Müge Akkar Ercan
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Editors

Valorising Underground Built Heritage in Cappadocia

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Foreword

Giuseppe Pace

When we started reflecting on a proposal for studying underground sites with outstanding cultural landscapes, our minds immediately journeyed to two remarkable settlements.

First on our mental map was the captivating "Sassi" in Matera, Italy. This troglodyte village stands as one of Italy's earliest human settlements, an architectural testament that earned the prestigious UNESCO World Heritage Site (WHS) designation in 1993. Its historic significance played an instrumental role in Matera clinching the esteemed title of European Capital of Culture in 2019.

In a different corner of the world lies Göreme in Cappadocia, a fascinating moon-like landscape sculpted over a million years through the artistry of rock erosion. Nature's handiwork has given rise to astonishing natural cones and columns, endearingly dubbed 'fairy chimneys'. Over centuries, skilled hands meticulously carved these formations into cave-dwellings, stables, and sacred sanctuaries. The valley of Göreme and its surroundings cradle around 300 cave churches and monastic Byzantine settlements, a living tapestry that echoes tales from the 9th to 13th centuries. This Turkish farming village, once known as *Maccan*, emerged atop the ruins of an ancient Byzantine settlement.

Göreme's allure, drawing millions of visitors annually, led to the establishment of the Göreme National Park in 1985, securing its distinguished status as a UNESCO World Heritage Site being a "… landscape of harmony combining human interaction and settlement with dramatic natural landforms" [1]. This enchanting milieu unfolded as the quintessential canvas to conceive a proposal amplifying the valorisation of the underground built heritage within a broader landscape narrative. What better place than Göreme could demonstrate why studying these landscapes, created by the long-standing interaction between groups of people and the nature, which transcend mere monuments or structures and give wealth and sense of belonging to the nearby communities?

However, places like Göreme are also ideal for reflecting of the emergent challenges precipitated by the ascendancy of heritage preservation and tourism. This ascendancy has fundamentally changed the dynamics between the local community and the sites in question. Protection policies, in a sense, have marginalised the inhabitants, dispossessing them of their spaces, and with them of their traditional activities, rituals, and cultural practices. Consequently, in numerous instances, these communities have yielded ground to the burgeoning tourist infrastructure.

Over time, the configurations of Göreme have undergone progressive changes, intricately woven into the fabric of its ecosystem. This transformation is a consequence of the gradual and daily interactions among the members of the local community within their anthropogenic and natural surroundings. These interactions, manifesting as a "complex set of interacting variables" [2], have given rise to considerable temporal diversity and a distinctive landscape. This distinctive character bestows upon Göreme an eminent heritage status, warranting vigilant preservation and valorisation.

Viewed from a broader perspective, contemporary shifts can be taken as indicators of a dynamic era, necessitating the adaptation of human practices and legal frameworks to an evolving world. These changes inevitably prompt alterations to the original cultural landscape and, consequently, reshape the "local community's sense of place" [3]. It is imperative to acknowledge that these landscapes are inexorably intertwined with their anthropogenic context, a context which has played a formative role in shaping them. Specifically, this context refers to the "collectivity of members sharing common territorial areas, identities, and values, who actively and voluntarily engage in the construction of specific accomplishments within the framework of public action" [4]. To achieve that, community members must be actively involved in sequences of collaborating or competing practices [5]. These practices are influenced not solely by elements of traditional ecology such as size, proximity, diversity, quality, and culture, but also by community-centric factors encompassing "historicity, identity, mutuality, plurality, autonomy, participation, and integration" [6].

In the initial stages of our COST action titled "Underground Built Heritage as a Catalyst for Community Valorisation (Underground4value)", our primary focus was the significant challenge of discerning the Underground Built Heritage's potential in fostering the development of local communities. Our main objective was not focused on successful but crystallised heritage sites. Instead, we aimed to aid (local) communities in discovering abandoned or underused "underground" landscapes, often

necessitating the adoption of fresh meanings and a new repertoire of practices.

What insights could be gleaned from Göreme? Arguably, an in-depth investigation could be conducted into the intricate and frequently fragmented interconnections between the local community and the broader national and global community committed to safeguarding heritage sites of exceptional universal value. In 2019, at the inception of Underground4value, the network was in the process of delineating its theoretical and methodological objectives. Many participants at that time lacked a clear conception of the on-field work that lay ahead.

During the first management committee meeting of the Action, a resolution was reached to allocate a portion of the budget to facilitate the establishment of living labs in four selected case-studies. A living lab framework serves as an innovative, collaborative environment for experimentation and real-world application of research and development. Significantly, due to the proposition made by Müge Akkar Ercan, a contributing editor of this publication, the Göreme region became a focal point for investigation as one of the chosen case-studies.

After that moment, two living lab meetings were scheduled on-site. A short-term scientific mission, conducted by Daniela De Gregorio, significantly enhanced the comprehension of the case. Additionally, a training school paved the path for the emergence of two compelling research proposals.

This book serves as an archival repository, encompassing the diligent endeavours undertaken by the promoters of this living lab, encapsulating, and synthesising the resulting research works pertaining to the subject matter. By portraying the Göreme living lab, Müge Akkar Ercan and Kerim Aydiner delve into the multifaceted world of UBH and its profound impact on communities and landscapes. Certainly, rooted in the recognition of the imperative to amalgamate diverse perspectives and research endeavours, the editors embarked on a journey to unify an array of distinct chapters, each a specialised lens offering unique insights into various aspects of this exemplary case-study. Their steadfast dedication and intellectual rigor were pivotal in ensuring a coherent and comprehensive narrative that binds these chapters together, weaving a comprehensive vision of the case study at hand – the Göreme region.

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Preface

Müge Akkar Ercan, Kerim Aydıner

With their multiple values, Underground (UBH) sites and artefacts are precious resources that should be protected for now and future. With their generative potential, the UBH sites and artefacts can be effectively used as catalysts for attaining community valorisation, achieving sustainable regeneration and development, and improving the quality of life in different localities. This book, focusing on the UBH potentials of Göreme and the Cappadocia region in Turkey, documents the research and living lab experience conducted within the COST Action CA18110 Underground4Value framework between 2019 and 2023. It develops a reliable knowledge base concerning the UBH as the catalyst for community valorisation, heritage conservation, urban and rural regeneration, and sustainable community development in Cappadocia. Within the framework of the COST Action, a participatory and inclusive planning process was followed to cooperate with the local stakeholders and the community. Hence, the book presents this participatory and inclusive process and outcomes of the living lab and Strategic Transition Approach. Besides, it presents studies on stability monitoring and controlling, geological and geomorphological mapping and visualisation of the UBH, artificial intelligence text-mining, and sentiment analysis methodologies for discovering tourist views and the complexity of heritage conservation, sustainable regeneration, and tourism development in Göreme and Cappadocia.

As the editors of this book, we would like to thank the Action Chair of Giuseppe Pace and all the proposers of the COST Action Underground4Value for giving us the opportunity to focus on this precious geography and the UBH sources of Cappadocia and Göreme in Turkey, conduct a living lab and bringing several researchers and young academics together to study and discuss this historical and cultural landscape from different disciplines' viewpoints, and create a synergy between international and national researchers and professionals, local stakeholders and decision-makers.

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CHAPTER 1

Introduction

Müge Akkar Ercan, Kerim Aydiner

Underground Built Heritage (UBH) definition comprises a variety of anthropic caves, mines, dismissed infrastructure, religious sites or human settlements with a long history extending to several thousands of years [1]. Over centuries, the UBH in urban and rural areas has been used for different purposes, such as sheltering people and animals from enemies, weather conditions, or natural disasters, producing and storing foods and goods, worshipping, conducting religious and cultural ceremonies, functioning as the physical infrastructure of cities, such as water storage spaces, or tunnels used to transfer goods and people. As archaeological, architectural, historical, and artistic artefacts, the UBH provides a unique historical and cultural resource and a source of identity for the locality (i.e. a territorial site that may cover a whole region, or a city, a district or a neighbourhood) and the local community. In this sense, it is a critical, generative, and valuable resource to explore, celebrate, promote, conserve, and (re)use for the sustainable development of localities and local communities, i.e., a catalyst for community valorisation. The UBH functions as a repository embodying local identity and historical essence. This reservoir holds significant cultural dimensions, thereby fostering prospects for a comprehensive urban regeneration strategy and community empowerment.

In the world, there are many UBH sites in need of conservation. The management and use of these heritage sites, characterised by their geographical, social, cultural, and historical contexts, can vary significantly. They may face either neglect and underutilization or excessive exploitation. In some UBH sites, tourism has emerged as a predominant economic sector, resulting in widespread commercialisation, commodification, and privatisation of the UBH, often disregarding their diverse values. Nevertheless, these UBH sites and artefacts possess intrinsic value through their multifaceted dimensions, which necessitate conservation for both present and future generations. Leveraging their generative capacities, UBH can

serve as a potent catalyst in achieving sustainable regeneration and development within localities, consequently enhancing the quality of life for local communities. Effectively harnessing the potential of UBH involves a delicate balance between conservation and development policies. Local authorities can strategically integrate these policies to stimulate sustainable tourism, innovative sectors, and a circular economy within these sites. Therefore, the presence of the UBH is valuable to attain sustainable conservation and development goals and make communities more sustainable. Here, two critical questions come to the forefront of the scientific community and local decision-makers who are responsible for UBH conservation:

- How to use the UBH as a catalyst for community valorisation?
- How to balance the conservation policies of the UBH and potential reuses of the underground spaces to make them sustainable, also in terms of community development?

Indeed, there are other questions to answer to this end, such as:

- How can knowledge sustain the UBH and its historic landscape?
- What methods ensure an inclusive, participatory governance for effective UBH site planning and management?
- How can local and non-local stakeholders be meaningfully engaged in inclusive processes for UBH management?
- What scientific approaches drive sustainability in UBH, encompassing urban and rural spaces, tangible and intangible values?
- How can conservation and management policies and practices promote sustainable usage of UBH?
- How can conservation and management policies align with broader sustainable regional and local development goals?
- How can sustainability goals be shaped, considering the inherited values and traditions of different cultural contexts?
- What innovative sustainable conservation and development scenarios, along with viable business models, can drive sustainability for UBH sites?

Such questions can certainly be increased and diversified according to the cultural, economic, social, spatial, technical, and technological contexts the UBH presents.

1.2. **COST Action Underground4Value and the case of Cappadocia in Turkey**

The COST Action 'Underground4Value' (CA18110 Underground Built Heritage as catalyst for Community Valorisation) aims to develop objectives and strategies for supporting, UBH conservation, valorisation, man-

agement and decision-making through community-led development [1]. One of the three main objectives of the Action is "to provide a balanced and sustainable methodology for supporting the conservation and re-use of the UBH, by classifying different approaches through case studies, by adapting, operationalising and testing the "Recommendation on the Historic Urban Landscape (HUL)", and by introducing new innovative technologies for the UBH knowledge, preservation, and valorisation [1, pp. 12-13]. The second objective of the Action is "to realise the potential of UBH for empowering local communities, by supporting their active involvement, stimulating bottom-up initiatives (e.g. Living Labs), and guaranteeing continuity of use and significance to the underground historic fabric, revitalisation of the public realm and skills development for townspeople" [1, p. 13]. Finally, the last objective is "to develop new skills for planners, decision-makers, promoters, and local development facilitators, by testing and running a new training course on UBH, which will integrate multidisciplinary knowledge about the underground heritage with a planning framework based on HUL and boosting cultural planning, strategic spatial planning, transition planning and management" [1, p. 13].

Cappadocia in Turkey presents a unique case, comprising a variety of underground heritage such as underground cities, caves, fairy chimneys, and other unique geomorphological rock formations in different parts of the region. These different cavity types also include hypogeal (i.e., underground, subterranean) civilian dwellings (permanent dwellings, temporary shelters, warehouses, stables, pigeon houses), hydraulic underground works (tunnels, wells, and waterways), military and war work (shelters for civilians and soldiers, galleries), religious works (places for worships and burial places) and transit (road tunnels). This unique heritage in Cappadocia gives us a great opportunity to study and discuss in depth how the UBH can be used as a catalyst for community valorisation and how to balance the conservation and use policies of the UBH to achieve its sustainable conservation and regeneration and the sustainable development of local communities.

1.3. **Aims, Scope and Content of the Book**

This book, focusing on the case of Göreme in Cappadocia, aims to document the studies and the living lab experience conducted within the COST Action CA18110 Underground4Value framework between 2019 and 2023. It seeks to develop a reliable knowledge base concerning the UBH of Cappadocia and Göreme and show the importance of the UBH as the primary driver of heritage conservation, urban and rural regeneration and sustainable development in Cappadocia and Göreme. The community

and other stakeholders in the UBH site, like Göreme in Cappadocia, have critical roles to play to this end. Within Underground4Value framework, the organisers of the Living Lab followed participatory and inclusive planning to cooperate with the local stakeholders. By using a Strategic Transition approach, the Living Lab on Göreme was launched in 2019 by a collaboration between the regional authority (Ahiler Development Agency – AHIKA) and a national university (Middle East Technical University – METU), supported by Underground4Value. The Action promoted and supported the Strategic Transition Practice [2] through the Living Lab in Göreme. The Living Lab was conducted between 2019 and 2020 with two subsequent stakeholder meetings, using online and face-to-face communication tools. As a result of these meetings, local stakeholders selected Karaya, a valley that stretches along the northern part of Göreme towards Avanos (a city by the Kızılırmak River), as the UBH site for the community valorisation. Hence, Karaya has become the subject of the possible future scenario of the expert group.

The outcomes of the Göreme Living Lab were widely discussed in the U4V Training School, organised in Naples in February 2020 [3], [4], [5], [6]. Although the COVID-19 outbreak halted the dynamic progress of the Living Lab, the senior researchers and young trainees of the Naples Training School worked collaboratively to develop a plan for the UBH conservation and sustainable local development of the neglected and abandoned cave site in Karaya. Within the Göreme Living Lab, a small multidisciplinary team was set up to work with the local stakeholders. A non-local participant who was granted the Short-term Scientific Mission of the Action helped the organisation of the stakeholder workshops, which increased the visibility of the Action at the local level.

This book presents the outcomes of the knowledge base studies on the case of Göreme and Cappadocia and the results of this Living Lab experience. In the preparation of the book, a special session was organised within the framework of the Fifth Underground4Value Meetings that was held at Middle East Technical University in Ankara on 23-25 May 2022 to present the earlier version of each chapter. Thus, the expert team, which came together throughout the Göreme case study process, found the opportunity to present their knowledge base contributions to the researchers and experts of the COST Action. This special session in Ankara also allowed the expert team to discuss their findings related to the case of Göreme with these researchers and experts from different fields.

This book is made up of eight chapters, including this introductory chapter. In Chapter 2, Müge Akkar Ercan focuses on the UBH of Cappadocia and Göreme, introducing the geological and geomorphological characters, the UBH features, types and the region's history. The chapter also

studies Göreme, its history, UBH specificities, the UNESCO World Heritage Site and surrounding UBH sites, and the town's recent spatial and economic changes. This chapter describes the main stakeholders of the UBH conservation and management at the national and international levels, reveals some of the problems and barriers to sustainable UBH conservation and local development in Göreme, and discusses how to approach the UBH to develop an integrated sustainable heritage conservation and tourism management plans and programs by highlighting the essential research topics before identifying the steps towards developing these plans and programs.

Chapter 3 examines the geotechnical and geo-environmental aspects of the UBH sites in Göreme. Kerim Aydiner describes the geological and geomorphological characteristics and assesses them on stability consideration. This chapter also introduces the potential threats and monitoring and controlling methods and technics for these underground structures during their lifetime. Besides the geo-environmental characteristics, possible geological and geomorphological mapping and 3D visualisation methods and tools, successful application examples from the world and potential mapping/modelling areas for Göreme are another critical focus of this chapter.

