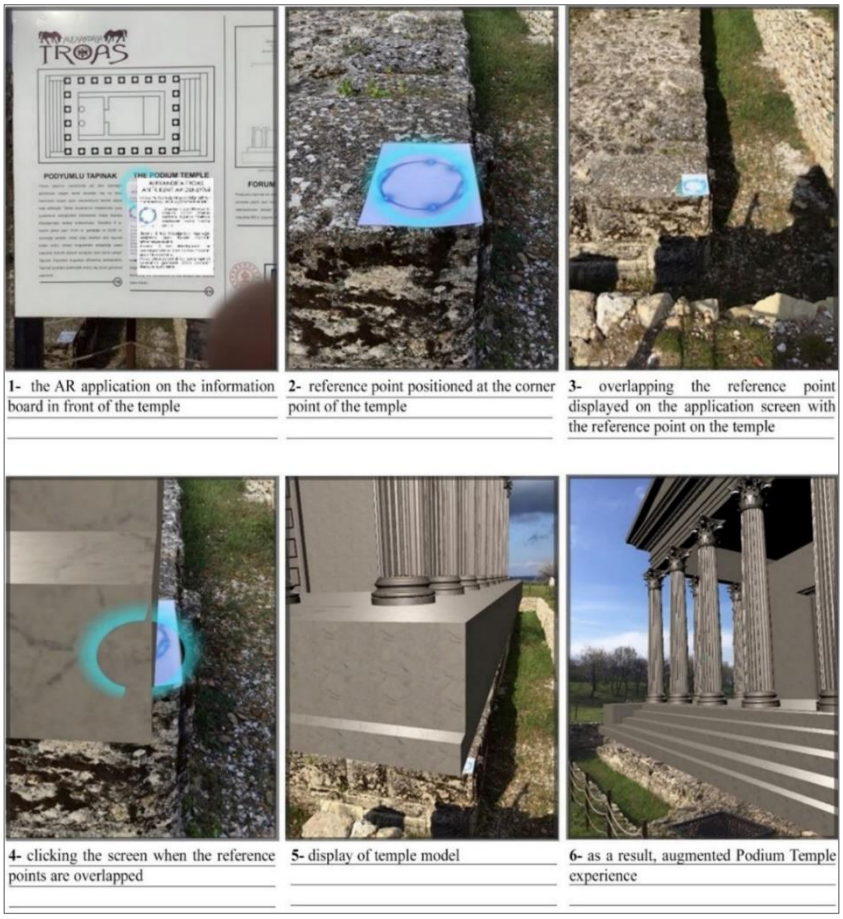

Figure 13 Manual Placement of Virtual Model.

[6]Unity is a real time cross-platform development environment. (https://unity.com/)
[7]AR Foundation is a cross-platform framework that allows you to build augmented reality experiences once, then build for either Android or iOS devices. (https://developers.google.com/ar/develop/unity-arf/features)
[8]Vuforia is a comprehensive, scalable enterprise AR platform. (https://www.ptc.com/en/products/vuforia)

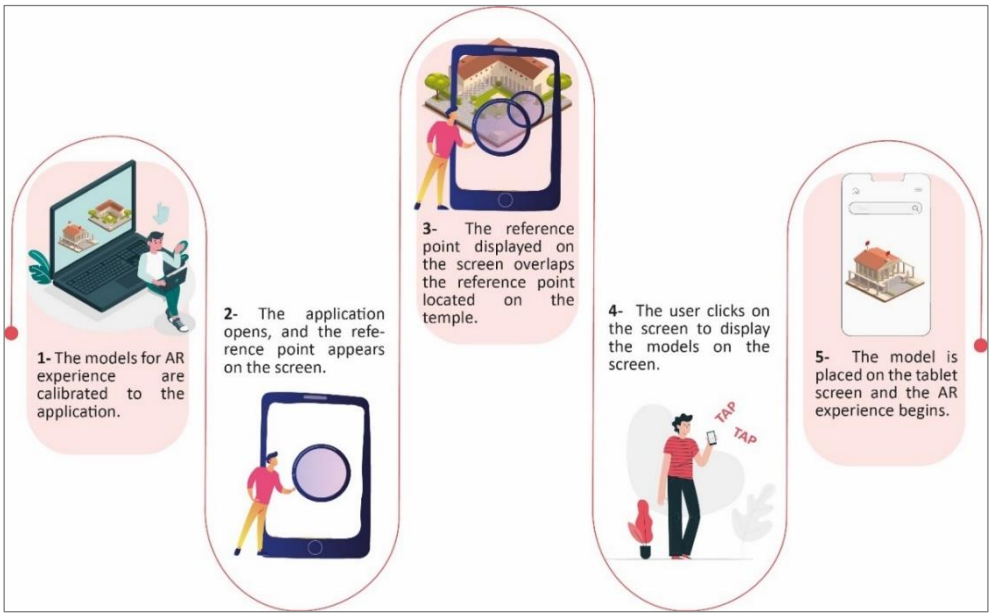

Figure 14 Calibration and Click-gestures of AR.

3.5. Field Studies: Basic Observations

After the development of the application field studies were carried out to calibrate, apply and evaluate the application. At this stage, a text describing the AR experience has been placed on the information board that visitors encounter while experiencing the area (Figure 13). On the board, visitors are told how they can experience the temple with the tablets on which the application is already installed. We also informed them this was a scientific study and asked if they would like to participate. We recorded and documented the experiences then go on to decipher and evaluate them. There were more than 200 participants during our studies (Figure 15). This was a separate study that has its own targets and specificities, and it is still being evaluated with its own methodology. However, sharing some of the first observations are particularly important for the present purposes.

In general, element of surprise was always there, and many of the visitors met the experience with exclamation. This is partially due to unfamiliarity with the AR. However, visitors also stated that they did not imagine the temple as such. After the experience, they expressed their firm belief on AR's support towards understanding of historical and cultural value of the structure. Some of the repeated comments are, "It triggered my imagination" and "It takes people to the past." These two shifts (or displacements) in perception and awareness we particularly find significant. One of the gestures after they see the model first time was a sudden urge towards paying attention to other parts of the site. The also expressed this verbally: "I wish I could see the entire historical environment," "What about the surrounding?" "What about the building there?" They also asked much about the use and the acts going on and around the temple. Visitors stated that they want to have such an educational and entertaining experience in the whole area and even in different ancient cities. Experience also triggered movement, we observed people tend to go around and examine the surrounding. It has been observed that especially the children and teenagers are particularly interested in the experience. Almost everyone demanded a photo or a selfie in front of the Temple and the visitors spent considerable time even during this single-building experience. Responses from experts (architects, archaeologists) also tend towards seeing "more" but in a different way. Professionals emphasized that the model could be developed further (especially in the detail level). However, they affirm that it would be highly educational to experience the field in

this way. We also observed that people have had no difficulty to adopt themselves to this new type of experience.

Figure 15 Visitor Experience.

4. Conclusion

Before going through conclusions and remarks one must not forget the fact that abovementioned observations are towards the use of AR for the (re)presentation of archaeological sites, not their conservation. All in all, AR is a serious candidate to be a considerable asset for the presentation of archaeological sites, without compromising the universal norms of conservation of cultural heritage, but maximum non-invasive characteristic of AR only takes us so far. A plausible (re)presentation model, whether it utilizes AR or not, should go hand in hand with a rigorous conservation approach and a master plan to ensure the preservation of cultural heritage. AR's potential contribution towards this ultimate aim, however, is yet to be addressed.

In addition, one must consider the fact that the present research was a pilot study with a number of limitations. While providing a number of answers to the initial conjectures, due to its limitations, first, it did not permit us to develop a full, comprehensive model and test all the conjectures at mind and second, it raised a number of new questions to be addressed. Perhaps next step would better be the expansion of the scope of the study, i.e. implementing a full AR application of the forum area as planned. We also believe that the application further needs to be raised to a higher level involving more depth (including life, history, stories or even a scenario as AR layers) and in detail (a more comprehensive AR models of assets, detailed revitalization of parts), while incorporating all these with interactivity and connectivity.

As it comes to conclusions, first thing to note is the that utilization of AR for the presentation of Archaeological sites demands a multidisciplinary study that involves quite distinct tasks to be addressed and, thus requires expertise in various fields, all to be organized in coordination. In turn, it is very hard to summarize and report such a multi-faceted, complex study, not only it contains much, and sometimes incompatible issues to address, but since it could be taken in various means, with various emphases. Here, in this report, we tried to make a review of the whole process, by giving an outline, and pointing out the essentials, without going into detail in any part of the study and without any particular emphasis. The ultimate aim was to examine and evaluate the potentials of AR for the presentation of Archaeological sites.

Perhaps the first thing to mention that AR brings to fore is the element of surprise and its potentials towards arousing curiosity and interest among visitors. Consequently, visitor from

passive observer stage became an active participant. People started to ask questions, wonder, seek, and try to see more, even touch. This is also related with missing layers replaced by AR, increased people's level of perception and awareness.

As we observed the behavior of the visitors, we identified a recognizable vibe and joy in their AR experience. Their attention was fully on the Temple through the screen; they showed things, made comments to each other, generally with enthusiasm, through wide spectrum of verbal, visual and auditory stimuli, people became active part of the experience. We particularly observed the full attention of children and young people, try to ask and learn. Apparently, apart from its recreational power there was also an implied pedagogical potential of AR. Visitors also tried to develop a familiarity with what they have been observing, through seizing and internalizing it by various means. They scaled it by their bodies, by movement, they tried to incorporate it within their previous experience and knowledge, even try to project back on what they have seen. This we believe implicates an urge towards developing a sense of belonging and immersion. Visitors also seemed to appreciate the AR technology itself, developed a quick familiarity with it although this was their first experience.

We strongly believe that AR is quite different from VR, as an approach to present archaeological sites, as it seems to work as a natural extension of corporeal and mental being and existence.

Apart from our observations deriving from in-situ application of AR concerning visitor experience, there are also observations concerning the use of AR in conservation and presentation of cultural heritage. As far as AR is concerned, presentation becomes as non-invasive as, and as rich as it gets; physically, almost next to the real thing, otherwise, almost to an unimaginable level. Of course, there seems no apparent active involvement of conservation, i.e. one cannot stop decay due to climatic conditions, natural disasters, through AR. But maximum non-intervention side by side AR's rich potential through which to say/present almost anything about the remains brings an unprecedented setting to play with, permitting variety and creativity; permitting temporarily with permanence, speculation with reality, all mixed together to be weaved into a new, sustainable environment. Beyond the obvious, i.e., use of AR for the augmentation of the missing physical parts, and providing general information, it comes with a number of novel capabilities those are worth to be explored further. First is about time and history, and it is related with the diachronic view of the historical phenomena: in an archeological site, you are at the end of its history, and only be able to gaze at the present, or a certain revitalized period frozen back in time, no matter how the site was presented in conventional means. AR however, permits breaking down this space-time continuum, and help us to roll-back and fast forward in time, warp between periods, and make a dynamic representation of time, and stratigraphy of periods possible. Second is about the synchronic view of its history and this also involves stratigraphy of periods and augmentation of incomplete layers. We already mentioned the obvious track to follow, i.e., completion of physical aspects. Here, AR makes synchronic projection of alternatives, varieties or sometimes speculations possible, presented side-by-side or one over another. And it is possible to reverse back a proposal or replace it with a more plausible one at any time. Such an environment, supported by AR is infinitely open to extension, expansion, and update, both in synchronic and diachronic levels.

In addition to all, AR enables intangible layers such as people, life, a story, or an event to be presented together with the physical. We particularly evaluate this as a valuable asset privileged by AR that would promote an unprecedented, rich experience involving both corporeal and mental presence, and immersion.

As such, AR seems to have its own agenda, coming with unprecedented possibilities still to be appreciated and adopted, which in turn might help us to go beyond the conventional conceptions and modes of conservation of cultural heritage and presentation.

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Resume

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GIS-based seismic vulnerability assessment for the Istanbul Historical Peninsula

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Abstract

According to the Index of Risk Management-INFORM 2020 Report, Turkey was included in the group of "high-risk" countries in terms of humanitarian crises and disasters with an index score of 5.0 in 2019. In statistics related to the damage caused by disasters, it is known that natural disasters cause a 3% loss in Turkey's gross national product every year, and this rate approaches 4-5% with indirect losses. Since disasters cause socioeconomic, physical, and institutional losses, attention has been given to the importance of disaster management and risk reduction studies. This paper focuses on vulnerability assessments and presents a multi-criteria decision-making and earthquake-related vulnerability assessment method by using physical and socioeconomic parameters in the Historic Peninsula. A Multi-Criteria Decision Making (MCDM) method was applied in this study because vulnerability assessments are complex and depend on many different criteria. Due to its flexible structure, the Analytical Hierarchy Process (AHP), which is one of the MCDM methods widely used in urban vulnerability assessment studies, was preferred and integrated with Geographic Information Systems. As a result of the study, it is found that approximately 49% of the district is at a moderate vulnerability level in terms of socioeconomic characteristics. For the structural characteristics, this rate is found to be at a high vulnerability level of 93%. The remaining 7% is moderately vulnerable. In this context, emphasis should be placed on identifying risky structures and strengthening and renovating them in the Historic Peninsula. The results of the method proposed in this study can be used as a basis for risk reduction studies. In addition, it can be a guide in pre-disaster risk reduction studies and can be integrated into city planning processes to keep disaster damage at minimum levels and predict the damage that may occur in settlements. The proposed method is a low-cost and short-term analysis that can be used, especially in public institutions that lack a technologically qualified workforce.

Keywords: earthquake, GIS, Historical Peninsula, Istanbul, vulnerability assessment

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1. Introduction

While the world is witnessing the most intense urbanization ever, population growth in urban areas increases the potential for disaster exposure (Dickson et al.,2012; UNISDR, 2012). It is estimated that exposure to earthquake and cyclone risk in the cities of developing countries will be more than double the current level in 2050 (World Bank and UN, 2010).

According to the report prepared globally based on the Index of Risk Management-INFORM (IASC and EC, 2020), Turkey, one of the developing countries, is in the group of "high risk" in terms of humanitarian crises and disasters with an index score of 5.0 in 2019. In terms of the hazard and exposure score of the sub-components of the index, it is the 10th most risky country (AFAD, 2020). Natural disasters cause a 3% loss in Turkey's gross national product every year, and this rate approaches 4-5% with indirect losses. On the other hand, according to the type of natural disaster, 66% of the damage was caused by earthquakes in Turkey (AFAD, 2020).

Istanbul is the leading city in Turkey and is under a severe risk of earthquake due to the North Anatolian Fault (NAF). Istanbul has become not only the financial and economic center of Turkey—Istanbul contributes the highest share of Gross Domestic Product (GDP) with 30.1% (TURKSTAT, 2021)—but also, it is one of the important historical cities hosting historically significant monumental structures in Turkey (IBB, 2018). Fatih, in particular, plays an important role in hosting the historical peninsula where the most cultural and historical heritage accumulates. However, Fatih is under the risk of disaster with a dense historical building stock that is vulnerable to earthquakes. According to the JICA (2002) report, the "heavy damage location coefficient" evaluation shows the geographical concentration of neighborhoods that require urgent action are concentrated in Fatih.

The determination of seismic vulnerability includes structural, social, economic, and physical factors. In the Historical Peninsula Management Plan (IBB, 2018), it is stated that conducted risk analyses are not sufficient for today because those analyses do not have a holistic approach. Risk analysis should consider not only all physical parameters but also social, economic, and administrative parameters as well (IBB, 2018). That is why, in this study, the Historical Peninsula is chosen as a case study area, and it is examined in the context of not only physical but also socioeconomic criteria to model seismic vulnerability. It is obvious that possible losses and damage caused by an earthquake can be reduced because of the effective implementation of risk mitigation policies. Planning decisions can be sensitive to disasters and reduce disaster losses by integrating risk and vulnerability assessment into every stage of the planning process (ISMEP, 2014a). For this reason, vulnerability information is an important input to determine the places that are likely to be damaged. Thus, this paper focuses on vulnerability assessment and aims to develop a seismic vulnerability assessment method to identify neighborhoods with high vulnerability and low coping capacity in the Historic Peninsula of Istanbul.

As the vulnerability assessments are complex and depend on many different criteria, the Multi-Criteria Decision Making (MCDM) method is applied in this study. Due to its flexible structure, the Analytical Hierarchy Process (AHP), which is one of the most widely used MCDM methods in urban vulnerability assessment studies, is preferred. Finally, a combined method of the Analytical Hierarchy Process (AHP), and Geographic Information System (GIS) is used to evaluate the seismic vulnerability.

This paper is conducted on a neighborhood basis and includes all neighborhoods of Fatih (57 neighborhoods). The criteria needed for vulnerability assessment are discussed under four main groups: structural, socio-economic, infrastructural, and critical urban facilities. It is necessary to assign weights to all earthquake vulnerability criteria and determine their degree of importance within the scope of the AHP. Experts, including a city planner, a sociologist, an architect, a civil engineer, and an environmental engineer are asked to weigh in on the criteria. Then, experts score for each main criterion and each sub-criteria by using pairwise comparison matrices.

This study, which was conducted to assess the vulnerability of physical and socio-economical parameters in earthquake-prone settlements, aimed to present an extensible earthquake-focused vulnerability assessment method suitable for integrating new data. Previous studies on earthquake vulnerability have focused more on physical parameters, while studies focusing on socioeconomic and infrastructure parameters are generally not neighborhood-based studies but cover larger areas. This study proposes a method that can be easily used by everyone by integrating all physical and social parameters with GIS.

This study can be seen as a low-cost and short-term analysis method that can be used in public institutions that have a lack of a technologically qualified workforce.

2. Theoretical Background: Hazard, Vulnerability and Risk

The vulnerability concept is one of the most significant phenomena in urban planning as it is directly related to the city's response capacity. To better understand the concept of vulnerability in urban areas, it is fundamental to have knowledge of terms like hazard, disaster, and risk. Hazard and risk are often used synonymously, but they are different concepts. All events and phenomena that have the potential to cause harm is defined as “hazard”. On the other hand, “Risk” is the probability of occurrence of harm in case of hazard (ISMEP,2014b).

Cova (1999) emphasized the mathematical formula of risk defined by UNDRO as follows.

Risk = elements at risk . (hazard . vulnerability)

Wisner et al. (2004) formulated the risk as.

RISK = H x V

Where,

H indicates the probability of occurrence of natural hazards, V indicates the degree of vulnerability.

Hence, under both Wisner et al. (2004) and the UNDRO definition, it is possible to see that there is a significant relationship between risk and vulnerability at the analytical level. In this respect, it can be said that the production of risk reduction strategies basically depends on vulnerability reduction strategies. Vulnerability and risk factors in the city should be kept away from the hazard in order to lessen the chance of a disaster.

2.1. Vulnerability and Conceptual Frameworks

Although vulnerability does not have a clear definition, it is a concept used in many different disciplines and in different strands of the academic literature, such as disaster management, geography, economics, finance, sociology, environmental sciences, and engineering (Cutter,1996; Timmerman, 1981). Measurement of vulnerability has become much more complex as the vulnerability concept has advanced in recent years (Cutter et al., 2003). Cutter (1996) also supports the idea that dealing with the vulnerability is difficult, and she conducts a literature review and introduces 18 different definitions of the vulnerability. In short, vulnerability can be defined as "potential loss" (Cutter et al., 2003). According to UNISDR's terminology, vulnerability is “the conditions determined by physical, social, economic, and environmental factors or processes which increase the susceptibility of an individual, a community, assets, or systems to the impacts of hazards” (UNISDR, 2009). Understanding this concept can often be difficult due to the different dimensions it has. Rashed and Weeks (2003) explain vulnerability as “ill-structured” because there are multiple representations or understandings of vulnerability. Thus, choosing the right design structure is perhaps the most important (Rashed and Weeks, 2003) and complex process.

Birkmann (2006) underlines the complexity of the concept of vulnerability. He provides one of the best overviews of how the concept of vulnerability has broadened over time and points out that trying to establish a universal definition of vulnerability can be misleading. He explained the reason for the complexity of the vulnerability to the different definition of the concept in different field, such as disaster management and environmental studies. Therefore, the concept of vulnerability is still somewhat ambiguous (Birkmann, 2005; 2006).

There are many different approaches in the literature on vulnerability. One of the approaches is the 'Vulnerability Hazards-of-Place Model' by Cutter (Cutter, 1996; Cutter et al., 2000). This model focused on describing the place-based interaction between biophysical vulnerability and social vulnerability. In this approach, it is explained how the vulnerability of a place is determined by factors such as socioeconomic status, urbanization status, and demography. Another vulnerability framework proposed by Turner et al. (2003) focuses attention on human-environmental systems and examines the vulnerability concept more broadly (global and local level). Another model, the Earthquake Disaster Risk Index (EDRI), defines vulnerability and hazard as a component in the context of risk. The conceptual framework considers risk as the sum of four components: hazard, exposure, vulnerability, and capacity (Davidson and Shah, 1997). On the other hand, the Pressure and Release Model (PAR Model) explains risk as an intersecting combination of vulnerability and hazard, and the model is based on the widely used risk equation (Risk = Hazard x Vulnerability). PAR indicates that disasters occur when hazards affect vulnerable people (Blaikie et al., 2014).

The mentioned conceptual frameworks differ in scope. Different disciplines serve different vulnerability frameworks. There is no general model that can be applied to all fields (Birkmann, 2006). According to those models, risk is basically a function of exposure to hazard, susceptibility, and the capacity to cope with hazard (Wisner, 2016).

2.2. Indicators of Urban Vulnerability

Urban risk is defined as “in addition to natural disasters, the entire possible loss and damage that may occur due to reasons such as general layout of a city, urban texture, usage areas, existing housing, transportation systems and infrastructure, planning and management weaknesses in a city.” (ISMEP, 2014b, p.12). Because of the complexity of urban structures, urban risk and vulnerability studies also become complex and contain various indicators.

In general, urban vulnerability indicators are divided into groups as social, economic, environmental, and physical vulnerability. The main goal is to achieve a holistic approach. For example, Cardona et al. (2012) grouped vulnerability under four different main criteria. These are environmental, social, economic, and other criteria that interact and intersect. The methods for the improvement of vulnerability assessment in the European Union (MOVE) framework are discussed under six main criteria, such as physical, economic, social, cultural, environmental, and institutional (European-Union, 2015).

Structural-physical vulnerability is generally studied by engineering approaches. In general, weak points are trying to be determined by evaluating the physical factors of the city, such as buildings, roads, and infrastructure systems (ISMEP, 2014b). Mostly, studies on building characteristics and behaviors in urban systems (Karimzadeh et al., 2014) have been carried out. The reason for this is that the behavior of the building during a disaster directly determines the injury or loss of life.

Socioeconomic vulnerability has been included in many studies in the literature and Cutter is one of the most referenced. Cutter et al. (2003) broadly categorized the social vulnerability metrics such as gender, age, race and ethnicity, family structure, income, residential property, housing quality, tenancy, built environment, infrastructure, and lifelines etc.

Systemic vulnerability (also referred to as critical vulnerability in some sources) is the damage of subsystems in the urban system, rendering other systems inoperable (ISMEP, 2014b). Damages to critical urban infrastructure cause services such as hospitals and fire stations, which will be used

most in the event of a disaster, to become out of use (ISMEP, 2014b). Sikich (1998) listed the infrastructure elements that could be damaged in the event of a disaster as follows: electric power supplies, gas and oil, telecommunications, banking and finance, transportation, water supply systems, emergency services. In this context, it is seen that urban vulnerability assessment indicators are very diverse and complex.

2.3. Multi-Criteria Decision Analysis

Many concepts, rules, and principles of vulnerability in cities are not precise enough. All the factors and processes that contribute to vulnerability cannot be accepted or expressed in analysis. The model should cover all aspects of possible risks while trying to avoid redundancy (Rashed and Weeks, 2003). Understanding and formulating vulnerability requires consideration of a wide variety of factors that can be addressed through an integrated approach (Cardona et al., 2012). In an integrated approach, an interdisciplinary perspective should be incorporated into risk assessment. Rosa et al. (2014) emphasized the importance of adopting a deliberative approach, using analytical methods and analysis, when assessing risks. In other words, an integrated and participatory approach is seen as one of the most appropriate methods in risk assessment studies.

Diaz-Sarachaga and Jato-Espino (2020) examined 72 urban vulnerability studies from different continents between 1998 and 2018. Among the 72 articles reviewed, Multi-Criteria Decision Making (MCDM) methods and Analytical Hierarchical Process (AHP) were the most used techniques, with 10 studies (Diaz-Sarachaga and Jato-Espino, 2020).

There are many factors that determine the seismic vulnerability of a city, and they all need to be considered at the same time. Therefore, multi-criteria decision-making (MCDM) is a suitable technique for that. It is considered one of the simplest methods to integrate all dimensions of vulnerability.

2.4. Multi-Criteria Decision Analysis and GIS

Unlike the classical MCDM process, spatial MCDM includes the spatial dimension originating from the geographical components it contains in the decision-making process. In classical MCDM studies, it is assumed that there is spatial homogeneity in decision making problems. However, as it is known, evaluation criteria can vary depending on spatial variables. Therefore, the necessity of defining new spatial dimensions for the MCDM process has emerged (Malczewski, 1999). So, Geographical Information System (GIS) integrated into vulnerability studies.

GIS-based MCDM analysis provides a useful platform for scholars, city planners or decision makers. The reason for the increase in the value of GIS in urban vulnerability analysis is that it has a technology designed to support spatial decision-making analysis and can integrate it into a field where there is a strong need to address multiple critical spatial decisions (Cova, 1999). Moreover, urban vulnerability is a spatial problem, as it is almost exclusively concerned with communities in a defined urban area (Rashed & Weeks, 2003). In general, what GIS-MCDA does is first it takes into consideration the decision-maker's concerns and use spatial data, and eventually transform spatial data into information to assist the decision-maker in choosing the best choice. Malczewski (2006) presents a very detailed literature review from 1990 to 2004. He showed that GIS-based MCDM analysis is used in many works in the fields such as environmental/ecology, transportation, urban and regional planning, waste management, water resources, agriculture and forestry, natural hazards, tourism, real estate, and geology.

2.5. AHP Method

The Analytical Hierarchy Process (AHP) is one of the multi-criteria decisions making (MCDM) methods, proposed by Saaty (1980). In this method the decision maker's problem is essentially decomposed into hierarchical sub-problems and these problems are analyzed independently. Therefore, AHP reduces the complexity of the initial MCDM problem and offers a smooth and well-structured problem. It also checks the consistency of the decision maker's evaluations to prevent

biases and incorrect suboptimal decisions. AHP is based on three basic principles: dividing an existing problem into parts and comparing it by creating a hierarchy (main criteria and a set of sub-criteria in each main criteria), forming a pairwise comparison matrix for those criteria, and giving weight values by synthesizing priorities (Saaty, 1980).

AHP technique is a powerful decision support framework. Therefore, it is easy to see that there are many studies involving the AHP technique in spatial analysis. More specifically, these studies range from, seismic hazard and building vulnerability (Karimzadeh et al., 2014), land use planning (Dai et al., 2001), to residential site suitability assessment (Al-Shalabi et al., 2006).

Considering the earthquake-oriented studies in the literature; Rashed and Weeks (2003) evaluated vulnerability against earthquake hazards by using spatial MCDM with Fuzzy logic. Sarvar et al. (2011) investigated earthquake risk assessment in the Tehran Region and used a combination of TOPSIS and AHP Models. Alam and Haque (2017) studied the spatial variability of residential neighborhoods in Mymensingh using AHP. Shayannejad and Angerabi (2014) examined the earthquake vulnerability assessment of Tehran using AHP and a fuzzy logic method. Alizadeh et al. (2018) applied GIS-based MCDM to perform seismic vulnerability analysis in the residential areas of Tabriz.

3. Case Area: Earthquake Vulnerability Assessment in Historical Peninsula of Istanbul

3.1. Study Area

The city of Fatih is a peninsula surrounded by the Golden Horn, a natural harbor in the north, the Sea of Marmara and the Byzantine walls in the south, and its surface area is 15.6 km² (Fatih Kaymakamlığı, 2019). It has an urban texture consisting of organic, grid and monumental structures. Although the area has extensive commercial and tourism facilities, it is densely residential. Urban Services in Historic Peninsula have an importance throughout Istanbul. Throughout its development process from the past to the present, the Historical Peninsula has been the most densely populated area of Istanbul and has been central business area (EMBARQ, 2014).

In addition to problems such as heavy traffic flow arising from a historical city structure, there are also problems such as dense housing and population, and the inadequacy of social and technical infrastructure. Although the area has a higher daytime population, the increase is due to the number of workplaces in the region (Fatih Belediyesi, 2015). The economic activities in the area are quite intense.

The Historic Peninsula can be defined as one of the most dangerous areas in Istanbul in terms of seismicity. In the JICA (2002) report, the "heavy damage location coefficient", which shows the geographical density of the earthquake vulnerability risk, was calculated. It was seen that the neighborhoods that need an emergency action plan are concentrated in the Historic Peninsula. Istanbul's Earthquake Master Plan reports that in terms of earthquake damage, the areas requiring urgent action are mostly located in the Fatih District (IBB, 2003).

3.2. Methodology

This section explains the methodology to be used for this study and shows the main steps related to data preparation for the analysis. The research method consists of three main parts. The first part includes the determination of the criteria and data preparation; the second part contains the application of the Analytical Hierarchy Process (AHP) method in the context of expert opinions, and in the last part, spatial analysis is performed with the help of the ArcGIS program by making use of the weights obtained. The steps to be followed are shown in the process diagram in Figure 1.

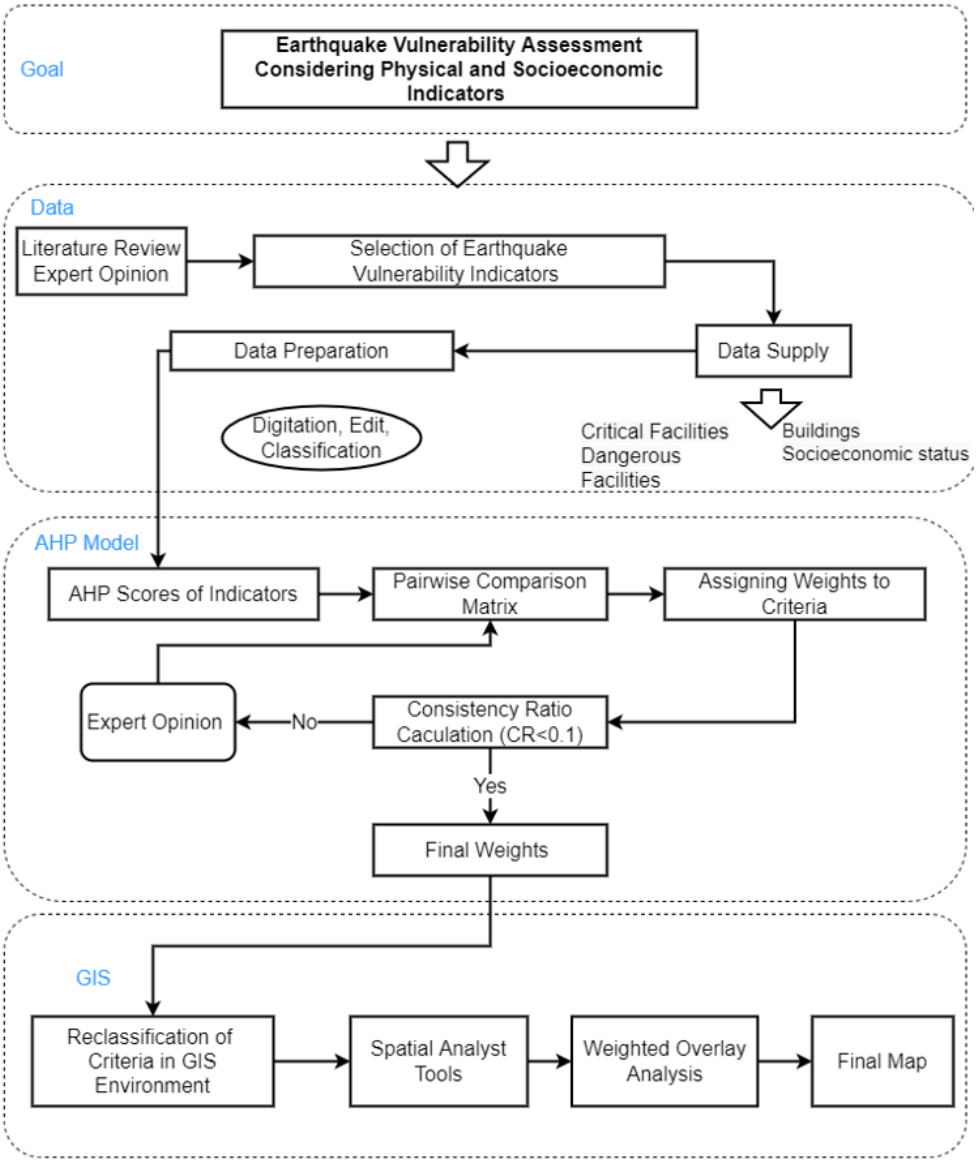

Figure 1 Process Diagram of Study.

The first stage of this study, which covers 57 neighborhoods in the Fatih district, is to determine the earthquake vulnerability criteria. The selection of criteria is determined according to the purpose of the study, theoretical frameworks, literature, and data availability. In this context, physical criteria are grouped into three main criteria. These are accessibility to critical urban services, infrastructure facilities, and structural criteria. Socio-economic criteria are grouped under a single heading. Once all the criteria are determined, the hierarchical structure is constructed (Figure 2). Unavailable data is not shown in the hierarchical structure.