Chapter 4 explores the knowledge base of the UBH through the text-mining and sentiment analysis methodologies in the case of Göreme. Pinar Karagöz and her research team present their study to illustrate using text-mining and sentiment analysis techniques to augment and extend UBH analysis. They analyse the UBH areas of Göreme National Park, Derinkuyu Underground City and Kaymaklı Underground City in Cappadocia and apply two types of Artificial Intelligence-based text analysis on the collection of social media posts from three different social media applications. In this complementary analysis, they firstly apply unsupervised techniques of clustering and Latent Dirichlet Allocation (LDA) on the posts to identify latent topics in the message collection. Following this, sentiment analysis is applied for each of the topics in order to extract the orientation of the opinions expressed in the groups of postings. The variations of the opinions along the timeline are also presented. The chapter also discusses the ways to utilise the text analysis results for understanding and studying a UBH site. It is concluded with a brief elaboration on further text mining techniques to contribute to UBH analysis.

Chapter 5 examines the views of tourists on the World Heritage Sites (WHS) of Cappadocia, using the textual content posted by tourists in online environments through text mining methods, and assesses how far tourism management in the region is seen as sustainable. Ibrahim Akin Özen and Arif Akpinar examine four UBH sites in the Cappadocia region, i.e., Göreme Open-air Museum, Zelve Open-air Museum, Derinkuyu Un-

derground City and Kaymaklı Underground City. The chapter analyses the content shared by tourists about underground cities, churches and open-air museums in the WHS of Cappadocia. It discusses the opinions of tourists on tourism management in the Cappadocia region based on sustainable tourism.

Chapter 6 presents the Living Lab of the COST Action Underground4Value on Göreme. Yunus Sacid Yildiz, as representative of one of the Living Lab organisation agencies, introduces mission, responsibilities, and projects of the Ahiler Development Agency (AHIKA) and its UBH conservation approach and their regional sectoral development policies in the Cappadocia Region. The chapter includes completed and ongoing projects of AHIKA and the Göreme Living Lab experience from the agency's perspective. This Living Lab experience is described through its methodology, stakeholders involved in the process, their views on the UBH of Göreme and Cappadocia, and the outcomes of the stakeholder meetings and the Training School.

Inspired by the initial teamwork developed in the Training School of the COST Action Underground4Value, Chapter 7 aims to study the framework and possibilities for the implementation of actions for the enhancement of the UBH of Cappadocia as a sustainable tourism resource, considering heritage conservation, local development, and environmental impact. Young trainees, Jorge Magaz-Molina, Meryem Bihter Bulut and Bernard Bugeja, seek to deepen the reflections developed on Naples around heritage, community, and identity considerations attributable to the abandoned UBH sites and the strategies of knowledge and re-signification of these spaces. They attempt to synthesise territorial and regulatory context of the proposed case study, analyse the problems that affect it, explore the strategies to implement its enhancement and outline a general itinerary.

Finally, Chapter 8 provides an overview of all the chapters in the book and discusses the outcomes of each chapter regarding the current and future challenges of planning and managing the underground and on-the-ground heritage values in Göreme and the Cappadocia region. It also seeks to underline the necessities and requirements for the sustainable UBH conservation and local development of Göreme and Cappadocia in the era of uncertainties and multiple crises, and to develop ideas for implementing Strategic Transition Practice.

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CHAPTER 2

Underground Built Heritage in Cappadocia and Göreme

Müge Akkar Ercan

Cappadocia is a region in Turkey with a unique geomorphological and geological landscape and a worldwide-known natural and cultural heritage site. It is located in Central Anatolia on the rugged plateau of the Taurus Mountains. Its boundaries reach Kızılırmak (Red River) in the north, Tuz Gölü (Salt Lake) in the west, and the Taurus Mountains in the south. This large region covers six provinces of different sizes, including Aksaray, Kayseri, Kırşehir, Nevşehir and Niğde (Fig. 2.1).

Figure 2.1: The location of Cappadocia in Turkey

Göreme, Ortahisar, Ürgüp and Derinkuyu are small settlements located at the centre of this region (Fig. 2.2). Etymologically, the region's name

originated from *Katpatuka* in the Hittite language, which means 'land of the beautiful horses' [1].

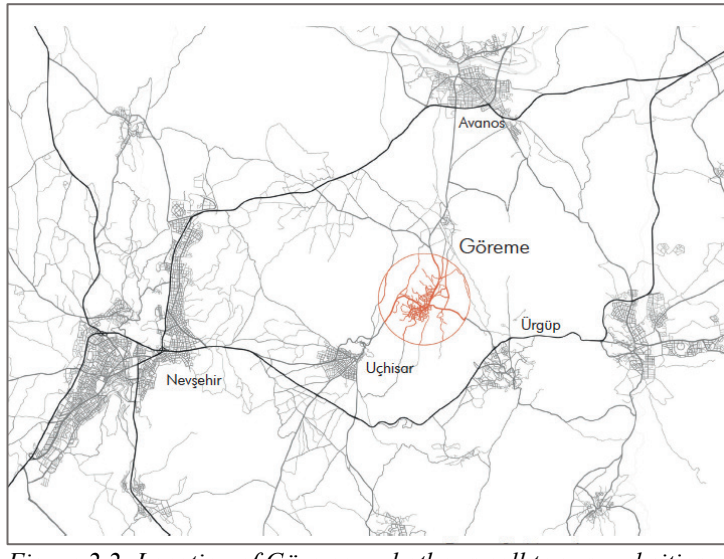

Figure 2.2: Location of Göreme and other small towns and cities in the Cappadocia region

This chapter focuses on the underground built heritage (UBH) of Cappadocia and Göreme. First, it introduces Cappadocia's geological and geomorphological characters, UBH features, types, and history. Second, it focuses on Göreme, its history, UBH specificities, Göreme Open-Air Museum and surrounding UBH sites, and the town's recent spatial and economic changes. Third, this chapter explains the main stakeholders of the UBH conservation and management at the national and international levels. In the fourth part, the chapter reveals the main problems and barriers to UBH conservation and local development. Finally, the conclusion underlines the need to develop comprehensive, sustainable and integrated heritage conservation and tourism management plans and programs. It also highlights the critical research topics before identifying the steps towards developing these plans and programs.

2.1. **UBH in Cappadocia: features, types and history**

Around 10-12 million years ago, the volcanic eruptions of Mount Erciyes, Mount Hasan and Mount Güllü formed Cappadocia's geological and geomorphological structure [2]. The lava of these volcanoes formed a layer of soft porous volcanic rock (i.e., 'tuff') on the plateaus, lakes and rivers with varied hardness and thickness of 100 and 150 meters. Ero-

sions, wind, rain and other natural conditions have shaped these soft volcanic rocks slowly and steadily. Rock towers and cones known as 'fairy chimneys', valleys and caves are today visible rock formations featuring this miraculous nature wonder in the world (Fig. 2.3). It is possible to see various forms of fairy chimneys, such as those with caps, cones, and mushroom-like forms of the pillar and pointed rocks [2]. Other geomorphological characteristics of the area are the sweeping curves of the valleys formed by rainwater. Besides, some valleys, such as Güldere Valley in Çavuşin, Meskendir Valley and Kızılçukur Valley in Göreme, and Pancarlık Valley in Ortahisar, have an array of different colours due to the difference in the heat of lava layers [2].

Figure 2.3: The unique landscape of Cappadocia.
Source: Akkar Ercan, 2023

Underground Built Heritage (UBH) is a prominent characteristic of Cappadocia. There are three types of UBH in the region. The first type is rock-cut settlements and caves. It is possible to find sites carved into the rocks in almost every city's historical parts in Cappadocia. The historic castle area and the small district, namely Nar, in Nevşehir, the old parts of Uçhisar, Avanos and Göreme are examples of these rock-cut settlements. The Göreme Open-Air Museum (the UNESCO World Heritage Site

(WHS)) and the rock fortresses of Uçhisar can also be considered under this type of UBH. Besides, many historical caves and rock-cut settlements along many valleys, such as Ihlara, Zelve, Paşabağ, Güllüdere, Zemi and Devrent, can be considered under this UBH category.

The second type of UBH is underground cities hollowed out of soft tuff from different historical times. In Cappadocia, there are approximately 200 underground cities. Among them, archaeological excavations were only made in eight underground cities. The biggest underground city in this region, which is open to the public, is Derinkuyu. Other underground cities are located in Kaymaklı, Özkonak, Mazı, Özlüce, Tatlarin, Kurugöl and Gökçetoprak (Fig. 2.5). Additionally, Soğanlı and Ihlara Valleys contain the settlement and religious centre systems that served as ideal places for the seclusion and worship of monks and a hideaway and defence area for people during the invasion years [3].

The third type of UBH includes individual dwellings, monasteries and churches built in a ferry chimney, cave or rock. They are used for different purposes, such as dwelling, worshipping, storing food or keeping domestic animals. According to the classification of the Commission of Artificial Cavities of the Union Internationale de Spéléologie, fairy chimneys and on-the-ground cave dwellings in Cappadocia are not typical UBHs [4]. Nevertheless, it is possible to come across different UBH types, and these rock formations are extremely rare and unique natural and cultural heritage characteristics of the Cappadocia region. These different cavity types include hypogeal (i.e., underground, subterranean) civilian dwellings (permanent dwellings, temporary shelters, warehouses, stables, pigeon houses), hydraulic underground works (tunnels, wells and waterways), military and war works (shelters for civilians and soldiers, galleries), religious works (places for worships and burial places) and transit (road tunnels).

The origins of Cappadocia can be traced back to the prehistoric periods -the Palaeolithic, the Neolithic and Chalcolithic ages- when craters and volcanic rocks dominated the landscape. For hundreds of years, Cappadocia became the home of many civilizations, societies and communities, which built dwellings and settlements by digging into this soft but firm tuff above and under the ground (Fig. 2.4).

The first inhabitants of Cappadocia were the Hattis, who lived between 2500-2000 BC. Later, the Assyrians (1900-1700 BC), the Hittites (1600-1200 BC), the Neo-Hittites (1200-800/700 BC), Phrygians and Lydians (1250-600 BC) lived in this region [1], [2], [5], [6], [7]. Persians expelled Lydians in 585 BC and ruled the region until 334-332 BC. After Alexander the Great defeated the Persians in 334 or 332 BC, the Kingdom of Cappadocia ruled the region from 400 BC to 17 AD. From 17 AD to 395,

Cappadocia became a province of the Roman Empire, and Caesarea (now called 'Kayseri') became the region's capital. After the division of the Roman Empire in 395 AD, Cappadocia remained within the boundaries of the Eastern Roman Empire (i.e., Byzantine Empire) from the fourth to eleventh centuries. During this period, the Sasanians (Persians), Arabs and Mongolians attacked the region. Following the battle of Manzikert (1071), the Seljuk Turks conquered the region. Cappadocia was ruled by the Seljuk Empire from the eleventh century to the thirteenth century and by the Ottoman Empire from the fifteenth century to the twentieth century.

Figure 2.4: History of Civilisation on a Timeline in Cappadocia
[1], [2], [5], [6], [7]

In Cappadocia, there are also numerous rock-hewn dwellings, churches, monasteries, and hermit cells along the hillsides and rock faces of the valleys. From early times, man-made caves and tunnels were used as refuges during periods of instability. Underground cities were built to act as shelters in times of danger due to the frequent foreign raids. Nearly every house in the region had a secret entrance to the underground city. Local people developed these cities by digging out rooms and corridors that were hard to pass, and they built traps to increase security. In time, they opened more rooms and corridors by digging further into the rock [2].

Underground cities had hundreds of dwelling rooms, production, storage and workspaces, stables, worship places, churches, wineries, millstones, and even graves. These rooms were connected with a complex pattern of passages, steps, and low, narrow and long tunnels like a labyrinth to restrict enemies' movements [3]. Ventilation shafts, run between the floors, ventilated these underground cities [3]. Huge stone doors were

used to block ventilation shafts and tunnels in times of danger. Most of the stone doors were carved in situ [2].

It is unknown when the first underground settlements were first built in Cappadocia. The earliest record of the underground cities was found in rock imprints and inscribed monuments on the rocks from the Hittite and the late-Hittite periods [2]. The presence of underground passages, known as 'Potern' in Hittite towns, and the superior building techniques are other evidence of the Hittite period. Secret tunnels found in Hittite cities were generally used to ambush attackers and for defence [2]. According to Xenophon's 'Anabasis', Hellene communities lived in Kaymaklı and Derinkuyu underground cities at the end of the fourth century BC [2].

Similarly, the first Christians who escaped from the persecution of the Roman Empire came to Cappadocia in the second century and built underground cities. As they had to live under the ground for a long duration without going out, they developed storage rooms, ventilation chimneys, wine production places, worship places, water wells, toilets and meeting rooms. From the fifth century to the tenth century, underground cities were used for defence and religious purposes [2]. The Arab-Sassanid raids in the seventh century also forced Christian communities to use these cities as refugees [2].

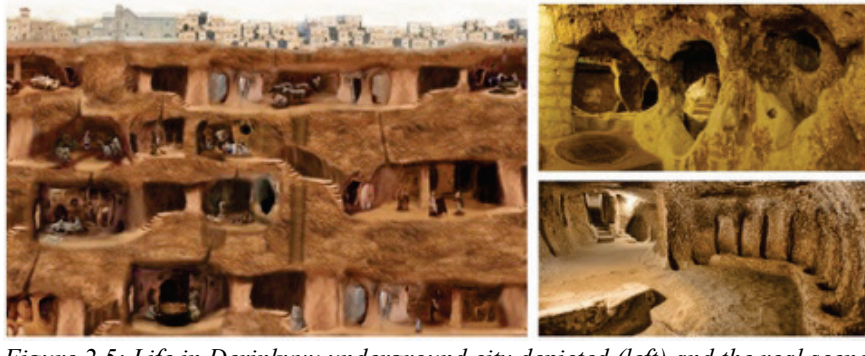

Figure 2.5: Life in Derinkuyu underground city depicted (left) and the real scenes from the underground city [8], [9], [10]

Besides caves and settlements constructed by carved-out rocks, other prominent UBH components of the region include rock-hewn churches and monasteries built between the fourth and the thirteenth centuries and traditional houses constructed on hillsides in the nineteenth century. In the valleys of Cappadocia, it is anticipated that there are more than 300 cave churches and monasteries built between the ninth and thirteenth centuries [1]; and 794 or more listed monuments and sites within the region belonging to the period from the first to the eleventh centuries [11].

The Cappadocian Rock is the only construction material in the region. It is a very soft material, which is easy to shape just after it is dug out from the quarry, but it hardens and turns into a strong construction material after contacting with air [2]. Due to the quality of this rock, the stonework has been well developed in the region. It is considered art and craftwork marking the area's architectural tradition, such as, in buildings, upper parts of the doors built with arches and decorated with stylized ivy or rosette motifs.

The Cappadocian buildings can be classified as i) rock-hewn buildings, ii) stone masonry buildings and iii) mixed buildings [3]. The mixed buildings are constructed using a mixture of hewn and stone masonry techniques. These buildings are also built by hewing the part of the houses leaning on the rock used for a pantry, storage, or stable [3]. Wood is used for courtyard gates and the houses' doors. The areas between floors are decorated in up to three rows of rosettes, fans, stars, pelmet, weather vanes, and stylized plant patterns. Windows are grouped in twos and threes, and stylized plant patterns are used as decorative borders. Two types of windows are used: two panes opening separately or guillotine style. In houses, there are numerous living rooms, a kitchen, a cellar, a storage room, an oven (called 'tandır'), and a wine vat. In the guest rooms, there are niches that are decorated with paintings of vases full of flowers under silk, tasselled curtains, scenes from nature or women filing or carrying water vessels. These scenes are painted on plaster.

The most interesting examples of local architecture belong to the late nineteenth and early twentieth centuries can be seen in Ürgüp, Uçhisar, Göreme, Güzelöz, Güzelyurt and Mustafa Paşa. With individual working, living, storage, production and worship spaces, traditional Cappadocian settlements carved into rocks and caves are one of the rarest settlements in the world. The historic buildings make use of the sloping land. Besides the underground hewn rock units, these buildings generally have two stories at the ground level. They include many terraces at different levels for different purposes and activities [3]. Dovecotes carved into rocks are other architectural specificities of Cappadocia. They can often be seen in Uçhisar, Göreme, Ürgüp, Çavuşin and Soğanlı.

2.2. **Göreme: A town of fairy chimneys, rock-hewn and cave dwellings tales**

Göreme is a small town in Cappadocia with approximately 2,000. Earlier, it was called Korama, Matiana, Maccan or Machan, and Avcılar. This small town is located between Uçhisar, Ortahisar and Ürgüp, and it is 20 kilometres far away from Nevşehir (Fig. 2.2). It was built on a natural

landscape formed by the out-spills and ash of three volcanoes that were later hardened and became tuff. This rock has eroded for millions of years to form natural giant rock cones and columns, i.e., fairy chimneys, which dominate the townscape and its surroundings (Fig. 2.6). The settlement structure of Göreme constitutes fairy chimneys, rock-hewn dwellings and historic cave dwellings along the hillsides and a significant concentration of Byzantine monastic settlements. The inhabitants hollowed out these rocks for centuries to build cave dwellings, places for worship, storage spaces for food, and stables for domestic animals.

Figure 2.6: Göreme's urbanscape around the fairy chimneys and rock-cut houses
Source: Akkar Ercan, April 2023

Göreme's history goes back to the Hittite period. The first comers settled in this area between 1600 and 1200 BC. It became a central location for rival empires, such as the Hurri-Mitanni, Hittite Empire, Middle Assyrian Empire, Neo Assyrian Empire, Persian Achaemenid Empire and the Greek Seleucid Empire [5]. For this reason, inhabitants tried to survive by digging and tunnelling into the rocks and escaping these attacks.

From the first century onwards, during the dominance of the Roman empire, Christianity became the primary religion in Cappadocia. By the end of the second century, a prominent Christian community had formed

in Cappadocia due to the proximity of two bishoprics in Caesarea and Melitene. In the fourth century, Cappadocia became known as the land of three saints: The Great Saint Basil (Bishop of Caesarea), his brother Saint Gregory of Nyssa, and Saint George of Nazianus. These three saints created a new unity in Christian thought, and many of Saint Basil's thoughts and actions are still important today. Saint Basil founded a small, secluded settlement far away from towns. He introduced worship within the community, and he was not bigoted. The same model was introduced in Soğanlı, Ihlara and Açıksaray. In the fourth century, Caesarea became a flourishing religious centre, and Göreme became a religious education centre [2]. Adopting the teaching of Saint Basil, Christians began to lead a monastic life in the carved-out settlement of Göreme, which is now preserved as an open-air museum. Daily worship used to be carried out under the supervision of a preacher. Similar to the Christian communities in Egypt and Syria, these groups were not privileged groups separated from the community.

After the twelfth century, Turks and Muslims became dominant in the town. Now, Turk Muslims and a few groups from different national, ethnic and religious origins live together in harmony.

Before the 1950s, Göreme was a farming village. In 1950, the Turkish government turned a part of the valley into an open-air museum. Since then, the governments have continued to restore the natural, archaeological and historical heritage. In 1985, Göreme Open-Air Museum and the National Park and Rock Sites became UNESCO World Heritage Site (WHS). Afterwards, the open-air museum and the National Park became the leading tourist destinations.

2.3. **UBH in Göreme National Park and Rock Sites and Open Air Museum**

Göreme National Park and Rock Sites, occupying an area of nearly a 100-kilometre square, constitute a rocky, water and wind-eroded landscape with ancient interconnected underground settlements and a large number of rock-cut churches and dwellings (Fig. 2.7). The park and rock sites include historical, cultural and natural heritage, which are used and conserved side-by-side. In Göreme, it is estimated that there are 45 ecclesiastical structures [12], [13], [14], [15], including 38 churches, one chapel and the monastic complexes of Aynalı Church and Kızlar Monastery [11]. Although many scholars such as Levidis [16], Messerschmidt et al. [17], Ramsay and Bell [18], de Jerphanion [12], Thierry [19], [20], [13], Ötüken [14], and Kalas [21], [22] attempted to make an inventory of the rock-hewn monuments and sites, no thorough study has been conducted

so far to develop a complete inventory of the region [11]. Nonetheless, it is known that the hewn-out churches in Göreme and its surroundings are unique in terms of their architectural plans that were very suitable for the religious lifestyle in the region and for the monks who withdrew into solitude [3]. They were also used as tombs [3]. The transverse rectangular plan type was of Mesopotamian origin [3]. Around four hundred sanctuaries are estimated to be spread into the entire region. The most important ones are Tokalı Church, Elmalı Church, St. Barbara Chapel and the Karanlık Church, located in the Göreme open-air museum [3].

The national park status of this site was annulled in 2019, just after the establishment of the Management Directorate of Cappadocia Heritage Site.

Figure 2.7: The historical and natural landscape of Göreme Open-air Museum and the national park
Source: Akkar Ercan, April 2023

2.4. **Culture and heritage-led tourism, creative industries, agriculture and urban-rural development in Göreme**

From the 1990s onwards, tourism has become the primary sector in the economy of Göreme and Cappadocia. The conservation efforts of the

Turkish government have gone hand in hand with the region's local economic and spatial development. Similar to many towns in Cappadocia, Göreme has transformed rapidly with the emergence of cave hotels, boutique hotels and pensions exhibiting traditional lifestyles, a variety of wineries, restaurants, pottery and ceramic workshops, and souvenir shops. Local tourism development has continuously generated new businesses and activities.

Besides culture and heritage tourism, hot balloon trips over ferry chimneys and valleys, trekking, walking, horse riding, motorbike and mountain biking, and ATV riding tours in many fascinating valleys, claypot making, and wine-tasting are other popular tourism activities. Tourism has also led to the development of the entertainment sector (e.g., Turkish nights and pottery kebab tours for tourists), gastronomy and wine culture, art and cultural festivals and sports events such as Capadox and Cappadocia Ultra Trail.

Cappadocia is famous for grape growing and winemaking. In Göreme and its surroundings, picturesque village life continues. Villagers and farmers still do daily agriculture and farming activities in the Göreme National Park. The local community still uses caves to store food and goods, shelter animals and live for people. Caves have always been used to store food. The harvested grapes used to be squashed in the rock-carved hollows to make wine, grape juice or grape molasses.

Göreme comprises many valleys, vineyards, agricultural lands, hotels, and a commercial centre with several restaurants serving local and international foods, cafés, bars, traditional coffee houses and souvenir shops. The increasing tourism activities, rising rents, and house prices have reduced the living population in Göreme. Many native residents have moved to other settlements close to Göreme. The majority of the working population commutes to this town every day. Göreme generally becomes a place for hosting national and international guests at night.

2.5. **Main stakeholders of the conservation and management process of UBH in Göreme**

Several actors can involve in the conservation and regeneration process of UBH in Cappadocia. International agencies involved in conserving UNESCO WHS include UNESCO and ICOMOS (Tab. 2.1). The national government institutions that are the critical actors in Cappadocia's conservation and management planning include the Ministry of Culture and Tourism, the Ministry of Environment and Urbanism, the Regional Conservation Board of Cultural and Natural Assets, and the Ministry of Forestry and Environment. At the regional and local levels, the principal government agen-

cy leading Cappadocia's conservation management plan is the Management Directorate of Cappadocia Heritage Site. Founded in 2018, this agency has become responsible for all the conservation planning and management of the UBH sites. Other local-level state agencies are the Ahiler Regional Development Agency (AHIKA), Nevşehir provincial authority, Nevşehir Greater Municipality, Göreme Municipality, the provincial directorate of the ministries (environment and urbanization, tourism and culture, forestry and environment), the Nevşehir Museum Directorate (the agency responsible for the management of Göreme Open-air Museum) and Nevşehir Restoration and Conservation Lab. Neighbouring district municipalities such as Avanos, Uçhisar, and Ortahisar Municipalities may also be involved in the conservation and management process of UBH if a project is larger than the legal vicinity of the Göreme Municipality.

From the private sector, a wide range of stakeholders in the tourism or hospitality sectors actively contribute to the conservation and regeneration planning and management of UBH. A variety of hotel companies are present: big hotel companies with large capital investment capacity, boutique hotels, cave hotels and small pensions. Travel agencies work collaboratively with the hotels and engage in several tourism activities such as tourist transfers from the airports to hotels, organisation of the balloon, horse, and mountain bike rides, ATV and jeep safaris, trekking, hiking tours along the valleys, and organizing visits to important UBH sites, hammams and special Turkish nights. Some travel agencies and hotels actively contribute to developing creative industries by organizing cultural and sports festivals like Cappadox and Cappadocia Ultra Trail. By performing in these festivals and cultural events, national and international artists contribute to developing creative industries in Göreme and Cappadocia. One of these artists is Andrew Rogers, an Australian artist who designed, produced and installed very large-scale land-art sculptures in Karaya, on a nearby site to Göreme, in collaboration with the old mayor of Göreme and the local community in the late-1990s. The sports players participating in international and national sports events can also contribute to the UBH conservation and tourism development in Cappadocia.

There are a variety of eating and drinking places. Restaurants serving a variety of Turkish foods, fast foods, foods from international cuisine and some specific countries' cuisine (e.g., Chinese and Korean restaurants) exist in Göreme. Besides, small boutique and cave hotel owners have restaurants serving the guests from the hotels and outside.

In agriculture, landowners who primarily engage in agriculture and farming activities are other important local stakeholders in the UBH conservation and management. Some hotel owners also have large agricultural lands, using agricultural and dairy products in their hotels.

In the education sector, there are two universities in Cappadocia. One is Kapadokya University and the other is Nevşehir Hacı Bektaş Veli University. Various departments from the Faculties of Tourism and Engineering and Architecture, departments of History, Art History and Archaeology provide the potential to contribute to the conservation planning and management of UBH sites and the tourism development in the area. At Kapadokya University, a Sustainability Commission is working on the region's sustainable development based on various dimensions (e.g., ecological, environmental, and cultural), including UBH values.

Some prominent civil society organisations in the region related to UBH conservation and regeneration include the local committee of the Association of Turkish Travel Agencies (TÜRSAB), Infrastructure Service Association of Cappadocia Tourism Region (KAP-HIB), Cappadocia Touristic Hoteliers and Operators Association (KAP-TID), the local Chamber of Tourist Guides, Göreme Tourism Development Cooperative and Cooperative of Local Women Entrepreneurs. Cooperative of Local Women Entrepreneurs have several restaurants in different towns in Cappadocia, such as Avanos, Göreme, Mustafapaşa, Uçhisar and Ürgüp, being run and served by local women and serving only local home-made foods.

Table 2.1: Stakeholders of UBH conservation and management
Source: Author

STAKEHOLDERS	Stakeholder sub-groups
• **International non-governmental agencies**	○ UNESCO ○ ICOMOS
PUBLIC SECTOR	
• **National government institutions**	○ Ministry of Culture and Tourism - the Regional Conservation Board of Cultural and Natural Assets ○ Ministry of Environment Urbanism and Climate Change ○ Ministry of Forestry and Environment
• **Regional and local government institutions**	○ Management Directorate of Cappadocia Heritage Site ○ Ahiler Regional Development Agency (AHIKA) ○ Nevşehir provincial authority ○ Nevşehir Greater Municipality ○ Göreme Municipality ○ Provincial directorate of the ministries (environment, urbanization and climate change, tourism and culture, forestry and environment), ○ Nevşehir Museum Directorate (also managing Göreme Open-air Museum), ○ Nevşehir Restoration and Conservation Lab

PRIVATE SECTOR	
• **Hotels**	○ Hotels with large capital investment capacity ○ Boutique cave hotels ○ Small hotels ○ Pensions
• **Travel agencies**	○ Specialized tour agencies (operating heritage and authentic place sightseeing tours, hot balloon tours, horse-riding, mountain bike, motorbike, ATV, jeep safari, trekking, hiking tours, airport transfer and hotel organisation agencies) ○ Wedding and honeymoon photography agencies ○ Travel agencies involved in the organisation of cultural and sports festivals, such as Cappadox and Cappadocia Ultra Trail
• **Restaurants, cafés and bars**	○ Turkish restaurants ○ Non-local restaurants (Chinese, Korean, etc.) ○ Restaurants of small boutique and cave hotels ○ Cafés and bars
AGRICULTURE SECTOR	
• **Agriculture and husbandry**	○ Local agriculture landowners ○ Small farm owners with livestock
EDUCATION, RESEARCH AND DEVELOPMENT SECTOR	
• **Universities**	○ Nevşehir Hacı Bektaş Veli University (state university) ○ Kapadokya University (private university)
VOLUNTARY SECTOR	
• **Civil Society Organisations of Cappadocia related to UBH conservation and regeneration**	○ The local committee of the Association of Turkish Travel Agencies (TÜRSAB) ○ Infrastructure Service Association of Cappadocia Tourism Region (KAP-HIB) ○ Cappadocia Touristic Hoteliers and Operators Association (KAP-TID) ○ the local Chamber of Tourist Guides ○ Göreme Tourism Development Cooperative ○ Cooperative of Local Women Entrepreneurs
• **Artists (national and international)**	○ Andrew Rogers ○ National artists who made art installations in the cultural festivals ○ Music bands and singers performing in the cultural events
• **Sport players**	○ Professional and non-professional sports players (participants in marathons
TOURISM	
• **Tourists**	○ International tourists ○ Domestic tourists and visitors
COMMUNITY SECTOR	

• **Local inhabitants according to:**	○ Age groups ▪ Children (aged below 11) ▪ Teenagers (aged between 12-22) ▪ Young people (aged between 23-45) ▪ Middle age people (aged between 46-65) ▪ Older people (aged over 66) ○ Gender groups (Man-Women) ○ Education level (primary school, secondary school, high school, university graduates) ○ Income groups
• **Local dwellers**	○ Property owners ○ Tenants

2.6. **Problems and challenges of UBH conservation and local development**

Following the announcement of the Göreme Open-Air Museum site as a UNESCO WHS in 1985, the primary sector driving the local economic development has become tourism. Over the last thirty-five years, international and national tourists visiting Göreme and Cappadocia have increased continuously. Tourism has brought an important impetus for local development and conservation of UBH by attracting investors, tourists and visitors, raising awareness of local UBH, natural and cultural values and cultural traditions, developing the agricultural sector, agriculture-based industry, education, creative and hospitality sectors, creating new employment opportunities and developing the organisational capacity of local entrepreneurs [5]. It has also increased the institutional capacities of local and regional governments by providing them with new financial resources and helping them improve their human resources, institutional infrastructure (better offices, technological availabilities, etc.) and organisational capacity. Like many other places in Cappadocia, all these tourism-led developments in Göreme have generated challenges regarding the sustainable conservation of UBH sites.

This unique natural heritage landscape and aboveground and underground settlements are at risk of rapid decay and disappearance due to human and nonhuman factors [5]. On the one hand, continuous degradation is produced by natural agents on rock formations due to erosion, rock falls, freeze-thaw cycles, flooding, etc. [23]. On the other hand, the increased impact of human factors, such as the construction of hotels, roads, car parks, and balloon take-off sites, causes the decay of UBH and rock formations. Polimeni et al. claim that non-archaeological sediment discharge, lowering of ancient tunnels, construction of masonry walls, gates and lighting systems for the ever-increasing number of tourists, and the

drainage of sewers quickly solve the problems of local urban services [23]; but the low sensitivity and knowledge of the local community cause the UBH decay and damage. Hence, a more sensitive conservation and management approach is necessary to reduce or minimize the deterioration of UBH and other natural and cultural heritage values.

The dynamic economic relations, activities and entrepreneurship in the region (especially in the tourism sector) create new development demands and desires. Mass tourism is a significant threat to the region against its sustainable development and sustainable UBH conservation [5]. The endeavours of the central and local governments to address these demands and desires with fast and fixed solutions generate new difficulties and challenges for conserving heritage spaces. Additionally, high demands from tourists and tourism agencies to organize balloon rides, ATVs and jeep safaris lead to severe damage to the natural, cultural and historical heritage of Göreme and Cappadocia. The constant development demands of some hotels and residential sites, their illegal extensions to their premises and unplanned tourism investments create new threats to conserving the valleys, fairy chimneys, other UBH components and the existing fertile agricultural and farming lands. The existing caves and ferry chimneys are not used carefully or sufficiently cared for. If the precautions for their conservation, security and safety are not timely, sometimes they collapse due to human and nonhuman factors.