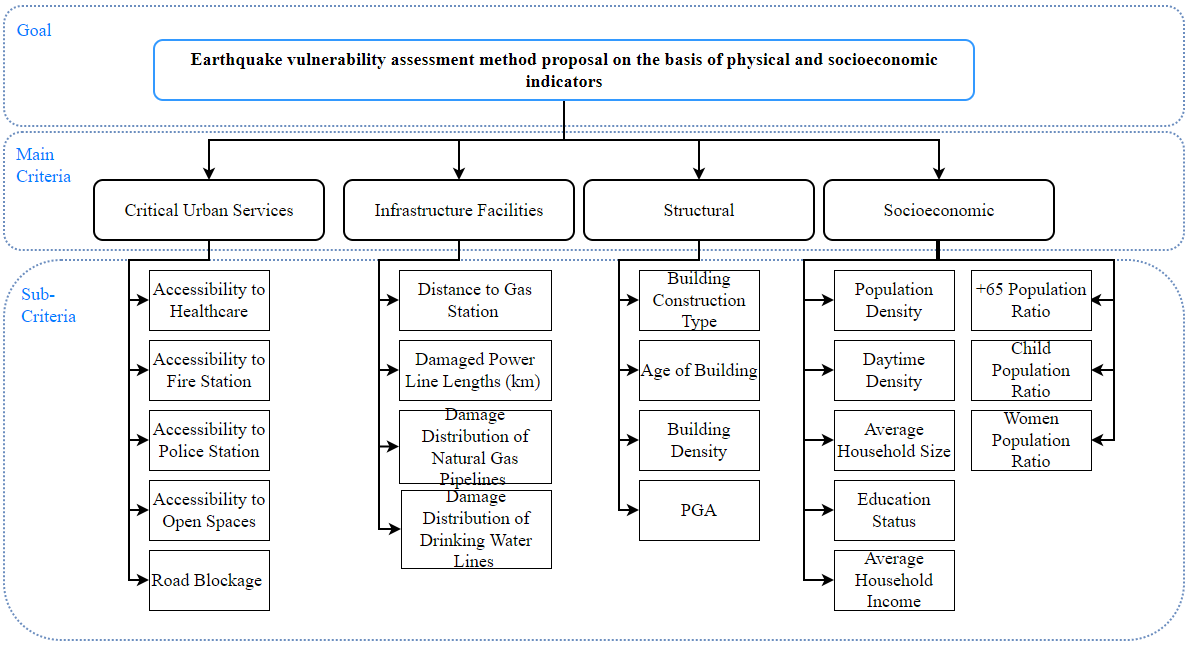

Figure 2 AHP Hierarchy of Study.

After the hierarchical structure is determined, data for each criterion is obtained in the next stage. Necessary data is requested from institutions for data supply. Some of the socio-economic data is obtained through TurkStat 2020 data and endexa.com, which publishes data based on neighborhoods by making use of TurkStat 2020 data. Infrastructure data is obtained from the JICA (2002) report. Land use, boundary and building stock data are obtained from the Istanbul Metropolitan Municipality- City Planning Department. Moreover, data such as migration, the number of disabled people, and building regulations could not be obtained. Fuel station information is downloaded from openstreetmap.org.

The data for hospitals and health centers consists of military hospitals, state hospitals, institution hospitals, private hospitals, university hospitals, foundation hospitals, SSK hospitals, clinics, family health centers, and polyclinics. Moreover, open space data consists of squares, sports fields, recreation areas, parks, green areas, and passive green areas. While determining the open spaces, the minimum size of the most suitable areas for preliminary evacuation as specified in the JICA (2002) report is taken as a basis (JICA, 2002, p.10-27). In this context, while choosing open spaces, areas with a size of 500 m2 and above are used in the analysis. Educational areas include universities as well as private schools, public schools, and foundation-owned schools. In summary, the data is separated into categories such as training areas, health areas, fire stations, and police stations.

The socio-economic data is based on neighborhoods and the analyses are carried out on the smallest administrative unit, the neighborhood. The socio-economic data consists of population density, average household size, education level, daytime density, average household income, elderly population ratio, child population ratio and woman's population ratio for each neighborhood. Daytime population is not available on a neighborhood basis. Therefore, instead of daytime population data, we use daytime density data. Daytime density data is obtained by calculating the ratio of trade and service usage to total usage (housing, etc.) on a neighborhood basis.

After the data is received from the institutions, data is made ready for analysis in the ArcGIS environment. Then the existing data are grouped according to the criteria and divided into feature classes. Polygon features are converted to point features to provide efficient use in spatial analysis. The data taken from the JICA (2002) report is converted to digitized data in the ArcGIS environment based on 500x500 m grids. After the conversion process, the data is grouped into four main criteria in the context of physical and socio-economic parameters. The sub-criteria included in these groups

are divided into classes using the literature. For example, the "building construction types" criterion, which is under the structural criteria, is divided into classes such as "wood", "reinforced concrete" and "steel".

After classification, each class is scored using a 1-5 rating scale, and the highest score is assigned to the class that most affects the seismic vulnerability (Table 1).

Table 1 Classification of criteria.

Main Criteria	Sub-Criteria	Classes	Reclassification Value	Vulnerability Score	Supporting Literature
Structural Criteria	Building Age	<1980	1	5	Ghajari et al. (2017) Reveshty et al. (2014)
		1980-2000	2	3	
		>2000	3	1	
	Building Construction Type	Wood	1	2	Alizadeh et al. (2018) Alam and Haque (2018) Ghajari et al. (2017) Reveshty et al. (2014) Karimzadeh et al. (2014) Duzgun et al. (2011)
		Reinforced Concrete	2	3	
		Steel Construction	3	1	
		Masonry	4	4	
		Other	5	5	
	Building Density (building/ha)	<15	1	1	Alizadeh et al. (2018) Alam and Haque (2018) Ghajari et al. (2017) Reveshty et al. (2014) Kundak (2006)
		15-30	2	2	
		30-45	3	3	
		45-60	4	4	
		>60	5	5	
	Peak Ground Acceleration (PGA-gal)	100-200	1	1	Alizadeh et al. (2018) Rezaie and Panahi (2015) Duzgun et al. (2011) Alam and Haque (2018)
		200-300	2	2	
		300-400	3	3	
		400-500	4	4	
		500-600	5	5	
Critical Urban Services	Accessibility to Health Facilities (m)	0-500	1	1	Rezaie and Panahi(2015) Alam and Haque(2018) Shayannejad and Angerabi (2014) Merciu et al. (2018) Duzgun et al. (2011)
		500-1000	2	3	
		1000+	3	5	
	Accessibility to Fire Stations (m)	0-1000	1	1	Rezaie and Panahi (2015) Alam and Haque (2018) Shayannejad and Angerabi (2014) Duzgun et al. (2011)
		1000-2000	2	3	
		2000	3	5	
	Accessibility to Police Stations (m)	0-500	1	1	Rashed and Weeks (2003) Rezaie and Panahi (2015)
		500-1000	2	3	
		1000+	3	5	
	Accessibility to Open Spaces (m)	0-50	1	1	Servi (2004) Shayannejad and Angerabi (2014) Rezaie and Panahi (2015)
		50-100	2	2	
		100-200	3	3	
		200-500	4	4	
		500+	5	5	

Table 1 (Continuation) Classification of Criteria.

Main Criteria	Sub-Criteria	Classes	Reclassification Value	Vulnerability Score	Supporting Literature
Critical Urban Services	Road Blockage	Low	1	1	JICA (2002)
		High	2	3	
		Very High	3	5	
Infrastructure	Distance to Fuel Stations (m)	0-100	1	5	Amini Hosseini et al. (2020) Kundak (2006) Ghajari et al. (2017) Rezaie and Panahi (2015)
		100-200	2	4	
		200-300	3	3	
		300-400	4	2	
		400+	5	1	
	Damaged Electricity Line Length (km)	0-1	1	1	JICA (2002)
		1-2	2	2	
		2-3	3	3	
		3-4	4	4	
		4-5	5	5	
	Damage Distribution of Water Pipelines (Rm (PGV): damage ratio (points/km))	0-2	1	1	JICA (2002)
		2-4	2	2	
		4-6	3	3	
		6-8	4	4	
		8-10	5	5	
	Damage Distribution of Natural Gas Pipelines (Rm (PGV): damage ratio (points/km))	0-0.04	1	1	JICA (2002)
		0.04-0.08	2	2	
		0.08-0.12	3	3	
		0.12-0.16	4	4	
		0.16-0.2	5	5	
Socio-ecoomic Structure	Population Density (Person/ha)	0-100	1	1	Armaş and Gavriş (2013) Rezaei and Tahsili (2018) Kundak (2006)
		100-200	2	2	
		200-300	3	3	
		300-400	4	4	
		400+	5	5	
	Average Household Size	<2.5	1	1	Armaş and Gavriş (2013) Duzgun et al. (2011) Alam and Haque (2018)
		2.5 - 5	2	3	
		>5	3	5	
	Education Level	Illiterate	1	5	Armaş and Gavriş (2013) Cutter et al. (2003) Rezaie and Panahi (2015) Duzgun et al. (2011)
		Literate uneducated	2	4	
		Primary School	3	3	
		High School	4	2	
		Higher Education	5	1	
	Average Household Income	Hunger Limit (2651TL)	1	5	Duzgun et al. (2011)
		2651TL-8638TL	2	3	
		More than Poverty Level (8638TL)	3	1	
	Daytime Density	Very High Density	1	5	Yu and Wen (2016) Yuan et al. (2019)
		High Density	2	4	

Table 1(Continuation) Classification of Criteria.

Main Criteria	Sub-Criteria	Classes	Reclassification Value	Vulnerability Score	Supporting Literature
Socio-ecoomic Structure	Daytime Density (Trade services/total services (housing etc-neighborhood scale)	Moderate Densitiy	3	3	Yu and Wen (2016) Yuan et al. (2019)
		Low Density	4	2	
		Very Low Density	5	1	
	Elderly Population Ratio (+65)	<%5	1	1	Armaş and Gavriş (2013) Rezaie and Panahi (2015) Alam and Haque (2018)
		%5 - % 10	2	3	
		>%10	3	5	
	Child Population Ratio (<5)	<%3	1	1	Armaş and Gavriş (2013) Cutter et al. (2003) Rezaie and Panahi (2015)
		%3-%6	2	3	
		>%6	3	5	
	Woman Population Ratio	<%25	1	1	Alam and Haque (2018) Cutter et al. (2003) Armaş et al.(2017)
		%25-%50	2	3	
		>%50	3	5	

All vector data should be converted to raster data for the weighted overlay analysis. So, reclassification values are assigned to data after rating classes. The reclassification process is carried out to make the data suitable for analysis and helps to simplify and group data according to classes.

After the classes are scored, the AHP is applied. The AHP model consists of 3 different parts:

1-A hierarchy structure is constructed for main criteria and sub-criteria

2- Pairwise comparisons of the main criteria and sub-criteria are made and the weight of each is identified according to expert opinion

3- Consistency between decisions and weights is checked (Rezaie and Panahi 2015).

In this process, experts determine the order of the importance among criteria in the pairwise comparison matrices according to Saaty's (1980) score scale:

Table 2 Saaty's (1980) score (value) scale.

Score	Explanation
1	Equal Importance
3	Moderate Importance
5	Strong Importance
7	Very Strong Importance
9	Absolute Importance
2,4,6,8	Intermediate Values

The pairwise comparison matrix is constructed by taking experts' opinions. Let 'A' be a pairwise comparison matrix. If the matrix has m evaluation criteria, then the dimensions of the pairwise comparison matrix become mxm. In each entry, ajk denotes the importance level of criterion j over criterion k (jth row, kth column). Then the importance level of the criterion k over criterion j becomes akj =1/ajk. In other words, the product of the symmetric elements in matrix A is equal to ajk*akj=1. If ajk>1, it is concluded that criterion j is more important than criterion k, and if ajk<1, then criterion j is less important than criterion k. If ajk =1, it can be interpreted that both criteria j and k have equal importance. In addition, diagonal elements of the comparison matrix A become ajj=1.

After the construction of matrix A, we first derive normalized pairwise matrix of A by making the sum of each column 1, and construct the criteria weight vector by averaging the entries of each row of normalized pairwise matrix A. Then the final weight is computed by a linear sum of given weights to main criteria and sub-criteria.

We find consistency ratio (CR) as $CR = \frac{CI}{RI}$ by following Saaty (1980). CI is the consistency index and CI= $\frac{\lambda max - m}{m-1}$ where λmax is the principal (largest) eigenvalue of the pairwise comparison matrix. Similarly, RI is the random consistency index and Saaty (1980) shows the Random Consistency index as in Table 3:

Table 3 Saaty (1980) Random Consistency Index.

Random Index Values (RI)										
m	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

In conclusion, if CR <0.1 then the comparison matrix is consistent. If CR>0.1, then the pairwise comparison matrix is inconsistent. Therefore, a CR between 0 and 0.1 becomes sufficient to ensure consistency.

As a result, pairwise comparison matrixes are created according to expert opinion and Business Performance Management Singapore (BPMSG) web site used the necessary calculations of AHP (Table 4, Table 5, Table 6, Table 7, Table 8).

Table 4 Weight values of socioeconomic criteria in the context of earthquake vulnerability.

Socioeconomic Criteria	Population Density	Daytime Density	Average Household Size	Education	Average Income Rate	Elderly Population (+65)	Child Population Ratio (<5)	Women Population Ratio	Weight	Final Weight
Population Density	1	1	4	3	4	2	2	4	0.25	0.0175
Daytime Density	1	1	4	3	4	2	2	4	0.25	0.0175
Average Household Size	0.25	0.25	1	1	1	1	1	2	0.08	0.0056
Education	0.33	0.33	1	1	1	1	1	2	0.09	0.0063
Average Income Rate	0.25	0.25	1	1	1	2	2	3	0.11	0.0077
Elderly Population (+65)	0.5	0.5	1	1	0.5	1	1	3	0.09	0.0063
Child Population Ratio (<5)	0.5	0.5	1	1	0.5	1	1	3	0.09	0.0063
Women Population Ratio	0.25	0.25	0.5	0.5	0.33	0.33	0.33	1	0.04	0.0028
Consistency Ratio = % 3.1										

Table 5 Weight values of critical urban services in the context of earthquake vulnerability.

Critical Urban Services	Accessibility to Health Facilities	Accessibility to Fire Stations	Accessibility to Police Stations	Accessibility to Open Spaces	Isolation Risk Caused by Road Blockage	Weight	Final Weight
Accessibility to Health Facilities	1	1	3	4	2	0.34	0.068
Accessibility to Fire Stations	1	1	3	2	2	0.29	0.058
Accessibility to Police Stations	0.33	0.33	1	1	1	0.11	0.022
Accessibility to Open Spaces	0.25	0.5	1	1	1	0.12	0.024
Isolation Risk Caused by Road Blockage	0.5	0.5	1	1	1	0.14	0.028
Consistency Ratio = % 1.4							

Table 6 Weight values of infrastructure facilities in the context of earthquake vulnerability.

Infrastructure	Distance to Fuel Stations	Damaged Electricity Line Length (km)	Damage Distribution of Natural Gas Pipelines	Damage Distribution of Water Pipelines	Weight	Final Weight
Distance to Fuel Stations	1	3	1	6	0.42	0.084
Damaged Electricity Line Length (km)	0.33	1	1	4	0.22	0.044
Damage Distribution of Natural Gas Pipelines	1	1	1	6	0.31	0.062
Damage Distribution of Water Pipelines	0.17	0.25	0.17	1	0.05	0.01
Consistency Ratio = % 4.3						

Table 7 Weight values of structural criteria in the context of earthquake vulnerability.

Structural	Building Age	Building Construction Type	Building Density	PGA	Weight	Final Weight
Building Age	1	1	2	2	0.32	0.1696
Building Construction Type	1	1	3	3	0.4	0.212
Building Density	0.5	0.33	1	1	0.14	0.0742
Peak Ground Acceleration (PGA)	0.5	0.33	1	1	0.14	0.0742
Consistency Ratio = % 0.8						

Table 8 Weight values of the main criteria in the context of earthquake vulnerability.

Main Criteria	Structural	Critical Urban Services	Infrastructural	Socioeconomic	Weight
Structural	1	3	3	6	0.53
Critical Urban Services	0.33	1	1	3	0.2
Infrastructural	0.33	1	1	3	0.2
Socioeconomic	0.17	0.33	0.33	1	0.07
Consistency Ratio = % 0.8					

After the determination of the weights are completed, a series of spatial analyzes should be made on the data. To perform these analyzes in bulk, a basic model was created in the Geographic Information Systems (GIS) environment with the help of the model builder using ArcGIS Pro version 2.6. Part of the model (for structural criteria) is shown in the Figure 3 as an example.

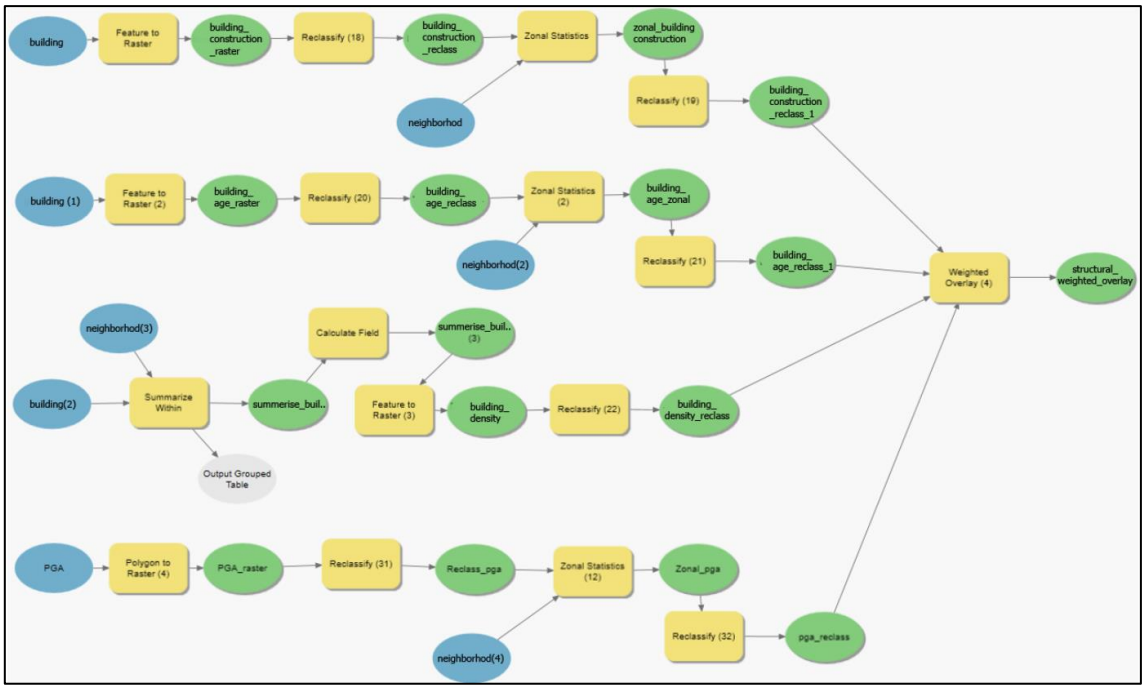

Figure 2 Model created for weighted overlay analysis of structural criteria.

Base-maps from various leading data providers, including Esri, HERE, Garmin, METI/NASA, USGS, were used via ArcGIS Pro. All data were converted into raster data as neighborhood-base according to the determined classes and values at Table 1. Subsequently, the weights obtained from the AHP process were included in the system, and weighted overlay analysis was performed based on sub-criteria first, and then all layers were combined to obtain earthquake vulnerability levels on a neighborhood basis.

4. Findings and Discussion

4.1. Structural Vulnerability Distribution

Considering the results obtained by using the opinions of the experts, it is seen that the most important criterion in terms of earthquake vulnerability is structural with a rate of 53%. Looking at the vulnerability distribution, it is seen that 50 of the 57 neighborhoods are at a high level of vulnerability in terms of structure. 93% of the study area at a high vulnerability level, and the population in these neighborhoods constitutes 99% of the total population. 1% of the population lives in areas with moderate vulnerability. The main reason why the area has such a high vulnerability potential is the risky distribution of building construction type and building age in the area. When the construction date of the buildings is examined (buildings with construction information), it is seen that 73% of them were built before 1980. Likewise, when we look at the building construction types, steel structures, which can be considered as the most earthquake resistant type, account for only 0.7% of all structures, while wooden structures have a rate of 2.5%. On the other hand, the rate of masonry structures with a higher damage potential from earthquakes is 33%.

4.2. Vulnerability Distribution of Critical Urban Services

One of the most important criteria in terms of earthquake vulnerability is accessibility to services such as hospitals and fire stations. Among the four main criteria, it is the second most important one, together with the infrastructure facilities criterion, and has a weight of 20%. In analyzing the vulnerability distribution of critical urban services across the Historical Peninsula, it is seen that only one neighborhood (Yedikule) has a high level of vulnerability. While the vulnerability level of 7 neighborhoods is very low, 42 neighborhoods are at a low vulnerability level. 4% of the population

in the area is at a high vulnerability level, and 5% of the population is at a medium vulnerability level. In other words, it is thought that 9% of the total population could have problems with accessibility to urban services. The fact that the vulnerability distribution is low in general can be explained by several reasons, such as the fact that the district is home to many private and public health institutions and the fire stations are homogeneously distributed in the area. Also, the Historical Peninsula has many police stations due to its being a touristic area.

4.3. Vulnerability distribution of infrastructure facilities

According to the AHP results, like critical urban services, infrastructure facilities, they have a weight ratio of 20%. The Zeyrek neighborhood is the only neighborhood with a medium vulnerability level and its vulnerability level is higher than other neighborhoods. Zeyrek constitutes 3% of the total population. Of the 57 neighborhoods, 14 have low vulnerability and 42 have very low vulnerability levels. Only 3% of the population lives in neighborhoods that are problematic in terms of infrastructure facilities. In other words, it is seen that the vulnerability level of infrastructure systems in Fatih district during and after the earthquake is generally low.

4.4. Vulnerability distribution of socioeconomic criteria

Socioeconomic criteria are determined by experts as the criteria with the lowest weight in the context of earthquake vulnerability. The vulnerability distribution by neighborhood is shown in Figure 4.1.

26 out of 57 neighborhoods in the Historic Peninsula are at a medium level in terms of socioeconomic vulnerability. This constitutes 78% of the population. The vulnerability level of 15 neighborhoods is low. The socioeconomic vulnerability level in 16 neighborhoods could not be estimated due to the lack of information on a neighborhood basis. Since the population of these neighborhoods is less than 250 people, the data was not calculated by TurkStat on a neighborhood basis. For this reason, data based on neighborhoods could not be reached.

4.5. Overall vulnerability distribution

After creating the vulnerability maps of the main criteria separately, the weights of all sub-criteria are multiplied by the main criteria. Then the overall weight values are obtained, and a weighted overlay analysis is performed. As a result of this analysis, the general vulnerability map obtained by combining socioeconomic and physical parameters can be reached (Figure 4). As a result of the analysis, three of the 57 neighborhoods, namely Aksaray, Binbirdirek, and Süleymaniye, have a low vulnerability level. 53 neighborhoods are at moderate vulnerability levels. Those 53 neighborhoods are a bit more problematic in terms of critical urban facilities; they also have a relatively higher vulnerability in terms of socioeconomic criteria. The ratio of wooden and steel structures, which are earthquake resistant and more flexible, is only around 4% in those neighborhoods. When the buildings in the neighborhoods are examined, it is seen that 71% of the buildings were built before 1980. In light of this information, it can be concluded that detailed studies should be carried out in the context of earthquakes in 53 neighborhoods other than Aksaray, Binbirdirek, and Süleymaniye neighborhoods. The reason why the general vulnerability map gives more homogeneous results compared to the main criteria is that it is based on neighborhoods. The distribution of analyses to be made in the size of the parcel will provide more precise results. Since all parameters are combined in the general map, the general weight values are close to each other, and this leads to a more homogeneous result.

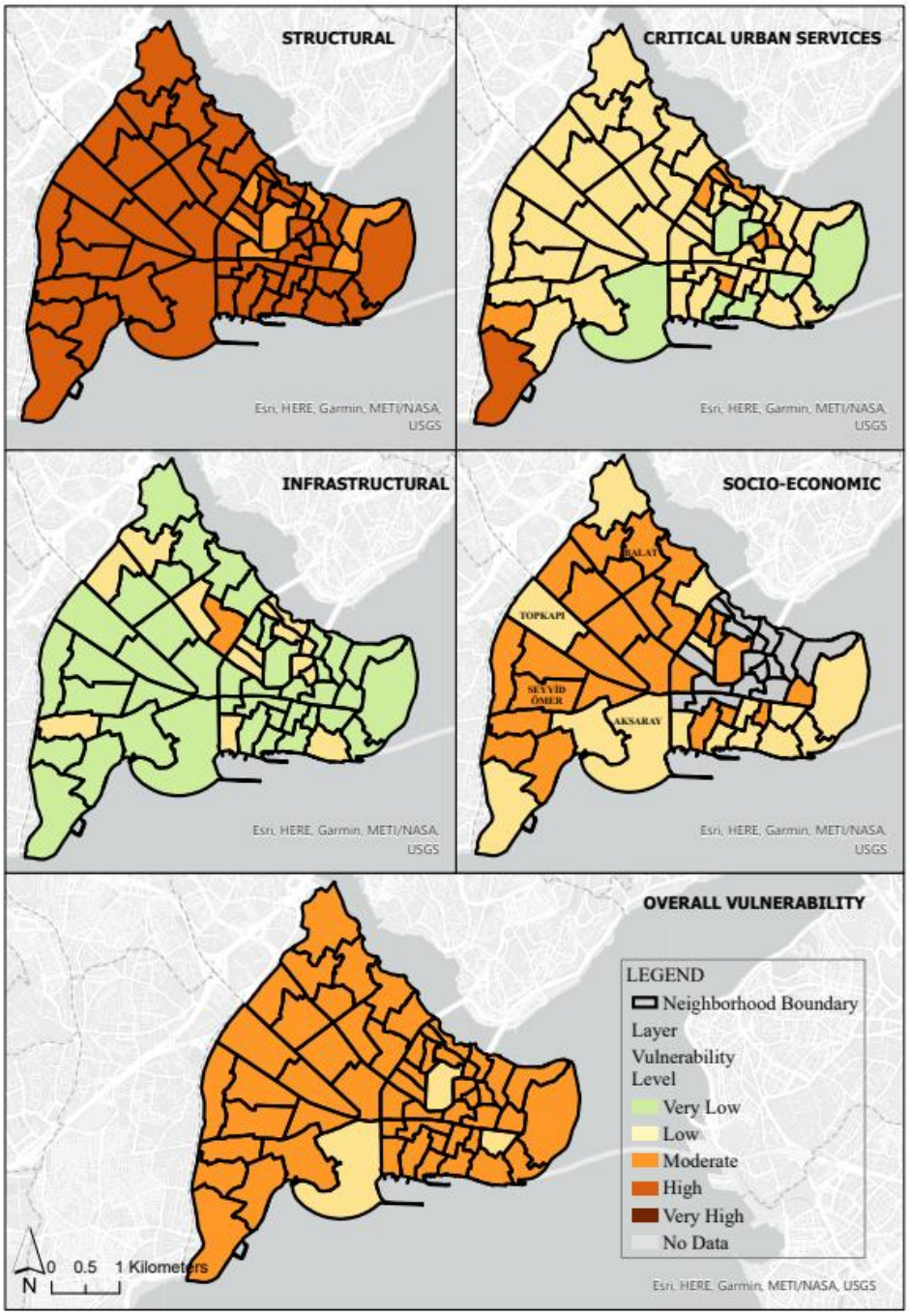

Figure 3 Vulnerability Maps of Main Criteria.

Table 9 Vulnerability Level of Neighborhoods.

Neighborhood Name	Vulnerability Level				
	Structural	Critical Services	Infrastructural	Socioeconomic	Overall
AKSARAY	High	Very Low	Very Low	Low	Low
AKŞEMSETTİN	High	Low	Very Low	Moderate	Moderate
ALEMDAR	Moderate	Low	Very Low	Moderate	Moderate
ALİ KUŞCU	High	Low	Low	Moderate	Moderate
ATİKALİ	High	Low	Very Low	Moderate	Moderate

Table 9 (Continuation) Vulnerability Level of Neighborhoods.

Neighborhood Name	Vulnerability Level				
	Structural	Critical Services	Infrastructural	Socioeconomic	Overall
AYVANSARAY	High	Low	Very Low	Low	Moderate
BALABANAĞA	Moderate	Low	Very Low	No Data	Moderate
BALAT	High	Low	Very Low	Moderate	Moderate
BEYAZIT	High	Low	Very Low	No Data	Moderate
BİNBİRDİREK	High	Very Low	Very Low	Low	Low
CANKURTARAN	High	Very Low	Very Low	Low	Moderate
CERRAHPAŞA	High	Low	Very Low	Low	Moderate
CİBALİ	High	Low	Very Low	Low	Moderate
DEMİRTAŞ	High	Low	Low	No Data	Moderate
DERVİŞ ALİ	High	Low	Low	Moderate	Moderate
EMİN SİNAN	High	Low	Very Low	Moderate	Moderate
HACI KADIN	Moderate	Moderate	Very Low	Moderate	Moderate
HASEKİ SULTAN	High	Low	Very Low	Moderate	Moderate
HIRKA-I ŞERIF	High	Low	Very Low	Moderate	Moderate
HOBYAR	High	Low	Very Low	No Data	Moderate
HOCA GIYASETTİN	High	Low	Very Low	Moderate	Moderate
HOCAPAŞA	Moderate	Low	Very Low	No Data	Moderate
İSKENDERPAŞA	High	Low	Very Low	Moderate	Moderate
KALENDERHANE	Moderate	Low	Low	No Data	Moderate
KARAGÜMRÜK	High	Low	Low	Moderate	Moderate
KATİP KASIM	High	Low	Low	Low	Moderate
KEMALPAŞA	High	Low	Very Low	Moderate	Moderate
KOCA MUSTAFAPAŞA	High	Low	Very Low	Moderate	Moderate
KÜCÜK AYASOFYA	High	Low	Low	Low	Moderate
MERCAN	High	Very Low	Low	No Data	Moderate
MESİHPAŞA	High	Low	Very Low	No Data	Moderate
MEVLANAKAPI	High	Low	Very Low	Moderate	Moderate
MİMAR HAYRETTİN	High	Low	Very Low	Low	Moderate
MİMAR KEMALETTİN	High	Low	Very Low	No Data	Moderate
MOLLA FENARİ	High	Low	Very Low	No Data	Moderate
MOLLA GÜRANİ	High	Low	Very Low	Moderate	Moderate
MOLLA HÜSREV	High	Low	Low	Low	Moderate
MUHSİNE HATUN	High	Very Low	Very Low	Low	Moderate
NİŞANCA	High	Low	Very Low	Moderate	Moderate
RÜSTEMPAŞA	Moderate	Low	Very Low	No Data	Moderate

Table 9 (Continuation) Vulnerability Level of Neighborhoods.

Neighborhood Name	Vulnerability Level				
	Structural	Critical Services	Infrastructural	Socioeconomic	Overall
SARAÇ İSHAK	High	Moderate	Very Low	Moderate	Moderate
SARIDEMİR	High	Moderate	Low	No Data	Moderate
SEYYİD ÖMER	High	Low	Very Low	Moderate	Moderate
SİLİVRİKAPI	High	Low	Low	Moderate	Moderate
SULTAN AHMET	High	Low	Very Low	Low	Moderate
SURURİ	High	Moderate	Very Low	No Data	Moderate
SÜLEYMANİYE	Moderate	Very Low	Very Low	Moderate	Low
SÜMBÜL EFENDI	High	Moderate	Very Low	Moderate	Moderate
ŞEHREMİNİ	High	Low	Very Low	Moderate	Moderate
ŞEHSUVAR BEY	High	Very Low	Very Low	Low	Moderate
TAHTAKALE	High	Low	Low	No Data	Moderate
TAYA HATUN	High	Moderate	Low	No Data	Moderate
TOPKAPI	High	Low	Very Low	Low	Moderate
YAVUZ SİNAN	High	Moderate	Low	No Data	Moderate
YAVUZ SULTAN SELİM	High	Low	Very Low	Moderate	Moderate
YEDİKULE	High	High	Very Low	Low	Moderate
ZEYREK	High	Low	Moderate	Moderate	Moderate

5. Conclusion

In this study, vulnerability assessment, which is a part of risk reduction studies, is discussed in the Fatih district in Istanbul on a neighborhood basis. A methodology is applied to determine the problematic areas by using both physical and socio-economic criteria.

Vulnerability assessments are complex in general because there are many criteria that can cause vulnerability in cities. For this reason, the analytical hierarchy process (AHP), which is one of the multi-criteria decisions making (MCDM) methods, is used in the study. Within the scope of the research, the criteria weights are calculated by taking the opinions of experts from different disciplines. Moreover, this study is integrated with geographic information systems (GIS) to make spatial evaluations.

In the terms of results, the structural criterion has the highest weight for the vulnerability assessment in the historical peninsula. 93% of the area is highly vulnerable, while the remaining 7% is moderately vulnerable. 50 neighborhoods are at a high level of vulnerability in terms of structure, and the population in these neighborhoods constitutes 99% of the total population. It can be concluded that in areas where monumental structures are concentrated, such as Eminönü and Golden Horn shores, the building stock is relatively stronger. For the other 50 neighborhoods, priority should be given to studies such as building strength tests and risky structure tests.

Considering the accessibility levels of critical urban services, there is a low level of vulnerability in general. It is concluded that 91% of the district population does not have a problem with accessing urban services.

Furthermore, considering the damage distribution of infrastructure facilities, the study shows that infrastructure is the criterion with the lowest level of vulnerability in the area. The Zeyrek neighborhood, where the historical texture is dense in terms of infrastructure facilities, is the area where the damage potential is most concentrated with its moderate vulnerability rate.

In socio-economic terms, approximately 49% of the district has a medium level of vulnerability and, 78% of the population lives in these areas. In particular, the Topkapı walls and the surroundings of Silivrikapı are problematic in socioeconomic terms.

It can be said that the areas where both socioeconomic and structural problems are clustered are generally located in the west of the district and around the city walls. Furthermore, this study reveals that Aksaray, Binbirdirek, Süleymaniye neighborhoods have lower vulnerability levels almost in all analyses made for every criterion.

When the general results obtained from the combination of the four main criteria, are examined, approximately 3% of the population lives in low vulnerable areas, and 97% of the population lives in moderately vulnerable areas.

In conclusion, this study and its spatial-based findings obtained with the proposed method can be used as a basis for the preparation of risk reduction plans and emergency management plans. Another result is that the method proposed in this study can be used as a decision support tool for city planners based on the strategic location selection approach. In addition, these methods can be used in planning processes as part of risk-reduction studies. They can also be used in the development of urban development policies.

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Resume

Selda Erdoğan graduated from Izmir Institute of Technology, Department of City and Regional Planning with an honor degree (ranked second among the students who graduated in the same year). After graduation, she worked as an urban planner in a municipality, and after about a year moved to a company working on GIS (Geographical Information System) and IT (Information Technologies). She has been working as a consultant in the same company for about seven years. She got her master's degree from Istanbul Technical University, Institute of Science and Technology, Department of City and Regional Planning, Urban Planning Master's Program in 2021. Areas of interest on GIS, Spatial Analysis, and Urban Risk Analysis.

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Investigation of the footprints of ecological criteria in a historical minority mansion in Kayseri Talas

Z. Özlem Parlak Biçer*

Abstract

Societies have reflected their cultures and lifestyles through the environment they have shaped. This is also true for minority groups in society. Environmental problems arise due to the use of all resources for cheap and fast production without considering the result of technological developments. Changes in nature, which form the basis of many disaster scenarios, also require urgent measures to be taken in many areas. Efforts should be made to minimize the damage to the environment. In this context, as in many other fields, the number of studies on ecology and sustainability in the field of architecture is increasing day by day. Ecological building designs are the most important reflection of this. In this direction, the development of certification systems and the promotion of ecological structures come to the fore. The research looks at the concepts of ecology and sustainability from a different perspective and traces the ecological architecture through a residential building belonging to minorities that can be qualified as a historical cultural heritage and located in the Yukarı Talas locality of Talas district of Kayseri. In order to produce sustainable designs in places where life is lived, it is considered important to consider the way in which human beings shape the environment in which they live in the historical process, also in minority architecture. Within the scope of the study, the mansion in Talas, Kayseri, which was built in the 19th century and passed from an Armenian family to a Turkish family in the process, was evaluated within the scope of today's ecological architecture criteria and it was found that a significant part of these criteria was met in this building. The mansion is discussed in terms of ecology, energy, economy, indoor environmental quality, health and welfare, innovation, management, land use, transportation, renewable technology, water, environmental pollution, CO2 emission, material and waste criteria. In the study; It has been determined that there are ecological approaches to the historical minority mansion. With reference to the findings, suggestions have been developed to produce ecological, nature-friendly and energy efficient structures for today and the future.

Keywords: ecological architecture, Talas, minority architecture, Karaman Mansion,

1. Introduction

The living spaces produced throughout the ages have been shaped in line with human needs. Especially the need for shelter has been one of the most basic needs of humanity throughout the ages. All structures built by human beings to meet their spatial needs have been the elements that affect and are affected in the entire ecosystem, especially in the immediate environment, both during the construction and usage process. With technological developments, man has chosen to

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change the nature in which he lives by interfering and created the threat of extinction. Reversing this situation has brought about the production and use of products that are compatible with the ecosystem and do not pollute the environment. Mankind has started to seek solutions to environmental problems in today's world. The production and use of buildings, which have a large share in the energy consumption of the earth, has begun to be reconsidered. The integration of the buildings with the natural environment and minimizing the harmful effects on the environment, resulting in the buildings becoming a part of the ecosystem, revealed the concept of ecological architecture. At the same time, producing designs that are compatible with the environment and do not harm the ecosystem are among the most basic goals of ecological architecture. Natural or minimally processed, biodegradable and renewable material for a livable environment, is tried to create sustainable structures where rational solutions are produced by calculating the energy consumed by the buildings from the project stage to the production stage, from the use stage to the demolition stage. The use of local materials, the use of systems fed by nature without harming the nature, the positioning from the street, the shaping of spaces by reference to the sun are some of the sustainable design inputs. It is possible to see the traces of the criteria in traditional houses. When the construction technique used in traditional houses is examined in terms of local material selection, settlement on the land and space organization; They guide the energy problem in terms of design and construction techniques. Traditional housing, produced on the basis of efficient use of resources, is produced without harming the nature; includes sustainable and ecological features (Gezer, 2013; Parlak Biçer, et al. 2020).

In the literature; Traditional Safranbolu Houses were examined in terms of layout, planning features and building materials (Gezer, 2013). Traditional Houses in Burdur, on the other hand, were evaluated in terms of harmony with the topography, preservation of the green texture, building form, space organization, building envelope, and materials (Çetin, 2010). In another study, the traditional stone dwellings in Ayvalık, which has similar climatic conditions, and the city of Oxford in England, were compared (Kıstır, Kurtoğlu, 2018). Traditional houses in İzmir FoçaKozbeyli settlement, topography, climate, green texture, etc. criteria related to the physical environment, location, form, material, etc. analyzed in terms of structural criteria and energy recovery aspects (Taşçı, Pekdoğan, 2018). In a study by Parlak Biçer et al. (Parlak Biçer, et al., 2016); in Kayseri-Talas, two historical buildings were handled in the light of CIB criteria, with ecological architecture and sustainable design aspects (Parlak Biçer, et al., 2016). In another study, In Safranbolu, the role of social sustainability in the protection of the historical environment was emphasized and the results were evaluated (Ayten, 2016).

In the literature, besides the studies on the housing function, there are studies on the area with different functions and/or sizes. Çorapçıoğlu (Çorapçıoğlu, 2016) discussed the protection of the “Sinan II SuDeğirmeni” (water mill) known as the industrial heritage and the granaries with their original functions in the context of their historical, cultural, technological and ecological values. In the study, which deals with the historical urban texture of Istanbul-Eyüp (Ulubaş, Kocabaş, 2016); site management plan studies have been carried out on Eyüp's historical texture as a sustainable urban conservation tool. In a study in which sustainability in public spaces in the historical environment was examined with the example of Süleymaniye Mosque (Arslan, et al, 2016); Süleymaniye and Vefa region were discussed, their historical importance was explained, the design criteria determined by the existing urban texture were mentioned, and the analysis of public projects for the revival of the region was made (Arslan, vd, 2016). In a study by Parlak Biçer et al. (Parlak Bicer, et al., 2018), a building in the former American College campus in Talas, Kayseri was examined in terms of ecology criteria. As a further study of this, Parlak Biçer and Akdağ(Parlak Biçer, Akdağ, 2020) examined the footprints of ecology criteria for a total of four buildings, two used as guesthouses by Erciyes University in the American College campus and two in the former American hospital and school lodging buildings.

In a study conducted in Konya; The situation of Mengüç Street, which is located in the only and last protected area in the city center, was examined before and after the Rehabilitation Project (Yanar, 2016). In another study, in which the sustainability of the traditional street fabric is discussed in Niğde; Yavaşcan et al. (Yavaşcan, et al, 2016). Ten residences located on Kadıoğlu Street are discussed. The traditional Diyarbakır house has contributed to another study area, which is examined under the title of materials and resources of LEED v.3 and v.4.1 certification systems, in terms of certification (Tuna Taygun, 2019). In the study of Parlak Biçer et al. (Parlak Biçer, et al., 2020); 10 traditional houses built on the same dates in Kayseri Talas district were evaluated comparatively within the scope of international building certification systems criteria. In a study, in Mersin; the design components of traditional Mersin houses are handled with ecological approaches (Gündoğdu, Birer, 2021). In the study, 30 traditional houses; It has been investigated in many ways such as floor height, carrier system, materials used in construction, roof form and material, topography, choice of direction, vegetation, building form, spatial organization, building envelope, use of renewable energy resources (Gündoğdu, Birer, 2021).

It has also been determined in the literature that ecological production concerns many actors in the construction industry, from designers to contractors and users. It also covers the design, production and use processes of a building. The ecological criteria applied in buildings in Turkey have been derived from different certification systems used in developed countries. The common focus of these certification systems is; to describe structures that do not harm nature, are compatible with their environment, consume less energy and, if possible, can produce their own energy. Buildings that were produced in the periods before ecology was positioned in the field of architecture can also be evaluated in this sense within their own conditions and with the common definitions of certification systems. Moreover, it would not be wrong to say that some of the foundations of the concept of ecological architecture, which is expressed within the framework of certain rules in contemporary life, are based on inferences from historical buildings.

In this study, the historical city of Kayseri, the historical city of the Central Anatolian Region and the center of commerce, the town of Talas, where the minority population was densely populated and rare examples of minority architecture, was also seen in the location selection of American Board schools. The house, whose construction was completed in 1879 in Yukarı Talas, and whose first owners were members of the Armenian minority, was evaluated in terms of ecological architectural criteria. The points where the features of the examined building coincide with the principles of today's ecological architecture are examined and its features that can be evaluated in the context of ecological architecture are discussed. As a result of the study on the residence, it has been seen that the structures belonging to the minority architecture produced with traditional methods, met most of today's ecological architecture criteria, during the period when the concept of ecological architecture did not form a literature infrastructure yet. With the study, it is aimed to contribute to the necessary literature in order to reflect this to today's technologies by researching the ecological traces in historical buildings produced with traditional construction techniques.

2. Materials and Method

Within the scope of the study, the mansion, which is one of the minority architectural examples, located on Yukarı Talas Fırın Sokak and whose architectural drawings were made, was examined. Together with the plan drawings obtained, the residence was examined on site and evaluated in the light of the common criteria of certification systems. The mansion, whose original character is generally well preserved, is among the surviving structures in Yukarı Talas; It is very important in terms of being a single example with its features such as area usage size and number of floors. While there are many residential buildings built by the Armenian and Greek minorities living in Yukarı Talas, the floor plan drawings of the house, which is one of the few examples that survive today, were made and visual documentation was carried out on site. In this study, first of all, the literature, which constitutes the conceptual framework for the subject, was searched and studies were carried out on ecology, ecological architecture, sustainability and ecological approaches. The

data obtained from the field study and plan drawings were examined in the light of the ecological approaches reached as a result of the literature review, and the findings for the housing were revealed and evaluations were made.

3. International Certification Systems and Ecology

The purpose of establishing certification systems is the effort to create unique standards for countries. Climatic data, culture, social life, level of development and construction methods differ according to different countries. Six certification systems, namely BREEAM, LEED, Green Star, CASBEE, DGNB and IISBE, have been accepted in most of the World Green Building Council (WGBC) member countries (Özgören, 2010). The common points where the evaluation criteria of these systems meet; It is seen that he focuses on energy, ecology, indoor environmental quality, environmental pollution and water issues. In addition, the economy is among the DGNB criteria (KingSturge, 2009). There are also differences between the evaluation methods of certification systems that are similar to each other, and the handling of different criteria with different scoring systems (Cheng, Venkataraman, 2013). While measuring with a building comparison technique made according to LEED, EPA (Environmental Protection Agency) standards for the water efficiency criterion, BREEAM calculates the per capita consumption value over m3/year. In terms of energy efficiency, when BREEAM and LEED are compared, BREEAM seems to be more challenging. When all certificate systems are examined, it is clear that there are differences and similarities. This has not made any of them a superior or more unsuccessful system. It is necessary to choose the systems that are suitable for the region where the building is built, the budget and the socio-cultural structure (Özgören, 2010).

The certifications emphasize ecology and sustainability. The term ecology was first used by Henry Thoreau in 1858, but no definition was given. It was later derived by Ernst Haeckel in 1866 from the ancient Greek words oikos=home-space and logos=science (KışlalıoğluveBerkes, 1994). Over time, ecology has become a popular field of study in many different disciplines. In the field of architecture, research and studies have been carried out on the subject and the concept of ecological architecture has emerged. It is aimed to produce an architecture that is compatible with the natural environment as much as possible by encouraging the economical use of energy and non-renewable resources, behaving sensitively to people and nature, and choosing materials compatible with nature, so that future generations can live at least in today's conditions, taking into account their past data with ecological architecture (Dedeoğlu, 2002). Therefore, in order for a building to meet the ecological design criteria, the building should not be imposed on the environment, but should create integrity and harmony with the environment (Fletcher, 1999, Dedeoğlu, 2002).

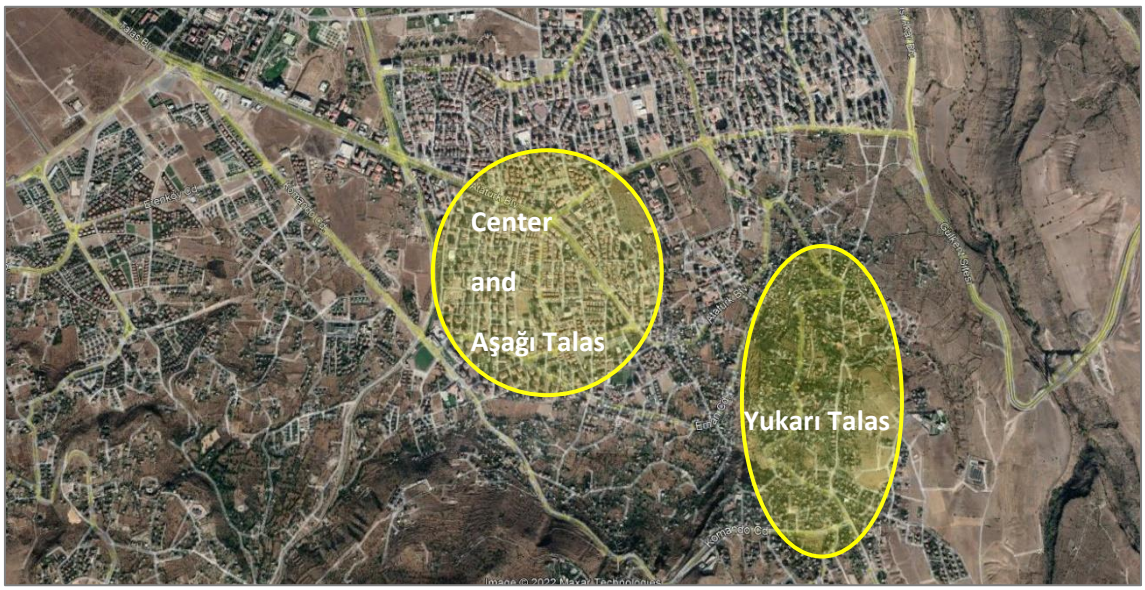
The fact that the building is in harmony and integrity with the environment has differed from the developments over time, especially with the beginning of the industrial revolution. The industrial revolution has caused significant changes in the building sector. This change has been effective in the construction sector, from construction techniques to building materials. Like every change, this situation has also brought about new problems. Rapid production and new materials started to be used, another system that will come after it, for example, problems related to building physics, and while using different materials for problem solution, situations that negatively affect the health of living things have begun to emerge. In this changing and developing process, the solution of the negativities has been tried to be found with ecological approaches (İnanç, 2010; Parlak Biçer et al., 2016, Parlak Biçer, Akdağ, 2020). As a result, the importance of sustainability and ecology concepts has increased, and these concepts have gained popularity in the academic environment. This issue, especially in housing, which constitutes a large part of the production activities in the building sector; It has come to the fore with issues such as low-cost fast production, easy transportation, use of natural and harmless resources to human health, and energy efficiency. Sustainability and ecology have gained great importance especially with the criteria of efficient use

of energy and the protection and correct use of natural resources, and studies on this subject have increased rapidly (Hoşkara, Sey, 2016; Parlak Biçer et al., 2016, Parlak Biçer, Akdağ, 2020).

Recently, with the increase of energy problems in almost every field, it is seen that the CIB (Fr: Conseil International du Bâtiment: Eng: International Council for Building) criteria are also taken into account in conventional and traditional construction methods and evaluated as an input that shapes the process in the design and production stages (Bozdoğan, 2003, Parlak Biçer, Akdağ, 2020). The reports prepared by the CIB in the construction sector are important in terms of guiding the sector and determining the boundaries (İnanç, 2010; Parlak Biçer et al., 2016, Parlak Biçer, Akdağ, 2020). The aforementioned organization has set out criteria related to ecological structures and especially residences, and these criteria have been widely accepted. In this context, within the scope of the study, the example of minority architecture in Yukarı Talas was examined and evaluated within the scope of ecology and sustainability within the framework of the common criteria of CIB and other certifications. In this context; Through the Karaman Mansion, which has been selected specifically for Talas traditional housing texture, issues such as the relationship established with the context and the natural conditions of the topography, the effects of the natural data of the environment on the design within the scope of ecological standards, the use of materials and sustainability are discussed. In the study, it has been tried to show the way for today and the future by drawing attention to the increase of awareness in ecological architecture and its benefits, especially for minority housing.

4. A Minority Housing; Karaman Mansion

Talas, one of the central districts of Kayseri city, is divided into two as Aşağı (down) and Yukarı (upper) Talas. The part located on the skirts of Mount Ali is known as Yukarı Talas, and the part located on flatter areas is known as Aşağı Talas (Map 1). Due to the higher altitude of Talas, where the continental climate is dominant, the effect of east and southwest winds is more than Kayseri. The height difference between the Aşağı and Yukarı Talas also causes the climate to become harsher in short distances. It is known that the water channels on the skirts of Ali Mountain and the natural sheltered structure of the region against the winds were effective in the selection of the region as a settlement during the historical periods. In particular, the topographic structure of Yukarı Talas and the easy workability of the soil properties are among the factors that contributed to the preference of the region as a settlement in the past. Because of these features, Talas has hosted different ethnic communities and has become a settlement with a rich cultural heritage where Armenians, Greeks and Turks, Protestants, Orthodox and Muslims live together.



Map 1 Talas town center and Yukarı Talas (Google earth pro, 2022)

Yukarı Talas has also been an important region for the American missionary. Talas American School and Hospital, which was established to raise the children of Greek and Armenian families living in the region, is one of the important structures. Karaman Mansion, which is a hundred meters away from these structures, is accessed from the narrow streets of Yukarı Talas, via Fırın Street (Map 2). Another important building adjacent to the mansion, which has a nascent garden to the east, is the physically devastated Gulbenkian mansion. It is located at the same distance from Atatürk Street, which is the main transportation axis today, as it was in the past. It draws attention as a surviving structure within the old and dilapidated housing texture around it. It is possible to attribute this to the fact that the biggest reason for this is that the building has not changed hands and that every owner has kept the building in active use.

Map 2 Karaman Mansion, Yukarı Talas (Google earth pro, 2022)

Karaman Mansion (Figure 1, 2), which is named after its first owners examined in the study, is one of the structures built in 1879 in a multi-national and religious ethnic structure. The change of ownership of the property, which is common in the minority residences, is also encountered in the Karaman Mansion. In the Cizye Defterleri dated 1834, the known person from the Karamanoğlu family, who was seen to reside in the neighborhoods where Karye-i Talas Millet-iRumiyan lived in Mahale-İ Yukarı (Cömert, H., 2010), is Gabriel Karamanoğlu. Robert Haroutunian reported that; his great great grandfather Kapriel Karamanianand his wife Gulkadin Khoubesserian were owner in Karaman Mansion. They had three children: Takuhi Karamanian Baliozian (1855-1936) Bedros Karamanian and my great grandfather Artin Karamanian (1860-1936) (Haroutunian, 2022). According to the land registry records (15.05.1947, 74 volumes, 103 pages, 01 rows and 07.05.1946, 176 volumes, 76 pages, 10 rows), Ohannes Karamanoğlu is the known owner of the property in the deed (Figure 3, 4, 5, 6). Afterwards, the mansion is seen under the ownership of Ahmet Karamancı and Kaniye Fevzioğlu. From the Fevzioğlu family, it was seen that it passed to Mehmet Ulutopçu by purchasing and to Mehmet and Mithat Ulutopçu by inheritance (Parlak, R., 2020). The current owner of the house is Ruşen Parlak. As it can be understood from here, the situation of being sold to many people in the old mansions is rare in this mansion. This situation; He ensured that the 143-year-old mansion was transferred to the present day with less damage and even without the complete destruction/partial destruction of other historical houses.


Figure 1, 2 Karaman Mansion (Parlak Biçer, 2020a) (Şenalp, 2019)


Figure 3, 4 Photos of family members living in Karaman Mansion (figure 3 was taken circa 1901. Artin (Haroutune) Agha Karamanian is holding his daughter Zaruhi KaramanianJamjian (1899-1992), Standing is Nectar Chalikian Karamanian (1880-1915), seated is her mother Sultan Gulbekian Chalikian with her grandson Kapriel Karamanian (1905-1970). Nectar and her two son Garbis and Kapriel are in the figure 4). Information and visuals of the person living in the mansion, the grandson who lives in New York were provided) (Haroutunian, 2022).

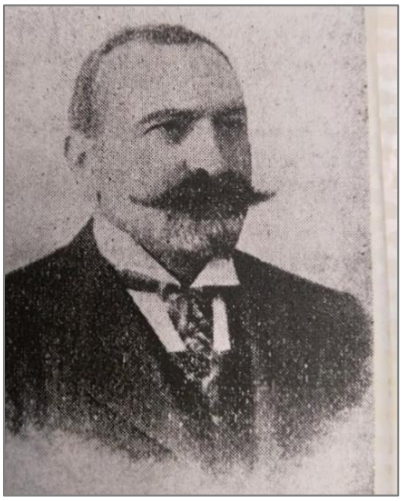



Figure 5, 6 Photos of family members living in Karaman Mansion (figure 5ArtinAgha Karamanian sitting His daughter Mary and son Garbis standing next to him. Kapriel standing in the back. Figure 6 Loghvet Baliozyan (1851-1899), was married to Artin's sister Takuhi Karamanian (1856-1936). He was an educated man. The Ottoman Government sent him to the US for an important meeting in Philadelphia. While he was in the US, he got sick and died in New York City in 1899) (Haroutunian, 2022).

While the minority population in Kayseri and its surroundings make a living through trade (Yılmaz, A. (ed), 2016), the Karaman family dealt with the trade of different goods, especially livestock, to Istanbul, especially to the palace, during the Ottoman period. It is said that there are also entrance privileges to the palace (Teke, 2019). The family's living standards and income levels are high even for where they live, especially considering the high incomes of minorities in Yukarı Talas. The buildings, which are still known as “KaramanBayırı” (Figure 7), were built in the period with the aim of providing access to the mansion in Yukarı Talas (Haroutunian, 2022), especially for their own vehicles, as well as for their immovable properties, and also to shorten and improve the transportation of all the people from a steep slope and a long transportation axis. construction works are also known. In addition, Karamans tried to create a livelihood for the poor minority families of the region by creating the terraced topography of Yukarı Talas and contributed to the development again (Teke, S., 2019). Despite the reconstruction works and commercial successes of the Karaman family in the region, it is not as well-known as the Gülbenkians, another Armenian family from Kayseri-Yukarı Talas.

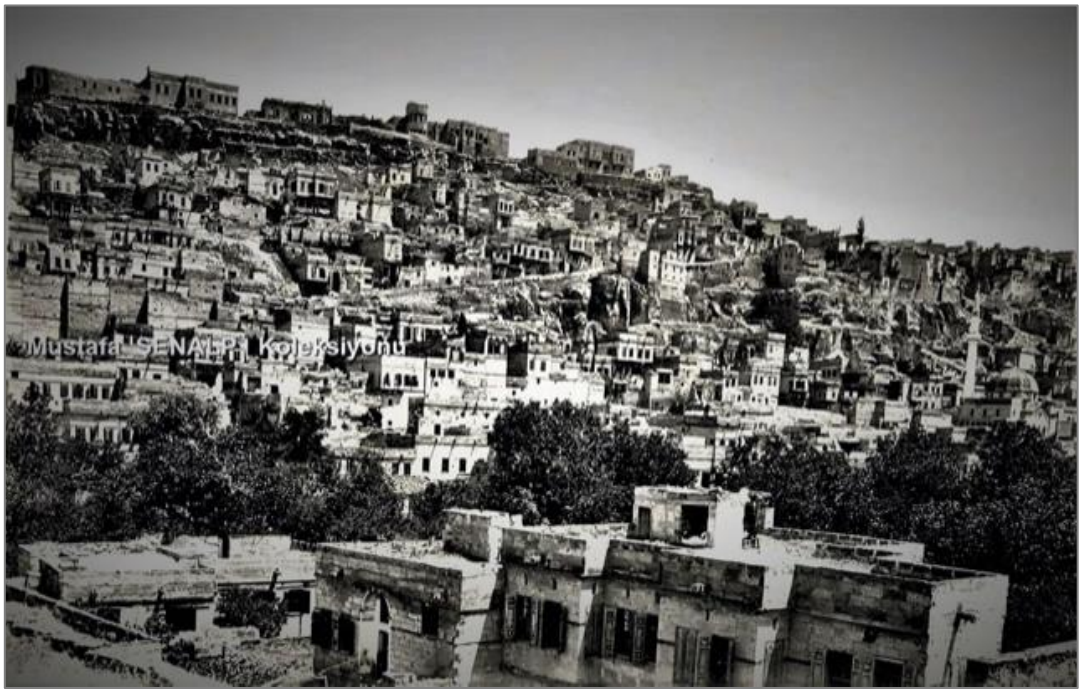
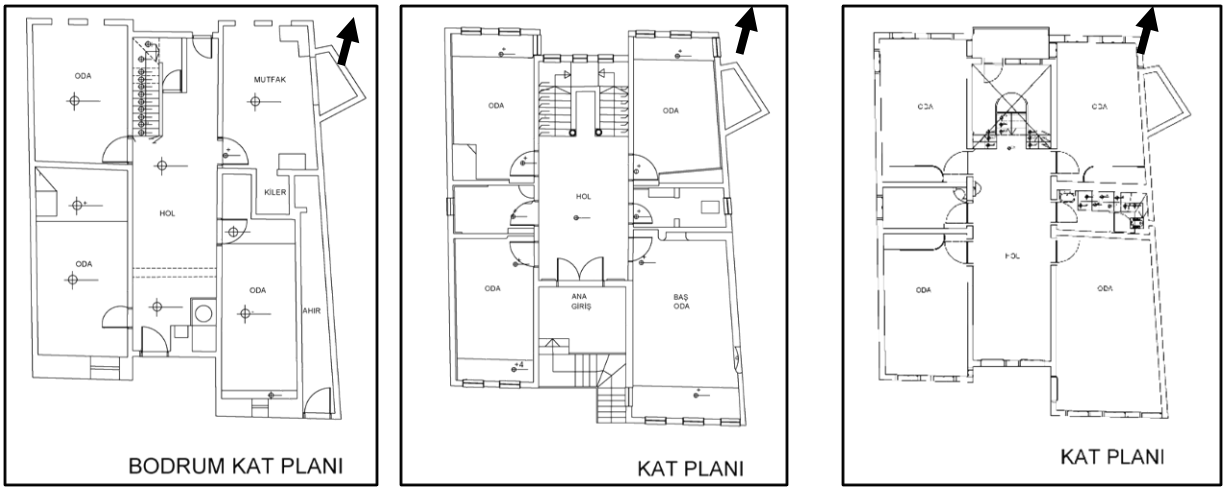


Figure 7 KaramanBayırı and Yukarı Talas (Şenalp,M., 2019)

Gulbenkian residence (Figure 8), located to the east of the land where the Karaman mansion is located, belongs to the family of Kalust Sarkis Gulbenkian, known as "Mr. Five Percent," in international business circles thanks to his oil shares. Although he was born in Istanbul, Gulbenkian (URL 1, URL 2, Tchamkerten, Astrig, 2017) is also relative to the Karaman family. As a result of the economic, political and war conditions of the period, both families settled in the USA by following different paths.

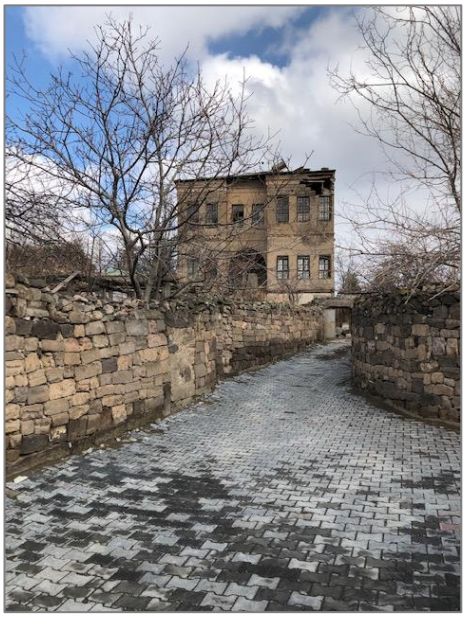
Figure 8 Gulbenkian mansion (Parlak Biçer, 2019)

The main entrance to the garden of the building is in the direction of the garden gate on Fırın Sokak. At the garden level, there are places frequently used by those who serve the residential life, such as the outbuildings, barns, and kitchens of the building (Figure 9). There is a secondary use staircase descending below this level and there are two small rock-carved warehouses where the residence is used as a cold storage. In one of these warehouses, there is a "şırahna" (the local pronunciation of the word şırahane for using grape jam and wine), where grapes collected from the residential garden and other vineyards are crushed and their juice is extracted. There is also a door opening to the north garden section from this level in order to facilitate the life intertwined with the garden (Figure 9). These spaces, which are at the same level as the garden and street level, are not used for the main entrance. The main entrance is provided from an upper floor, which is reached by ostentatious stairs (Figure 10). There are four large rooms around a large hall on the main living floor, and two service areas, one of which is thought to be used for the service of the prepared food in the basement kitchen, and one is the place where a toilet was added later. The upper floor is reached by a two-armed staircase. On the upper floor, there are four rooms around a large hall (Figure 11). There is a wooden staircase leading to the roof of the building from one of the two small spaces between the rooms. It is thought that the roof and this ladder were added later by the second users.



Figures 9, 10, 11 Basement, Main and First Floor Plans of Karaman Mansion (Parlak Biçer, 2020b)

The main spaces of the building, like the main entrance of the building, are oriented to the north and south. This situation is also reflected in the facade layout. On the south façade facing Mount Ali, two or three window openings were made on both main floors, depending on the size of the meanders. The entrance and the space above it are emphasized by pulling in (Figure 12). There are also openings on the northern façade of the building. However, it is less in number compared to the south facade (Figure 13). There are no openings on the east and west facades of the mansion (Figure 14, 15). There are no window openings on the western façade as it is a single storey adjacent building. The absence of windows on the eastern façade of the building, which overlooks the garden area, suggests that the first users of the house wanted to build another house in the future. Because it is seen that the necessary labor has been done in order to add to the carrier parts on this facade.



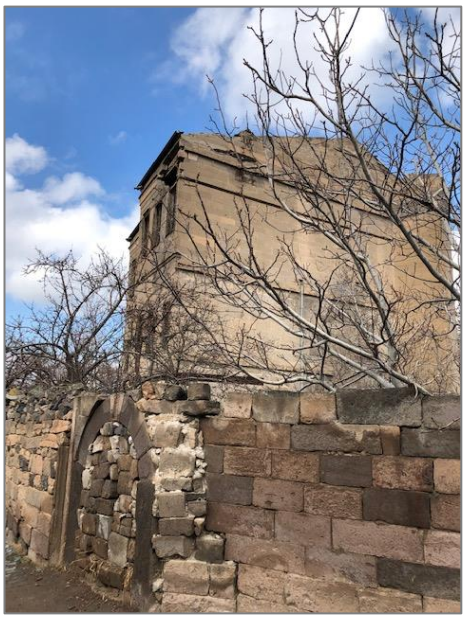
Figures 12, 13 The south and north facades of the mansion (Parlak Biçer, 2020a)

Figure 14, 15 The silhouette of the mansion with Mount Ali and its east facade (Parlak Biçer, 2020a)

Local stone material was used as construction material in Karaman mansion. This material is seen not only for the carriers of the building, but also on the garden walls as a divider (Figure 16). It is thought that the roof of the building was created by the second users with metal elements. Because it is seen that the historical houses in Talas had a terrace roof when they were first built,

and these terraces were turned into roof shapes such as cradles and hipped roofs by closing them with sheet metal later on (Figure 17). Stone, which is the main construction material, was used in the load-bearing walls and partition walls by cutting it to a certain size, as well as being used in different parts of the building by processing a single piece for decorative purposes (Figure 18). This type of usage is encountered in the direction of the three-armed stairs, which reach the upper floor from the main entrance floor, facing the main entrance door and hall. There is a total of two street gates, one which is thought to be in use, and one left by brickwork, which reinforces the impression that another residence is planned to be built next to the mansion in the future, at the transition of the mansion to the streetatan garden. While an arch is made of cut stone in the garden corner, which has been closed for use (Figure 19), a single piece of stone jamb and lintel can be seen in the used one (Figure 20).

Figures 16, 17 Use of stone as building material on exterior walls and interior stairs (Parlak Biçer, 2019)



Figures 18, 19 The use of garden gates on Fırın Street (Parlak Biçer, 2019)

There are stairs leading to the main entrance of the mansion, an arch above the main entrance that also carries the floor, and a single piece of cut stone on the main entrance door with outstanding workmanship (Figure 20). The fact that the color of the stones around the main entrance of the building, which also emphasizes the entrance, is different from the stones used throughout the building, shows that these stones were obtained from a different quarry in the region (Figure 21). On the main entrance door, there is the construction year of the building, which is integrated with the ironwork. These details are also decoratively reflected on the rose window, which is used for the illumination and ventilation of the space, located on the entrance door (Figure 22). Stonework can also be seen on the items made as a single piece for squeezing grapes and detailed with embroideries on them (Figure 23).

Figures 20, 21 Residence Main Entrance and Main Entrance Gate (Şenalp, 2019)

Figures 22, 23 Rose window detail including the construction date and monolithic stone pool (Parlak Biçer, 2020a)

Wooden beams were used as carriers in the main entrance and first floor floors of the building. While stone covering material was used on these beams on both the main floor and the first floor,

wooden sweat ceiling was applied as the ceiling covering (Figure 24). Based on the wooden decorative ornaments on the ceiling of some residential buildings, which were restored by the municipality, it is thought that this mansion also had ceiling decorations and disappeared over time due to weather conditions, people's dismantling, and moving to another place. The wood used as a beam on the load-bearing walls also acts as a lintel on the window openings. Windows are made of wood in a double-opening manner (Figure 24, 25). There are wooden shutters on the outside of the windows (Figure 25). These blinds, especially located on the north facade windows, contribute to protection from the cold in winter (Figure 26).