The complex property ownerships (e.g., multiple owners of historical buildings) are another factor causing delays in taking action to restore UBH sites. The commodification and commercialization of UBH generate an undervaluation of the current UBH values and some given scarce natural resources such as water, endemic plants and animals, and old customs and traditions. Some intangible cultural heritage values (such as local cuisine) are slightly modified according to the taste and expectations of tourists. In every restaurant, one can find similar types of food. New international restaurants have been opened (such as Chinese or Indian food served in the new restaurants), which spoil the local identity of Göreme. Some community members lack sufficient sensitivity to their UBH and associated heritage values. Heritage values and natural resources are generally perceived as assets being taken for granted. Water, as a scarce resource, is used extensively. No recycling strategy has been developed yet. Precious heritage lands are turned into balloon take-off sites, ATV driving routes, and horse-riding sites at the expense of damaging the unique natural and ecological landscape and spoiling beautiful UBH scenery. There needs to be a continuing education or learning experience to attain a sensitivity and awareness towards UBH, to remind the uniqueness of the existing heritage values and help the community re-discover their past values.

As restoration, conservation and renewal costs of historic properties are very high, another factor causing the loss of UBH is the local authorities' and some property owners' lack of financial resources. Most residents cannot afford their houses' restoration and maintenance costs, so they sell their homes to investors at the highest possible prices, and this causes continuously rising sale prices of heritage spaces and the gentrification of heritage spaces by tourism investors and non-local people. Or, some inhabitants turn their homes into hotels and live in another town nearby Göreme. This trend has created a town which only serves tourists while losing its residents. As for local authorities, they have limited financial resources for the conservation of UBH sites. Finding and generating necessary financial resources is another critical challenge for the local governments in Göreme and Cappadocia to implement conservation plans and projects. They are actively looking for funding national and international opportunities to support the conservation and restoration projects of UBH sites.

Heritage conservation has a very complicated administrative and legal structure in Turkey. Over the last century, the legal and institutional organisation of urban conservation and regeneration has created a highly complex conservation planning and governance system, generating conflicts between the legislations, agencies and jurisdictions of agencies [24]. The authorities and responsibilities of the central, regional and local state agencies overlap and create difficulties in planning and managing heritage conservation [24]. These overlapping jurisdictions of the state authorities ultimately lead to significant obstacles to protecting heritage in Cappadocia.

Currently, the Management Directorate of Cappadocia Heritage Site is leading the development of conservation and management plans at the regional level to resolve the conflicting jurisdictions of agencies and establish an integrated conservation planning model in the region. They commissioned the regional-scale conservation and management plan to a private planning consultancy company, UTTA Planning Consultancy Office, which was to deliver this plan in 2023. Giving planning power and responsibilities of the region to one state agency seems to resolve the conflicts between the jurisdictions of many state authorities legally responsible for the conservation and management of UBH sites. Nonetheless, the Management Directorate of Cappadocia Heritage Site took the duty of making the regional-scale conservation and management plans from UTTA due to some conflicts, and they commissioned it to an expert group at Kapadokya University. This extended planning process creates new opportunities for illegal developments, thereby leading to new risks for the deterioration of natural and cultural heritage in the Cappadocia and small towns and cities in the region. Until the time when the new conservation

and management plan is to be approved by the Ministry of Culture and Tourism and to be in power, the local governments have to make their implementations based on the development conditions of the transition period determined by the Regional Conservation Board. This extended transition period is currently creating some difficulties for the local authorities, and some jurisdiction and authority gaps for illegal developments.

For the sustainable conservation of UBH in Göreme and Cappadocia, it is critical to develop a conservation plan with a comprehensive and integrated approach, as the HUL approach of UNESCO suggests [25]. Such a conservation plan should include sustainable urbanism and tourism development policies and strategies. Commissioning such planning, design and restoration projects to private expert companies or universities and developing public-private partnerships (including local voluntary and community groups) may help implement successful UBH conservation projects. Such successful projects can be exemplary for future conservation projects in the region. However, strict state control, which limits construction, tourism and agricultural activities and pursues heritage conservation rules, requires this region to protect its natural and cultural heritage, including the UBH.

The lack of experts with sufficient technical knowledge is a significant problem in many small municipalities. It causes difficulties in developing sustainable conservation policies within the jurisdictions of municipalities and preparing urban plans for heritage sites [24]. Municipalities must connect to experts and universities to conduct necessary research and develop conservation and urban design policies and projects for their locality.

The physical, natural, historical, and cultural UBH resources are not well documented and archived systematically. Because of natural reasons (such as rockfalls and erosions), continuous damage happens in UBH. This constant destruction is not recorded either. In this sense, it is necessary to establish a UBH documentation system to monitor UBH sites in scientific, systematic and multidimensional ways. Such a documentation system requires a significant amount of financial resources. Nonetheless, it will help create an archival and monitoring system for UBH values and support future scientific research, decision-making and planning. It will also contribute to developing a smart and sustainable management system for UBH sites and local development.

Likewise, participatory planning and an inclusive decision-making approach are not practical and pragmatic for local authorities while managing their heritage spaces. In general, they would like to attain successful outcomes for themselves in the shortest possible way. Participatory processes continuously operated in conservation and regeneration require new experts, financial resources and offices. This idea is unfamiliar to the

local authorities, private entrepreneurs and communities. There is a great potential to implement several projects through bottom-up approaches with a theme of sustainable urbanism, conservation and management, such as the waste management strategy, public space strategy, and rainwater collecting strategy. However, the municipalities in Cappadocia are not very open to implementing new participation tools and methods. A professional urban design team can develop well-thought design-based solutions promoting sustainability principles of the upper-scale plans by collaboratively working with the municipality, hotels' and local businesses' representatives and some residents in Göreme. In this sense, Göreme could be a significant pilot study site for the region. Developing bottom-up and top-down strategies for sustainable urbanism, which pursue a balanced approach between conservation and local development, is critical, because Göreme's sustainability problems are complex. Such endeavours should be well-coordinated by the local or central state authorities. Otherwise, such efforts may create new conflicts and wrong implementations, which can harm natural and cultural heritage resources.

Last, the local network among the local tourism investors and population in Göreme is strong. Some business groups have a high self-organisation capacity. They can act cooperatively and actively in the local government's decision-making process. Among the tourism investors and hotel owners, some have the higher financial power to invest in, restore and maintain the existing UBH. In this sense, there are much more well-restored, cared and maintained heritage spaces in some parts of Göreme than others. However, many heritage spaces still need to be restored, rehabilitated and re-functioned to turn this small town into a sustainable heritage space.

2.7. **Conclusions**

Cappadocia is an economically and socially very lively region. The private sector investments have intended to attract more tourists, thereby increasing economic benefits to the region. However, policymakers have not sufficiently considered the possible adverse outcomes of this mass tourism. UBH in Göreme and Cappadocia are under the threat of several human and nonhuman factors, such as erosions, rockfalls, mass tourism, hotel developments leading to gentrification of the site, ATVs, balloon and trekking activities damaging continuously the natural landscape, commercialization and commodification of heritage, which endangered the sustainability of communities, heritage values and potentials, ecosystem and cultures. These complex problems require developing comprehensive, sustainable and integrated heritage conservation and tourism

management plans and programs, accompanied by integrated and long-run development plans. It is critical to raise awareness about UBH, tangible and intangible heritage values among local communities, and develop new entrepreneurial, educational and human capacity development activities to complement conservation endeavours. Local communities (including several business and entrepreneurial groups) have the potential to start bottom-up initiatives with the support of local and regional government agencies, universities, private enterprises, and voluntary groups. However, it is still critical to examine Göreme with its UBH as a resource and value, its potential, problems and obstacles. More specifically, there is a rising need to study systematically:

- how far the present heritage conservation and tourism management plans at the regional, city and community levels are comprehensive, sustainable and integrated;
- how far these plans are concerned with the rising issues such as climate change, energy efficiency and nature-friendly solutions;
- how far local development and conservation plans provide and pursue short-, medium- and long-term sustainable development goals;
- how far they develop strategies regarding the governance processes, financial resources, legal and administrative backgrounds, limitations and potentials;
- how far they ensure both top-down and bottom-up governance models to advance collaboration, cooperation, and co-creation in the UBH conservation;
- how far the community awareness about UBH (tangible and intangible values among the local community and other stakeholders) complement the government's conservation endeavours;
- how far the local communities can start bottom-up initiatives with the support of local and regional government agencies, universities, private entrepreneurs and voluntary groups is attained in this locality;
- what social and informational technologies can support such bottom-up initiatives:
- what are the multiple values of locality based on heritage, traditions, daily life experiences; and
- how heritage-led and community-led regeneration projects can sustainably protect these values.

It is critical to initiate such extensive and comprehensive studies to reveal the levels of conservation and regeneration of UBH in Göreme and its surroundings and to identify the steps forward toward more sustainable conservation and regeneration.

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CHAPTER 3

Stability Assessment of Underground Built Heritage at Cappadocia Region

Kerim Aydiner

3.1. Geo-environmental Characteristics of the Region

3.1.1. Geography and climate

The modern Cappadocia area extends over 5000 km^2 within the triangle of Kayseri–Aksaray–Niğde in central Anatolia of Turkey (Fig. 1). This area forms a high plateau and is covered by almost horizontally layered acidic volcanic tuffs and lavas from Erciyes, Melendiz and Hasandağ volcanoes in several hundred meters thick [1].

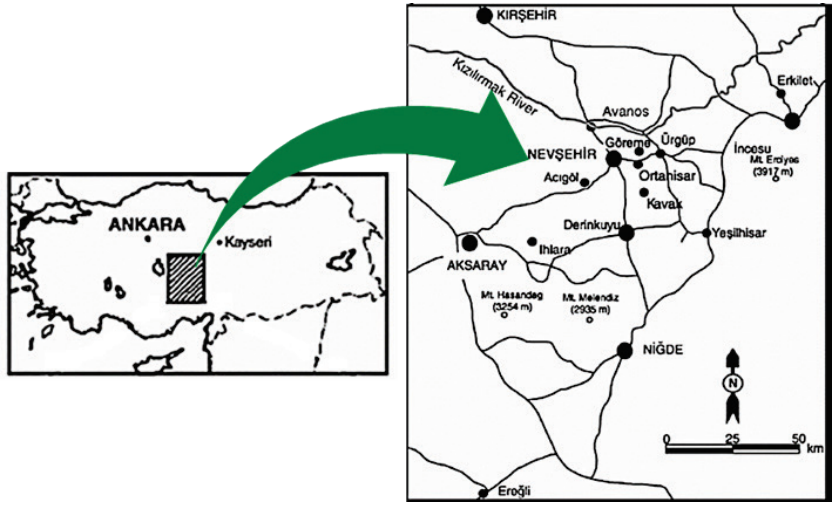


Figure 3.1: Location map of Cappadocia Region (modified after [2])

Located in the Central Anatolia region of Turkey, Cappadocia is surrounded by Erciyes (3,917 m), Melendiz (2,935 m) and Hasandağ (3,254 m) volcanoes (Figure 3.1). The region is above 1,300-1,400 m sea level. The Kızılırmak river passes through the north of the region. It is known that it contributed to the shaping of the topography of the region together with its branches [1]. The topographic elements of the region are the valleys and the volcanic tuffs forming the slopes. Tuffs are also found in many parts of the region in the form of fairy chimneys, which are the products of erosion caused by atmospheric conditions. In Cappadocia, where the continental climate is dominant, winters are cold and severe and moderate snowfall is observed. Ground is covered long time by snow. The season is hot and dry. The hottest months are July and August (Figure 3.2).

The temperatures in July and August in the Cappadocia range usually between 30-35 oC. In January and February, temperatures generally drop below zero. The spring and fall seasons are milder, with temperatures ranging between 15-20 oC on average. The difference between daytime and nighttime can reach up to 10-15 oC.

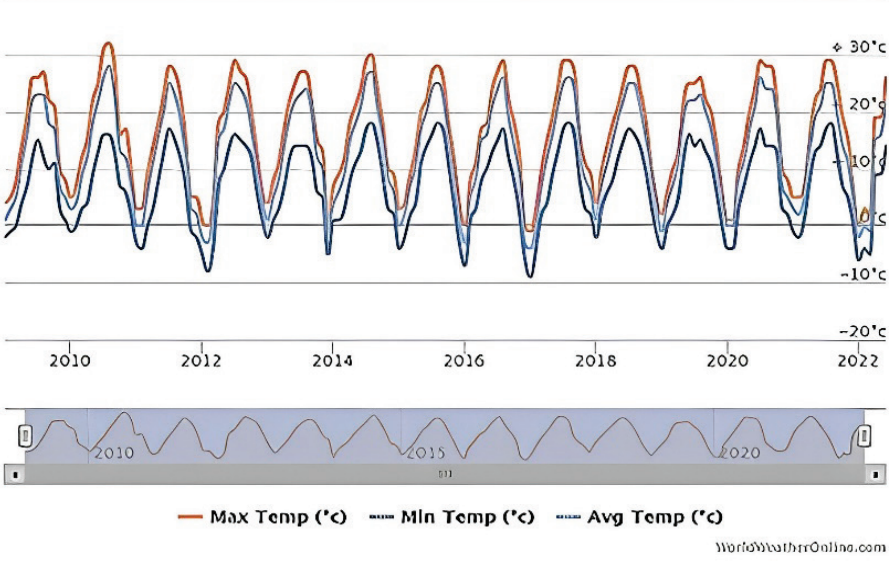


Figure 3.2: Temperature records in Nevşehir between 2008 and 2022 [3].

The Cappadocia region receives an average of 350 mm of precipitation annually, which generally occurs in the spring and winter seasons. In the region, winter precipitation mainly occurs in the form of snow (Figure 3.3). While the average rainfall approaches 100 mm in the winter seasons,

it has been observed that the number of rainy days has decreased in recent years. Figures 3.3 and 3.4 present the precipitation characteristics of the region between 2008 and 2022.

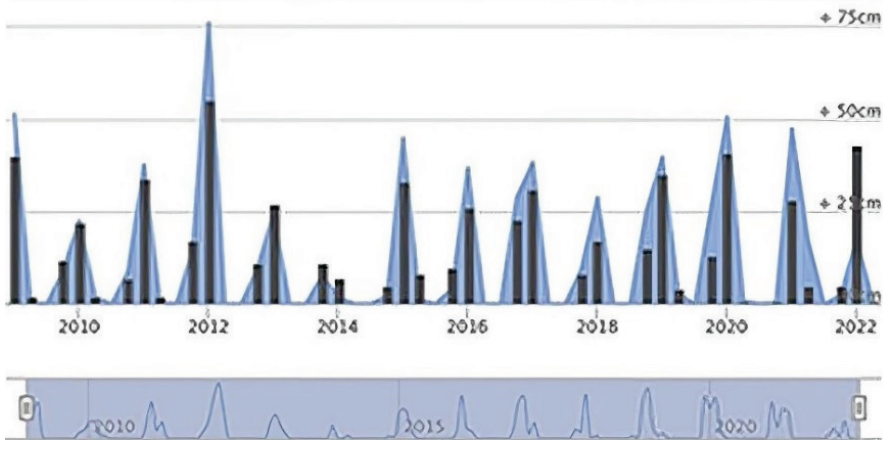


Figure 3.3: Precipitation records in Nevşehir between 2008 and 2022 [3].

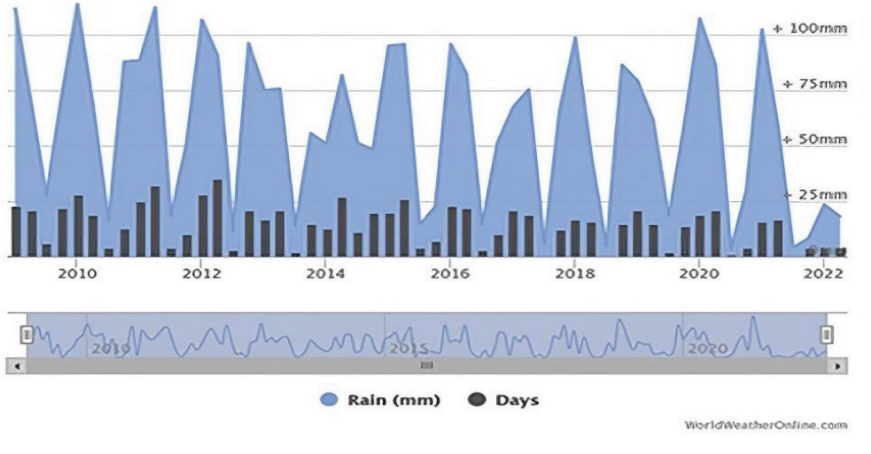


Figure 3.4: Records of rainy days in Nevşehir between 2008 and 2022 [3].

3.1.2. **Geology**

The Cappadocia region is largely located on volcanic rock units dating back to Neogene- Quaternary period [Figure 3.5]. The long axis of this region is about 300 Km and extends at the NE-SW. It is widely accepted that the volcanic rock unit formed as a result of the plate convergence and continental collision occurring between African– Arabian and Eurasian Plates in the Eastern Mediterranean [4].

The rock units in and around the region are basement rocks, Yeşilhisar formation, Ürgüp formation and Quaternary deposits. The Yeşilhisar formation is a coarsely bedded fluvial deposit. Red mudstone, sandstone and conglomerate alternations are observed in the unit. Also, granite, quartzite, chert, marble and limestone and ophiolitic fragments are also the elements encountered at some regions.

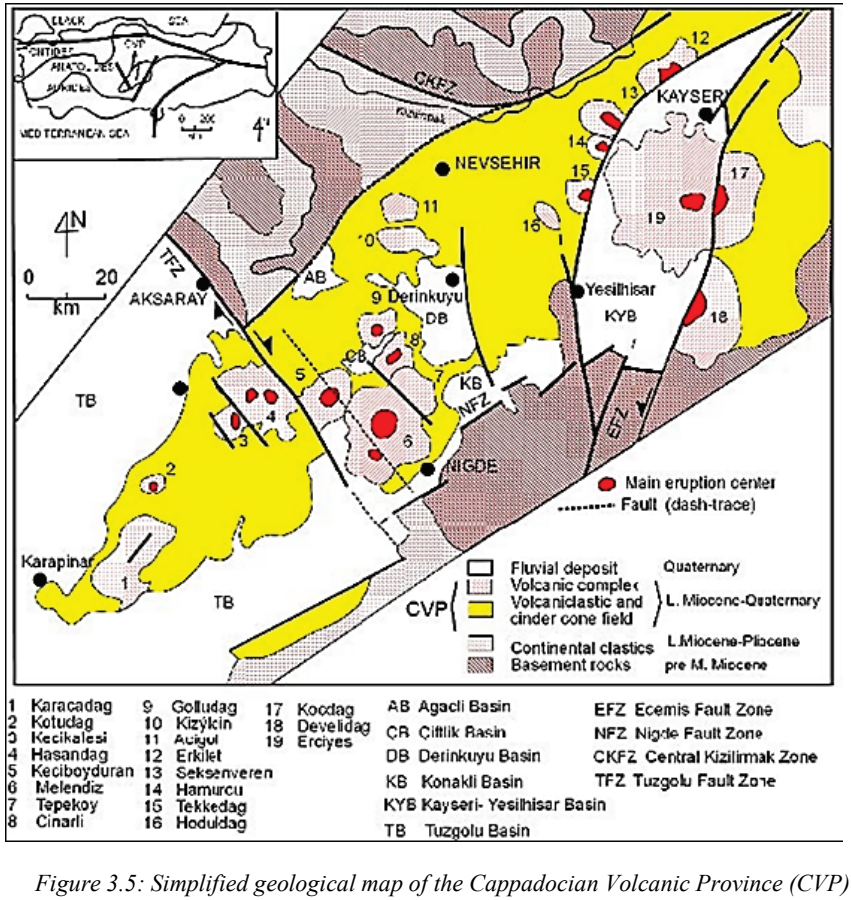


Figure 3.5: Simplified geological map of the Cappadocian Volcanic Province (CVP) and its tectonic setting [4]

The Ürgüp volcanic formation overlies the Yeşilhisar formation. This formation spreads over a wide area and the underground rock structures and fairy chimneys are found in this area. It is a structure that contains pyroclastic sediments and intertwined continental sediments. Approximate horizontal extension of the formation is 1100 – 1200 m and forms the high plateau near Ürgüp. Its age is Late Miocene (Tortonian)–Pliocene. It is considered as 10 separate volcanic units, as a result of the lithological variability in both vertical and horizontal directions.

The volcanic units of Cappadocia are generally in off-white, grey and pink colours and have a clastic character. They are of fine to coarse grain structure and contain pumice and obsidian lumps of different sizes. They are interbedded with tuffs in some regions and clay and marly clay beds in some regions [Figure 3.6].

Figure 3.6. Core sample showing macro textural properties of volcanic tuff from Kaymaklı region [4].

The Kavak tuff is made up of ashfall and flow deposits interbedded with volcanic clastic sediments. It is well exposed in the Kavak village and also observed at some towns such as Ürgüp, Ortahisar and Göreme. Its thickness is between 10 and 150 m. The Zelve tuff is composed of a single pyroclastic flow unit and its best exposures appear in the Zelve area at the north of Ürgüp town. The areal extent of this tuff is 4200 Km2 and has an average thickness about 60 m. Zelve tuff and Kavak tuff are found generally at the same regions. Near the Kızılırmak River the Zelve tuff is highly altered but has partly been eroded in Avanos town and its close vicinity. The thickness of ranges between 10 and 15 m in Özkonak town.

The Gördeles tuff occurs mainly in the southern part of the Nevşehir plateau. Its estimated extent is about 3600 Km2. These tuffs are matrix-rich with a generally dark-grey colour. Although the bedding planes involved by the tuffs are nearly horizontal, they are not distinct everywhere in the area. Therefore, generally widely spaced and subvertical joints are the major discontinuities within these tuffs.

Two fault systems cut across the volcanic province. The first system, trending dominantly in NW– SE direction, is the Tuzgölü Fault Zone (TGF) (Figure 3.5). The faults within this system are still active and played a role in the recent deformation of the Anatolian Block. The second fault system, Ecemiş Fault Zone (EF), strikes NE– SW, almost parallel to the long axis of the province. Although some of these faults are still active, most of them were buried beneath the later eruptions of the CVP [1], [2], [4]. The region is seismically less active compared to other regions of Turkey. The largest earthquake with a magnitude of 5.2 occurred in 1940 near the Erciyes Volcano at the NE region during the instrumental period.

3.1.3. Rock structure and settlements

In the Cappadocia Region two categories of heritage structures can be defined as cliff or semiunderground settlements (Figure 3.7) and underground settlements. Cliff or semi-underground settlements are those settlements carved mostly on dominant hills or steep slopes that can usually be reached by passage and stairs. Such settlements are usually located around a castle. In these settlements, chapels, basilicas, small or larger churches and residential openings in some places up to 6 floors.

Figure 3.7: Typical cliff settlements at Cappadocia: Uçhisar Castle (left) and Selime Caves (right).

There are 22 known large-scale underground cities in the Cappadocia Region (Figure 3.8). These cities in fact show a labyrinth-like structure of spaces with different dimensions connected by narrow tunnels and steps.

Special units in the cities are the shafts that were used for ventilation, communication, and water collecting wells. The four underground settlements, that is, Derinkuyu, Kaymaklı, Mazı, Tatlarin and Özkonak have well known settlements and all underground cities are open to touristic visits.

Kaymaklı Underground City is consisting of small halls and rooms connected by narrow passages to large kitchens, water cisterns, and wine cellars, and to storage rooms. It has also little chapels and ventilation chimneys. Four levels are open to public visits.

Derinkuyu Underground City is an eight-level residential area covering approximately 2,500 m2. The deepest level of the city is 85 m from the surface. Kitchens, storage rooms, bedrooms, dining halls, wine cellars, and toilets are located on the first two floors. The third and fourth floors include residences, halls, churches, wardrobes, and connecting tunnels. For the ventilation of the settlement, 52 shafts with a length of 70-85 m were built.

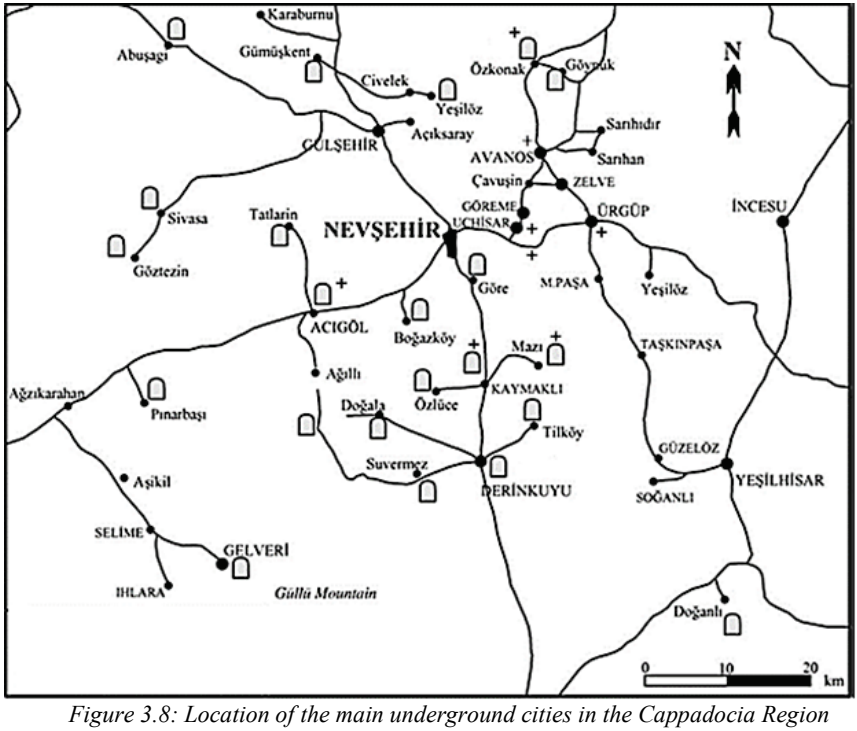


Figure 3.8: Location of the main underground cities in the Cappadocia Region (modified after [1])

Özkonak Underground City is located 14 km north of Avanos town. In the settlement, 14 spaces of different sizes and very long and narrow passages between levels are found. The two big spaces at the entrance have

been used as stables. Total visitors in 2021 reached at 2,285,895 [5]. Mostly visited locations are Zelve (645,695 visitors), Göreme Open Air Museum (560,379 visitors) and Kaymaklı Underground City (321,163 visitors).

3.2. Geotechnical Characteristics of Rock Structures in Cappadocia

Studies carried out for the geotechnical characterization of the Cappadocia region contain a few limitations. An important part of the studies within this scope are related to the newly created underground openings for different purposes in the region. Excavability, analysis of tensile structure and material quality are the main research topics. Few studies for geotechnical/geomechanical characterization have been completed in areas where such structures exist, due to the difficulties or constraints of taking samples from their vicinity or in some cases taking measurements from protected structures such as underground cities. The studies carried out by Aydan and Ulusay [1] are one of the important studies carried out in the regions where the protected areas/structures are located. A study supporting this study was also conducted by the same researchers [4].

In the first study, Aydan and Ulusay [1] performed some tests on the variables as a) unit weight, b) porosity and void ratio, c) slake durability tests, d) indirect tensile strength, e) triaxial compression, f) uniaxial compression and static deformability, (g) block punch index (BPI), h) uniaxial compression after wetting–drying and freezing–thawing cycles, i) elastic wave velocity and (j) water migration properties and associated variations of physical and mechanical properties. Below given is a summary of the past research focused on the geomechanical characteristics of Cappadocia rock structures and mostly relies on the findings of the Aydan and Ulusay and Ulusay et al. [1], [2].

1. The Cappadocia tuffs are prone to atmospheric conditions and, therefore, seem to be susceptible to physical weathering. Slake durability index [6] of the tested eight specimens ranged between 53.5% and 66%, indicating low to medium durability. Therefore, it seems to be more realistic to classify the tuff from Avanos (Zelve tuff) as a low durability rock, particularly. The geomechanical properties of tuffs of Derinkuyu and other locations in the Cappadocia Region are strongly influenced by their water absorption characteristics [2]. Topal and Doyuran [7] found that the average pore diameter of Cappadocian tuff is 0.11μm showing that it is susceptible to frost damage.
2. Totally 16 core specimens obtained from the blocks in vertical direction were used to determine their tensile strength by the Brazilian indirect method. When the tuff specimens taken from the Ürgüp and Avanos

are separately considered, the tensile strength of the Ürgüp samples seems to be slightly greater than those from Avanos.

3. Uniaxial compressive strengths (UCS) from the tests on air-dried specimens suggest that these tuffs are classified as weak to very weak. Strength of the Avanos samples is lower than that of the samples of Ürgüp and Derinkuyu. UCS tests aster freezing– thawing and wetting–drying tests showed important decreases by the increase of cycle numbers. These results show that these rocks may lose their strength depending on the exposure to atmospheric effects.

4. The results of the static deformability tests suggest that the tuffs studied have high deformability, and Poisson's ratio of the samples from two different locations seems to be identical (average 0.27 and 0.29 for Ürgüp and Avanos, respectively).

5. The shear characteristics of tuffs tested is determined by triaxial compression tests. It is found that the all the tuff samples have identical shear strength values of about c = 1.1 MPa and ϕ = 16.5o

6. Bedding and schistosity have strong influence on the physical and mechanical properties of rocks. The effect of bedding and schistosity planes is high if they are spaced closely. Beddings of the tuffs in Cappadocia are generally widely spaced and their effects are expected to be smaller. However, the composition of the matrix of tuff may lead to spatial variation of properties. Wave velocity measurements showed different variations in different tuffs.

7. Derinkuyu samples (Gördeles tuff) gave the high wave velocity within the bedding plane than that perpendicular to the bedding plane. However, Avanos samples (Zelve tuff) and Ürgüp (Kavak tuff) tuffs showed opposite results.

8. The investigation on the stress state of the Cappadocia Region by Watanabe et al. (1999) showed that the present maximum principal stress is almost vertical while the intermediate stresses were aligned either at NS or EW directions, and the ratio of horizontal stresses to vertical stress was about 0.5.

As a general summary of the past geomechanical research, it can be said that most dominant rock mass in the region have high susceptibility to deformation. Main weaknesses of the rock mass are related with the material properties which affected from the atmospheric effects (water, air, temperature change). In addition, the increase of settlements and traffic around the underground cities and increasing daily visitor numbers (especially at summer) may lead to accelerated ageing of the rock mass in the underground cities. These structures suffer from a number of weaknesses as a result of inappropriate design methodology, material characteristics, and geotechnical condition.

3.3. Potential Risks for Underground Settlements

The fundamental factor that creates stability problems for underground and aboveground structures in the Cappadocia region is the material properties of the rock mass. Tuff, which can easily deteriorate under the effect of water and air, is prone to deformation in the entrance of underground cities as well as in some surface openings. Cappadocia tuffs, with their low pore diameters, tend to retain the water they absorb for a long time. This causes the material to deteriorate during the freeze-thaw process (especially in winter). Since changes in temperature and humidity do not show significant variations in underground cities, material weathering due to atmospheric effects is less common in openings deeper than the surface. On the other hand, swelling minerals in the tuff may cause deformation of the material under squeezing conditions.

Another factor that has the potential to lead to deformation in both underground and surface structures is the geological discontinuities. These cause rockfalls and block slides in surface structures. Persistent fracture sets create rock blocks that exhibit sliding or falling. Göreme Open Air Museum, Zelve, Uçhisar Castle and Ürgüp town (Kavak tuff) are the typical localities where the rockfall and sliding type of instabilities appear.

The increase in traffic and settlement in the region, especially around the underground cities, is one of the main reasons for the stability problems. Factors such as time-dependent deformation (fatigue) of underground openings under constant/static load, weathering of rock material under atmospheric effects, and location and geometry of openings also contribute to the increase of settlement and traffic. Some deformations resulting related with these effects in Derinkuyu underground city are shown in Figure 3.9.