Figures 24, 25 Room interiors located to the south and north (Parlak Biçer, 2020a)

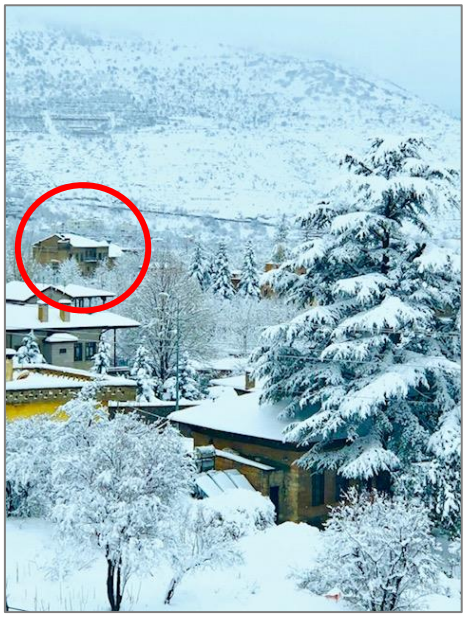


Figure 26 Karaman Mansion (Parlak Biçer, 2022)

5. Ecology in Karaman Mansion

While the use of machines and high-tech products is mostly seen in the buildings used today, it is seen that the ecological criteria are met without harming the environment and transforming the environmental conditions into an advantage in the traditional historical buildings. The relationship between nature and the way they are positioned in the regions and buildings where the historical texture is located constitutes the starting point of sustainable design solutions. Climatic conditions,

topographical features and cultural factors in living spaces affect the settlement, form, orientation, dimensions and spatial organization of the building in traditional settlements (Parlak Biçer, et al., 2020). It is thought that this situation is also seen in minority architecture. In this context; the mansion, which is discussed in the study, has been discussed under the common criteria of international certification systems, especially the criteria set by the CIB (CIB, 1999). Topics that certification systems combine; There are 15 topics in total, including ecology, energy, economy, indoor environmental quality, health and welfare, innovation, management, land use, transportation, renewable technology, water, environmental pollution, CO2 emissions, materials and waste (Parlak Biçer, et al., 2020). Karaman mansion has been examined over these determined topics.

In Yukarı Talas region, there are buildings with larger gardens. It has been determined that the entrance doors of traditional houses are located in the direction of the sun's rays. The south façade is the façade that benefits from the sun's rays at the highest level. This ensures that the snow in front of the entrance gate melts quickly during the winter months. Consisting of basement, ground and first floors. By examining the plan schemes of the building, it was tried to obtain information about the ecological architectural traces. In the living culture of the region, the basement floor is used as service spaces, the ground floor is used as a winter floor, and the first floor is used as a summer floor (Parlak Biçer, et al., 2020). Karaman mansion also has these features. Benefiting from the rock structure of the region, the presence of rock-carved spaces accessed from the basement in the mansion prevents the food from being damaged by being less affected by the heat in the summer and the cold in the winter, that is, from the outside weather conditions. In addition, the fact that these places are isolated from daylight can provide suitable conditions for use as cold storage. Therefore, energy usage can be saved. The fact that daylight can be adequately received by all buildings at any time of the year is also an energy-saving feature in the building (Table 1).

It is seen that there are fewer and smaller openings on the northern façade of the mansion. In addition to having more openings on the south façade, the skylights on the upper part of the main entrance door of the mansion and in the south rooms are positioned for natural ventilation in the rooms heated by the sun in summer. There are also wooden shutters that provide cold control, especially on the north facade (Table 1).

While stone was used on the walls, wooden material was used on the floors. Although some of the buildings have hipped roofs that were added later, the soil flat roof application is seen in the period when all of them were built. Wooden materials are used in the decoration of the ceiling coverings, door and window joinery of the buildings (Table 1).

The title of economy, one of the criteria of international certification systems, aims to consider the efficiency to be taken in every decision during construction activities. An approach available in the Karaman mansion, which is an example of Talas minority architecture, is to ensure that the building can be expanded by making additions. This situation allows the same users to use the same structure for many years, even as families get bigger and smaller. It is possible for the mansion to be evaluated within a sustainable approach, thanks to the fact that the changing systems can be easily integrated into the structure and the construction systems allow this (Table 1).

Passive energy is utilized at the highest level in the mansion. The window shutters used in the building provide the indoor environmental quality. The shutters are opened and closed by the user to provide sun and cold control. The skylights, which provide air circulation in the interior, are another ecological trace detected in the mansion. In the summer months, the heated air in the middle sofa and rooms is evacuated through the skylights, increasing the indoor air quality. In addition, in the context of providing interior comfort conditions and realizing health and welfare criteria, the manpower is utilized at the highest point in the mansion examined. Because aspects such as the high number of applications that require building maintenance and the effectiveness of life in connection with the garden encourage people to move. The barn located on the ground floor

also contributes to the heating of the main room of the mansion, which is in plan type with a middle and inner sofa. With its interior sofa plan, it is ensured that the sun's rays reach the interior parts of the building (Table 1).

In ecological building designs, the innovation criterion is of great importance in order to emphasize the importance of buildings using new systems that give importance to research and development. In the mansion, which is in the minority architecture, maintenance should be done because if the roof maintenance, which must be applied at certain times of the year, is not done, it will cause water to leak and cause the wooden carrier floor to lose its strength over time. This type of building maintenance implemented by building users is innovative (Table 1).

In ecological criteria, attention is paid to the balance between land use, green and building area, the non-use of agricultural lands and their proximity to social facilities. The fact that the examined host uses the products obtained from his own garden as food has revealed the necessity of a large garden (Table 1).

Within the scope of transportation criteria, the use of public transportation vehicles and bicycles is encouraged in today's ecological structures, and the use of vehicles that do not consume fossil fuels is supported. It is seen that the transportation with the barn section under the Karaman mansion is provided by using animal power and that the family has built the “KaramanBayırı” that bears its name and the transportation vehicles used enable them to travel short distances (Table 1).

In terms of renewable technology and water use, the mansion, which is provided by using passive systems, has been an efficient example for the stone material to be used for heat storage and when the building has completed its life. From the point of view of water use, saving water in the use of water is an important issue in contemporary ecological structures. In the follow-up, high efficiency is aimed with irrigation and use as fertilizer from wastewater. Since the mansion was built, the lack of infrastructures for drinking water and wastewater enabled ecological solutions to be produced on the basis of buildings. Thus, collecting rain and snow water in wells and using it for drinking and garden irrigation has become an ecological approach. There are two drinking water wells both in the garden and inside the mansion (Table 1).

In order to prevent environmental pollution, it is necessary to use renewable energy sources in buildings and to apply ecological criteria from the production of the materials used to their transportation. Since all of the applications in the examined mansion were carried out with the use of natural products, there is no application that will cause pollution of the environment. Looking at the CO2 emissions; There is no CO2 emission problem thanks to the energy obtained from renewable sources during the construction period of the mansion (Table 1).

The use of materials is a criterion that covers all the products used at every stage of the construction of a building and concerns all other criteria of ecology. It covers many areas from the production of a material used in the building using renewable energy, to the harming of its wastes to the environment, to the arrival distance to the construction site. The use of local materials in accordance with environmental data stands out in Karaman mansion. Considering the energy use of the mansion and especially the construction material forming the carrier system and the selected carrier system; The use of cut stone, which is a local material, by local masters in traditional construction systems overlaps with many of the ecological architectural criteria. It was observed that extra energy and manpower were not used for the transportation of the stone, which is the main material of the building. In addition, the heat retaining feature of the stone is a right decision in terms of balancing the temperature differences between summer-winter and day-night. When examining in terms of human health-material relationship; it has been observed that the mansion was produced from natural and untreated materials (stone, wood, etc.). Ecological approaches can be observed especially in materials used in decoration and fine construction. The use of natural wood in roofs, floors, ceiling coverings and door and window joinery are appropriate choices in

terms of both air quality and thermal conditions within the scope of ecological criteria. It is known from the plans that the interventions to be made by the current owner of the building, Parlak family, will not use negative materials that do not prevent the breathing of the buildings and do not spoil the originality of the building, especially in the paint applications used in the interior. Sustainability will be ensured in the building with conscious homeowner approaches (Table 1).

In international certification systems, waste is one of the common topics from the construction process to the use stage and recycling of the products formed after the end of the building's life. The main goals are to reduce the amount of waste that will occur by saving on material usage and to make the used material recyclable. Choosing materials that do not harm the environment in the mansion ensures that the wastes do not harm the environment, and also obtaining energy from organic-based wastes obtained from animals ensures that the resulting wastes are converted into energy. The fact that the materials used in the mansion are natural and organic have also brought about that they do not harm the nature, can be mixed with nature when necessary and can form a harmonious integrity with nature. It is also possible to reuse and recycle the materials used. In this way, it is possible to reuse materials with almost no material loss. Therefore, the ecological and sustainable state of the mansion is strengthened (Table 1).

In terms of economy, initial production, maintenance and repair costs, energy use and cost are prominent topics related to the concept of ecology in the building and construction sector. In the mansion examined, the stone and wood used as production materials have a long service life and the maintenance-repair requirement and cost is low, provided that the necessary precautions are taken, as well as minimizing the transportation and labor requirement due to the fact that the materials are obtained from places close to the construction site. It enables it to be evaluated economically in terms of cost, usage and maintenance and repair costs (Table 1).

In terms of ecological criteria, at the planning stage of a building, its useful life, cleaning and maintenance, and usage costs are important. In old buildings, there is continuity of maintenance and repair at each layer, depending on the use. However, no serious renovation and maintenance has been done in the Karaman mansion, except for the first users. It is seen that today's building owners will carry out this process. The terrace roof, which is observed to be frequently preferred especially in the examples of Yukarı Talas civil architecture, was not preferred by the second users of this building during the repair, since it requires frequent maintenance and could not provide sufficient insulation, and the wooden gable roof was incorrectly applied instead. With this annex on the roof, instead of periodic maintenance and repair for roof-related problems, repair works and material renewal were carried out only in case of need, depending on the wear, deformation and wear that may occur over time. Although it contributed to the sustainability of this structure, it was not enough and it was an inappropriate intervention to the original architecture (Table 1).

The relationship between function and aesthetics is seen by the CIB as an important ecological criterion (CIB, 1999). It is seen that the function of the mansion shapes its form and design. The stairs built to highlight the main entrance of the mansion and the outward mass effect on it show that the building function was planned with aesthetic concerns. In addition, the formal searches and decorations that can be read on the main entrance components placed in the direction of the dominant view and approach give clues about aesthetic concerns. The opposing windows of the mansion, which open to meet the prevailing wind, are another design that contributes to the general ventilation (Table 1).

Table 1 Karaman Mansion Ecology Criteria Review

Criterias	The condition of the Karaman Mansion
Ecology	*It will set an example for ecological architectural buildings.
Energy	*Energy from organic-based waste *Wood
Economy	*Material that can be used again in the same function *Building system that allows adding locations
Indoor Environmental Quality	*Material selection *Bound of the building *Window sizes *Upper windows *Contribution of solar control with wooden shutters to heat control
Health and Wellbeing	*Feeding with natural products without additives
Innovation	*Opening the way for technological developments with the reference taken from historical buildings
Management	*Building maintenance management *Expandable build system *Usage management
Land Use	*Surrounding green space
Transportation	*Location close to main transportation axes
Renewable Technology	*Energy from organic-based waste *Wood
Water	*Finding wells where rain and snow waters are collected
Environmental pollution	*Renewable energy sources *Providing with energy efficient applications
Co2 oscillation	*Renewable energy sources
Material	*Choosing materials that do not harm nature
Waste	*The materials used in the construction do not harm the nature and can be recycled *The ability to use the stone material repeatedly in the same function

6. Conclusions

Yukarı Talas is a location where there are unique examples of minority architectural examples, generally on the basis of residences. In general, within the small-scale housing texture, Karaman mansion is planned on a relatively large land located in Yukari Talas locality. The mansion meets the criteria of ecological architecture with its many features from the choice of location to the settlement using the elevations on the land, from the production of local materials by local craftsmen to its orientation.

It is hoped that the Karaman mansion study, which is evaluated through the CIB and certification systems criteria, will guide the future studies in sustainability and ecology. It is clear that the studies on minority architectural examples made on the basis of Karaman mansion will contribute to the inclusion of Turkish architecture in the studies of world ecology criteria. It is expected that the examination will be encouraging in terms of creating an architecture that can meet ecological requirements by combining the truths of the past with today's possibilities, techniques and technology. It is hoped that the data obtained from the study will contribute to the development of existing techniques and technologies on the basis of ecology, in particular minority architecture.

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Resume

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Understanding the cultural landscape value of traditional agrarian landscapes of African Sahara Desert: The case of Timimoun, Algeria

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Abstract

In 1992, the World Heritage Convention became the first international legal instrument recognize cultural landscapes as a human heritage that must be protected. The Cultural Landscape - Past, Present and Future considers different aspects of man's intervention with natural vegetation and the landscape resulting from a long equilibrium of co-existence. These landscapes are not stable, and the recent and ever accelerating changes in technology and life-style have increasingly affected many ancient landscapes, as old land-use practices are abandoned and traditions forgotten (Birks et al., 1988). Human communities in desert areas formed a special landscape, providing these cultural landscapes within a special ecosystem of sustainable living conditions, which helped to create many social, economic, and cultural systems in addition to preserving biodiversity. Unfortunately, the cultural landscape in the African desert is constantly deteriorating under the influence of urban, economic, and social changes. In the southern Algerian Timimoun city of is one of the most important global desert touristic destination due to the natural cultural landscape characterizes it, but unfortunately this landscape in continuous deterioration. Agricultural landscapes of desert environment, with its remarkable knowledge culture and world of practices, must be seen as a living library where this knowledge is transferred from generation to generation. It seems certain that scientists will need more of the know-how stored in this living library in the near future, especially given the effects of climate change in the world today. This paper aims to identify cultural landscapes in the oasis and analyze their transformation and change in cultural landscape and traditional green infrastructure elements by relying on a historical analysis of spatial images based on quantitative analysis using ArcGIS software with the aim of identifying the real reasons of this deterioration in the urban cultural landscape in desert cites. In conclusion the study will propose an action strategy to prevent this degradation

Keywords: cultural landscape, Ksar ecosystem, social resilience, Timimoun-Africa

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1. Introduction

Agricultural activities are man's first form of action in shaping the earth, and they have an ancient origin of knowledge, often guided by the conditions of the natural environment. In extreme environments where natural conditions make it difficult to survive, these actions create special landscape patterns that are highly differentiated from its surrounding texture. Thousands of years, man in the African desert adapted to the harsh climatic conditions, established human settlements, developed irrigation systems and agricultural technology, and built cities and forts that provide him with protection and economic independence. Oasis settlements in Africa's Sahara Desert are a good example of these patterns. In addition to these fertile patterned structure in desert landscape, the social lifestyle they contain is a successful example of the harmonious relationship that man can establish with nature and himself, having lived for thousands of years and survived until today. Agrarian landscapes of desert environment represent the continuum of socio-ecological memory, knowledge transmission to next generations and generate the vital components of humankind' heritage. They provide multiple economic and social benefits, multifunctionality, cultural support and ecosystem services for human societies (ICOMOS, 2017).

UNESCO and ICOMOS defines the rural landscapes as 'organically evolved continuing cultural landscapes' which means the living evidence of human-nature relationship reflecting the evolution of traditional life over time. The practical contact between human and nature in the agricultural heritage landscapes sustains bio-cultural diversity including agrobiodiversity, as well as cultural and spiritual values (ICOMOS, 2017). From this point of view, agricultural heritage, with its remarkable knowledge culture and world of practices, must be seen as a living library where this knowledge is transferred from generation to generation. It seems certain that scientists will need more of the know-how stored in this living library in the near future, especially considering the effects of climate change we are experiencing today.

According to ICOMOS definition, the landscapes of African Sahara, and especially the city of Timimoun reflects the whole characteristics of a second category of cultural landscapes in which agricultural activities shaped the evolution of earth and humankind for some 3000 years.

The definition of "organically evolved continuing cultural landscapes" particularly consistent with the character of the Gourara region because of its major components such as *Ksar*[1], palm groves, *foggara*[2] system, traditional architecture and agrarian-based social life.

In such cultural landscapes, where mostly agricultural activities are a part of life, the relations established with the contemporary society's culture are extremely important for the sustainability of the heritage site. Thus, in their statement in 2017 ICOMOS-IFLA pointed out that the issues and threats challenging on the agricultural activities within contemporary cultural, environmental, economic, social, and legal contexts. On the other hand, cultural landscapes construct proposes that heritage places are not isolated islands, there is an interdependence between people, social structures, and the landscape.

The aim of this article is to reveal the cultural landscape characteristics of the "*Ksar* ecosystems" as a part of the desert landscape character of the African Sahara region, which has now become more important in terms of measures to be taken against future climate risks, and to discuss the possible threats to the continuation of the global agricultural heritage. In order to define possibilities of intersection between the traditional ancient lifestyle and the contemporary social culture in the region; this study will try to reveal the degree of pressure created by urbanization based on cultural tourism, which would be a bad scenario unless being managed well.

[1] *Ksar* or qsar, plural ksars, qsars, *ksour* or qsour, is the North African term for "fortified village," from Arabic qaṣar, itself possibly loaned from Latin castrum. The term generally refers to a Berber fortified village.

[2] *Foggara* is local name of ancient irrigation system of African desert, is a system for transporting water from an aquifer or water well to the surface, through an underground aqueduct.

2. Method

Our case is Timimoun Oasis, which is considered one of the most important Sahara oases because of its largest coverage in the region. This oasis dominated by a vast Salt Lake, site specific irrigation system, local traditional settlements and palm groves named as *ksar*, has suffered the impact of the population explosion and the lack of economic and social policies like other Algerian cities. The oasis is experiencing many problems that have led to a decrease in its area, which has led to a reduction in its ecological, social, and economic roles. Considering the critical situations and threats on oases landscapes and *ksar* ecosystem, our study aims to shed light on its status in order to preserve the continuity of this millennium human system. Depending on the case study this research will try to exemplify characteristics and threats on *ksar* ecosystems in African Sahara context.

For this purpose, the study will first try to reveal the tangible and intangible elements that constitute the cultural landscape values in the study area. Our research claimed that the tangible elements of the cultural landscapes in the African desert are *ksar*, *foggara*, *kasbah* and palm groves; and the integration of these elements creates social culture and social resilience in this geography. In the next step the study will try to reveal major threats on the cultural heritage through using the ICOMOS-IFLA (2017)'s approach designated for rural landscapes. The threats on the site will be analyzed under three categories of ICOMOS-IFLA (1) Demographic and cultural threats, (2) Structural Threats (3) Environmental Threats. ARCGIS application was used to understand the quantitative amount of the effects of uncontrolled urbanization and tourism actions on Timimoun's cultural landscape that do not consider the capacity of this special area and the sensitive ecological balances it contains. In the last part, the study will try to draw a road map that will guide the decision makers in order to ensure the continuity of this unique cultural landscape example and to get maximum benefit from it.

3. Cultural Landscape Heritage Characteristics of African Sahara Desert's *Ksar*

3.1. Ksar Ecosystem Characteristics

North Africa symbolizes a very distinct cultural mix and deep-rooted beginning of human civilization. In this representative environment the desert ecosystem covered a large part of North Africa (Figure 1) and was known for the fusion of North and South African cultures, in which humankind was able to build population groups in very harsh natural conditions known as *Ksar*.

Figure 1 The Satellite image of African Sahara Desert (Google Earth)

Desert *ksar*'s are similar in their urban and social pattern, but there remains a difference in their ecological pattern, where there are *ksar*'s next to valleys, Erg *Ksar*'s and Sabkha *Ksar*'s. It is possible

to make a first typological classification based on the geographical location and the territorial model of implantation wadi ksour; ksour of sebkha and ksour of erg (Laureano, 1987).

The *ksar* is basically a group of non-separate houses. Like the castle, it is surrounded by walls, and sometimes there are structures outside the walls, in addition to a palm oasis. The methods of irrigation differ according to geographical data. Basically, this type of *ksar* consists of three main components, which are the *foggara*, the *kasbah*, and the palm groves. These components make up an integrated ecosystem. Figure 2. shows the principle for the operation of this system.

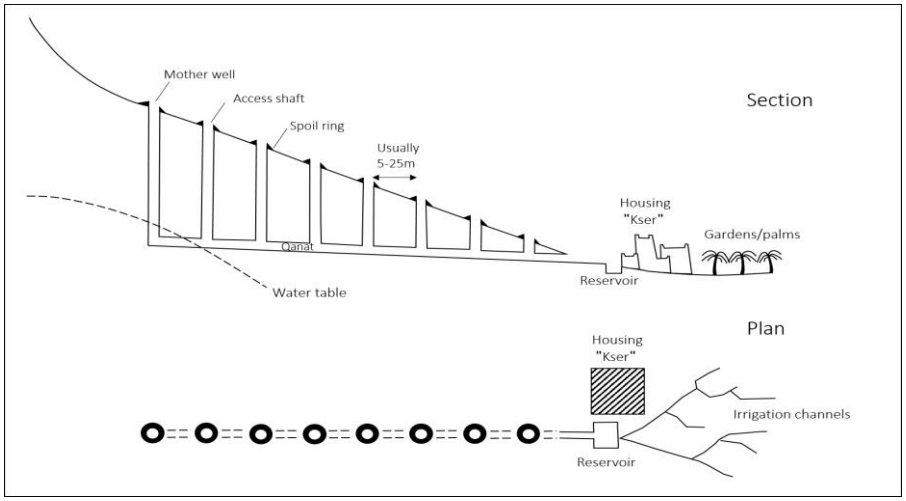

Figure 1 The sectional schema of components of *ksar* ecosystem (adopted by Guerrout, C. from Mobile Technologies in the Ancient Sahara and Beyond)

The size of the *ksar* and the importance of its built space depend on the nourishing capacities of the terroir. When it loses, the *ksar* is abandoned; when, on the other hand, the terroir can develop to receive the population grow, the *ksar* is multiplying.

The ksour are these impregnable fortresses erected on the major caravan courses that connected north and south of sub-Saharan Africa. Their different defensive devices have attracted the interest of researchers as to their historical origins, their modes of construction and the customs of the ethnic groups that created them. These Saharan architectural and urban ensembles are components of Algerian historical heritage.

The "*ksar*" is a blatant example of the cultural landscape representing a clear interaction between human and natural environment. The nested logic of *ksar* reflect precise techniques for the sustainable use of land, considering the characteristics and limits of the natural environment, through a tight regulation of the relationship between water use and cultivated spaces and built spaces, and having specific spiritual relationship with nature. Architecturally, living places constitute a built-in group, closed and hanging.

The *ksour*[3] of the regions of Touat, Gourara and Tidikelt represent a unified pattern by relying on the technique of irrigation *foggara*. All *ksar* structures are located within the boundaries of the property and protect the buffer zone its environment. The dirt buildings are very weak due to lack of maintenance and regular reform caused by their population abandoned *ksar*.

4. The analysis of potentials and threats on Timimoun's Cultural Landscape

4.1. The Elements of Timimoun's Cultural Landscape

Timimoun is the administrative capital of Timimoun department, also the historical capital of the Gourara region[4] (Figure 3), in which consists of a group of *ksour*. According to the 2008 census

[3] Plural usage of *ksar*, means *ksars*

[4] Gourara (Gurara) is a Zenati Berber language spoken in the Gourara (Tigurarin) region, an archipelago of oases surrounding the town of Timimoun in southwestern Algeria.

Timimoun has a population of 33,060. The *ksar* is the original urban style of Timimoun, where this settlement style is based on three basic components: the poor, the oasis, and the housing. Together, these components constitute a social and urban ecosystem characterized by urban resilience, self-sufficiency, and sustainability.

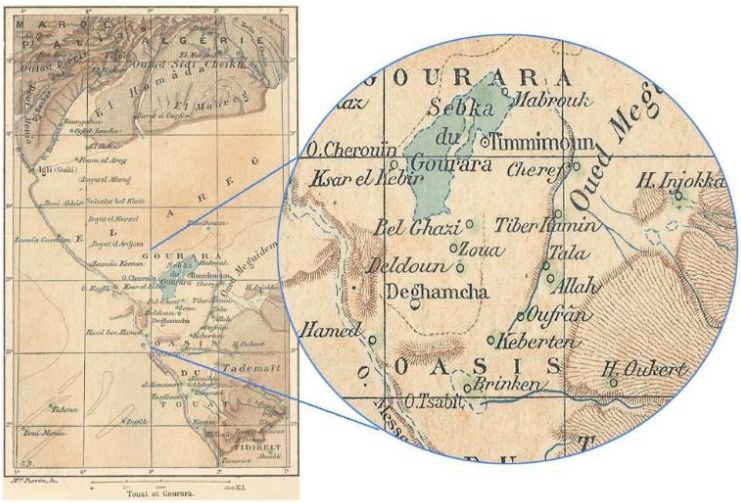

Figure 3 The map of Gourara region in the Algeria map of 1894.

By 1900 Timimoun occupied by French forces and opted as the military post (BORDJ) by French military in order to “protect” and supervise region from attacks. The needs of the French military garrison attracted merchants and traders, who came to settle around new city. The location of Timimoun city as caravans meeting point from all sides, made it a strategic center also contributed to a great extent to the enrichment of the caravans which found a developed market. As a result, Timimoun became a beaming city overall Gourara region. The city, made of earth and local materials, may extend until the inhabitants are able to derive sustenance from the surrounding physical environment. The production system is therefore a constitutive part of the founding act; it is often physically included, and the settlement is already measured depending on the available resources (De Dominicis, 2014). From an urban and architectural point of view, the colonial architecture of the area orients the outset not only for Sahara region but a so-called Sudanese architecture, which imported from sub-Saharan Africa (French West Africa). This style is characterized by colonial urban fabric and conical shapes made from clay. These forms include many decorations; it is still an element in thermal protection of facades. Also, the small openings 20 to 40 cm on the walls are in the form of skylights, holes, mesh, or window, influence indoor temperature regulation (Figure 4).

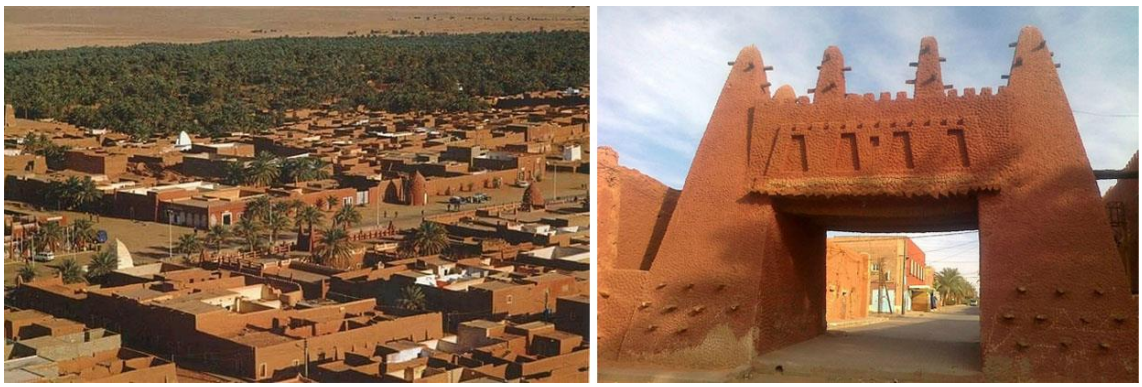

Figure 4 The colonial architectural character of the city in general and detail.

Due to the natural landscape that characterizes the city, Timimoun has become the preferred tourist destination for Europeans, and during this period hotel buildings started to be constructed. After independence (1962), the state's tendency was to develop tourism, considering that

Timimoun has a significant tangible and intangible heritage in addition to the natural landscape. In addition to investing many properties in housing and touristic dormitory, large scale touristic building complex (Figure 5), had been constructed which designed by the icon architect Bernard Pouillon. Also, some residents of the northern regions bought some of the orchards and became the secondary residents use the city to rest in the winter seasons.

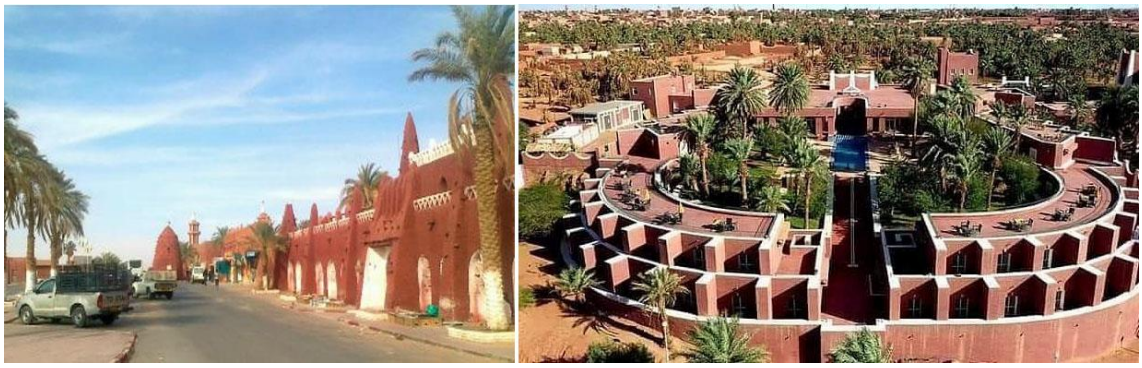

Figure 5 Comparison of colonial(left) and modern(right) archetypes of tourist complexes in Timimoun.

Considering these economic and social changes, the rural domination of the oasis was gradually reduced in favor of new economic activities. Economic diversification and the induced new attraction also played a full role in bringing about a fundamental modification in the social and spatial organization of the oasis which today finds itself facing the problems of managing the fragile interaction between man and its environment. The palm grove, which remains an essential component of the oasis landscape as an identity for Timimoun, is increasingly suffering from the pains of urbanization and the shortcomings of urban management. The deterioration of these landscapes threatens the ecological, social, and economic systems of life. Timimoun's cultural landscape has three remarkable tangible components[5]: "*Palm Groves*", "*Kasbah*" and "*Foggara*" (Figure 6).

Figure 6 (a) The general landscape of Timimoun, (b) Palm groves and orchards, (c) *Ksar*, (d) the streets of *Ksar*, (e) *Foggara* system and water distribution shaft.

[5] The oasis is a space rich in cultural landscapes elements, but in this research paper i will focus only three main elements of the oasis that constitute particularly landscape of *Ksar* system.

Timimoun Oasis is considered one of the most important desert oases dominated by a vast Salt Lake (sabkha[6]) (Figure 7). On the edges of sabkha were built dozens of *Kasbah*s (Massin, *Kasbah*, Tela etc.) inclined on the rocky cliffs. The irrigation system *(foggara)* in the oasis is very special this system slightly inclined underground gallery, which drains water from the aquifer upstream to the driest land located downstream, towards the palm grove.

Figure 7 The landscape of Sebkha; Salt Lake of Timimoun.

The establishment of the Ksour and the oases of Gourara is the result of the presence geomorphological conditions by the existing Meguiden plain and Tadmait plateau, and also the underground waterflow. All these facts contributed to the construction of the Ksour and formed a chain linking between the north and south of the African continent through the establishment of trade routes for thousands of years. This ancient infrastructure promotes the development of sustainable life systems through irrigation techniques that led to the establishment of oases and make possible cultivation in this arid region.

The *foggara* system is the most common traditional irrigation system in the Timimoun oases, and it is a system that was built thousands of years ago, based on extracting water from the underground water tank in underground corridors with a slight slope that does not exceed one percent. The corridors are interconnected by a series of wells that end with a waterwheel on the face of the earth, and its water is divided among the groves according to a very precise division system. (The section in the Figure 2 shows how the *foggara* system works.)

Compared with other ksour in southern Algeria, Timimoun *ksar* has maintained its architectural connection in terms of composition and materials. In addition to the oasis and the water collecting system, Timimoun *ksar* represents one of the most important shortcomings in terms of architectural excellence. The architectural style has been well maintained and dirt buildings are completely adapted to climatic conditions conveying with the natural and social environment. Also, the *ksar* represent a continuous landscape that maintains an active social role in contemporary society closely linked to the traditional way of life, and in which the evolutionary process is still in progress.

4.2. The Analysis of Threats on Timimoun's Cultural Landscapes

Increasing human populations, urbanization and effects of climate change make agrarian landscapes more fragile to risks of loss, abandonment, or radical changes. According to the declaration of ICOMOS-IFLA (2017); the threats to rural landscapes reflect three interrelated types of change:

[6] sabkha, also spelled Sebkha, (Arabic), saline flat or salt-crusted depression, commonly found along the coasts of North Africa and Saudi Arabia.

1-Demographic and cultural threats (population growth in urban areas and depopulation in rural areas, urban expansion, intensive infrastructure works, development pressures, loss of traditional practices, techniques, local knowledge, and cultures).

2- Structural threats (globalization, change and growth of trade and relations, economic growth or decline, intensification of agricultural practices and techniques, change of land and loss of native pastures and of domesticated species diversity).

3- Environmental threats (climate change, pollution and environmental degradation including non-sustainable resource mining, impacts on soil, vegetation, and air quality, and loss of biodiversity and agro-biodiversity).

In the next section the study try to analyze the existence of these changes and possible threats in *Ksour* of Timimoun's.

4.2.1. Demographic and Cultural Threats

The group of Gourara *Ksour* constitutes a regional system that encourages the establishment of an economic life and a mixed social pattern between the Bedouin and the urban system, through which commercial and cultural exchanges are active. Timimoun is the most dynamic shopping center of Gourara. Like the Touat region, this area was favored by trade between the nomads of the High Plaines Steppe of Oran region (Despois, 1959).