Fractures and slabbing occurred in roofs and in pillars show the yielding of the rock mass. In addition, deformations are the indications of poor material quality at these points. At the same time, it can be said that the stress state of these regions deteriorates. Another factor affecting the deterioration of the state of stress is the dimensions and geometry of the underground openings.

As engineering principles were not applied in locating and selecting the sizes of the openings, the openings located too close or created too wide have the potential to be damaged due to constant loading conditions, time-dependent deterioration of material quality, persistent discontinuities and dynamic loads from the nearby settlement and traffic. Aydan and Ulusay [1] reported a couple of block falls as a result of the above-discussed factors in Derinkuyu Underground City.

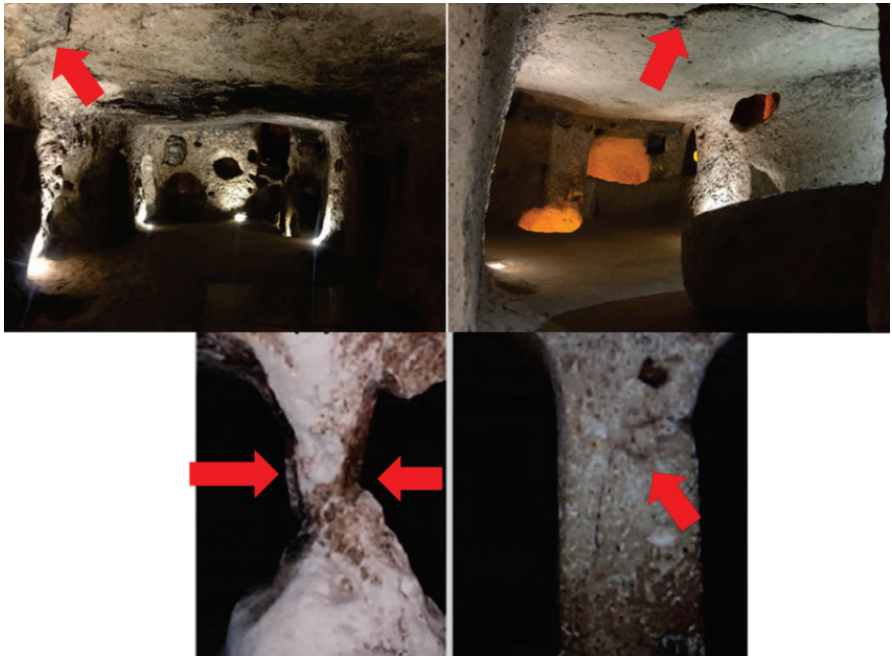


Figure 3.9: Different deformations observed in Derinkuyu Underground city: Cracking (top left), Slabbing (top right) and cracking and slabbing (bottom left) [1] and cracking (bottom right) [1].

3.4. **Monitoring and control for stability**

Stability monitoring can be done at every stage of an underground opening. In the construction stage, the basic aim is to obtain data and verify design. Monitoring maybe the most important process in the life of an opening. Monitoring is expected fulfil the following objectives [8].

i. Assessing and verifying the performance of the design,
ii. Calibrating models and optimizing design, if needed,
iii. Obtaining warning about ground behaviour in advance,
iv. Assessment of safety / stability.

In the current practice of monitoring and the technological possibilities there are large number of alternatives of devices and systems. Depending on the monitoring objective and the conditions of the measurement environment the best possible selection can be made. Some measurement systems/tools may directly measure the final data. However, most devices measure variables such as length, pressure, mass, time and then, convert them into final data. In stability monitoring strain, load, pressure, deformation, tilt and vibration variables are produced after the measurements by

monitoring systems [9]. Various operating mechanisms or principles for the monitoring or measuring tools include followings:

1. Strain gauges: Use changes in electrical resistance to measure strain and deformation in an object.
2. Vibrating-element (resonant) sensors: Measure changes in the resonant frequency of a vibrating element under stress. The change in frequency is proportional to the amount of stress or strain experienced by the sensor.
3. Inductive sensors: Tracks the movement of an object that changes the electromagnetic field of the sensor around a coil of wire.
4. Piezoelectric sensors: When a mechanical force is applied to the sensor, it causes the piezoelectric material to compress or deform generating an electrical charge. Piezoelectric sensors convert the mechanical energy (pressure or vibration) into electrical energy.
5. Radiometric sensors: An object under stress generates heat due to friction and deformation. Radiometric sensors detect this thermal radiation and use it to determine the amount of stress on the object.
6. Photoelectric sensors: Consist of a light source that emits a beam of light, and a detector that detects changes in the intensity of the light beam. Stress on an object can alter its shape or position, causing the light beam to be interrupted or reflected differently. The sensor detects the change in light intensity and uses it to determine the level of stress on the object.

Existing measurement devices are designed on measurement principles listed above. In stability monitoring methods, basically, two variables as the amount of stress accumulation around the interested points and the amount of strain at a reference point are measured. Mostly these data converted to decision criteria in the subsequent processes. A couple of general purpose and widely used tools come forward. These devices are listed below and will be explained in the following parts. Each group has a number of alternative tools designed generally using different measurement principles.

a. Extensometers
b. Stress meters
c. Strain gauges
d. Pressure Cells

The listed measurement devices are able to monitor both static/quasi-static and dynamic loads. In static/quasi-static loading conditions major source is the gravity loads of upper rock masses and surface structures (hills etc.). These loads are nearly fixed or constant loads but may lead to fatigue of opening walls and roof. Under dynamic loading conditions rock masses are subjected to cyclic loading. Earthquakes, blasting vibrations from mines and quarries, vibrations transmitted through rock mass as a re-

sult of vibrations of tall buildings and heavy traffic from motorways and railways are of dynamic loads. Long duration and/or high magnitude dynamic loads cause sudden deformations. Low magnitude and/or low frequency loads may result in fatigue and deformations in longer exposure times. Figure. 3.10 displays the effect of static and cyclic loading conditions.

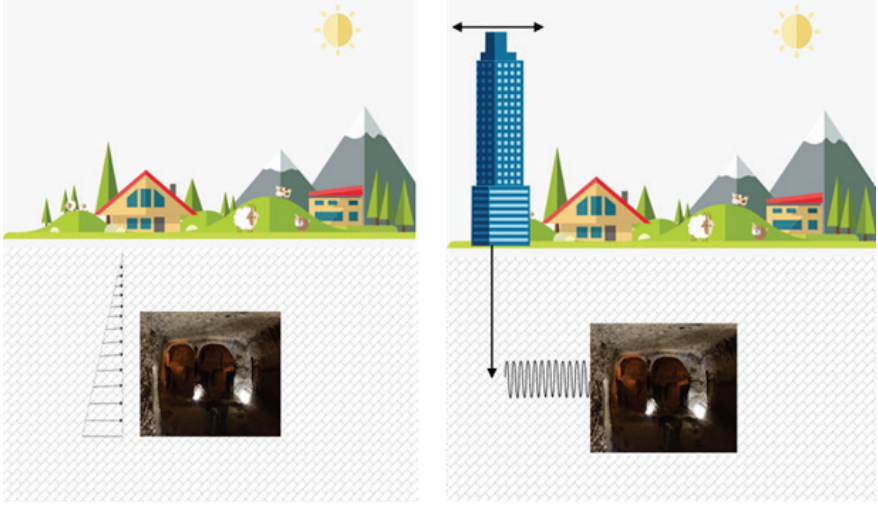


Figure 3.10: Static/quasi-static loading (left) and dynamic loading (right) conditions [10].

3.4.1. **Extensometers**

Extensometers measure the distance change between two points. Measuring points can be placed on the surface to measure ground movements or placed in a borehole. In the borehole displacement are measured along the borehole. Alternative extensometer designs are found for different measurement needs, places and measurement methods. Most developed extensometers are those using vibrating wire electronics, differential transducers and fiber optics extensometers. High technology systems increase measurement accuracy. Measuring accuracies of these devices change between sub-millimeters to meters, depending on the type of the measurement system [11], [12].

The extensometers can measure displacement, convergence, settlements and movement of fracture surfaces. They can be installed in openings (tunnels, drifts, shafts, caverns, chambers etc.) between 2 fixation points. Different types of extensometers are given below [12], [13]:

1. Rod extensometers

2. Bar extensometers
3. Tape extensometers
4. Wire extensometers
5. Magnetic extensometers

An electromechanical transducer (LVDT; Linear Variable Differential Transformer) is the main part of extensometers. LVDTs used for measuring linear displacement converting linear motion into an electrical signal.

LVDTs are robust and inherently frictionless transducers (Figure 3.11). They have a virtually infinite cycle life when properly used. AC operated LVDTs do not contain any electronics, therefore they can be designed to operate at cryogenic temperatures or up to 1200 °F (650 °C), in harsh environments, and under high vibration and shock levels [10], [14].

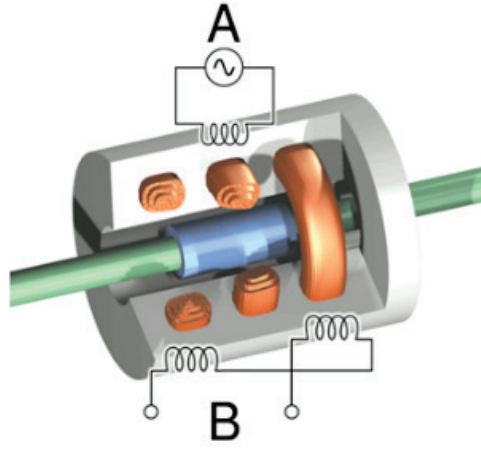


Figure 3.11: Structure of an LVDT [14].

Some designs having extensive use in displacement and stress measurements have been described in the following sections. The devices given below have versions for both singular and systematic monitoring.

i. Rod Extensometer

A typical rod extensometer consists of a reference head, installed at the collar of a borehole, and one or more in-hole anchors, each of which is fixed in place at a known depth in the borehole (Figure 3.12). As the rock deforms, the distances between adjacent in-hole anchors change, as do the distances between the individual in-hole anchors and the reference head. This allows determination of the rate and acceleration of deformation in the rock mass intersected by the drill hole [12].

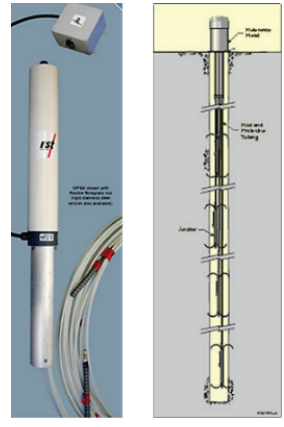


Figure 3.12: Rod extensometer [12]

ii. Borehole Extensometer

A wide variety of borehole probe extensometers are commercially available according to their measurement capabilities and the technology used (such as magnetic, sonic, fibber optics and vibrating wire). The mechanical or electrical probe using extensometers monitor distances between fixed points along a borehole. Accuracies for probe extensometers range between submillimetre to millimetre over distances of less than a meter [8].

Magnetic extensometers consist of spider magnetic anchors positioned along a PVC tube with a stable anchor at the base of the borehole. The vertical movement of the anchors can be monitored manually with a probe. Multipoint borehole extensometers monitor displacements in a borehole at various depths. They usually comprise up to eight rods per drill hole and have manual readout or vibrating wire transducers (Figure 3.13).

Figure 3.13: Multi-point rod extensometer [13]

The Increx system, a magnetic extensometer design allowing automatic monitoring, has been seen on Figure 3.14. A probe measures distance between successive rings. Measured data is then compared to initial survey data. Measurements are made at periodically therefore the type (compres-

sion or tension) of the deformations and their range can be monitored. This system has found broad use in monitoring vertical and horizontal deformations.

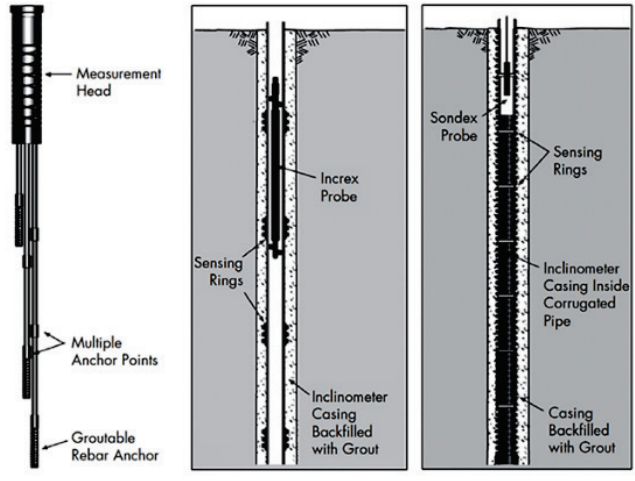


Figure 3.14. Different rod extensometer designs [8].

Another borehole probe extensometer (Sondex system) employing sonic probe extensometers uses regularly spaced steel sensing rings and a corrugated Sondex pipe installed over inclinometer casing (Figure 3.15). The annulus between the borehole wall and the Sondex corrugated pipe is filled with soft grout. This couples the pipe to the surrounding ground. This installation allows the pipe and rings to move with settlement or heave. As the probe passes a ring, an audible sound emits, and the depth reading is taken. These extensometers are suitable for roof, wall, and floor deformations [11], [15].

Figure3.15: Rod Extensometer and its installation [16].

iii. Digital tape extensometer

The Digital Tape Extensometer is a portable device used for measuring displacement between reference anchors fixed to an excavation or structure (Figure 3.16). These extensometers are as follows are monitoring convergence (change in excavation face height), monitoring deformations (change in boundaries) and monitoring displacement of retaining structures, bridge supports, and other structures (environmental effects of excavation).

The extensometer consists of a precision punched steel tape, incorporating a repeatable tensioning system and dial gauge readout. The tape winds onto a reel, which incorporates a tape tensioning device and a digital LCD readout. Measuring range is up to 30 m and measuring accuracy is up to ± 0.1 mm [12].

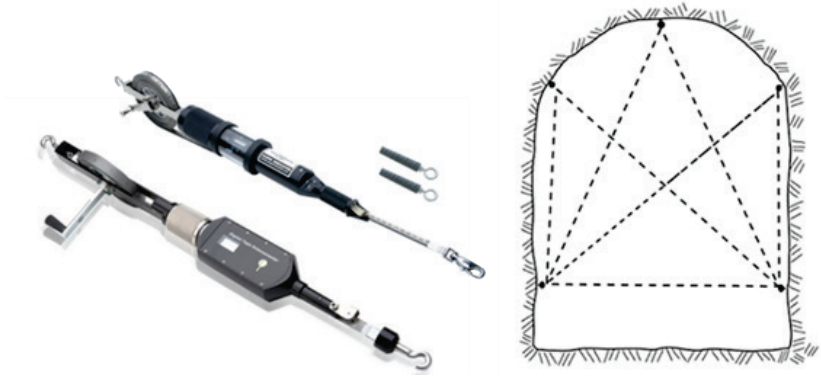


Figure 3.16: Digital tape extensometers (left) and digital tape extensometer application scheme in a tunnel [12].

3.4.2. **Stressmeter**

The Stressmeter is used to monitor compressive stress changes in rock. It consists of a high-strength steel test ring firmly placed in a borehole and a vibrating wire stretched across the other end inside the stress gauge (Figure 3.17). The stress variation causes the resonant vibration frequency of the stretched wire to change. The measuring accuracy of the device is about 0.1% of the maximum value. Stresses are measured perpendicular to the sensor axis. The stress gauge should be grouted in the borehole with a material such as resin or concrete.

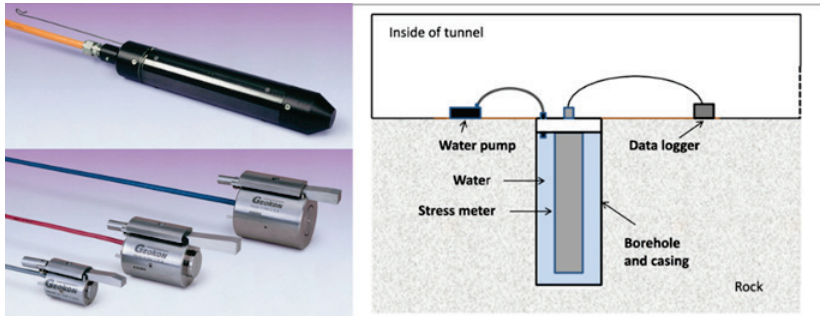


Figure 3.17: Different stressmeter designs (left) and installation patter of a stressmeter [12].

3.4.3. Pressure Cells

Pressure cells are used to measure pressure on a specific point. When the external pressure on the plates increased the pressure of the internal fluid also increases. Steel tubing the fluid pressure is transmitted to a sensor. Sensor converts the pressure into a readable unit. Measuring accuracy is about 0.1 % of maximum pressure. The cells consist of two rectangular steel plates welded together around the periphery with a de-aired fluid occupying the space between the plates. A short tube connects the cell to a vibrating wire pressure transducer (Figure 3.18 left) [13]. In the pressure cells measurement principle is based on the vibrating wire system [17].

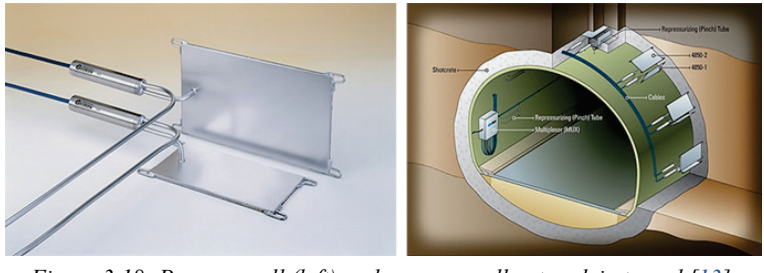


Figure 3.18: Pressure cell (left) and pressure cell network in tunnel [13].

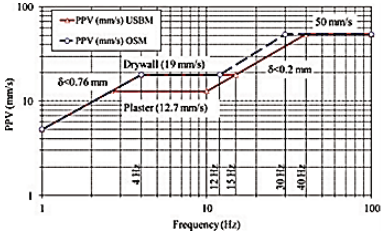
3.4.4. Vibration Measurement

Dynamic effects such as earthquakes and blasting generate vibration waves. Starting from the source, the waves spread away in the rock masses. As the vibrations move to different environments, their size decreases. Due to these reductions, vibrations disappear at a certain distance from the sources. Vibrations affect the surface and underground structures they encounter. They can damage the structures depending on factors such as vibration magnitude, frequency of vibrations and the quality of the affected structure.

Dynamic effects may not always completely destroy a structure at once but can cause minor damage (fatigue). However, the effects in these low magnitudes may cause the structure to become unexpectedly deformed in time. For this reason, earthquakes, repetitive blasting (mines and quarries), roads with high traffic loads and tall buildings can create dynamic loads with different magnitude and frequency. Therefore, it is an appropriate approach to monitor the vibrations, to which the surface and surface structures are exposed. Vibration measurements are made using specially designed devices called vibration meters (Figure 3.19). These devices basically measure the speed of displacement (peak particle velocity) caused by the thrust applied to the rock particles as vibrations propagate inside the rock, or the acceleration of the thrust caused by the wave. Peak particle velocity is measured for effects such as blasting, but the acceleration is used for tectonic effects such as earthquakes.

Figure 3.19: Vibration measurement system [18]

Interpretation of the measurements can be done on standard charts, tables or criteria. Most trusted standards are USBM RI 8507 and German DIN 4150 standards (Figure 3.20). DIN standards can be applied for the sensitive structures.



Structure type	Peak particle velocity (mm/s)		
	4–8 Hz	8–30 Hz	30–100 Hz
Commercial	20	20–40	40–50
Residential	5	5–15	15–20
Very sensitive	3	3–8	8–10

Figure 3.20: USBM RI 8507 (left) and German DIN 4150 standards (right).

Currently, there is a lack of large-scale and/or integrated efforts in the literature on continuous monitoring of underground buildings and houses (UBHs) in the Cappadocia region. Typically, monitoring may be performed on a spot basis (if needed) or for academic research purposes, such as the one conducted by Aydan and Ulusay [6], in response to potential threats. As part of a physical and mechanical characterization study, Aydan and Ulusay monitored temperature changes in conjunction with the swelling characteristics of tuffs. However, temperature changes between day and night, changes in precipitation patterns, the potential effects of local faults formed in the region after earthquakes in nearby regions (Adana, Kahramanmaraş, Kayseri), and the construction in the region necessitate adopting a systematic and comprehensive monitoring approach.

3.5. Digital mapping and 3D visualization of UBH sites in Göreme

3.5.1. Digitization

The digitization of heritage objects and sites can simply be defined as the documentation. Some additional benefits may also be defined. Digital replicas of heritage objects and sites create a room to efforts to preserve the past, to raise public awareness, and improve interpretation capability [19]. Digital cultural heritage may be of texts, still and motion images, sounds, graphics, software, and web pages. Currently, lots of information techniques benefit for built heritage modelling, management and conservation, including 3D computer graphics, photogrammetry, laser scanning, and Geographic Information System (GIS) [20]. The three-dimensional copies of heritage objects/sites are the most important product of digitalization efforts. 3D copies may allow to create digital catalogs, virtual reality, and augmented reality models [21].

Pavlidis et al. [22] see the 3D models as the first stage of digitization. A 3D model development process exhibits variations size, type and the completeness of cultural objects/sites. Currently there are a number of methods and tools to create digitized versions of heritage objects/sites. Complexity in size and shape, morphological complexity (level of detail) and diversity of raw materials are the three factors influencing the suitability and applicability of an 3D digitization system/tool.

Digitization is a time consuming and costly process requiring theoretical, field and modeling work. Modeling work includes mainly data handling and visualization in computer environment. Complexity in the representation of digitized objects/sites increased as the technology develops in years. Earlier efforts produced basically the 3D models of the objects or some monuments. Developed 3D models are mainly from 3D computer

graphics on photogrammetry and laser scanning data and only illustrate the shape of the heritage [20].

A 3D model of cultural heritage is expected to include more details (semantic, attribute, material, temporal, and relationship) of the object and its sub-elements, together with the highly accurate geometry. Current understanding in digitization is the development of accurate virtual physical models including additional data. Type of data may vary depending on the objective and audience of the of the model. This perspective transferred the Building Information Modeling (BIM) method from architecture and produced Heritage Building Information Modeling (HBIM) approach [20]. BIM combines 3D modeling and information management and therefore is related to management of the life-cycle construction process. HBIM of a historical building can provide, i) a complete survey and geometrical model, ii) attribute, material and relationship information of the sub-elements and iii) possible deformations and changes over time [23]. The use of a 3D model by researchers for the specific purposes requires much more than a geometric model. In this respect, HBIM offers a significant benefit that includes information on the geometry, material properties, elements/components and structural and functional change of a heritage structure/site over time. A geometrical model of a heritage object is on the core of HBIM. There are various methods to create 3D model of a heritage object/site.

3.5.2. Potential tools and methods for digitization

3D modeling tools allow to create a virtual copy of a heritage object/area to create 3D printed copies and to create copies of objects and sites in a virtual environment. Well-prepared digital replicas allow scientists to analyze remotely, such as measuring for detailed analysis, improving the visibility of surface topography and producing technical drawings.

Four kinds of 3D models are defined by Yang et al. [20].

1. Geometric model: creates the real entity with a holistic shape in 3D,
2. The semantic model: explains the meaning of the elements of heritage,
3. Parametric model: defines the shape of the elements by parameters,
4. Information model: a database containing information about attribute, material, and relationship information about the entity and its components and 3D geometry.

Historical heritage documentation is currently a more comprehensive process than creating a 3D model of an object or a structure. In this process, 3D visualization of structures can be seen as a core function. However, a heritage site model must be an integrated model in which the site/structure is modeled together with the topography, surrounding struc-

tures and/or sub-elements, geometry and material properties. In this context, a heritage model database is a structure consisting of GIS and visualization modules. Below are the main parts needed to be included in a heritage model.

i. Databases

A database covers data in a wide range, starting from the location information of the heritage site to the geometry, material properties and the functions and relations of the units or sub-elements present in the site. In the historical evolution of database creation and management, simple tables evolved into object-oriented databases to establish relationships between data, objects, and data. However, the introduction of GIS enabled a link between object data and location data. With this structure, it also enabled the surrounding nature and other structures to be modelled in relation to the building. This also means a holistic digital reconstruction.

ii. Geographical Information Systems (GIS)

GIS create relationships between data and allow managing, querying and analyzing spatial, attribute, and relationship information among elements. Most of the heritage documentation applications using GIS focuses mainly on the heritage management (monitoring of known sites or identification of new ones) and explanatory framework (site catchments or analysis of the intervisibility of the sites) [24]. GIS provides a powerful tool to query the data for preservation purposes and to realize advanced analysis [25]. GIS is a flexible and effective tool for heritage documentation studies that require processing large amounts of heterogeneous data. It allows to define structures with complex and special geometrical properties to be manageable in a 3D spatial context. In recent years, the development of the possibility of obtaining higher amount and sensitive data with LIDAR or photogrammetric methods has also increased the number and sensitivity of GIS-based models. 3D WebGIS, an online GIS application, provides the ability to develop 3D embedded heritage models that can be visited in a virtual environment. In addition to its core features, GIS is also a suitable tool for modeling large-scale heritage scenes. CityEngine uses a rule-based system to shape generation and allows a large amount of detail. Well-known product of this tool in heritage modelling is the model of the ancient Roman town Pompei [20].

iii. Visualization

Visualization is a phenomenon that gains new dimensions with the development of data processing and computer technology. Although it basi-

cally means a visual expression of data, today, it is a richer concept corresponding to a representation that includes features such as 3D and animation, beyond a two-dimensional figure or drawing. Early products of visualization work were only those that created the above-ground 3D views of structures. Later, surface models were included in models. But these models incorporate no information regarding the solid geometry of a building and simply present it as a series of two-dimensional flat surfaces that can be rendered or viewed in a variety of ways [24].

Today, an impressive evolution has been observed in the creation and virtual representation of 3D digital models of heritage objects and sites. This evolution has brought improvements that have eliminated some of the earlier problems experts face regarding the 3D modeling of cultural heritage objects, such as the selection of the appropriate technology for image acquisition and post-processing, the automation of the image matching procedure, the visual and metric quality of the final product, and the appropriate documentation [26]. Rapid technological advances in photogrammetry, laser scanning, computer vision and robotics are now widely used for visualization and archiving of cultural heritage objects. 3D digitization is a complex process consisting mainly of three phases [22].

1. Preparation: critical decisions are made about the technique and methodology and the place of digitization, security planning issues, etc.
2. Digital recording: taking digital records on the interested heritage object
3. Data processing: the modeling of the digitized object through the unification of partial scans, geometric data processing, texture data processing, texture mapping, etc.

When the cost is excluded, the site/object size (scale), material properties and technological equipment features to be used stand out as the basic evaluation criteria in the modeling study. Basically, the size of the modelled object/site and the technological needs for the modelling define the cost and the complexity of work. Technological possibilities offer a wide range of options. The brief overview of techniques or technological alternatives which is available in digitization of cultural heritage are given in the following sections. If high resolution, digital photos can be used to produce 3D models. 2D or 3D coordinates can be obtained from one or two photographs by applying orientation processes and transformations of digital photogrammetry. The method can be supported by CAD software. It is relatively simple and low cost yet provides acceptable precision.

The precision can be increased when combined with topographic or empirical measurements. Although it is suitable for rendering complex objects with high surface detail, the space requirement is high as photographs are used. It can be used to track/record the evolution of a heritage over

time if it is possible to use high resolution photographs. Combined with accurate photogrammetric measurements, it can produce highly accurate models for 1:100 and in some cases higher scales.

3.5.3. Digitization Applications

An important part of the past studies on the digitization of the heritage structures/sites has aimed at 3D modelling of objects. In this regard, the findings of the search for suitable methods and tools have an important place. Today, laser scanning has found widespread application. There are many examples showing the success of this method in object and single structure modelling. One of them is the 3D digital image of Michelangelo's David at the *Galleria dell'Accademia* in Florence created by two million data points [27].

Remondino et al. [28] created the image-based 3D model of the Erechtheion monument in Greece. Their work was basically concentrated on creating 3D models from high quality images. They also experimented laser scanning and found that one type of model generation tool may not produce successful results.

Meyer et al. [24] proposed a Virtual Research Environment where in-site Cultural Heritage data can be used. The proposed system is an open-source design environment that provides a GIS-based 3D model development system with defined tools and modules. Using the system, Meyer et al. (2017) also developed models of heritage sites from the Luxembourg National Sites and Monuments Service.

Marzouk [29] discussed the process of creating a 3D palace model, which he describes as a BIM. This model is an example that specifies the function defined for a 3D model. In addition to the locational data and 3D image, a BIM model also contains a lot of data related to the structure. LIDAR scanning was used for the developed 3D model.

The one pioneering work on the digitalization of heritage sites is the Virtually Rebuilding Çatalhöyük Project (VRCP) [30]. This project aimed basically to virtually reconstruct and simulate a 3D sequence of Neolithic buildings to provide young students with a powerful digital learning tool that enables visual-interactive explorations of Çatalhöyük and to provide archaeologists with an analytical-interpretative tool to be used in the discussion and interpretation of Çatalhöyük's archaeological record. Currently in the project the virtual models of some buildings were developed. In the future the aim of the project is to construct an integrated interactive 3D model of Çatalhöyük.

3.5.4. Digitization Potential in Göreme

Currently there is no mapping and 2D/3D modeling work covering the structures in Cappadocia Region. The region has the potential for damage due to the age of the structures, atmospheric factors, the weaknesses of the rock mass and the increasing visitor traffic each year. A comprehensive modeling study, whose main purpose is ensuring the safety and stability by recognition, protection and monitoring of UBHs is necessary. Such a study would require researchers from different fields to perform a data collection process as the first step. Because Cappadocia is a large region. There are components with different geometry, layout and material properties both above ground and underground. Data should also be collected on the function and historical background of these components. Under the current technological conditions, a modeling study for Cappadocia is expected to include the following components.

GIS Mapping: It will serve as an infrastructure for all models to be created. It should contain 3D spatial data of the region. Interactive models and functions will be developed on GIS map.

3D Models: They are high-resolution models of the structures in the region. These also carries structured data and information about the unit so that different user groups can use. Image and laser scanning-based data collection systems seem to be possible methods to generate 3D models within the current technological possibilities.

Interactive Use Opportunities: Interactive access opportunities where the created models can be used for different purposes will enable the models to serve a wide range of users. This will also contribute to the development of models.

Structural Health Monitoring System: Surface and underground settlements in the region have the potential to be damaged due to many effects. Under the control of the material properties, the structural features of the rock mass and the atmospheric conditions, the possibility of deformation of underground and surface structures is always present. Also, there are weaknesses arising from the construction characteristics (such as geometry, layout, and size) of the openings created underground. External factors as increasing number of visitors, increase of the building stock in nearby areas and increased traffic have the potential to create stability problems for surface structures as well as underground structures in the future. Therefore, the risk of possible deformation should be dynamically monitored by establishing a continuous monitoring system. It is vital for especially underground settlements. Such a system should cover all underground settlements in the region, especially in areas where openings are densely located and areas close to external effects such as vibration.

Monitoring systems can be installed to monitor stress and strain variables. However, non-invasive devices should be selected since the borehole type instruments may lead to additional weakness points. Especially at the critical places where more openings are found and defects crowded. One of the two approaches may be accepted for the monitoring. In the first method natural effects may be measured. This means that the system records only the stresses or strains yielded by the effective factors around the measurement device. In the second approach controlled seismic effects can be measured. This approach does require to wait for strains to occur. Instead, an artificial source produces seismic waves and these travel times of these waves measured by the devices. This approach produces data to assess using numerical analysis methods or allow evaluation of data by means of data process methods as machine learning and deep learning.