With the increasing population growth, the food supply of the city started to be obtained from modern agricultural products in the northern regions of the state. Moreover, parallel with this degradation in the Oasis areas, which lost its economic efficiency, a new type of urbanization has been raised with the increase in urbanized population. As a result of two different dynamics feeding each other in this way, the threat of losing the traditional desert life and cultural landscape elements peculiar to Timimoun has emerged in the long term. Furthermore, the city's outsourcing of food supply has led traditional farmers to seek employment in different sectors. Along with this, the farmers chose to sell their gardens and houses, which were considered a good opportunity by tourism investors. In this process, palm groves and traditional settlement pattern began to transform into residences used for touristic purposes, and the traditional socio-cultural structure deteriorated to some extent.

The population of Timimoun seated over the last fifty years, according to the statistics of 3,000 inhabitants in 1954 to 20.607 inhabitants in 2008. The small Saharan village of the 1950s became a full urban agglomeration according to a generalized process, named as Sahara of rural shift to urban (Bisson, 2003). This economic change of the oasis has provided the local population with more job opportunities in the field of tourism, but at the same time it negatively affected to the oasis ecosystem through neglecting the traditional sustainable irrigation system and palm groves in the oasis. It is obvious that, if the policymakers are not considered to take precautions against this progress, it might create irreversible loss of socio-economic and socio-ecological heritage of the region.

Maintenance of *foggara* systems is essential to preserving them in working order. This work was formerly one of the most difficult tasks of the indigenous population and was previously carried out collectively by the Twiza. This process of cooperative work has disappeared, due to the disintegration of traditional social structures, in addition, the low-flow gains obtained after cleaning or stretching the *foggara* channel, and the lack of qualified labor to do this work has exacerbated this phenomenon (Figure 8).

Figure 8 (Above) abandoned and collapsed *foggaras*(Remini et al., 2011) ; (Below), Collective work of maintenance for *foggara* in palm groves of Timimoun (Project *Foggara* Amghiar Timimoun) .

All these problems are the result of a clear neglect to preserve the social ecological memory. The neglect of the oasis system, in addition to the wastewater that is dumped in the marsh, caused the spread of diseases, harmful insects and unpleasant odors, which affected the ecosystem of the oasis in general, in addition to the negative impact on the cultural landscape of Timimoun. Landscapes change constantly from natural and anthropogenic drivers, and land use and land cover changes by humans have been identified as a primary effect of mankind on natural systems. These changes underlie fragmentation and habitat loss, which are the greatest threats to biodiversity and ecosystem services. The complex interactions between development decisions and ecosystems, and how the consequences of these decisions may then influence human values and subsequent decisions is an important area of research interest (Petrosillo et al., 2015).

There exist a great variety of landscapes that are representative of the different regions of the world. As combined works of nature and humankind, they express a long and intimate relationship between peoples and their natural environment (Nofal, 2011). The oasis system and cultural landscapes are the product of the fusion between human work and natural data. Where man worked with the social system to develop oases in harsh natural conditions, and through this, social ecological knowledge was formed by experiences acquired through practice, which is known as socio-ecological memory. It is a well-known fact that any changes on the social system caused disappearance of this knowledge, which directly affected the lack of space in the oasis through neglecting the participatory work and techniques for maintaining irrigation systems and preserving the original plant species and agro-biodiversity. The joint use of micro- and macro- remains underlined once more that the landscape reconstruction depends on both wild and cultivated plants, and the cultural landscape is a complex mixture of indigenous and exotic plant elements. Their development depends on the interaction between human and environmental setting (Sadori et al., 2010).

On another side, the building system is a very important part of the desert ksour, and they have developed throughout history through their compatibility with the natural and environmental data. The *kasbahs* are characterized by distinctive architectural techniques that consider the availability of building materials, natural conditions, and cultural and social needs. Due to the economic and urban changes in the city, the cultural landscapes of *ksar* and *kasbah*s have changed through their incompatibility with the needs of the population. Availability of new materials prompted the residents to use modern construction techniques and materials which negatively affected the original appearance of the *kasbah*s (Figure 9).

Figure 9 An example for the usage of new construction materials in *Ksar* (Produced from Rouani, 2017).

4.2.2. Structural Threats

In this part of research, the study describes the green surroundings of Timimoun oasis and understand its change during the last 35 years, between 1985 and 2019. A period during which there was a severe shortage of green cover and an increase in urbanization. The analysis proceeded based on images taken from Google Earth images correspond to the following years: 1985, 1906, 2010 and 2019. The images were selected according to the same coordinates. Table 1 lists the characteristics of the images obtained.

Table 1 The features of the images used for LU/LC change analysis.

Image	Date	Spatial coordinate 01	Spatial coordinate 02	Spatial coordinate 03	Spatial coordinate 04
Image 01	1985	29°17'36.68"N 0°14'0.59"E	29°15'37.56"N 0°12'21.61"E	29°16'36.45"N 0°15'36.55"E	29°14'49.62"N 0°14'10.95"E
Image 02	Jul. 2006	29°17'36.68"N 0°14'0.59"E	29°15'37.56"N 0°12'21.61"E	29°16'36.45"N 0°15'36.55"E	29°14'49.62"N 0°14'10.95"E
Image 03	Dec. 2010	29°17'36.68"N 0°14'0.59"E	29°15'37.56"N 0°12'21.61"E	29°16'36.45"N 0°15'36.55"E	29°14'49.62"N 0°14'10.95"E
Image 04	Dec. 2019	29°17'36.68"N 0°14'0.59"E	29°15'37.56"N 0°12'21.61"E	29°16'36.45"N 0°15'36.55"E	29°14'49.62"N 0°14'10.95"E

Classification of satellite data is the most widely used method for extracting spatial information. This method works by assigning a pixel to each land use pattern. Under supervision, a classification method is chosen for this study, considering the knowledge of the field and available documents. Before proceeding with the classification of images, our analysis focused in the first stage on determining the green cover in the original oasis of the city to obtain the area of the oasis with the ArcGIS application. Four thematic maps were extracted with the analysis using the ArcGIS application (Figure 10).

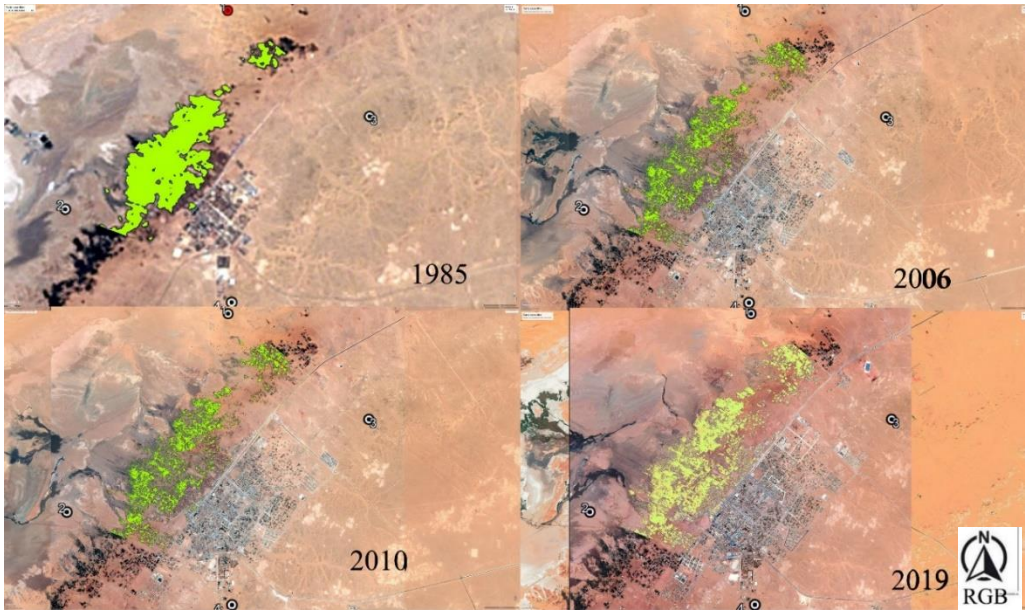

Figure 10 Classification and decreased change of green patches (Palm Groves) in Timimoun by ARCGIS

Through the application of ArcGIS, the study can obtain the amount of change in green cover in the study area, which is the data recorded in Figure 11. It is possible to see that palm grove areas have decreased rapidly over the years and more than 1.5 million square meters of palm grove areas have been lost since 1985. This situation proves that even though having great value of tourism and cultural potentials, Timimoun cultural landscapes are in endangering risks for future sustainability of the region.

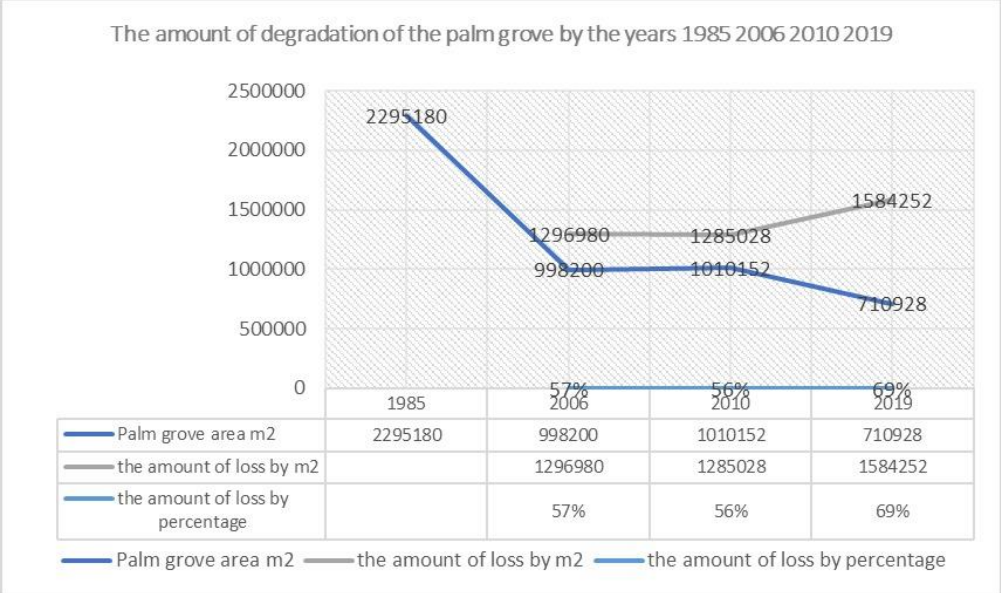

Figure 11 The amount of degradation of the palm grove areas by the years of 1985, 2006, 2010, 2019.

4.2.3. Environmental Threats

The Timimoun Oasis is currently facing with water scarcity because of a drop in the groundwater level, and the extension of the sabkha area gradually expanding toward the palm grove. Several 21 *foggara*s with a length of 53 km of underground galleries cross the urban fabric from southeast to northwest and collect water from the aquifer in the continental region. As a result of the decrease in the groundwater level, the volume of water bottled by blasters decreases because of drilling eighteen wells in the same underground reservoir to supply the city and other ksour belonging to the municipality with potable water. The volume of water in 2007 was assessed at 35,337.6 m3/day, or 409 L/sec, most of which is for Timimoun City (Otmane & Kouzmine, 2011). Locals put a direct relationship between draining blasters and realizing wells. Of course, there is a relationship between the two phenomena, but the problem is also more global and complex. The draining of the *foggara* began long before excavation was carried out by hauling or due to lack of maintenance of the galleries: Amrir of *foggara*, among the largest in Timimoun, which mustered 15 l/s in 1900, had already seen its flow. Decreased to 11.8 liters / sec in 1950.

Today, the world witnesses the gradual disappearance of *foggara*s; there is a lose about one to two *foggara*s per year for over half a century. The discharge of the 250 functional *foggara*s shows a significant drop: 850 l/s in 1960 and 355 l/s in 2001, enough to irrigate 350 ha. The causes of declining *foggara*s are technical, social, and environmental. The exploitation of groundwater affects all regions of the three countries concerned (Algeria, Tunisia, and Libya). Excessive water consumption continues. Timimoun Oasis is one of the type of oases attached to the sabkha the oasis in this type depends on the ecological and social knowledge to control this system by draining the salty water rising from the sabkha through the draining channel.

Urban growth has a negative impact through the increase in the amount of sewage water (24,736 m3/day), which is daily dumped in Sabkha (Salt Lake) of Timimoun and significantly affects the whole system. Besides the problem of the low groundwater level, which pushes the gardens towards the lower areas in order to benefit from gravity irrigation by the *foggara*, the water that

seeps into the corridors of the *foggara* is the sewage of the city drained into the sabkha. This phenomenon led to the disappearance of intercropping in orchards in contact with saline areas (Figure 12).

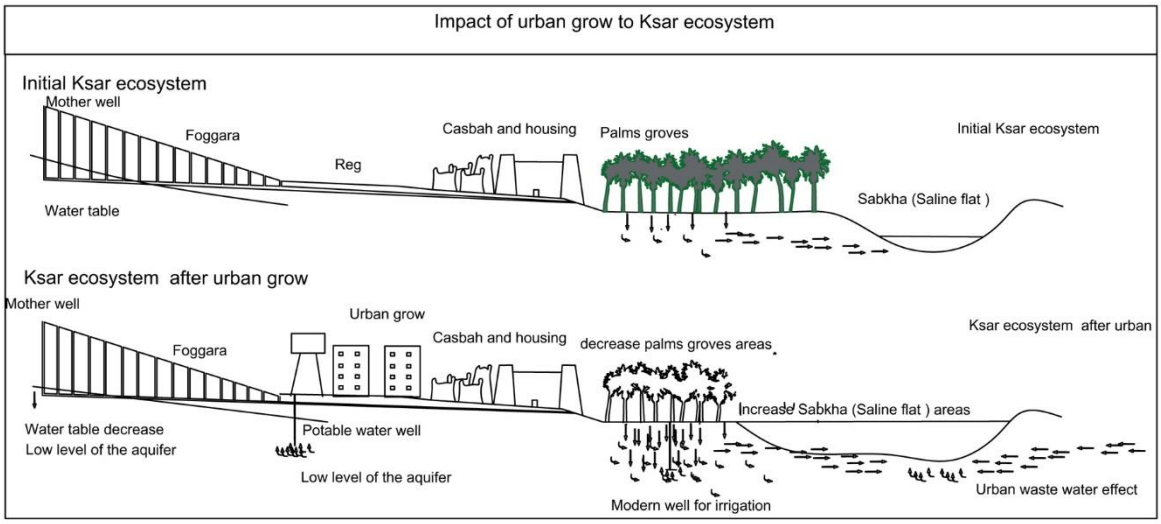

Figure 12 Diagrammatic sectional illustration of negative impact of urban growth to *ksar* ecosystem.

Unfortunately, this phenomenon affected the traditional agricultural system of the oasis, which is a mixture of palm, grain, and horticultural cultivation, and practiced by farmers. In this delicate ecosystem, the relationship between the parts has a wonderful balance. Even though palm groves are the main part of *ksar* ecosystem, monocultural palm cultivation is not supported because it causes salinity in oases, product diversity and agro-biodiversity are one of the elements that provide the balance of this system. Worse than monocultural gardening, because of urban expansion and the increase in the need for land, many farmers prefer build houses in the oasis or sell their lands to foreigners for constructing touristic facilities.

The Timimoun palm grove is clearly suffering from a decline in the green cover and the groundwater level, and the extension of the sabkha that gradually feeds on the palm grove, in addition to the invasion of cement buildings. These developments led to several explanatory factors, and clearly raise the issue of sustainability, which is one of the foundational elements of the identity of the desert settlements. On the other hand, investors in tourism projects aimed to exploit the palm groves in the oasis due to their low prices and the natural landscapes that they provide (Figure 13).

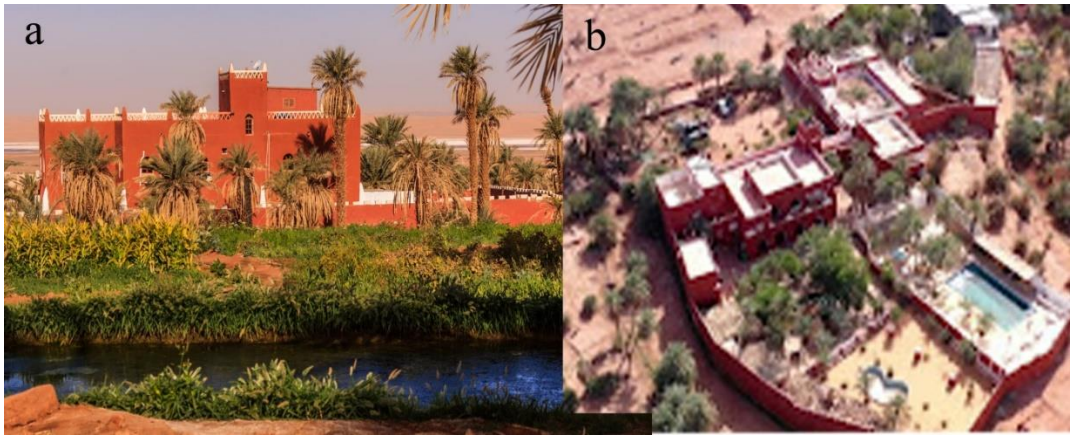

Figure 13 New touristic buildings in old *Ksar* of Timimoun, (a) Side View (b) Top view.

5. Conclusion

The desert of Africa especially Sahara is one of the most occupied landscapes in the continent. With its common definition oasis, and the local traditional nucleic settlement type the *Ksar* - with its three components (*Foggara*, *Kasbah*, *Palm grove*)- constitute the original identity of this cultural landscape. Unfortunately, these cultural landscapes suffer from obvious threats and imbalances in their ecological system, which have persisted for centuries because of changes in the social, political, and economic systems.

This paper has studied the problem of the gradual decline of the oasis during the last thirty years and presented the reasons for this decrease around the oasis. The oasis ecosystem has remained a key factor in the human presence in Sahara and has preserved through interconnectedly balanced ecosystem the biological diversity and the provision of urban food and the availability of space for social interactions.

Our study showed the effects of population growth and unsustainable urbanization, which is not include the oasis ecosystem in its strategies, cause a real threat to the cultural natural landscapes in the region. It is necessary to take the oasis system within a clear urban strategy, considering it as an essential component of green infrastructure, which ensures its preservation and benefit from it environmentally, socially, and economically. The oasis is a real space and ecological memory carrier, the disappearance of the oasis certainly means the loss of social ecological memory knowledge.

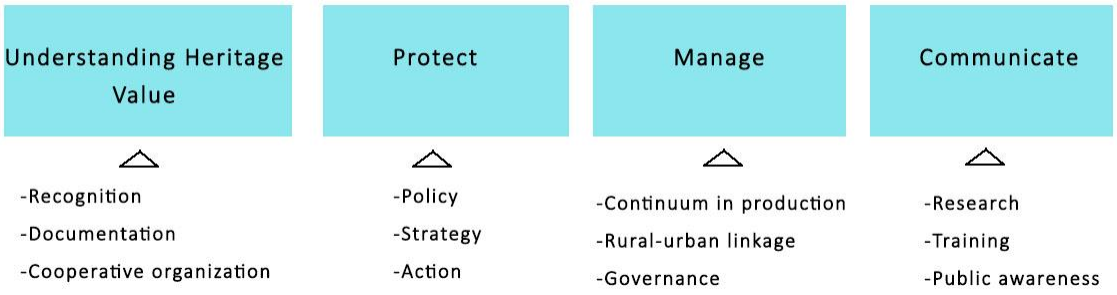

Figure 14 The operational action path for sustaining cultural landscapes (Adapted from ICOMOS, 2017).

Rural landscapes often provide distinct economic and tourism benefits when closely associated with the communication and enhancement of their heritage values (ICOMOS, 2017). We are in a period when the administrative authorities must act strategically for the continuity of the traditional cultural heritage areas that have survived to the present day in a whole of delicate balances interconnected to each other for thousands of years. What the study tried to do in this research was to reveal the threats put forward by ICOMOS-IFLA, which emphasizes the importance of preserving the rural landscape within the world cultural landscape heritages and draw a theoretical path for the action strategies against these threats for Timimoun's *Ksar* Ecosystem as a cultural landscape heritage (Figure 14).

The first step is understanding and recognizing the value of the heritage by making inventories and following changes over time. Second, as the study explain here; it is necessary to determine the potentials, pressures, and threats of the nominated cultural landscape and to develop a political strategy that considers the balance between conservation and use. In order to ensure the continuity of the cultural landscape, a management plan should be implemented, and innovative solutions should be developed for its relations with the city and contemporary life culture due to reinforced it against the pressures coming from tourism and urbanization. At the final stage, creating community awareness through participatory actions is necessary for supporting the transmission of the collective socio-ecological memory. This increases the spread of environmental illiteracy, which is a key factor in impeding all sustainable development strategies in urban settings and destroying cultural landscapes in this part of the world.

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Resume

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A comparative analysis of building large-scale projects in developing countries by emphasizing on land value changes: Tehran-Iran Mall versus Istanbul-Third Airport

Somaiyeh Nasrollahzadeh*

Abstract

Today's cities are competitive in the process of globalization. Their survival depends on attracting as much capital as possible for the various productive, infrastructure, economic, political and social sectors. The more capital raised, the parts that use it also get improved in number and scale. The process of raising capital depends on the circumstances of each city. So that, in some cities, high demand leads to increase the capacity of economic infrastructure sectors, in others, they make demand by creating economic, social, infrastructure capacity and opportunities on a large scale. This is even more important for cities in developing countries as it helps them reach the development thresholds. Meanwhile, the Tehran (Iran) and Istanbul (Turkey) cities, due to their location, economic and political conditions, have always been challenged to attract capital. Therefore, in recent decades, they have started to make investment capacities by developing large-scale projects. This study aims to verify two of the most challenging large-scale projects in these two cities. To achieve the study's goal, the projects and their types are first discussed. Also, the impact on the lands values in the neighboring area is evaluated as one of the existing effects on the host environment. The rate of impacts varies depending on the type of projects. According to the research findings, the essences of the two projects and the purposes of their constructions are different from each other. One attempts to attract as much capital as possible in order to show off its social and cultural capitals (Iran mall- Tehran), and the other aims at economic and political benefits in competition with similar projects. Regarding land prices, in addition to the fact that these two projects have caused significant increases in land values of the host districts, they have also transformed the social structure of the residents living there.

Keywords: Airport, flagship, developing countries, land value, large-scale,

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1. Introduction

Megaprojects are defined as large scale projects cost billion dollars or more (Flyvbjerg et al, 2014). Such types of projects take many years by multiple public and private stakeholders (Sarkheyli et al. 2016, 2017). Large-scale projects can be considered as powerful tools for implementation of radical plans contrary to current approval urban plans (Kuyucu & Ünsal, 2010; Kuyucu, 2014, 2017). To policy makers, implantation of right-done large-scale projects provides extensive investment for city and region such as high-quality of life by improvement of infrastructures, providing sustainable employment, productivity and competitiveness (Flyvbjerg, 2005; Flyvbjerg et al, 2014; Kheyroddin & Omidi Bahremand, 2017). Risk is an irrecoverable part of large-scale projects. Long-term planning horizons, Process of decision making and its multi-actor who seek their own interests are among the reasons. Having long planning horizons, large scale projects' scope, stakeholders or physical borders can be changed over time. One of the challenging issues of such projects, especially in developing countries is cost and interests of wide range of stakeholders which lead to civic mistrust (Flyvbjerg et al., 2003; Kuyucu & Ünsal, 2010; Kuyucu, 2014, 2017; Sarkheyli et al.,2016).

Tehran (Iran) and Istanbul (Turkey) cities, due to their location, economic and political conditions, have always been challenged to attract capital. Therefore, in recent decades, they have started to make investment capacities by developing large-scale projects. In recent decades, unlike the harsh economic sanctions (Ghasseminejad & Jahan-Parvar, 2021), the implementation of mega-projects in Iran accelerated (Sarkheyli et al.,2016; Kheyroddin & Omidi Bahremand, 2017). Extensive investment of such projects is mostly based on promoting the conditions at both national and international level through public-private partnership. The vision of building Iran mall project was creation a world-class socio-cultural and commercial complex (ATC, 2019).

In 2003, while global nations were dealing with crisis, Turkey was improving its civil aviation which had started operations in 2002. Istanbul's two airports were facing significant capacity constraints that could not be able to deal with the growing passengers and goods demands. Definitely construction of a new airport was required to deal with the short of capacity of Ataturk and Sabiha Gokcen airports in the early 2000s. In order to reach its 2023 targets, Turkey's infrastructure projects are being planned and implemented with high-speed and in large-scales. Istanbul as the largest metropolis of Turkey is planned with strategic projects to be an international hub of airway transportation. The purpose of such large-scale airport was providing opportunities for economic growth in addition to meet air traffic needs (Düzgün & Tanyaş, 2014; Saldıraner, 2013; Deveci et al., 2020).

Considering the scale of the projects, financially and physically, they can definitely have significant effects on the host environment and even neighboring districts. The present study with the purpose of understanding the influence of large-scale projects on land value changes in developing countries try to answer the following question:

- What is the relationship between building large-scale projects (Iran mall and Istanbul airport) and land value changes in adjacent neighborhoods in Tehran and Istanbul?
- What are the similarities and differences between implementation of large-scale projects in Tehran and Istanbul?

This paper is arranged as follows: Section 2 reviews the literature on large-scale project definition and its relationship with land value dynamics. Section 3 introduced the methodology and materials. Section 4 described the case studies and specifically large-scale projects in both cities. Result and discussion are described in section 5. And finally difference between two studies and suggestions for future research.

2. Literature – Large scale projects

After the World War two, damaged cities and generally mass destructions lead to demand for implementation of large-scale projects (Orueta & Fainstein, 2009).

Large-scale project is often defined as combination of diverse small-scale projects (Flyvbjerg et al, 2014). These types of projects are also considered as mega-projects which could be categorized due to their cost (Flyvbjerg, 2006). City branding contributes large-scale projects to choose their type, scale, activities, and target groups by focusing on already known dimentions of cities in global arena (Dogan & Stuper, 2017). In fact, Large-scale projects are the result of the strategic view of the territory (Borja & Castells, 1997).

Mega projects are used the preferred delivery model for goods and services across a range of business and sectors, life, infrastructure, water, and energy. From view point of land use, large-scale projects include expensive infrastructure (airport, expressway, etc.) and flagship projects (shopping malls, etc.) (Bahrainy & Aminzadeh, 2006; Flyvbjerg, 2006; Flyvbjerg et al, 2014; Sarkheyli et al., 2016, 2017). For instance New York's Chrysler building (1930) with 319 meter height was the tallest building in the world (Dubai, Burj Khalifa (2010) with 829 m)-(Flyvbjerg, 2014). Chinese's high speed rail project is one of the longest megaprojects that costs hundreds billion dollars (Orueta & Fainstein, 2009).

Since the 1970s, socio-economic dynamism in urban areas has contrasted large-scale projects with metropolitan projects. Although this conflict has not invalidated urban plans, they challenge urban plans in terms of their size and impacts on the host environment. Besides The contradiction and ambiguity in the concept and performance of these projects is that a project implemented with the aim of generating short-term revenue for the private sector must meet long-term responsibilities for the public. It must be noticed that large-scale projects are in fact elements of an articulated system, the activity of each of which affects not only the other part but the whole system in a transformational manner (Borja & Castells, 1997).

In terms of main features, mega-projects transited from government-fund including environmental impact assessment (EIA)-(1950S-1960S) to public-private partnership with or without EIA (1980-Present). Since 1980s government prefer to encourage private sector to play developer role in building large-scale projects by facilitating legal, political and economic issues rather than involving as developer itself (Borja & Castells, 1997; Altshuler & Luberoff, 2003; Orueta & Fainstein, 2009; Sarkheyli et al. 2016). The form of public-state collaboration in implementation of such projects is one of the main reasons for successful operation. Without necessary social and political support large-scale projects face movements against their operation. Since they have massive environmental impact on people and enormous economic cost lead to civic mistrust (Flyvbjerg, et al. 2003; Orueta & Fainstein, 2009; Kuyucu & Ünsal, 2010; Kuyucu, 2014, 2017).

Orueta and Fainstein (2009) define other categories for large-scale projects considering their operation. Due to their study such projects can be included in regeneration, renovation or recovery of old and historic areas or construction of totally new projects or their extensions (Orueta & Fainstein, 2009).

The approaches of planning such projects differ from country to country regarding their political and economic context and also nature of urban processes (Orueta & Fainstein, 2009; Orueta & Fainstein, 2009). The reason for this is due to the contemporary circumstances of cities which are not merely restricted sites to their boundaries and deal with specialized local economic, and political issues, rather hey are elements of a global model of capitalist urbanization which has multidimensional tendencies (Brenner, 2009).

In some cases, large-scale projects built to meet consumers' demands while for some others symbolizing their rise to ower is main purpose (Shanghi – Dubai)- (Flyvbjerg, 2009; Flyvbjerg et al, 2014). In developed countries obsolete industrial lands, waterfronts, old warehouse zones, and

ports are chosen for large-scale projects (Flyvbjerg et al, 2014). Bilbao Guggenheim Museum and its environment is one of the examples in European countries while in developing countries, slum areas and generally residential neighbourhod with vulnerable residents often are the best choice for building large-scale projects. Obviously, the aftermaths of such location choice are displacement of a group of households or their resistance which challenge the implementation by law issues (for more study see Nasrollahzadeh & Koramaz, 2021).

Mega projects are attractive to decision makers in terms of four sublimes: technical, political, economic and aesthetic. To technological approach, engineers and technologists eager to push the boundaries by building innovative design and large-scale projects such as larger towers, bridges and etc. (San Francisco, Oakland by bridge). Political sublime emphasized on building megaprojects by politicians who are media magnets and use such projects for better visibility to get reelected. Economic sublime is a context for business people and traders to make lots of money by achievement enormous budgets for large-scale projects. Through this approach a wide group of bankers, scholars, and owners, contactors and etc. reach their interests. Finally the last sublime, aesthetic, focuses on designers and planners who appreciate masterpieces of large-scale buildings (San Francisco's Golden Bridge, Sydney's Opera Home) -(Flyvbjerg et al, 2014).

Sakheyli et al (2016) about sustainability of assessment of large-scale redevelopment plan in one of the metropolise in Iran (Mashhad) deals with deviation of projects from its approved EIA report. Due to their study sustainability issues were neglected while encouraging private investment. such modifications in redevelopment program due to attract more investment and extend the scale of project lead to inefficiency of designed policies and defeat in public participations , and accelerating heavy traffic, and etc. (Sarkheyli et al.,2016). Kheyreddin and Bahremand (2016) studied estimating the impact of urban mega projects on housing price in adjacent neighbourhood in Tehran by evaluating the relationship between the value changes and fitting years. Before, during and after implementation of large-scale project (Sadr Multi-layered expressway) due to his findings, residential properties prices declined sharply by starting construction. But prices increased after project completed. To their study, farther neighbourhood to the Multi-layered expressway achieved economically benefits comparing to the closer districts. One of the reasons for the aforementioned impact is that the entry of more vehicles to these areas and increase quality of residents' lives (Kheyroddin & Omidi Bahremand, 2017).

Pouya et al (2016) In their study, examined the three large-scale projects located in the northern peripheral areas of Istanbul from an environmental point of view, and compliance with approved urban plans. According to the designed SWOT model, the weaknesses and threats of the Third Bridge project outweighed its opportunities and strengths. Most of these threats were environmental and degrade the quality of urban life in Istanbul. In relation to the third airport, the environmental aspects were discussed as threats and weaknesses, while its functional, economic, and social aspects were categorized as opportunities and strengths (Pouya et al, 2016).

2.1. Land value and large-scale projects

Analyzing the impact of large scale projects and land value changes is one of the significant topics that has been studied frequently from many aspects. According to related studies, large scale projects impact land value fluctuations in host districts from the very beginning of the announcement. To what extent the impact of such project infiltrates land values across the neighborhood depends on how the projects change the quality of living life in host neighborhood and its adjoining districts. (Kheyroddin & Omidi Bahremand, 2017, Nasrollahzadeh & Koramaz, 2021, Lukowski, 2019).

Examination of land value fluctuations is a significant factor that reflects the potential worth of urban land, which determines the type and scales of upcoming urban projects. According to the results of this examination, urban lands are divided into two types of values; "use value" and "exchange value". Use-value focuses on the main feature of urban land that is expected to meet

and support residents' needs, such as providing housing for households or commercial land for employees. However, in exchange value, land is a commercial commodity that is bought and sold with the aim of utilizing investment as much as possible regardless of meeting the needs of real consumers of urban spaces (Pivo, 1984; Logan & Molotch, 1987). The relationship between land type in terms of value and location of large-scale projects is a reciprocal relationship, so that sometimes large-scale projects give exchange value to host urban lands and sometimes fluctuations in land value drives the value of land to exchange which recall such projects (Pivo, 1984; Blanco et al., 2016; Albrecht, 2016).

Lukowski (2019) in his study evaluated the impacts of three different large-scale projects on land value changes in Hamburg, Germany. He restricted the impact radius of project construction to 1.500 m. He found that the projects which have overlapped impact radiuses need to be considered in one regression while the totally separated impact radiuses can be considered in one or in separate regressions (Lukowski, 2019). In most of the large-scale projects' construction periods, land value in the closer district declined as result of noise pollution, construction debris, and etc. But whatever distance is taken from the projects, the positive impacts can be generated (Lukowski, 2019; Kheyroddin & Omidi Bahremand, 2017).

Regarding studies with urban land value variability, changes in real estate values are considered as various shocks such as construction of shopping mall, Bridge, airport, sport arenas, entertainment facilities, etc. It must be noticed that, types of large-scale projects have various impacts on land value in host district. The impacts vary from land uses it generated. Residential construction large-scale projects, sport arenas, infrastructure, and etc. (Sarkheyli et al., 2016; Lukowski, 2019; Nasrollahzadeh & Koramaz, 2021).

3. Materials and methods

In the current study, in order to analyze the impact of building large-scale projects on the host neighborhoods, the variable of land value is chosen and quantitative method is applied. To define the type, and scale of large-scale projects (case studies) the theoretical framework is used. In order to compare different types of simple linear regression model, polynomial linear regression model degree 2 is chosen. For both case studies data obtained through a secondary data method and as external resource. Considering case study of Tehran, the average value of each residential land use (sqm) is extracted from Iran statistics center (between 2010 and 2021). In order to explore the depth of projects' impact, the adjoining districts' land value fluctuations are also discussed (Distracts 5, 21). For data analysis of Istanbul's large-scale project, land value (Tax assessment) are extracted from official resource; Ministry of Treasury and Finance of Turkey (2009-2022).

It must be noticed that Iran mall was inaugurated in 2019, and a few months later, in 2020, the covid pandemic began, which slowed down and, in some cases, stopped the activities of businesses in Iran. Also, by using this project as a hospital in the Coronavirus pandemic, its main activity was practically stopped. Therefore, the process of influencing on its environment continued at a slow speed. However, the significant increase in land values was the first notable impact since the resumption of the project activity, which is preferred as the focal point of this study.

4. Case Study

4.1. Iran- Tehran- Iran mall

Tehran, as the capital of Iran, includes 22 municipality districts and covers 730 km2. It is limited to the green areas of the Caspian Sea from the north and to the arid desert region from the south (Pishgar et al.,2020). District 22 of the municipality, located in the northwest of Tehran with an area of about ten thousand hectares equivalent to twice the largest district of Tehran, in other words, one-seventh of the city. It is one of the newly built areas of Tehran, which has been built to meet

the service needs of the western part of Tehran and to relocate part of the population living in the worn-out tissues of central Tehran. This district is restricted to the Alborz Mountains from the north to the Kan River area from the east to the Tehran-Karaj freeway from the south, and to the Wardavard plantation forests from the west. Iran Mall, one of the biggest shopping malls including various commercial, cultural, and social functions located in this district (Tehran Municipality, 2021).

Iran mall is among the top 5 projects in the world and also the first in the middle-east. Construction of the project began in early 2012 and completed in 2019 despite of its massive size. This outstanding multiple purpose project is a world class mega project. Iran mall is considerably larger than The Trafford center in the United Kingdom and the Mall of America in the United States (ATC, 2019). The projected budget amounts 3 billion and 149 million euros (Bid, No.32, 2022).

The purpose of building such project is attraction of domestic and international investment through business owners. Its funding is based on private sector (Banker). According to its special designs (like Didar-garden, Mahan Garden, resembling traditional bazaars) and gathered activities (as Jondishapor library, Mirror Salon …) it is a little Iran in Tehran. This project was planned with aim to apply the sustainable principles (environmental, economic, social) by providing a platform to attract tourists, improving economic growth, building cultural and social centers with iconic structures for local people to socializing and familiarizing. To what extent it achieved this goal can be the discussion of another study (ATC, 2019; URL 1; URL 2).

Figure 1 View of Iran mall, URL 1.

Iran mall is located in the municipality district 22 of Tehran. The project form the north reaches to Botanical park and from east to Chitgar park. The project form other sides is surrounded by various residential, recreational, and commercial projects which made its accessibility more convenience from northeast, south and west. The location choice was based on having equal distances from the center of two cities (Tehran –Karaj)- (Tehran Municipality, 2021).

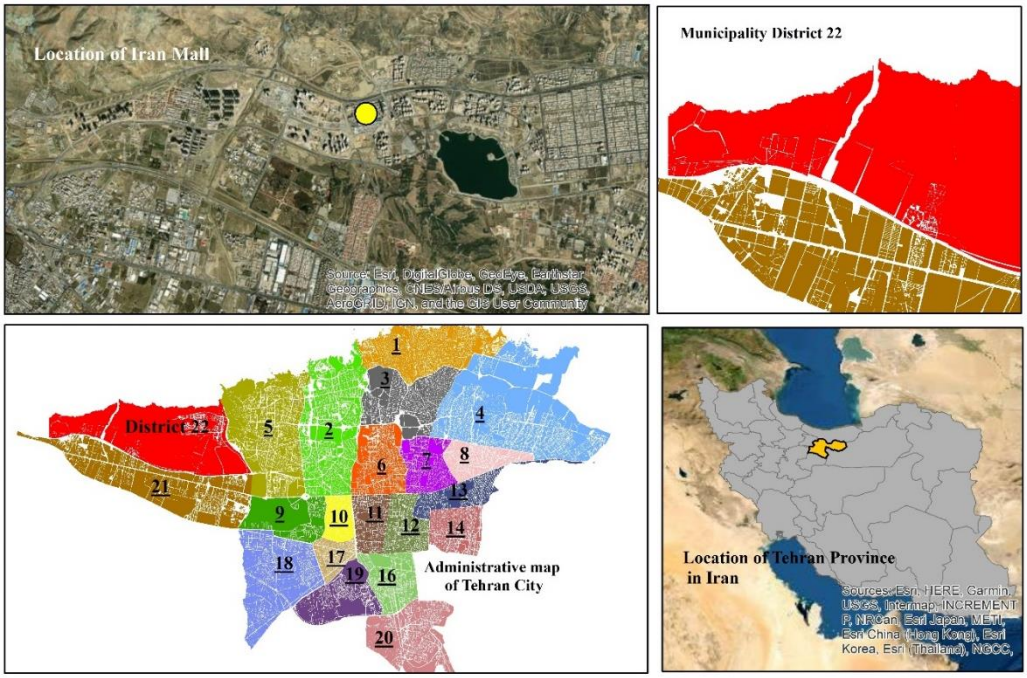

Figure 2 Location of case study in district, province, country. Tehran municipality, 2021 (URL 3).

Iran mall projects with floor area of 1700 000 m2 (Project's length is 14.7 km) took about 5 years to complete and includes the following section (ATC, 2019): Persian Garden (as the heart of the project and one of the most beautiful parts of Iran Mall), ice rink, porch crystal, diamond reception hall, car gallery and exhibition, cinema complex, food court and family entertainment center, amphitheater, 5-star Iran Mall hotels, Iran Mall Lake with water show and dance, as well as future development plan which includes a large store complex and Tehran International Trade Center and Exhibition Center, movie theater, libraries, sophisticated musical fountains, ice hockey auditorium, hotel, concert hall, international convention center (under construction), A collection of restaurants and cafes (URL 1; URL 2; URL 3; ATC, 2019)

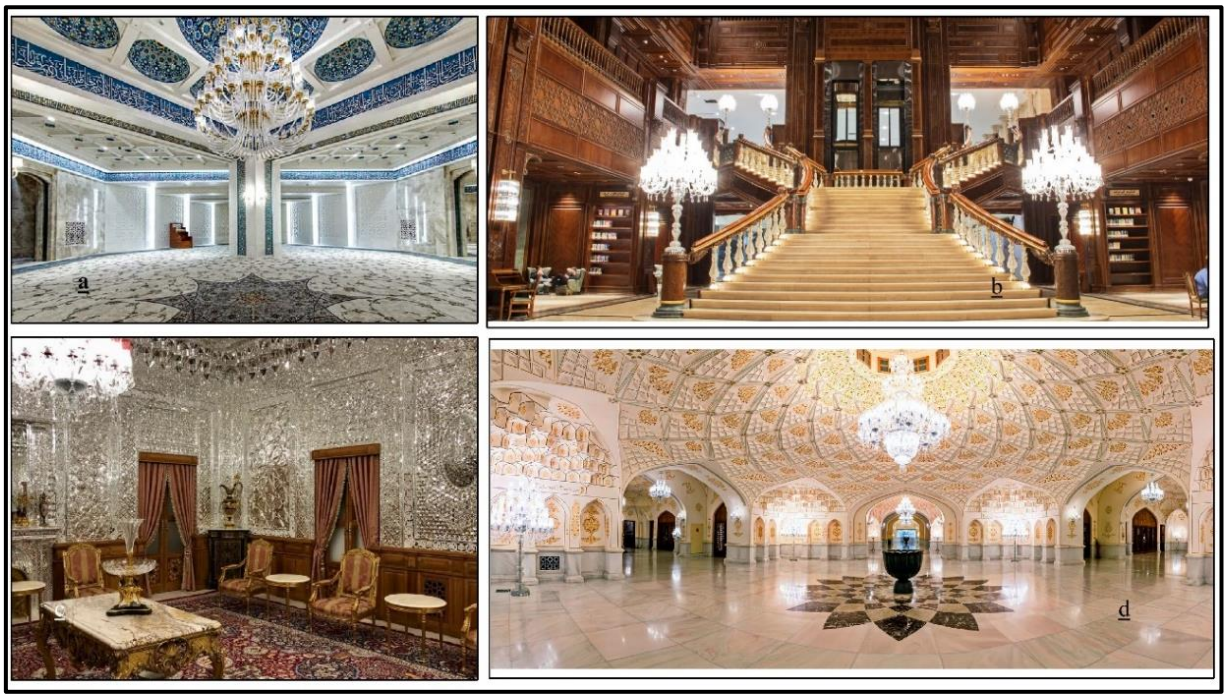

Figure 3 View of some activities inside Iran Mall. Mosque (a), Library (b), Mirror salon (c), Grand bazaar (d). URL 2, URL 6

4.2. Turkey- Istanbul – 3rd Airport

Istanbul is known as a megacity located on the continents of Asia and Europe. The city has hosted numerous large-scale construction projects in recent decades like Marmaray motorway, Third bridge, Canal Istanbul, Istanbul third airport that are distributed throughout the city. The location of these projects is a challenging issue for Istanbul's urban planning system. Since Istanbul is densely populated city located in a significant area of protected natural resources such as forests and watersheds, and also valuable cultural heritage and old urban textures, it is difficult to find a suitable location for projects of this scale (Dogan & Stupar, 2017; İlhan & Gülhan, 2020).

Eyüp, as one of the districts of Istanbul that its northern part covers the protected forestry areas, has received more attention in recent decades for large-scale urban constructions. The district also includes residential neighborhoods surrounded by forestry areas like the Gokturk neighbourhood, and Kemerburgaz (Eyüp municipality, 2018). The background of their development refers to the urbanization process in the northern peripheral areas. One of the most challenging projects that has been built in this district is Istanbul Airport, which is located 15 km far from the Gokrutk neighbourhood (Nasrollahzadeh & Koramaz, 2021).

4.2.1. Istanbul third airport

Istanbul as the largest city of Turkey has hosted many international and domestic passengers. Located in the passage between two continents, Istanbul's air transportation faces annually increase in global traffic. According to the official reports (General Directorate of State Airport Authority-DHMI, and Turkish Statistical institute-TUIK, Union of Chambers and Commodity Exchange of Turkey-TOBB) the number of aircrafts increased with 179% between 2002 and 2013 (Alan, 2014; Baş et al., 2018; Deveci et al., 2020; Düzgün & Tanyaş, 2014; Saldıraner, 2013; TUIK, 2002-2013; DHMI, 2013). The passenger traffic, including direct transit and domestic passenger increased respectively 5 and 10 times for such a short time (Düzgün & Tanyaş, 2014). Such a tremendous growth encompasses economic, tourism, international trade in addition to air sector in turkey. Due to the government authorities the number of passengers even overpassed Istanbul's population at the period of time (Baş et al., 2018; Deveci et al., 2020; Düzgün & Tanyaş, 2014).

The decision makers of building the third airport aimed to meet the constantly growing international demand for good, load and passenger traffic in response to the insufficiency of Ataturk Airport's (1953) and Sabiha Gokcen's (2001) capacities. The construction of the afore-mentioned mega-project started in 2014 and opened in 2019 (Saldıraner, 2013). Due to the global experiences such analytical reports are also issued for many busy airports that would fall short of needed capacity (George Bush Intercontinental, London-Heathrow, Baltimore-Washington International, and etc) (Baş et al., 2018; Düzgün & Tanyaş, 2014). The Third airport of Istanbul is located in the European side on an areas of 7650 hectares in Arnavutkoy on the Black Sea coast. Arnavutkoy is a district in the northern part of Istanbul. Project budget amounts to 22 billion 152 million euros (Kahraman & Alkan, 2018).

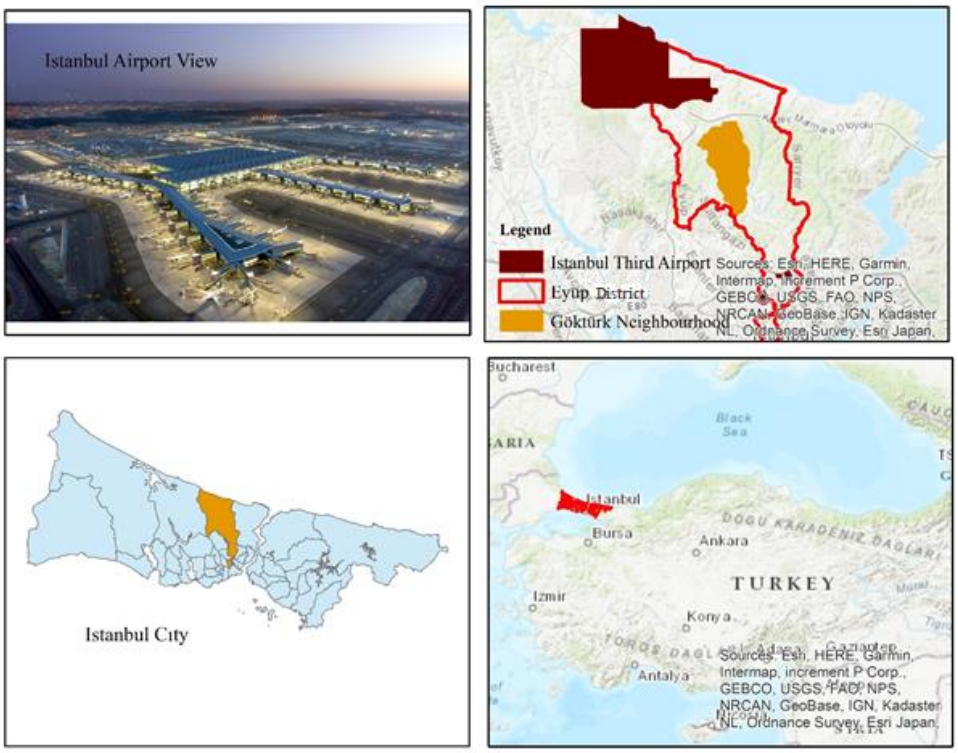

Figure 4 Location of Third airport in district, region, province, and country. Derived from Eyüp municipality, 2014, Istanbul metropolitan municipality, 2020

The third airport project constructed due to some strategies in planning and building process. Providing necessary infrastructures to Turkey's 2023 vision, protecting national interests, creating a closed and strong airport project organization are among the planned strategies (Düzgün & Tanyaş, 2014). Located on the coastal area, this mega project instigate the environmentalists to rise against aftermaths of ecological problems (Kahraman & Alkan, 2018; Bayrakdar & Durmaz, 2014). Accordingly, the large-scale airport project encountered growing challenges coming out of specialists during construction and implementation (Bayrakdar & Durmaz, 2014; Karacor & Korshid, 2015). The extent to which the concerns of environmentalists and urban bachelors are substantial can be explored in another study.

Göktürk neighbourhood is as one of the residential districts of Eyüp district in Istanbul is the closest quarter to the new airport. Therefore, it has been directly exposed to the impacts of the project. The extent to which such effects interfere with the environmental context of the neighborhood is analyzed in the discussion section.

5. Results and discussion

In the Iran Mall project, most of the prominent architectural, historical, social and cultural indicators have been deliberately exploited so that in addition to economic acquisition, these indicators can also be introduced. By restricting the applied architectural styles to historical masterpieces of Iranian architecture, Iran mall emphasizes on aesthetic sublime to provide a vitrine of Iran' magnificent events. Second priority in construction of this project focuses on the activities including recreational, and commercial that rely on economic sublime feature. The project's extensive allocation to a temporary hospital for the hospitalization of Covid -19 patients during the pandemic period (URL 1) indicates its success in multi-purpose applications. Recently Iran mall project faced with criticism of urban financial and legal debates, which reminds that in developing countries, projects in this scale that are not supported by the state and public deal with the civic mistrust. Being located in an area surrounded by large-size land uses, the project doesn't confront with inconsistency with its adjoining land uses. The financing of the Istanbul third airport project was private, but due to the location of the project in the northern coastal-forestry area of Istanbul

and the neglected reports of environmental impacts, the project also faced considerable opposition from urban experts. Despite all these obstacles, the project was built. Since the aim of the project is to address the lack of capacity of the two former airports and also to keep Turkey in the EU candidate position, so the emphasis of this project is on the economic and political aspects (Table 1).

Table 1 Type and scale of large-scale projects of Tehran-Iran mall and Istanbul-Third Airport, ATC, 2019, URL1, 2

Project Name	Location	Sublime Type	Funding	Vision	EIA
Iran mall	Iran- Municipality district 22 of Tehran	Aesthetic – economic	Private Sector (Banker)	Observing massive investment and tourists to relieve harsh economic sanctions. Valuing socio-diversity	The EIA report is issued.
Third Airport	Turkey-Northern Part of European side of Istanbul	Technological-economic – political	Private-state funding	Meet the short capacity of international Ataturk airport Keep economy growing Achieve the Turkey's 2023 vision	The EIA repost is issued. Some reports claim the deviation from principals.

Tehran – Iran mall project

According to the chart of land value changes, it can be seen that the host district for Iran Mall project has being matched to the 5th municipal district of Tehran in terms of land value especially after the project is completed and opened to public. It must be noticed that Tehran's municipality districts considering land value and quality of living environment is classified from 1 to 22 which implies respectively the highest and the lowest districts.

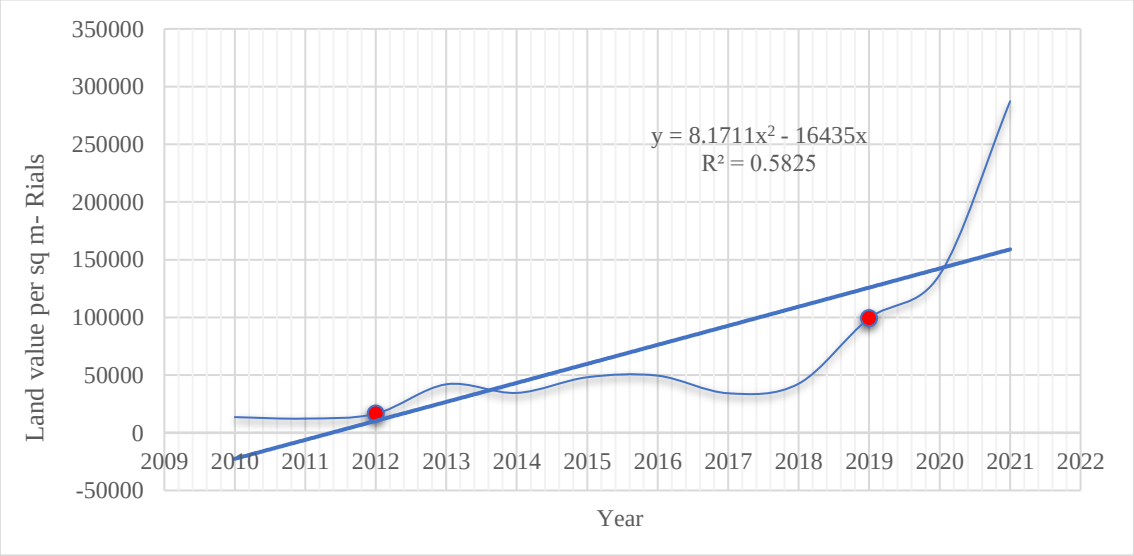

Figure 5 Land value changes around fitting years of building large-scale projects in the district 22, Iran Mall

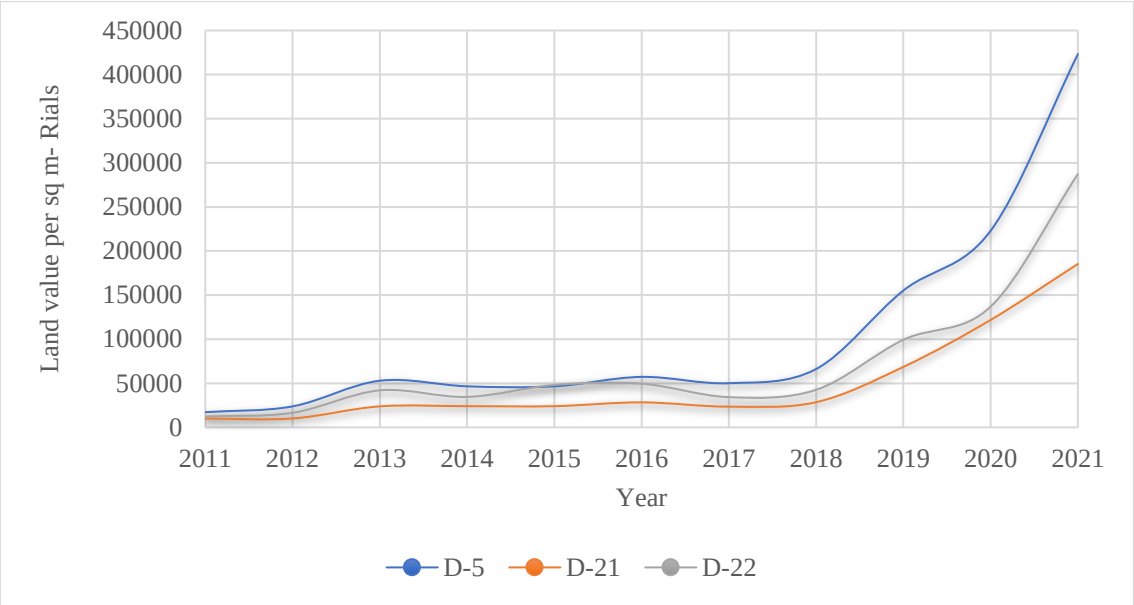

Figure 6 Land value changes by fitting years of building Iran mall in adjacent districts

On the other hand, in construction period of Iran mall, land value fluctuations in all three districts has increased with a slight jump while district 22 (host) unlike neighboring areas has experienced significant ups-downs from the construction year by the completion. Looking at the changes in land values and its approach to one of the best urban areas in Tehran, it can be concluded that this area has improved in terms of environmental quality due to the existence of this project. The construction of luxury residential complexes and towers near this project and the increase in the demand for purchase and rental units during the years of construction and completion of the project imply the rapid development of district 22.

Istanbul- Third Airport:

Gokturk neighborhood has gradually altered from a rural to an urban area, and residents of its informal settlements are being disappeared due to the rapid expansion of residential projects for high-income households. With the presence of the gated communities, the neighborhood has undergone fundamental adjustments and transformations. Quality of living environment in the neighborhood had being improved slightly by newcomers before construction of the third airport large-scale project in 2013. In the last decade the neighborhood has witnessed a significant increase in the speed of urban quality transformations. The presence of the third airport accelerated strongly the impact of the building gated communities and luxury apartments on socio-economic and physical aspects of host neighborhood.

Table 2 Descriptive analysis of land value- Göktürk neighborhood, Derived from URL 8.

Year	Minimum	Maximum	Mean
2009	57	343	90.643
2010	100	750	209.616
2011	104	779	217.007
2012	115	1188	240.871
2013	148	926	257.767
2014	400	1100	325.822
2015	420	1156	341.436
2016	432	1188	350.962

2017	448	1233	364.403
2018	583	1603	512.449
2019	652.17	2069.51	1552.12
2020	725.8	2303.16	1727.36
2021	725.8	2408.06	1797.7
2022	4811	4399.24	4658.2

Compared to the years before and during the implementation of this project, the price difference across the Gokturk neighborhood is decreasing. For instance, Gül street's value was 7.4 sqm in 2005, as the cheapest, and Hızır street in the same year was 73.98 as the most expensive. Due to the statistics since 2019, the price difference between these two values has narrowed. It clearly demonstrates that Gokturk neighborhood in terms of land value and, consequently, its households has achieved homogeneity. The process of land value fluctuations in the district has taken place in such a way like the streets created during the years of the project implementation, which initially had the lowest value, have been quickly ranked in the high value areas in four years. For instance, Gül Street, which had the lowest price during the years before the project, was replaced by the new street, 1516 Parcel (2017-2018). In the same way, Hızır Street has been replaced by Zerrin Street. Surprisingly, in the last four years, the value difference between the aforementioned streets has also narrowed. The value difference has declined from 317% to 91% in one period which indicates that the development of the neighboring residential areas is designed based on the target group. It must be noticed that the initial low value of the adjoining areas is merely due to the temporary low quality of the environment as a result of their construction processes. Then after the completion of the new housing projects, in terms of value, it quickly approaches and adjoins its neighboring areas. In fact, there is a vibrant and high-speed valuation system for the development of residential areas, which has been strongly influenced by the airport project.

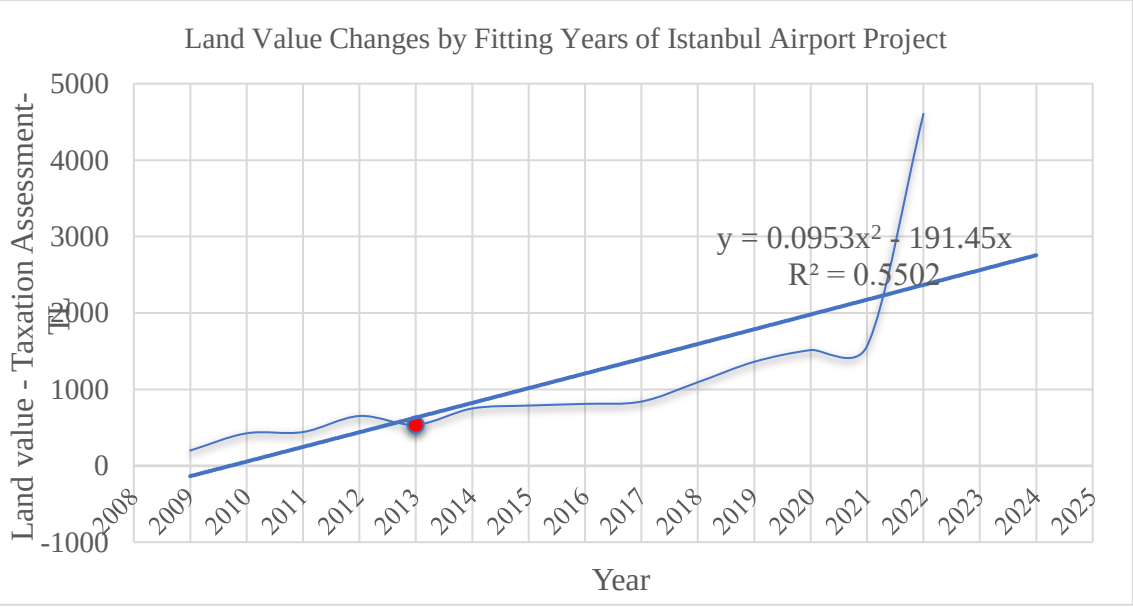

Figure 7 Land value changes by fitting years to Third airport project

6. Conclusion

In the present study, the phenomenon of large-scale projects in urban areas, as a result of neoliberalism and the philosophy of competitive cities, was discussed. The journey of large-scale constructions from Europe and the United States to developing countries in recent decades is a significant issue since acceptance and adaptation such projects by these countries brings new

challenges to them. Therefore, in this study, two examples of large-scale projects in developing countries have been discussed.

This study sought to answer the following questions:

1. What is the relationship between building large-scale projects and land value changes in adjacent neighborhoods in Tehran and Istanbul?
2. What are the similarities and differences between implementation of large-scale projects in Tehran and Istanbul?

In both of these projects, environmental impact assessment is in a state of ambiguity. Such kind of official reports are either not available or have not received much attention and support. Iran and Turkey, as two developing countries but with completely different political and economic challenges, define and implement large-scale projects. Under international economic sanctions, Iran is focusing on building projects based on its domestic social and cultural assets. It goes without saying that large-scale projects that seek to meet local needs are still under construction.

The location of the Iran Mall project has been well-selected in several ways; it is located at an equal distance between the two city centers, and this will greatly contribute to the development and exchange of services and employment in these two cities. On the other hand, it is among other touristic land uses such as Chitgar, which in addition to being complementary and compatible with this project in terms of activity, will also be an opportunity for them to develop themselves and integrate with the Iran Mall project.

In terms of impact on neighboring areas, the construction of this project over time and with further development will increase the environmental quality of the poor urban districts located in its south. Being located in the largest district of Tehran can be effective in improving the quality of neighboring environments since large-scale projects recall their complementary land uses swiftly. On the other hand, by generating employment opportunities for the residents of these areas, it will also cause the prosperity of the local economy in its neighboring neighborhoods. It must be noticed that during the years of construction of this project, the development of residential towers and complexes, has changed the use-value of urban land to exchange value. If Tehran municipality fails in the management of such construction projects, the opportunities created to improve the environmental quality of neighboring areas will become a threat to destroy the only lungs of the city.

For case of Turkey, it has been trying to join the European Union for years. Therefore, it is improving its infrastructure and economic situation in line with the standards of European countries. Given the nature of the crossroads between the two continents, it has focused on infrastructure projects to meet international needs and standards. Therefore, the construction of the third airport project is inevitable and according to the predictions before its construction, Ataturk and Sabiha Gokcen airports were no longer responsible for passenger and cargo exchanges. Whether the location of this airport was appropriate from an environmental and urban planning point of view can be debated in the form of another study. Their large scale and the accumulation of capital at the national level in such kind of projects lead to the rapid changes in the land values of the host and neighboring districts of the projects. One of the effects of this project on the nearest neighboring neighborhood is the change in its social context due to the introduction of a new group of households working in the airport complex (including pilots, flight attendants, owners and employees of international companies working in airport complex). From the comparison between these two projects, it can be seen that time is a very important factor in building large-scale projects in developing countries. Because these projects address the vital concerns of these countries. Therefore, achieving economic goals takes precedence over environmental considerations and some deterrent laws. In both of these countries, the construction of projects of this scale has always faced many legal obstacles that can be overcome depending on the governing structure of the

government (Table 3). According to studies, large-scale construction projects in Istanbul are faster and more numerous than in Tehran, which is due to Iran's economic sanctions.

If in the future, the economic and political circumstances in the countries get improved, the supporting reports will be demanding and clearer. As Wagner (2014) also emphasized in her study large-scale projects can function as a catalyst tool which can accelerate development in urban arena, and that is exactly the instrument which developing countries need it. But it should not be overlooked that it can be catastrophic without providing the necessary prerequisites for large-scale projects.

Table 3 Answers to research questions

<table>
<tr><td>Qs</td><td colspan="4">Answers</td></tr>
<tr><td></td><td colspan="4">Land values</td></tr>
<tr><td>Q1</td><td colspan="4">Price decline during construction and leapfrog increase after project completion (IA & IM).
Changing the socio-economic context of the nearest neighborhood (IA) – From low-middle income group and informal settlements to high-middle income group (gated communities-luxury apartments)- (Gokturk neighborhood)
High quality of nearest neighborhood as a result of land value changes brought newcomers (Airport International companies' employees, pilots, hostesses)
Rising land values in neighboring districts (5-21) as well as arranged residential complexes in district 22
Use-value of urban lands turned to exchange-value in adjoining neighbourhoods (IA & IM)</td></tr>
<tr><td rowspan="5">Q2</td><td colspan="2">Differences</td><td colspan="2">Similarities</td></tr>
<tr><td>Location</td><td rowspan="2">Istanbul Airport located in a challenging place in terms of urban planning regulations (Unsuitable location).
Iran Mall in a suitable place for urban development (Barren land between two cities that have socio-economic interactions)</td><td>Project approval process</td><td>Facing legal obstacles and building the project despite it</td></tr>
<tr><td rowspan="2">Type</td><td rowspan="2">Commercial-Cultural-Sports project (IM)

Infrastructural project (IA)</td><td>Type of land value</td><td>Creating exchange value for the neighboring residential land (IA)
and non-residential (IA & IM)</td></tr>
<tr><td rowspan="2">Social fabric</td><td rowspan="2">Since the construction of both projects has caused jumps in neighboring land values, newcomers from high income group replaced low-middle income group</td></tr>
<tr><td>Aim</td><td>Raise capital to improve the national economy (IM)

Not lagging behind the global transportation system and attracting more capital / Launched due to meet the demand of increased air traffic (IA)</td><td>Complementary reports</td><td>Ambiguity in EIA reports</td></tr>
</table>

IM: Iran mall, IA: Istanbul Airport

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Resume

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Resilience of rural settlement morphology dynamics: The case of Kargalı district (village)

Begüm Demiroğlu İzgi*

Abstract

In this study, the term resilience has been examined in terms of ecological, economic, and cultural parameters specific to residential areas. Recently, changing needs and increasing the speed of change due to developing technology are reflected as internal and external threats to residential areas. Change is inevitable for each parameter over time, but it can also pose a threat to the morphology and identity of residential areas. The buffer zone to be created by the residential areas against this threat reduces the severity of the incoming impact and revises it and provides the adaptation of identity and morphology dynamics to the new situation with its resilience. In the first part of the study, the identity of the settlements and the resilience factor against change/transformation threats are explained according to the definitions in the literature. In the second part, the dynamics of rural settlement morphology are defined and the effect of rural resistance on the dynamics is presented. In the last part, a stratification analysis is made according to certain year intervals over the Kargalı district (village) of the Polatlı District of Ankara. The sample was analyzed in terms of rural area, road traces, environmental location relations, structural boundaries, landmarks, and the changes/transformations of all these morphology dynamics over time, its resilience, and adaptation/mutation processes. The effects and possible results of the resilience of rural settlements for sustainable rural settlement, which are more affected by similar internal or external threats than urban, on the dynamics of settlement morphology and resident over time, constitute the desired findings of the study.

Keywords: rural resilience, settlement morphology, rural morphology dynamics, rural adaptation, morphological resistance

1. Introduction

Shelter has been the most basic human need from past to present. With the transition to settled life in the Neolithic Period, the shelters came together permanently. Due to the increasing population and needs, settlement areas with different sizes and dynamics began to diversify. Although the abstract and concrete elements that define the settlements whose main user is human are the same, different hierarchies of demographics and dynamics have characterized different definitions of the settlement locality.

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Settlements exist together with the abstract and concrete dynamics of the place where they are located. All abstract and concrete dynamics and their changes/transformations over time allow to characterize the region in terms of shape and form, and this is defined as settlement morphology. The determination of the abstract and concrete dynamics and the examination of the region within these limitations allow the stratification analysis of the changes and transformations of the settlement pattern over time.

Holling (1973) defines resilience as reorganizing the shaken balance of the system by absorbing the sudden changes and shocks that come to the existing system in the most accurate way possible (Holling, 1973). Resilience, which has been studied by many different disciplines, is also a concept that is basically valid for settlement morpholog. The reactions of societies to an existing crisis and the risks as a result are also a valid definition for the resilience of residential areas (Atlger, 2003). On the other hand, the absorption ability and strength of each settlement texture differ. Because it is the most common acceptance that each region is different and subjective from each other in the global sense (Dupre & Bischeri, 2020). However, it is possible to examine the resilience of rural settlements under three main dynamics: economic, ecological and cultural. The continuous and balanced combination of these dynamics directly affects the strength and sustainability of the rural settlement (Heijman et al., 2019).

Today, settlements are divided into rural and urban areas. This dividing is made based on demographics, size of settlement, and economy. However, rural and urban titles are much more detailed when morphological examination of the regions. Both rural and urban settlements are affected by the change over time. However, studies today focus more on urban areas since the pace of change is higher in cities. On the other hand, rural settlements have the same morphology dynamics and encounter the same change factors. Rural settlements are regions with specific settlement identities with specialized morphology dynamics, like urban settlements. In fact, frequently altering urban settlements do not transform depending on a change factor. They simply adapt to the new situation. However, the same change factor can affect and deform rural areas.

Technological development, increasing population, and requirements will bring about an irresistible change in settlements. Change is a dynamic process for every rural and urban residential area. If the settlements can adapt to this process without damaging their subjective identity, the sustainability of the settlement will be ensured. There is a certain resilience to change. This resilience to the settlement texture is crucial for the preservation of identity. Using the resilience for the adaptation of all the morphological dynamics of the region ensures the typo-morphological continuity of the rural settlements and the sustainability of the identity (Walker et al., 2004).

This study aims to explain the identity definitions of settlement patterns, the equivalents of settlement morphology dynamics for rural settlement, and the change and resilience in rural settlement stratification. All these definitions were supported by stratification analysis over the years on Kargalı village in Ankara province Polatlı district.

2. Residential Identity

Residential identity is the combination of the flawless existence of the nature of the region and the built environment elements. Factors such as natural environmental factors, built environment spaces, socio-cultural characteristics of the residents of the area, economy, internal and external interventions, and politics also directly affect the formation and change of identity.

The dynamics of the built environment are an integral part of the existence of the space/settlement (Norberg-Schulz, 2019). Concrete dynamics, as well as abstract dynamics, become elements that make up spatial identity over time. Structural elements that shape the memory of space are formed regardless of urban or rural settlement. The change/transformation of these elements directly affects the identity of the user and the space.

The residence is the definition of the sense of belonging that occurs with the combination of the abstract and concrete elements that people create with the place. The residence is a combination of the natural world with tangible structures and everything else (Norberg-Schulz, 2019).

The identity of the residential area is formed by the combination of abstract and concrete components and the change/transformation of these components over time. Erdem (2012), examined the concrete dynamics that create the identity of the settlement as natural components and artificial components and examined the abstract dynamics as socio-cultural components (Erdem, 2012). Besides, the settlement identity is directly related to the time factor. With the fact that change is inevitable, all components are affected, and eventually, the identity adapts to the new order or deforms. Thus, the settlement identity consists of all the construction, destruction, writing, and erasure processes of the time (Lukez, 2007).

3. Rural Settlement Morphology Dynamics

Settlements are regions with certain morphology dynamics, whether regular or irregular. These differ based on the basic needs of users, regional characteristics, and policy. Morphology dynamics can be read more clearly for urban textures that grow and develop in a relatively regular and controlled manner. On the other hand, the morphology dynamics of the spontaneously formed rural settlements are directly affected by the economy and culture and are shaped more dependent on the resident and topography.

Erdem (2012) argues that the morphology dynamics affecting the rural area consist of three basic elements as natural identity components, artificial identity components, and socio-cultural identity components (Erdem, 2012). Although rural morphology dynamics are listed under similar titles with urban morphology dynamics, they should be handled subjectively. For instance, the morphology dynamic called "landmark" expresses a definition for both urban and rural settlement texture. However, in the rural area, in the residential area where the social network is stronger and more effective, even a specific person's house or a piece of rock that is contrary to the topography of the region can be called a landmark.

It is possible to characterize the morphology dynamics of rural and urban settlements with dynamics such as road networks, gathering places, borders, sign elements, regions, and structural elements (Lynch, 1960). Abstract and concrete settlement morphology dynamics constitute the identity of the settlement texture. As a result of changing needs, internal and external interventions over time, a change/transformation obligation occurs in all dynamics. While urban settlement patterns can absorb most of the impacts, the impact with the same intensity can radically change the morphology of rural settlements. On the other hand, dynamics also have to change due to changing life conditions, the user needs, socio-economic necessities, and policies. It is the necessity of the sustainability of rural areas to be able to resist without harming the identity characteristics by meeting the severity of the incoming impact and to adapt to the new order without being altered (Walker et al., 2004).

Rural settlement is not only a community of shelters, but also a set of social organizations and economic activities of the resident of the area (Hill, 2003). Residents in rural settlements, unlike urban residents, have a more spiritually focused action of being together. Since they are far from the city center, people need each other more because of their limited opportunities. For this reason, even the houses are built within walking distance.

Rural settlement patterns are more dependent on the regional community's commonalities such as language, religion, and ethnic values than the city itself. Each society, apart from the top political administration to which it is affiliated, also assumes the autonomous social role of the smallest unit of society to which it belongs. Even though it is not possible to analyze one by one due to the demographic density, the same is true for cities. However, in rural settlements where interpersonal social communication and collective relations are more important, this situation increases its distinctiveness.

Routine daily work, ceremonies such as funerals and weddings require more people to interact with than urban residents. Ceremonies held in a designated area such as a wedding hall in the city are held in the garden of the owner of the ceremony in the village or in the village courtyard with the help of everyone.

One of the most important parameters in the formation of rural settlements is the socio-cultural similarity of their residents. Although cultural parameters such as religious beliefs, daily routines, customs, and traditions are among the abstract dynamics of the society to which they belong, they also directly affect the concrete dynamics.

Political interventions on a national or international scale are just written titles. However, rural development decisions and other political interventions, which are not specific, but generally, are not studied in detail on the identity of each rural person, also cause the change/transformation of the local identity on an abstract and concrete scale.

Changing needs and developing technology has a direct impact on the demographics of rural settlements, accelerating the migration of local rural users to the city. For rural areas, which are the basic economic dynamics of agriculture and animal husbandry, employment provided in the city poses a threat that will cause the rural area to be abandoned and destroyed. Resistant rural settlements can ensure the continuity of the settlement by changing the existing economic dynamics with interventions such as rural tourism or new agricultural policies.

4. Resistance in Rural Settlement Morphology

Nature is in a state of escaping from all rational actions and possessiveness factors that affect it from the moment it exists (Lefebvre, 2017). Unbuilt nature is also an area that has been gradually shaped and transformed for the settlement area in the face of every dynamic that builds up and occupies the land (Lefebvre, 2017).

Lefebvre (2017) mentions the continuous dialectic of urban and rural life. This dialectic is an opposition that brings both into existence. Symbolisms and images of the rural are the primitive quality of the existence of the urban. Both settlement textures diverge primarily in terms of production systems. Simplifying the rural as gardens, cultivated areas, narrow and shallow production areas has caused the subjective identity of the rural to keep in the background from past to present (Lefebvre, 2017). The continuity of identity of these settlements that bring each other into existence and the resilience formed for this should be examined separately for each settlement pattern.

Although the settlements are classified under two categories as rural and urban, the definition of "rurbain", which expresses the mixture of these two settlements, has been used recently (Lefebvre, 2017). Even though two separate titles fail to adequately describe the subjective identities of settlement textures and examine their subjectivity, the word "rurbain" causes conceptual confusion.

Settlements are going through a forced change/transformation with the diversification of needs over time. The necessity of innovation and change directly affects both rural and urban settlement patterns. This change affects all the morphological dynamics of the settlements as well as directly affecting the identity of the settlement. Despite the constantly changing morphology structures of urban settlement patterns, the change of rural settlements is relatively slow. The speed and impact of change give different outputs for rural and urban settlement patterns. Due to demographics and cultural habits, the impact of change may be major for rural residents than for urban residents. On the other hand, the compulsory change arising from factors such as increasing needs, employment problems, and cultural exchange, which is accelerating due to the information age, affects all abstract and concrete dynamics in the rural settlement. The resilience of the settlements to the incoming threats will prevent the mutation of the region and ensure its new and controlled

adaptation. Proper handling of the change factor for the settlement can turn the region into a settlement that adapts with its identity and morphology dynamics rather than a mutant settlement.

Adapting to its new state without losing its identity in the face of the compulsory change that the settlement will face and creating a sustainable and innovative rural settlement area instead of a heterotopia order will ensure the maturation of a sustainable and resilient settlement morphology without transforming it completely. While transformation and metamorphosis will destroy the rural settlement texture identity over time, the absorbing effect of flexibility and resilience in the existing dynamics will transform the transformation with the least damage to the identity and evolve it to diversity.

There are multiple external and internal dynamics affecting rural settlements. These come within the politics that we have defined as abstract dynamics. The circumstances that the region is exposed to for development plans also play a significant role in the future identity of the region. It is possible to say that the factors affecting the rural settlement area are private rural services, public services, industry, and local rural residents (Torabi & Brahman, 2013).

Rural settlement resists the factor of change that affects it with all its abstract and concrete dynamics. If the mutation of a settlement texture is unfavorable, it is also unfavorable to not be able to adapt to the new world order and therefore not be able to preserve its current identity. The settlement dynamics are all subjective. Hence, the weights of the existing dynamics, breakpoints, and absorption coefficients of the buffer zones for the rural settlement texture should be examined by developing different approaches and methodologies. Resistance to change can result in extinction. In this case, the resilience to change and the absorption coefficient of the rural settlement pattern will be different.

A useful measure of the economic, ecological or cultural resilience of the settlements will ensure the continuity of the existing identity and dynamics by creating another set of variables without undermining the stability and system controls (Folke, 2006).

Another important reason for the disturbance to the existing system of settlements today is climate change. This threat, which cannot be prevented directly and in the short term, affects all the abstract and concrete dynamics of the settlement pattern (Mackey et al., 2016). Many scientific studies have been conducted on how climate change and its consequences affect the morphology dynamics and identities of the region, and attention has been drawn to the results (Burroughs, 2007). The threat to residential areas can be varied. Mandatory change/transformation of existing morphology dynamics may occur as a result of government policies or as a result of natural factors. Resilience against a certain threat becomes sustainable with the balance of environmental, economic and socio-cultural parameters (Dupre & Bischeri, 2020).

Rural areas are settlements with cultural patterns and natural values (ÖZHANCI & YILMAZ, 2017). Religious belief, social relations, and culture have a more stable effect on the urban resident. Although the change of abstract dynamics is slower than concrete dynamics, the change affects these abstract dynamics with different intensities over time (Rossi, 1984).

Changing rural settlement dynamics also directly affects the socio-cultural characteristics of the residents of the region, which is one of the reasons for being the first commune. Especially as a result of the intense migration from the city to the countryside, the faster socio-cultural changes of the urban residents lead to untimely encounters by the rural residents. In this case, a social adaptation problem arises in rural residents. As a result of urban opportunities and socio-cultural exchange, rural heritage dynamics such as ceremonies, traditions, and religious routines that make up the region are facing extinction. With the inevitability of change, there will be differentiation in abstract dynamics. In the developing new world order, the rural resident can resist and maintain these dynamics, perhaps on a more local scale and by changing them.

4.1. Resistance of Rural Settlement Morphology Dynamics

Lefebvre (2017) mentions three main topics related to urban and rural settlement, namely rurality, urban texture, and centrality and the balanced harmony of the dialectic between them. The first rural settlements, most of which are formed spontaneously, change towards the urban scale with all their dynamics. In this process, the three basic parts of the above-mentioned dialectic constantly affect each other. The transformation of the rural settlement pattern to full urbanization with the change/transformation can be explained as follows (Lefebvre, 2017).

1. Zero Urbanization; agricultural life and complete domination of the rural.
2. Political City; The settlement phase that dominates agricultural life and is organized accordingly.
3. Commerce City; a small-scale district formed on the commercial periphery.
4. Industrial City; settlement, where agricultural production has become insignificant, and which has grown with uncontrolled immigration as a result of industry and employment.
5. Critical City; a settlement in a state of extreme population as a result of increased migration and rapid growth.
6. 100% Urbanization

The stages of transition from the rural to the urban mentioned above are at a different speed for each residential area. Such that, the above-mentioned steps are evident for some settlements, while for some settlements, the steps are so brief that it is almost unnoticeable. But each step changes with the breaking point caused by an external factor affecting it. Lefebvre described the transformation of rural into urban under the title of "dual process" (industrialization and urbanization). Although the transformation is fundamentally opposed, the sustainability of residential areas is also in line with the unconditional necessity of change. The residential area resistance will create the absorbing effect of the region morphology dynamics at these fracture intervals. Residents, who are the most important actors in the formation of residential areas, can directly affect every breaking point of the region that changes and transforms, as well as being the party directly affected by this new situation. Residents of rural settlements, who are particularly affected by the employment problem due to the changing or unchanging nature of rural settlements, will have to adapt to the new situation by being affected by the sustainable change of settlements. The sustainable situation of the rural settlement constitutes the full adaptation process not only with the resilience of the morphology dynamics but also with the resilience of the users. In the new situation, rural settlements, which are expected to have a sustainable identity through resistance, often gain new residents (post-residents). In this case, the rural resident of the settlement and the post-resident will affect the same residential area. Thus, it can be said that the rural creates two similar resistances, concrete and abstract; rural morphology dynamics and all rural residents. While the buffer role of the resistance for the morphology dynamics creates a sustainable rural settlement texture, it can create a meta-resident from the combination of resident and post-resident over time. The resistance created against the change factor that affects the dynamics and residents over time is effective for a sustainable rural settlement (Figure 1).

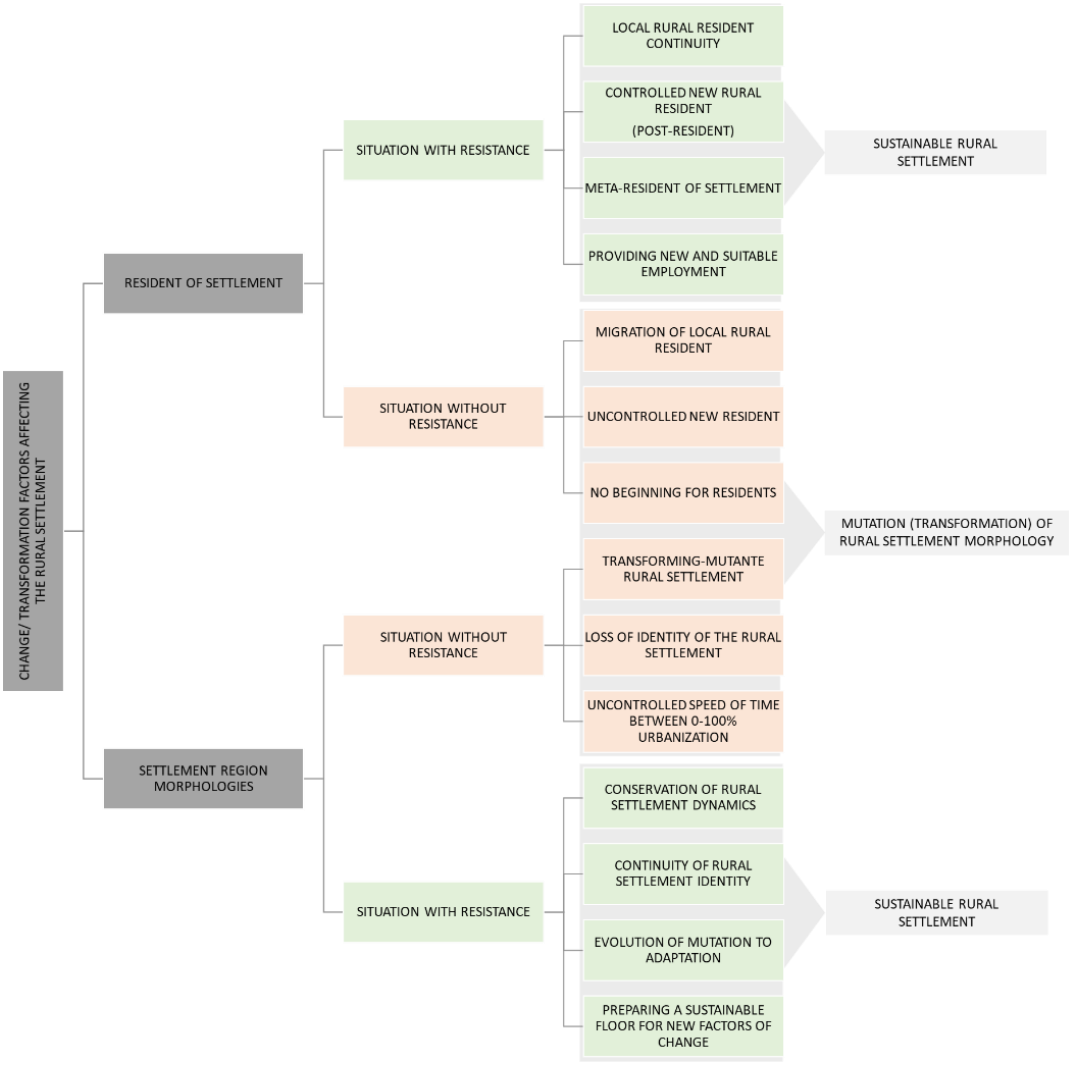

Figure 1 Change/ Transformation Factors Affecting the Rural Settlement

4.2. Rural Heritage and Conservation

Rural areas are not just settlements where subjective traditional factors and cultures come together with local architecture and whose economy is mostly land-based. Rural heritage consists of communities with subjective value judgments, traditions, economy, and architecture, where the social and cultural characteristics of the society that created them are reflected in their living patterns and housing patterns. Rural settlements are mostly defined as the primitive state of the city. Rural areas that produce, cooperate, and maintain a symbiotic relationship with nature are described as an important part of cultural heritage at the national and international levels.

The concept of rural heritage was first discussed within the framework of the concept of protection of architectural heritage in the 1970s (Madran & Özgünül, 1999). In the Amsterdam Declaration published in 1975, the scope of architectural heritage was emphasized as a concept that includes not only invaluable and superior buildings but also rural areas, which have historical and cultural characteristics, and traditional and historical local textures that form the basis of settlement (URL 1). Granada Request: Rural Architecture in Regional Planning, European Pilot Projects Program Symposium No: 5 (COE, 1977) states that rural settlements are in danger of extinction with their environment and architecture (URL 2). It is emphasized that rural settlements cannot maintain their effectiveness, especially due to intense migration from rural to urban areas and inadequate protection policies. In addition, the excessive and unconscious exploitation of the existing topography is interpreted as another situation that will lead to excessive deterioration of

the rural heritage. The decisions are taken after the "Conference on Conservation of the Identity and Attractiveness of Settlements and Natural and Natural Environments" include decisions on the protection of the natural environment in which rural settlements are located (Eres, 2009). These decisions, which define the rural cultural heritage within certain limitations, also reveal the conservation problems and solution proposals. In the definition of cultural heritage, it is explained that the identity of the community, the built and natural environment, and all the abstract and concrete cultural heritage require holistic protection (URL 3).

Rural heritage has found a place for itself in literature and conservation policies, especially with the expansion of the concepts of cultural and natural assets in Europe. Rural heritage is examined within the framework of concrete and non-concrete cultural heritage due to the subjectivity of value criteria, the unique typology, and the use of the geography it belongs to. Although this new category cannot find sufficient place in Turkey, large-scale conservation studies are among the national-scale rural development plans (Table 1).

Table 1 International Development of Rural Heritage (Gökalp, 2019)

INTERNATIONAL DEVELOPMENT OF RURAL HERITAGE	
DATE	**DOCUMENTS WITHIN THE SCOPE OF WORK**
1964	ICOMOS
	"Venice Charter" "The International Charter for The Conservation of Monuments and Sites"
1975	COE
	"Declaration of Amsterdam"
1976	UNESCO
	"Recommendation Concerning the Safeguarding and Contemporary Role of Historic Areas"
1977	COE
	"Rural Architecture in Regional Planning
1979	COE
	"Recommendation 881 (1979) on the Rural Architectural Heritage"
1989	COE
	"Rural Architectural Heritage Conservation and Value Increasing"
2000	COE
	"European Landscape Convention
2006	European Parliament
	"On the Protection of the European Natural, Architectural and Cultural Heritage in Rural and Island Regions"
2010	COE-CEMAT
	"On the Pan-European Charter for The Rural Heritage: Promoting Sustainable Spatial Development "The Rural Heritage as a Factor of Territorial Cohesion
2017	ICOMOS – IFLA
	"Concerning Rural Landscapes as Heritage"

4.3. Sample Rural Settlement Village: Kargalı District (Village)

Kargalı District (village), which is connected to the Polatlı district of Ankara province, is a rural settlement area that later turned into a local administration due to state policies. The settlement history of the region dates back to the periods before Christ. Existing water resources constitute an important morphology dynamic for the settlement, which mostly makes its living from agriculture and animal husbandry. The region, which is a two-center residential settlement, has many agricultural and vineyard (Erdoğan, 2013).

The reason why the village was selected as the sample area is that its rural morphology dynamics have undergone a concrete change/transformation from the first establishment to the present. Housing settlement areas and transportation networks have developed and differentiated. In addition, the artificial pond that was built in the region later and the weekend houses formed around it have differentiated the rural identity. On the other hand, the housing patterns and vineyards, which have survived from the first establishment to the present day, have continued their existence despite the changes and created an example of rural resilience.

The traces of the first settlement areas of Kargalı village are on a hill in the southwest. There are building remains from the Roman Period in this area. The residential settlement, which was later moved into the southern valley, continued its mosque-centered and cluster-shaped settlement form (Erdoğan, 2013).

The oldest aerial photograph of Kargalı Village, obtained from the Harita Genel Müdürlüğü, belongs to 1944. This rural settlement has undergone changes and transformations within the scope of morphology dynamics of its environment-location, road networks, structural borders, natural and cultivated areas, and landmarks. The morphology dynamics that changed with the change factors it was exposed to over time, created a sustainable rural texture with the resistance realized by the rural.

Rural areas are in a slower change process than cities -unless there is an extraordinary effect- due to factors such as technology, infrastructure, demographic circulation, and meeting current needs. However, the results of this change have more severe reflections than cities. The selected sample village was analyzed by interpreting the upper scale maps obtained from the Harita Genel Müdürlüğü. In order to be able to read the temporal stratification, ten-year time periods were taken in which the change/transformation processes of the sample rural, which do not show great changes every year like in the cities, can be analyzed. As a result of the analysis, all the change/transformation that the countryside has undergone has been examined and no additional situation has been observed in the interim times (Demiroğlu, 2020).

Figure 2 Changes in Settlement Morphology of The Kargalı Quarter (Village) in 1944, 1955 and 1970, (HGM)

In 1944, 1955, and 1970, the village consisted of two separate residential areas, one in the south and one in the north. The settlement in the north consists of barns built for livestock and temporary accommodation houses. The vineyards in the east of the region are parceled separately and established in a higher topography than the residential settlement. In the settlement located in the south of the region, the natural and residential-limited pathways between the houses were formed on a radial plane, centered on the village square. It is observed that the vineyard area expanded towards the south in 1955 and 1970. The most important main arterial transportation network that connects the village with the district and other villages is the vehicle road in the southeast-northwest direction, which also runs along the Mucuköz Stream. In addition, the roads connecting the seasonal settlement in the north and the vineyard areas in the east are the second important

transportation axes that are actively used. The increase in the development of the vineyard area has been effective in the strengthening of the road networks reaching that region. The area and other lands between the two settlements of the region are used as natural pastures and fields. The residential settlement in the south, which continued to develop continuously until 1970, caused the nearby cultivated areas to turn into building blocks.

As a result of the increasing population and current needs, the requirements for housing have increased and natural-cultivated area dynamics have turned into built region dynamics. Natural areas, on the other hand, have been transformed into agricultural areas in order to respond to the increasing need for cultivated land. In the northern settlement area of the village, which is used only as an animal shelter and seasonal residence, the housing texture has increased and the secondary settlement feature has been strengthened (Figure 2).

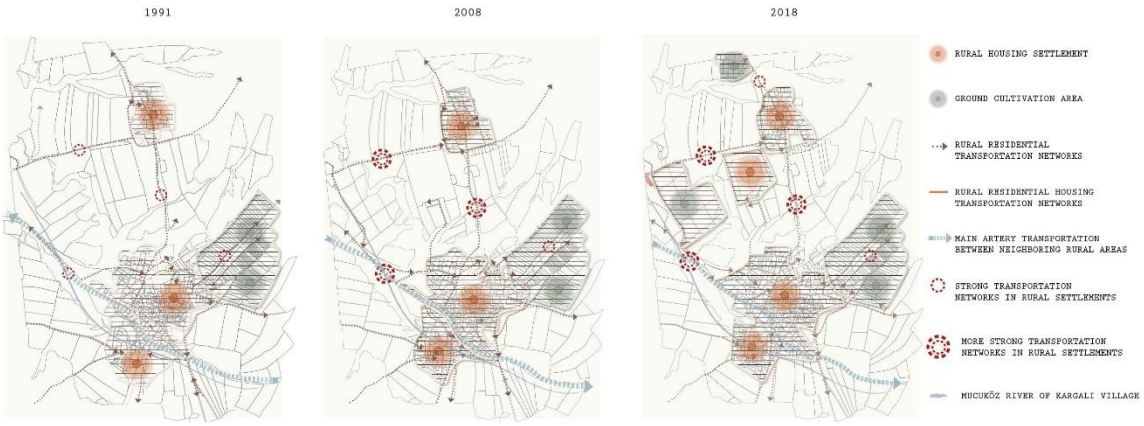

Figure 3 Changes in Settlement Morphology of The Kargalı Quarter (Village) in 1991, 2008 and 2018, (HGM)

Decreasing employment in rural areas and not being able to respond to increasing needs has increased the rate of migration from village to city. Rural regions have tried to differentiate their economic resources, which are only agriculture and animal husbandry, in order to maintain their current existence. An artificial pond was built in the northwest of the village as a solution to this problem in the examined village. This situation created an artificial intervention in rural morphology dynamics. With the artificial water dynamics, a new residential focus has been formed between the northern and southern settlements.

As a result of the increasing population, the two settlement textures in the north and south have grown and approached each other at the same time. Thus, the transportation axis between the two residential areas was strengthened and a new road network was formed to reach the new settlement pattern. The main arterial road network (Polatlı-Kargalı Road) connecting the village to the district has increased its importance and residential settlements have increased around the newly formed road. The southern residential settlement, which previously used the district road track as a threshold, continued its existence by transforming its "cluster-shaped" form into a "track-shaped" form that runs parallel to both sides of the road.

New residents of settlement (post-resident) in the region use the area mostly for weekend houses or hobby gardens. This allowed post-residents and rural residents of settlement to coexist while maintaining the rural identity of the region. The vineyard settlement in Kargalı Village, which has existed for a long time, has continued to exist by increasing its importance. Today, this region has both maintained its existence in the region by adding various “wine house” facilities and added a new type to the rural economy dynamic. The residential area, which is used seasonally, has expanded, allowing the formation of mostly permanent housing structures. As a result, Kargalı Village, which has a new structural dynamic with three centers, has managed to preserve its current dynamics by changing it and has turned into a sustainable rural settlement texture (Figure).

Figure 4 Temporal Change of Settlement Morphology of Kargalı District (Village)(Demiroğlu, 2020)

The settlement morphology features that most of the rural settlements have formed by irregular and spontaneous district relations are also present in Kargalı village. However, artificial morphology dynamics, increasing need, and population made it necessary to make changes in the structural dynamics of the village over time (Figure).

4.4. Kargalı District (Village) Resistance of Rural Morphology Dynamics

The changes and transformations of Kargalı village's morphology dynamics such as "environmental location relations", "cultivated and natural areas", "road networks", "built areas" and "landmarks" were analyzed in the years of 1944-2018. Due to the employment problem in rural areas between the years 1950-1970 in Turkey, there has been an intense migration from rural to urban areas in this sample village (Keleş, 1990). The rural and urban policies produced to prevent this situation and the new agricultural machinery used together with the development of technology allowed the settlement in the countryside to be sustained (Figure).

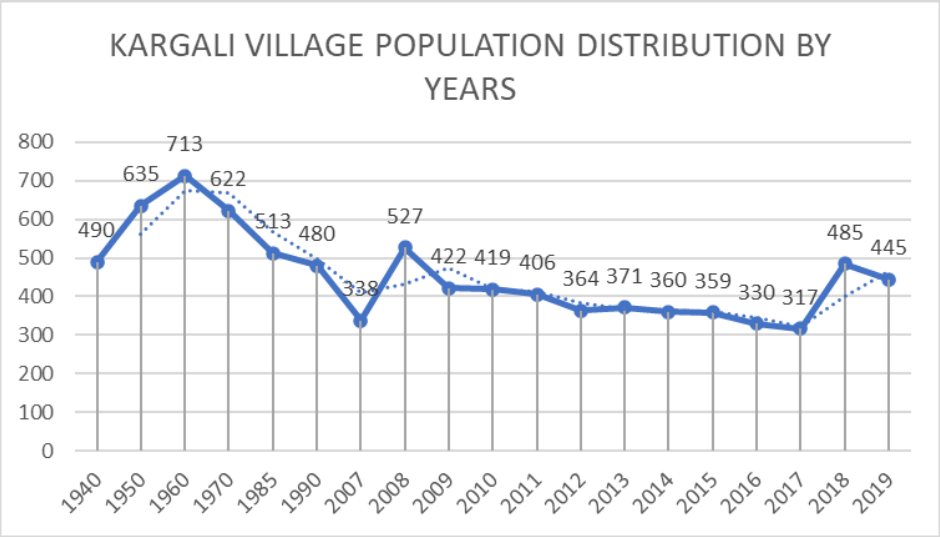

Figure 5 Kargalı District (Village) Population Distribution by Years, (URL 4)

The intense work pace of urban life and especially the hobby gardens, which are popular today, cause temporary migration of people from big cities to rural settlements. As a result, the socio-cultural, economic, and ecological balance of many rural settlement dynamics has deteriorated. Rural settlements that resist this situation provide balance by producing new morphology dynamics and by controlled change of existing dynamics. The lake, which was formed by artificial intervention in the current geographical dynamics in Kargalı Village, caused the agricultural areas around it to turn into a built environment. In addition, there has been a change/transformation in the current dynamics of the region due to the new rural resident formed as a result of migration from the city to the rural. The vineyard areas, which have survived since the first settlement in the region, existed only for rural residents on a more local scale. While the vineyard area maintains its existing texture as a result of increasing urban residents, it has been transformed into a rural tourist area for the region by changing with commercial areas such as a wine house added to the vineyard area.

The settlement formation in the south of the rural housing settlement has also changed along the strengthened Polatlı-Kargalı road and evolved from the form of a cluster to the form of a road trace. However, this situation did not destroy the rural settlement, it only changed with the effect of intense dependence on the city and continued its existence with stability.

The artificial pond built in the Kargalı village has been a completely new intervention to the existing morphology dynamics. It has also led to the formation of many weekend houses around the artificial pond, which has a transformative effect on the rural texture. The weekend house, which is external intervention to the structural morphology identity, brings with it temporary users from the city to the rural, leading to an unstable demographic increase in the identity of the rural. As a result of this formation, which is shaped as a parasite outside the existing heritage of the countryside, Kargalı village has been a factor in the deterioration of its identity and morphology. The residents of the newly formed settlement texture exist with completely different needs from the residents of the region. The local resident and the post-residents with a separate settlement are in the synthesis of two separate morphology dynamics away from holistic life. Parasitic articulations like this have irreversible consequences on the existing rural heritage texture.

Kargalı village, which belongs to its subjective identity, residential settlements, vineyard areas, agricultural areas, livestock, etc. it resisted transformations by providing revision without destroying the dynamics. As a result, today Kargalı Village is neither a village like it was in 1944 nor a settlement pattern that has completely changed from its rural settlement identity. The resistance is shown by keeping the new and compulsory changes parallel with her own identity was able to create a buffer zone for the village of Kargalı. While the residential settlements continued to exist, their formal form continued to evolve. The settlement form, which was two-centered, turned into three centers with the effect of the changing morphology dynamics. This, on the other hand, has created a sustainable user dynamic with resistance by allowing the local rural resident continuity in the resident of the region, the formation of controlled new rural residents (post-residents), and the meta-rural residents (Table 2).

Table 2 Changing, transformation, and resilience of the dynamics of the sample area over time.

Year	Socio-Cultural/Physical Dynamics	Socio-Cultural/Physical Transformation	Socio-Economic Transformation	Evaluation of the Result Within the Scope of Resilience
1944 1955 1970	• The structural settlement is in the form of clusters in the south of the village and in the north of the Mucuköz stream. • There are parcels where residential gardens and orchards form borders. • The village mosque, village room, fountain, and the village square surrounding them are the most important landmarks. • The vehicle road in the southeast-northwest direction, which provides access to the district center, constitutes the most important transportation axis. • The built area, which was formed as an animal shelter in the north, leads to the formation of secondary settlements with increasing residences over time.	• The settlement in the south has expanded along the stream axis in the form of a road trace. • The expanding settlement pattern has contributed to the formation of new landmarks. • The development of the built environment has led to the formation of new road networks in the region. • In the area created for the animal shelter in the north, housing patterns have increased, and new transportation axes have been formed between the two housing patterns. • The area used as a vineyard area has expanded to the south but has continued its function.	• Immigration to the city caused intense economic loss in the region. • The growth of cultivated areas between the first and second residential areas has led to the transformation of agricultural areas, which is one of the economic resources of the region. • Cultivated areas on the axis of Mucuköz Stream, which were used only for agriculture, have turned into residential lands.	• Until 1970, Kargalı village was experiencing demographic and economic difficulties. • Migration of the workforce to the city center indirectly affected agriculture negatively. • The use of agricultural tools developed in the region contributed to the facilitation of existing agriculture. • Rural resistance was the fact that the elderly population, who could not migrate to the city, remained in the region due to the residence requirement. • The people of the village, whose residences mostly moved to the city center, cultivate the fields seasonally. • The southern construction, which was used only for animal shelters before, started to take on the character of a secondary housing pattern for the village people, and this ensured the continuity of residence in the region.
1991 2008 2018	• With the residential construction in the north, the structural dynamics of the region have been updated as two housing patterns in the north and south. • An artificial pond has been built in the countryside with an artificial intervention to the existing morphological dynamics. • The transportation networks between the two newly formed housing patterns forked and increased their importance. • Vineyard cultivation area has strengthened its existence by increasing its regional volume. • The rate of infrastructure and service has increased in rural areas that have turned into local administrations. • The new weekend houses built in the region have created local morphology dynamics independent of the countryside.	• Most of the cultivated areas of the region are turning into residential areas with unplanned settlements. • The first residential area, which is cluster-shaped and single, has turned into a road trace that leaves the district center inside. • The county road is no longer a threshold. • The plant-natural area dynamics and structural dynamics of the artificial pond built between the first and second residential settlements have been transformed, resulting in a loss of identity. • Mucuköz Stream, which is an important water source for the cultivated areas of the region, has been transformed by losing its intense nutritive feature due to the artificial pond.	• The existing vineyard cultivation area has also evolved into an economic morphology dynamic with the addition of a commercial function. • Agricultural lands, which are important rural heritages, lost their economic power and turned into residential areas.	• Between these years, the biggest strength example in the countryside has been the vineyard area, which has gained a new dynamic and has not lost its original purpose. • Although the first settlement area has undergone a formal change, it continues to exist in the form of a road trace. • The road axis providing access to the district lost its main artery feature due to the increasing transportation axes between weekend houses and building blocks but remained important. • Despite the many deformations in the rural heritage identity, the region continues to exist as a local administration with its transformation and parasitic additions.

5. Conclusion

In this study, the meaning of the term resilience in residential areas and its effects on rural settlement morphology is focused on. Regardless of urban and rural settlements, they are faced with the constant change of the identities of the settlements, which are constantly exposed to internal and external threats, and the dynamics that create them. The purpose of the resilience shown against this is to keep the ecological, economic and cultural integrity of the region in balance and to protect its identity. The identity elements of each rural settlement are subjective, and the severity of the same threat will be different. In this case, the resilience of the regions and the resulting outputs can create different changes and transformations.

As a result of the fact that change is inevitable and the resistance expected from the rural settlement identity, it is aimed to adapt and sustain the region, not mutation. However, this resistance cannot occur only for residents. Rural settlement morphology should be analyzed with stratification analysis from the first formation to the present, and the identity elements that define the region should be analyzed correctly. The outputs of the resilience against the incoming threat will be handled separately in structural, cultural, economic, and ecological parameters and will be calculated in line with these analyses. This situation will not only absorb the current threat and provide adaptation but also will be a solution to the policies to be formed for sustainable rural settlement in the new change/transformation processes to be experienced in the future.

It is seen that the rural settlement morphologies mentioned in the study are in transformation and change movements over time in the sample examined. The decrease in rural residents, especially with the increase in migration to the city, has jeopardized the economic, social, and cultural continuity of the rural. Rural heritage and conservation studies in Europe, which are applied in large numbers, are examined under general titles in Turkey. This causes the subjective needs of all rural settlements to be gathered under a single title, and therefore, an effective solution cannot be produced. As seen in the sample examined, the added structural morphology dynamics, regardless of the existing socio-cultural rural heritage of the region, led to deterioration in rural identity. The increasing housing of Kargalı village causes agriculture, which is one of the most important economic activities of the countryside, to be put into the secondary plan. One of the common concerns in the process of protecting rural heritage is the impact of the built and natural environment on identity, which must be preserved. The unplanned increase in housing has increased the built areas of this region and caused a rapid decrease in its natural and cultivated areas.

It is seen that rural settlements that have transformed from village status to neighborhood status in Turkey benefit from many opportunities such as infrastructure, service, or economic improvements that the city benefits from. However, all this local administration status also alters the subjective parameters of rural heritage that need to be protected. Thus, rural areas, which are among our most important intangible cultural heritage, may result in destruction that cannot be transferred to the posterities.

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Hgm: Harita Genel Müdürlüğü Arşivi, 2019, Kargalı Village Aerial Photographs and Orthophotos.

Resume

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Retrofit suggestions from resilient design perspective in educational buildings lighting systems

Kasım Çelik*

Abstract

Educational buildings need to be properly built and renovated because of the number of users served, the rate of usage, the potential for energy savings, and their number in public buildings. Physically, educational buildings that do not meet the essential comfort conditions cause more energy consumption, have a negative effect on academic performance of students and also cause disruptions in educational program applications. According to 2021 data, there are approximately 67,000 school buildings in Turkey. A major portion of these buildings were constructed before 2000 and are now nearing the end of their economic life. It is essential to renew the insufficient buildings make them suitable for the conditions of the age. In this context, resilient systems that continue to function in a variety of negative conditions while maintaining comfort conditions become a priority in the design of the created environment. The lighting arrangements of educational buildings that are directly connected to visual comfort, academic performance, and energy consumption are discussed in this study. Within the framework of resilient design, certain suggestions have been developed in light of the current lighting standards in effect regarding the processes to be followed before the retrofit works to be performed in the lighting arrangements of the school buildings. These suggestions were discussed in three categories as short-, medium-, and long-term periods, taking into consideration the duration of the improvement processes and without interfering with the existing activities during the school education period and it was aimed to create a guide for designers and practitioners with the improvement systematics to be made in these periods. In order to test these suggestions, a classroom from the Ministry of National Education's type school projects is used as an example. The existing situation of the natural and artificial lighting system of this classroom and short-, medium- and long-term improvement suggestions were estimated through the Dialux Evo program. According to the findings, the recommended improvements enhanced visual comfort criteria and resulted in a considerable reduction in energy consumption. With the help of the improvement calendar, it is possible to modify the lighting systems of existing school buildings and increase visual performance.

Keywords: school lighting design, retrofit, resilient lighting design, visual comfort, educational buildings

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1. Introduction

The subject of "Quality Education" is one of the titles determined by the United Nations in line with the "Sustainable Development Goals". The purpose here is to ensure that all students receive quality education in quality places (Nazar et al., 2018). In this regard, improving the physical facilities of schools is critical for fulfilling educational activities and increasing the academic success of students. Scientific studies have also shown that the schools that are unable to offer the required comfort conditions have a negative effect on academic performance of students.

School buildings, as well as their indoor and outdoor environments, should be handled, designed, and built in a way that contributes positively to student development while also making students and teachers happy to be there. For this reason, it is important to maintain the existing positive conditions without affecting the educational environment. Thanks to resilient designs, it is possible to maintain the current function in the event of natural disasters, power failures or extraordinary situations. The important issue here is the process of designing buildings, including their interior, exterior, and environment, to decrease the impact of these situations while taking negative conditions and other external dangers into consideration. In this context, it is necessary to take steps within a resilience framework in order to develop future educational buildings that are practical, durable, accessible, inclusive, and sustainable. Both the design of the new schools to be built in this manner and the enhancement of the physical facilities of the existing schools should be a priority for a good education.

In today's world, where the importance of sustainable designs is increasing day by day due to limited natural resources, school lighting systems that directly affect visual performance should be designed and improved within the context of sustainability (Çelik, 2019). Within the scope of resilience, several recommendations are made in this research to ensure that lighting systems in schools are managed and enhanced, taking the artificial and natural lighting requirements in the standards in the account. The aim of the study can be summarized as supporting individuals and institutions in relevant occupational groups for the systematic implementation of natural and artificial lighting system retrofitting in education buildings.

1.1. Retrofit In Lighting Design in Terms of Resilience

The term resilience can be defined as the ability to adapt to changing situations and preserve functionality or regenerate itself after an interruption. In simple terms, resilience the ability to recover after a disruption or interruption (Campos, 2022). According to the American Lighting Association, lighting systems in the context of resilient design are defined as lighting that has the ability to prepare, plan, endure, regenerate, and adapt more successfully against negative circumstances. The issue to be addressed in this context is the concept that lighting should be regarded as a system, designed, planned, and it does not focus on a single element.

Retrofit in lighting systems can be referred as replacing inefficient elements with new energy-efficient ones (IEA SHC, 2016). In this context, the retrofit process can be interpreted as a method of achieving resilient design in the lighting system in buildings.

It is possible to adapt to lighting technologies that are constantly changing with technology and to enhance systems that lost their efficacy over time using retrofit applications.

According to data of the International Energy Agency, artificial lighting consumes around 12% of electrical energy utilized in households and 25% -40% in non-residential usage. It is estimated that the energy spent for artificial lighting constitutes approximately 19% of the global electricity consumption. Energy consumption in the field of lighting is predicted to rise further in the next years as a result of easy access to lighting products, diversity of usage areas, and technical advancements. As a result, including systems that use energy more effectively through enhancing

building systems in order to minimize the energy needed for artificial lighting has become a current issue.

Lighting systems in buildings are one of the most important application areas in retrofit, due to their energy saving potential. By replacing the old lighting elements, it is possible to save up to 50% in the energy consumed according to the usage area (Benya & Leban, 2011). Investments in energy-efficient lighting systems, according to studies, are one of the most cost-effective ways to increase energy efficiency and reduce CO2 emissions (Gentile et al., 2016). Research and field studies have shown that lighting retrofit applications are simple to implement and have a high economic return rate (Dubois et al., 2016). In addition, studies have shown that retrofit applications in the field of lighting in schools reduce the energy consumption for artificial lighting by 31% to 57% (Booysen et al, 2021; Clark, 2007).

Its aim is to provide visual comfort through new lighting technologies combined with improved practices, and to reduce electricity and maintenance costs arising from artificial lighting. The strengths, weaknesses, opportunities and potential threats of the improvement applications in lighting systems are summarized (SWOT analysis) in Table 1.

Table 1 Retrofit SWOT analysis (IEA SHC, 2016).

Strengths	• High energy savings that can be achieved with new lighting technologies and control systems • Short payback period of the system • More efficiency with less intervention compared to other retrofit issues
Weaknesses	• Lack of knowledge and inexperience in some areas (*reducing the level of illumination, not lighting according to the function, etc.)* • In some cases, the savings potential cannot be determined precisely and the reliability of some control systems is low (*use time, dimming, etc.)*
Opportunities	• Reducing energy consumption and supporting environmental sustainability by renewing existing buildings over time • The need to improve and modernize indoor environment quality with visual comfort • Obsolescence of existing lighting installations in developed countries
Threats	• The potential to increase the energy consumed for artificial lighting by 40% in 2030 • Consumption increase that may occur with the decrease in consumer expenses (*Rebound effect*)

Before carrying out the improvement processes in the lighting systems, it is essential to define the current situation well and to determine the appropriate solution proposals. The wrong steps from the beginning without proper planning may prevent the improvement process from providing the expected efficiency. In this regard, it is critical to ensure that lighting systems are kept up to date, particularly in locations such as school buildings that need continuous usage and which have a direct impact on the academic performance of students.

2. Educational Buildings Lighting Design Criteria

Studies have shown that both natural and artificial lighting affects people's health, mood, and alertness (Cajochen 2007; Van Bommel, et al 2004). For this reason, it can be said that the lighting systems of educational buildings directly affect the academic performance of students (Sleegers et al, 2013). In addition to serving as learning places for future generations, educational buildings play an essential role in the construction of public structures. According to the "2020-2021 National Education Statistics" of the Ministry of National Education, there are a total of 67,125 public and private (pre-school, primary, secondary and high school) school buildings in our country. The number of students studying in these schools is over 18 million. These structures, approximately 75% of which were built 20 years or earlier, have a total of 732,381 classrooms. Therefore, outdated technologies are still used in the lighting systems of some schools in parallel with the construction years or necessary improvement studies are not conducted.

Considering the number of users served by educational facilities, it is understood how large society and the physical environment they have an impact on, either directly or indirectly. Studies

that will enable school buildings to use energy more efficiently and enhance physical comfort conditions have become important in this regard.

Before starting the improvement works in the field of lighting, the current situation should be analyzed and deficiencies should be determined in the light of the standards and regulations in force. In our country, the related "TS EN 12464-1 Light and lighting - Lighting of work places - Part 1: Workplaces in closed areas" and "TS EN 17037 Daylight in Buildings" are in force. In addition, there is some information on the lighting design of schools in the "Minimum Design Standards Guide for Educational Buildings" published by the Ministry of National Education for the design of school buildings.

Sufficient and appropriate lighting enables people to perform their visual actions efficiently and accurately. The visual and comfort needs required in various workplaces are determined by the type and duration of the action. According to TS EN 12464-1 Light and lighting - Lighting of workplaces - Part 1: the lighting requirements of indoor areas with different functions in the indoor workplace standard, Numerical values and special requirements depending on the function are presented under the following headings:

- Illuminance level (E_m, *horizontal, vertical and cylindrical planes*),
- Glare (R_{UGL}),
- The uniformity of the light distribution (U_0),
- Color rendering (R_a),

As an example of this information, the lighting requirements for classrooms in educational buildings are presented in Table 2.

Table 2 Lighting requirements for classrooms (TS EN 12464-1)

Type of task/activity area	E_m (lx)		U_0	R_a	R_{UGL}	$E_{m,z}$ (lx)	E_m (lx)	E_m (lx)	Specific requirements
	required	modified				$U_0 > 0,10$			Lighting should be controllable for different activities and scene settings. For classrooms used by young children, an Ēm required of 300 lx may be used by dimming. Ambient light should be considered.
Classroom - General activities	500	1000	0,60	80	19	150	150	100	
Black, green and white boards	500	750	0,70	80	19	-	-	-	Vertical illuminances. Specular reflections shall be prevented. Presenter/teacher shall be illuminated with suitable vertical illuminance.

Daylight should be the primary lighting source for all spaces in terms of visual comfort, pleasure and energy use. TS EN 17037 Daylight in Buildings Standard encourages designers to use and evaluate daylight effectively in spaces. At the same time, it defines minimum performance standards for natural lighting design of spaces. The criteria presented for the daylight performance of spaces in this standard are:

- Providing sunlight,
- Providing an outside view,
- Exposure to sunlight
- Daylight dependent glare control

In the standards, general natural lighting parameters have been specified for all building types, not just for education buildings, it has been stated that daylight should contribute considerably to the lighting requirements of any typology structure.

It is aimed to determine the design criteria in educational buildings with the "Minimum Design Standards Guide for Educational Buildings" prepared by the Ministry of National Education. This guide aims to keep up with the changes that education systems will go through throughout time as

a result of rapidly developing technologies and new needs. Suggestions regarding the amount of illuminance levels, window orientations and window area are presented for some spaces. The lighting recommendations for the classes in the guidebook are shown in Table 3.

Table 3 Lighting recommendations for classrooms

Type of activity	E_m (lx)	Area of windows	Additional Information
Classroom	300	**Windows area/floor area:** %25-%50	The classroom should be designed in such a way that daylight comes from the left side for students, and furnishings and door openings should be arranged accordingly.

The said standards and guides are also updated over the years depending on the changing terms of use, user characteristics and technology. In this regard, these developments should be followed and the researches in this field should be kept up-to-date.

3. Method

Within the scope of the research, an action plan has been developed to assist in the elimination of problems with artificial and natural lighting systems of educational buildings and their retrofit in terms of visual and energy performance. In the context of this action plan, an information and timetable has been created so that designers and practitioners can take action in a systematic way. While preparing improvement ideas for this plan, the current natural and artificial lighting standards and design guidelines in force in Turkey were taken into consideration.

For this purpose, it was aimed to create a theoretical infrastructure by first making a wide literature review; Design, lighting, retrofit, energy, etc. for educational buildings published by various institutions and organizations, with papers, articles and theses made on the subject at home and abroad. Guidelines and standards on the subjects were examined.

After the theoretical infrastructure is formed, the other steps followed in the study can be listed as follows:

- Creating an information (*What-Why-How*) table that will provide explanatory information to designers and practitioners in addition to the numerical information provided for educational structures in the standards and guides,
- Determining in which areas and at what time the improvement processes that can be done during the school education period can be made,
- Establishing a short, medium and long-term retrofit calendar in accordance with the determined improvement processes,
- Selection of the space for retrofitting and implementation of the suggested action plan for this space.
- Application of the proposed retrofit processes to the space and comparing the lighting performance of the existing and suggested situation with the lighting program,
- Analyzing the obtained data.

A case study was conducted to implement the action steps with the help of the information and timeline suggested from the study. In the case study, a classroom was chosen because it is a repetitive space in all schools and its total number. According to 2021 data, there are 732381 classrooms in schools. The selected classroom belongs to a type secondary school project with 24 classrooms implemented by the Ministry of National Education. Dialux Evo program was used to analyze the lighting performance of the existing and suggested situations.

4. Suggestion for Lighting Retrofit in Educational Buildings

There are numerical values and brief explanations for the lighting conditions of school buildings in the regulations and various guidebooks prepared to determine the lighting requirements. Apart

from numerical values, it can be suggested that lighting design suggestions will be more descriptive and beneficial for both designers and users. In this context, short suggestions about what criteria presented in the lighting standards are, why they are essential and how they should be obtained are presented in Table 4.

Table 4 General information on lighting design criteria in educational buildings *(What-Why-How)*

What *(is it)*	**Why** *(it is necessary)*	**How** *(should it be)*	
		Natural lighting	**Artificial Lighting**
Illuminance level (E_m)	• Visual comfort • Visual performance • Academic performance • Energy consumption	• The windows should be oriented and designed in appropriate dimensions to make maximum use of natural lighting. • External obstacles that will prevent daylight entering the space should be avoided. • The reflection factors of the inner surfaces should be chosen at appropriate values.	• The most suitable light source should be chosen in terms of energy consumption and efficiency. • Devices with high light efficiency should be selected. • The reflection factors of the inner surfaces should be chosen at appropriate values.
The uniformity of the light distribution (U_0)	• Visual comfort • Academic performance • Energy consumption	• Windows should be designed and positioned in accordance with the space function and dimensions. • Furnishing-window relation should be arranged in accordance with the light distribution.	• The relationship between the furnishing and the lighting arrangement should be considered in accordance with the space and function. • Luminaires light distribution features (light intensity diagram) should be selected according to the function.
Glare (R_{UGL})	• Visual comfort • Academic performance	• The windows should not be positioned behind the students to avoid silhouette effects and glare. • The light should generally be placed on the left side so that students can see what they write. • Disturbing direct sunlight should be prevented from entering the space. • Solar control elements should be used when necessary.	• Lightings should be positioned considering the viewing direction and working area so that they do not cause glare. • Luminaires to be used in places should be chosen in a way that will not cause glare.
Color rendering (R_a)	• Visual comfort • Academic performance • Ability to distinguish colors	• In order to perceive the objects in their true colors, maximum use of daylight should be made in the spaces.	• Lamps with high color rendering should be preferred so that objects can be perceived in their true colors.
Daylight Factor (DF)	• Visual comfort • Visual performance • Academic performance • Energy consumption	• Window sizes, positions and orientation should be designed to take advantage of daylight.	-
Transparency Ratio	• Visual comfort • Visual performance • Academic performance • Energy consumption	• Window sizes, positions and orientation should be designed to take advantage of daylight.	-
Energy consumption (W/m^2, $W/m^2/100$ lx)	• Energy consumption	• The windows should be oriented and designed in appropriate dimensions to make maximum use of natural lighting. • Cleaning of windows and interior surfaces should be done at regular intervals.	• The most suitable light source should be chosen in terms of energy consumption and efficiency. • Luminaires should be maintained at regular intervals.

A lighting improvement calendar was designed, taking into account the lighting design standards and the time limit within the education period, without interrupting the activities.

In this context;

- Visual comfort criteria

- *Illuminance Level (E_m),*
- *Uniformity of the light distribution (U_0),*
- *Glare (R_{UGL}),*
- Daylight factor (DF)

- Energy consumption
  - Total power (W)
  - Lighting power density (W/m^2, W/m^2/100 lx)

are taken into account. The parameters were created by taking various constraints (time, cost, structural, etc.) into consideration. Table 5 presents suggestions for natural and artificial lighting and space features under the headings of "short (≤15 days), medium (≤90 days) and long-term (>90 days) improvements", taking the implementation period of the improvement processes into account. These recommendations were created by taking the time intervals in the academic year into account.

Table 5 Retrofit suggestions in terms of lighting design criteria and time

Retrofit period		Lighting design criteria			
		Illumination level (*E*)	**Uniformity of illuminance (U_0)**	**Glare (UGR)**	**Energy comsumption (W/m^2, W/m^2/100 lx)**
Natural Lighting	**Short term improvements** (≤15 days)	• Maintenance and cleaning of windows • Trimming of plants and trees outside the building	• Changing the furnishing order	• Adding indoor solar control elements (curtains and blinds etc.)	• Maintenance and cleaning of windows • Trimming of plants outside the building
	Short term improvements (≤ 90 days)	• Improvement of glass and joinery properties	• Use of light shelf elements etc	• Adding solar control elements to the façade	• Replacement of glass and joinery
	Short term improvements (> 90 days)	• Rearrangement of size, position, number properties of windows • Redesign/change of building skin and transparent areas	• Redesign of the building envelope		
Artificial Lighting	**Short term improvements** (≤15 days)	• Maintenance and cleaning of lamps and luminaries • Lamp change (in terms of lm/W, color etc.)	• Luminaire change *(in terms of light intensity diagram)* • Luminaire replacement (in terms of reflector, mounting type, etc.) • Changing the furnishing order		• Lamp and luminaire maintenance and cleaning • Lamp and luminaire replacement
	Short term improvements (≤ 90 days)	• Change of lamp and luminaire types • Changing the location of luminaires			
	Short term improvements (> 90 days)	• Redesign of the lighting system			
Space specifications	**Short term improvements** (≤15 days)	• Cleaning, painting, changing the furnishing order of interior surfaces			
	Short term improvements (≤ 90 days)	• Arrangement of light reflection factors of interior surfaces and facings	• Arranging the lighting system according to the task areas	• Arrangement of light reflection factors of interior surfaces and facings • Arranging the lighting system according to the task areas	
	Short term improvements (> 90 days)	• Redesign of the interior			

The goal of the determined retrofit calendar is to regulate and improve the deficiencies in school lighting systems in a systematic manner.

4.1. Case Study

It is aimed to test the retrofit calendar and improvement suggestions created within the scope of the study on a sample classroom, taking the existing education conditions into account. First, a typical secondary school project implemented by the Ministry of National Education was selected and a classroom belonging to this school was modelled in the Dialux Evo 10.1 lighting simulation program. The natural and artificial lighting performance of the specified classroom was calculated seperately for the existing situation and the short-medium-long-term improvement ideas offered within the scope of the study.

The existing classroom is a volume of 7.60x7.70x3.10 m, with 3 windows measuring 1.50x1.70 m. The parapet height of the windows is 0.90 m. Window area/Floor area= 13.07%, The transparency ratio (Window area/Wall area with windows) is 32.47%. It's considered that the area is a highly dirty space with a five-year maintenance cycle (MF:0,57). The plan and sections of the classroom are presented in Figure 1.

Figure 1 Plan and sections of the sample classroom

The study areas in the classroom are divided into two parts, the desk surface and the blackboard surface, in order to evaluate the horizontal and vertical illuminance level and uniformity of the light distribution. The calculation plane for the area with the desks is positioned horizontally at a height of 0.80 m from the ground. A calculation area has been created in the vertical plane for the blackboard. For glare, a calculation surface was created at a height of 1.2 m from the ground in accordance with the field of view of the students (Figure 2).

Figure 2 Work planes for calculation

Daylight calculations were made for Adana on 15 December at 12:00 am, according to the closed sky conditions determined by the International Commission on Lighting (CIE).

The "short-term (15 days), medium-term (90 days), and long-term (> 90 days)" recommendations in Table 5 were taken into account while developing lighting recommendations for the sample classroom to be improved. In this context, the suggestions implemented in the short, medium and long-term time frame can be listed as follows:

Short-term lighting improvement suggestions;

- Maintenance and cleaning of windows,
- Cleaning, painting of interior surfaces,
- Maintenance and cleaning of lamps and luminaires,
- Lamp change (lm/W)

Medium-term lighting improvement suggestions;

- Enhancement of glass and joinery,
- Change of lamp and luminaire types,
- Arrangement of light reflection factors of interior surfaces and facings,

Long-term lighting improvement suggestions;

- Rearrangement of windows size, position, number, etc.
- Change of lamp and luminaire types,
- Changing the location of the luminaires,
- Arrangement of light reflection factors of interior surfaces and facings,

The existing situation of the sample classroom and the improvement suggestions for the natural lighting system are presented in Table 6.

Table 6 Existing situation and natural lighting improvement suggestions

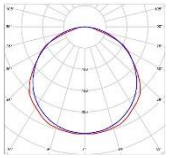
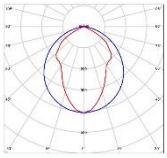
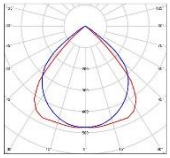
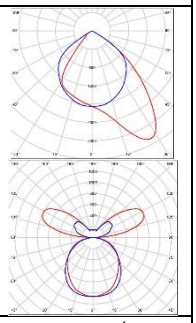
Specifications	Existing situation	Short term improvements	Mid term improvements	Long term improvements
Inner surface reflectance factors *(Floor/Wall/Ceiling)*	0,20/0,30/0,60	0,30/0,50/0,70	0,30/0,50/0,70	0,30/0,60/0,85
Glass light transmission factor *(t)*	%74	%80	%80	%80
Room maintenance factor *(MF)*	0,57 *(Dirty room)*	0,80 *(Clean room)*	0,80 *(Temiz oda)*	0,80 *(Temiz oda)*
Transparency Ratio	%32.47	%32.47	%32.47	%48.13

There is no any structural applications in the short and medium-term suggestions, but the window area was increased in the long-term suggestion.

The existing situation of the artificial lighting system of the sample classroom and the improvement suggestions are presented in Table 7.

Table 7 Existing situation and artificial lighting improvement suggestions

Specifications	Existing situation	Short term improvements	Mid term improvements	Long term improvements
Inner surface reflectance factors *(Floor/Wall/Ceiling)*	0,20/0,30/0,60	0,30/0,50/0,70	0,30/0,50/0,70	0,30/0,60/0,80
Room maintenance factor *(MF)*	0,57 *(Dirty room)*	0,80 *(Clean room)*	0,80 *(Temiz oda)*	0,80 *(Temiz oda)*
Number of luminaires	6	6	6	8
Light output ratio of luminaire	%76	%82	%87	%100
Lamp type	TL-D Fluorescence	TL5 Fluorescence	TL5 Fluorescence	LED

Number of lamps	12	12	12	8
Lamp power (W)	2 x 36 W	2 x 35 W	2 x 35 W	40 W / 31 W
Total system power (W)	432 W	462 W	462 W	302 W
Lamp luminous flux (lm)	6500 lm	6650 lm	6650 lm	5489 / 3773 lm
Lamp efficiency (lm/W)	68,5 lm/W	70,5 lm/W	75 lm/W	134,1 lm/W
Color rendering (R_a)	80	90	90	80
Type of luminaire	Bare	Bare	with louvre	with louvre / with opal diffuser
Luminaire image				
Light intensity distribution/lighting pattern				
	Direct	Direct	Direct	Direct / Semi-Direct

In the existing situation fluorescent lamps are used. While fluorescent lamps are used in short and medium-term improvement suggestions, LED lamps are used in long-term improvement.

5. Evaluation and Conclusion

The visual comfort and energy use performance of the current situation and suggested situations were determined using the Dialux Evo 10.1 software. Visual comfort criteria of the created improvement suggestions (horizontal and vertical illuminance level Eh, Ev, distribution uniformity of horizontal and vertical illumination; Uh, Uv, glare; UGR) and calculation results for energy use (W, W/m2, W/ m2/100 lx) are presented in Table 8. The classroom study areas are divided into two sections, the desk surface and the board surface, in order to determine the horizontal and vertical illuminance levels as well as the uniformity of the luminance distribution. The calculation plane for the area with desks is horizontally positioned 80 cm above the ground. Natural lighting calculations were made for Adana on 15 December at 12:00, according to the overcast sky conditions determined by the International Commission on Illumination (CIE).

All the data obtained for the existing situation and suggested scenarios are presented in Table 8.

Table 8. Lighting values of existing and suggested scenarios

Existing situation									
	E_h	**U_h**	**E_v**	**U_v**	**UGR**	**W/m²**	**W/m²/ 100 lx**	**P_t (W)**	**DF**
TS EN 12464-1	**500**	**0,6**	**500**	**0,7**	**19**	-	-	-	-
TS EN 17037 *(to exceed 500 lx)*	-	-	-	-	-	-	-	-	**%2,6**
Artificial lighting	267	**0,75**	153	**0,76**	20,7	7,9	3,09	462	-
Natural lighting	145	0,18	75,1	0,44	<10	-	-	-	1,257

Integrated lighting	412	0,58	227	**0,71**	20,5	7,9	3,09	462	1,257
Short term improvements									
Type of lighting	**E_h**	**U_h**	**E_v**	**U_v**	**UGR**	**W/m²**	**W/m²/ 100 lx**	**P_t (W)**	**DF**
Artificial lighting	459	**0,74**	196	0,6	19,8	7,39	1,94	432	-
Natural lighting	151	0,2	68,9	0,43	<10	-	-	-	1,308
Integrated lighting	**609**	**0,64**	264	0,58	19,8	7,39	1,94	462	1,308
Midterm improvements									
Type of lighting	**E_h**	**U_h**	**E_v**	**U_v**	**UGR**	**W/m²**	**W/m²/ 100 lx**	**P_t (W)**	**DF**
Artificial lighting	**529**	**0,69**	189	0,46	**19**	7,39	1,68	432	-
Natural lighting	178	0,21	94,5	0,48	<10	-	-	-	1,554
Integrated lighting	**706**	**0,63**	282	0,52	**19**	7,39	1,68	462	1,554
Long term improvements									
Type of lighting	**E_h**	**U_h**	**E_v**	**U_v**	**UGR**	**W/m²**	**W/m²/ 100 lx**	**P_t (W)**	**DF**
Artificial lighting	**512**	**0,61**	**559**	0,62	**17,7**	5,17	1,02	302	-
Natural lighting	333	0,27	191	0,56	<10	-	-	-	**2,959**
Integrated lighting	**837**	0,49	**745**	**0,70**	17,7	5,17	1,02	302	**2,959**

Bold texts represent values provided by standards

When the findings are examined, it is seen that in all suggested conditions, all visual comfort and energy consumption measures improve progressively. When the criteria are examined one by one;

Short term improvements; In this suggested scenario, some advantages that can be obtained with improvements to be made in a very short time are aimed to be revealed. In this context, the interior surfaces, windows and fixtures are cleaned, and the maintenance factor *(MF)* and the window light transmission coefficient are increased. In addition, more efficient lamps are used to produce more luminous flux with the same energy.

It is seen that the average illuminance level *(Eh,v)* values in the horizontal and vertical planes have increased compared to the current situation. The horizontal illuminance level has approached the required values in the standards.

While the uniformity of illuminance can be achieved in the horizontal plane *(Uh),* it is close to the standard values in the vertical planes *(Uv).*

Although the glare *(RUGL)* values decreased compared to the current situation, the standard value could not be achieved.

Medium-term improvements; In this suggestion, it is aimed to reduce glare by using luminaires with louvres compared to the other two situations. In addition, more efficient lamps are used to produce more luminous flux with the same energy.

Although the average illuminance level *(Eh)* values in the horizontal plane are insufficient in terms of natural lighting, they have reached the standards in terms of artificial lighting. As a result of the reduction of window joinery thickness, the daylight level increased. Vertical illuminance *(Ev)* values did not reach the standards.

While the uniformity of illuminance could be achieved in the horizontal plane *(Uh),* it could not be provided in the vertical plane *(Uv).*

While the current lighting scheme causes glare, in the proposed case the Glare (RUGL) is below the required values.

Long-term improvements: In this suggestion, the artificial and natural lighting system was redesigned. LED lamps were preferred as artificial lighting elements, and window sizes were increased to increase daylight. In addition, the reflectivity factors of the interior surfaces have been increased *(Floor/Wall/Floor; 0.30/0.60/0.80).*

The average illuminance level *(Eh,v)* values in the horizontal and vertical planes provided the standards. Natural lighting values alone did not meet the standards.

The distribution of the illuminance has reached the standards in the horizontal and vertical planes *(Uh, v).*

The glare *(RUGL)* values provided the standard values.

While the daylight factor *(DF)* could not be provided (2.6%) in the current and other recommendations, this value was obtained (2.959%) by increasing window sizes without long-term improvement.

As a result, it can be said that the suggestions presented give successful results in terms of increasing the illuminance levels, reducing the glare value, improving the distribution uniformity and reducing the energy consumption. While short- and medium-term improvements are especially beneficial in terms of energy consumption and illuminance level, it is clear that a more comprehensive improvement process is needed to improve other visual comfort criteria. In this respect, it is an indication of this that more successful results are obtained in the long-term improvement proposal than in other suggestions.

Improvements should not only be considered as increasing the illuminance level and reducing energy consumption, but all other visual comfort criteria should be taken into account. Other improvement suggestions can be used depending on the need to improve a classroom with the features within the scope of the acceptances. Considering the results, it can be said that the proposed improvement proposals provide systematic solutions for the improvement of the lighting conditions in the classrooms.

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Resume

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