Potential risk can be defined by evaluating the obtained data in a numerical analysis system. The system can be designed on the basis of machine learning or deep learning methods. In this case, it turns into a decision support system that can suggest measures such as limiting the number of visitors and controlling activities that may cause seismic effects in nearby areas. Also cause-effect and/or result-contributor analyses may be conducted. The monitoring system can be enhanced with additional functions such as monitoring air quality in underground structures.

The monitoring process can generate data on potential risks and their magnitude. The data obtained needs to be solved by experts from the fields of geomechanics, geology, construction, archaeology, and data science. Based on the characteristics of the site and the type and the estimated size of the potential threat, possible solutions should be determined, such as limiting visitor numbers and supporting structures or restricting construction in nearby areas. Because the conditions affecting the structures in the rock or ground show significant changes even at short distances. Therefore, it is important to develop measures depending on the conditions of each site and the characteristics of the threat.

3.6. **Concluding Remarks**

The Cappadocia region is an important historical heritage site. However, the age of region and settlements, atmospheric effects, increasing building load and traffic in the nearby region, as well as the structural weaknesses of the dominant rock masses in the region are important threats. There are two basic requirements to keep Cappadocia survive for years. The first is the construction of a digital copy of the region and the underground and surface heritage structures. This means re-creating Cappadocia

as a virtual model on GIS-based medium. A model of this kind will have 3D visualization possibilities of all kinds of information about Cappadocia.

Digital copy of Cappadocia will provide an opportunity for researchers from all fields to work and will also form the basis for the conservation and rehabilitation processes of the region.

The second step is the installation of a structure health monitoring system for both surface and underground structures in the region. The deformations observed in underground and surface settlements should be expected to increase over time. The factors listed as risks for the region in the relevant sections may be more effective in the future. Therefore, continuous monitoring of the stability of underground and surface structures would be a logical approach.

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CHAPTER 4

Enhancing Underground Built Heritage Analysis with Text Mining: A Case Study on Cappadocia

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4.1. Introduction

Underground structures, naturally occurring caves or human-made structures, have been used by people in a variety of ways throughout the history of mankind. Underground cities of Cappadocia, tuff caves of Naples, and historical mining sites in Spain are just a few examples of Underground Built Heritage (UBH) sites. Within the scope of the COST Action CA18110 Underground4Value[1], UBH sites are focused as valuable resources to understand, reuse and valorise in order to support local communities' development. Underground4Value involves a set of case studies to analyse UBH sites and develop methodologies towards valorisation. In this chapter, the phase of understanding and analysing a UBH site is emphasized, and the use of computational techniques for such analysis is elaborated on. Considering the Göreme case study of the Cost Action, we consider a broader view and consider Cappadocia as the area to study. Particularly, social media messages and postings on the area related to touristic activities in relation to UBH sites are analysed with computational techniques and tools.

In the last decade, with emerging technology, automated and semi-automated computational solutions have become a crucial part of research in a variety of domains, including social sciences. As a result, a wide array of computational models is proposed for modelling and analysing different social processes. One such social process is understanding the public's opinion from the textual content. In the past few years, natural language

processing and text mining techniques have been heavily used to extract information from textual data that exposes public opinion.

A comprehensive understanding of public opinion is extremely important for stakeholders or policymakers in any field. Consequently, the literature is rich with studies that focus on public opinion mining utilizing different methods. Zhai and others use clustering techniques on user review data to understand public opinion about product features [1]. Claypo and others also use a similar approach to understand public opinion about restaurants [2]. As another approach, Ma and others use topic modelling to understand public opinion about popular news stories [3], and similarly, Xue and others use topic modelling to understand the public's concerns about mega-infrastructure projects [4]. Sutherland and others use topic modelling on accommodation reviews to understand what services users find important [5]. Irawan and others combine topic modelling with sentiment analysis to understand tourist perception towards Indonesia using TripAdvisor data [6], and Prameswari and others combine the same approach with neural networks on TripAdvisor data specifically focused on Bali [7].

Similar to the other works in the literature, there exists a handful of studies focusing on the Cappadocia region. In their 2020 publication, Özen and Ilhan first discuss the importance of opinion mining for tourism and conduct a case study of sentiment analysis techniques on restaurant reviews in Cappadocia [8]. More importantly, in a recent study, Özen utilizes opinion mining techniques on TripAdvisor comments about Göreme National Park and Cappadocia Rocky Area to extract common phrases from the comments to obtain information that concerns the protection of the world heritage region. Özen claims that the world heritage region is sufficiently protected, with some raised concerns from the tourists about the regions being “painted” or “drawn” over. Özen also claims that in general, analysis of tourist comments can be helpful to warn the authorities and take additional precautions. Another finding of the study is that tourist perception of the area is generally positive [9].

Previous work in the literature, including but not limited to the aforementioned ones, show promising performances when it comes to extracting opinions from textual data and utilizing these opinions to take action. With the motivation of enhancing the UBH analysis, this chapter aims to propose different computational models that expose the public’s opinion of Cappadocia and its underground cities to understand the shortcomings of the UBH site. First, public commentary between the years 2018 and 2022 is collected from three different social media platforms in a semi-automated manner to create three different data sets. Secondly, automated pipelines that utilize text mining techniques including topic modelling and sentiment analysis are designed. Finally, these pipelines are

used to understand public opinion by extracting the most mentioned phrases and sentiments of the comment from the created data sets.

In this chapter, we present the results of our analysis of public opinion on Cappadocia. Section 4.2 presents an overview of the text mining techniques utilized in our study. Section 4.3 describes the process of analysing public opinion by social media analysis on posts related to UBH sites in Cappadocia. Section 4.4 discusses the results of Section 4.3 and Section 4.5 discusses how to utilize them. Section 4.6 presents the conclusions of the study.

4.2. An Overview on Text Mining Techniques

The proposed study involves the analysis of social media messages through computational techniques for text mining and text analysis. More specifically, we apply topic modelling for extracting latent discussion topics within the collection of messages, clustering for extracting inherent groupings in the collection, and sentiment analysis to extract opinion orientations of the written messages.

4.2.1. Topic Modelling

Topic modelling is a statistical text mining technique that is applied to discover abstract and latent topics within a large set of documents [10]. It does not require prior annotation or labelling, hence it can be effectively applied to massive data in various formats such as texts [10], images [11], and social networks [12]. It is a probabilistic approach that captures latent semantic themes to provide insights into a collection of instances. For its use on text collections, a document is considered to contain multiple abstract topics in various proportions, and a topic is considered as a group of semantically and syntactically similar terms. Therefore, a document is classified according to its relevance to discovered topics on the basis of the terms appearing in the text.

Latent Dirichlet Allocation (LDA) [13] is one of the most popular topic modelling algorithms. It is a generative statistical model that originated from evolutionary biology. LDA includes Dirichlet priors for document-topic and topic-term distributions. More specifically, it is assumed that the documents are generated using Dirichlet distributions which are used to infer per-document topic distributions, and then the terms in a document are assigned to various topics according to their relevance to the terms in the discovered topics.

4.2.2. **Clustering**

Texts are inherently unstructured data, and hence having representation in n-dimensional vector space facilitates automated text processing and analysis. Word embedding algorithms such as word2vec [14] learn word representations from a large corpus of documents. Moreover, document embedding algorithms such as doc2vec [15] represent a whole document as a vector. There also exists sentence embedding algorithms [16], [17], [18], [19] to encode short texts such as sentences to a vector space which can help calculate the semantic similarity of sentences. Transformers [20] made a breakthrough on Natural Language Processing (NLP) tasks that outperformed traditional NLP models with a substantial margin. Reimers et al. [21] introduce S-BERT, a transformer-based sentence embedding model, which is built on the pre-trained BERT [22] model to extract semantically meaningful sentence embeddings.

Clustering is an unsupervised machine learning technique that groups similar data instances together. Once documents are represented as n-dimensional vectors, clustering algorithms can be directly applied to gather the texts on the basis of similarity over their vectorial representation. K-Means clustering [23] is one of the most popular clustering methods that partition n data points into k clusters, where each data point is assigned to a cluster whose centre is the nearest. Since unsupervised models do not have ground truth labels, clustering quality is measured by using quality metrics such as silhouette coefficient that check the similarity between the data points in the same cluster versus those in different clusters.

Dimensionality reduction techniques such as t-SNE [24] can be applied to transform high-dimensional data into a lower-dimensional space by preserving the meaningful information in the data. t-SNE is a nonlinear and statistical dimensionality reduction technique that aims to maintain the local neighbourhood of data instances while reducing the dimensions. Moreover, it can be used for plotting clusters in 2-D space [24]. We utilize the t-SNE method to reduce the dimensionality of sentence embeddings before clustering. This is because it has been shown that as dimensionality increases, for any given data point, the distance between the furthest and the nearest points becomes closer [25]. Additionally, using t-SNE, we visualize the clusters after performing the K-Means algorithm.

4.2.3. **Sentiment Analysis**

Sentiment analysis is one of the widely used tasks in automated text analysis, and NLP, which aims to identify whether the given text expresses an opinion or not. Furthermore, for the opinionated content, it is

recognized if the opinion is positive or negative. Since the task focuses on opinionated content, it is also called *opinion mining*. More generally, sentiment analysis systematically identifies, extracts, and quantifies affective states and subjective information [26]. There are variations of the sentiment analysis task focusing on shorter (sentence) or longer (paragraph or an article) pieces of texts. There are also sentiment analysis solutions recognizing sentiment on different aspects of a domain (such as which dishes and services are positively opinionated).

There is a rich variety of academic solutions and software tools available for sentiment analysis. In general, the proposed solutions can be grouped into two, as machine learning based and rule based approaches. In the first one, sentiment analysis is considered as a supervised learning problem and a machine learning model is constructed by using a collection of texts annotated for the sentiment as a training data set. In the second group of approaches, a hand curated corpus including sentimental words and their sentiment scores is constructed. A text is scored on the basis of the matching of its content with the corpus.

In this study, we use the sentiment analysis tool Valence Aware Dictionary and Sentiment Reasoner (VADER), which contains a glossary and a set of rules to analyse sentiments posted on social media. More specifically, VADER is a rule-based model for sentiment analysis, and it is reported to provide comparable accuracy performance in comparison to other state-of-the-art sentiment analysis solutions [27]. VADER uses lexicons of sentiment-related words, each of which is rated as to whether it is positive or negative, and in many cases, how positive or negative.

4.3. Social Media Analysis on posts related with UBH sites in Cappadocia

In this section, the computational process of social media analysis is described with the details of the collected data on the Cappadocia case. Constructed computation pipelines and their results are presented. The utilization of the extracted results in UBH analysis is discussed in Section 4.4.

4.3.1. Data Sets

To understand the public opinion about Cappadocia, reviews and comments from different national and international resources are collected. When collecting data about Cappadocia, UBH sites such as Göreme National Park, Derinkuyu Underground City, and Kaymaklı Underground City are specifically taken as keywords. Two example data instances, both in Turkish and English, are shown in Table 4.1 and Table 4.2, respectively.

The details about the data sets are summarized in Table 4.3. All instances in the collected data are dated between 2018 and 2022. The details about individual data sets collected from TripAdvisor[2], Google Maps[3] and Eksisozluk[4] are shared in Tables 4.4-4.6, respectively.

Table 4.1. An example Turkish data instance from TripAdvisor data set

Field	Content
Title	Derinkuyu Yeraltı Şehri
Text	Güzel bir gezi oldu bizim için. Girişte biraz yoğunluk vardı ama değdi gerçekten. Bazı kısımlar oldukça alçak ve dar bazı kısımlar kapalı bazı kısımlarda sanırım göçük olduğu için daha fazla genişletilmemiş. İçerideki atmosfer kesinlikle harcadığınız zamana ve sarf ettiğiniz efora değecektir.
Travel Date	2022-05
Rating	5 (out of 5)

Table 4.2. An example English data instance from TripAdvisor data set

Field	Content
Title	Unique as can be
Text	If you want a unique experience, then any of Cappadocia's underground cities will fill the bill. The fact that Derinkuyu exists at all is amazing. I highly recommend it... just watch your head, as many of the passageways are so small you have to bend over in half to get through. Not for the claustrophobic or faint of heart.
Travel Date	2021-03
Rating	5 (out of 5)

Table 4.3. Overview of the collected data sets

Source	# of English instances	# of Turkish instances
Tripadvisor	921	589
Google Maps	191	-
Eksisozluk	-	41

Table 4.4. TripAdvisor data set

Title in TripAdvisor	# of English reviews	# of Turkish reviews
Göreme Open Air Museum	286	187
Göreme National Park	426	210
Kaymaklı Underground City	137	83
Derinkuyu Underground City	72	109

Table 4.5. Google Maps data set

Title in Google Maps	# of reviews (English)
Göreme Open Air Museum	54
Kaymaklı Underground City	69
Derinkuyu Underground City	68

Table 4.6. Eksisozluk data set

Title in Eksisozluk	# of entries (Turkish)
Göreme	4
Göreme Open Air Museum	7
Removal of Göreme's National Park Status	3

Göreme Valley	2
Cappadocia	11
Kaymaklı Underground City	4
Derinkuyu Underground City	10

Collected data can also be analysed by combining the different data sets by location. Table 4.7 shows all data combined under the location information. Three locations are used for generalization: Göreme National Park, Kaymaklı Underground City, and Derinkuyu Underground City.

Table 4.7. Number of comments per location

Location	# of entries (Turkish)	# of entries (English)
Göreme National Park (combined with *Göreme, Cappadocia, Göreme Valley, Göreme Open Air Museum, Removal of Göreme's National Park Status* topics)	424	766
Kaymaklı Underground City	87	206
Derinkuyu Underground City	119	140

4.3.2. **Location-based Top Word Analysis on Reviews**

To understand the difference in public opinion regarding the three locations, top word analysis is conducted. For each location, the top 15 words (excluding stopwords in both languages and also common verbs such as "etmek" or "almak" in Turkish) are identified using the well-known term text analysis weighting schema of TF-IDF scoring. In TF-IDF scoring, the aim is to give higher scores to terms that appear frequently yet are distinctive.

Table 4.8 shows the top words for each location for the Turkish reviews. For all locations, positive words such as "harika (great)", "iyi (good)" or "güzel (beautiful)" are in the top 15 words. Also, words such as "mutlaka (definitely)", "gereken (necessary, must)" or "tavsiye (recommendation)" are in the top words together with words such as "gez (visit)" and "gör (see)". There are also a couple of words with negative

connotations such as “ücret (price)” and “tl (Turkish Lira)”. These words are representative of the reviews that include fees of different museums, generally included to complain about the high prices.

When the top words for the Göreme National Park are analysed, other words that stand out include “doğa (nature)” and “kilise (church)”. Here, “doğa” is generally coming from the positive reviews mentioning the landmarks around the region. Similarly, “kilise” is coming from the reviews that mention the churches in the region. For Kaymaklı Underground City, other words that stand out include “çocuk (child)”, “dar (narrow)”, “etkile (impress, fascinating)”, “kapalı (closed)” and “tünel (tunnel)”. Here, “dar”, “etkile”, “kapalı”, and “tünel” are used to describe the features of the underground city, with some visitors finding the city fascinating, and with some visitors having problems since the city is too narrow and claustrophobic. A surprising word here is “çocuk”, and this is mostly coming from the reviewers mentioning that their children had a great time exploring the underground city. For Derinkuyu Underground City, additional to the words for Kaymaklı, there are “büyük (big)”, “nasıl (how)”, “tarih (history)” and “zor (hard)”. These are representative of the reviews where the visitors are amazed at how big the underground city is, and could not believe how people were able to live in such a hard place to even visit.

Table 4.8. Top words for Turkish reviews

Location	Top Words
Göreme National Park	açık, doğa, gereken, gez, gör, güzel, harika, kilise, mutlaka, müze, rehber, tarih, tavsiye, tl, ücret
Kaymaklı Underground City	altı, çocuk, dar, etkile, gereken, gez, gör, güzel, iyi, kapalı, mutlaka, tavsiye, tünel, ücret, yeraltı
Derinkuyu Underground City	altı, aşağı, büyük, çocuk, dar, gereken, gez, gör, mutlaka, nasıl, tarih, tl, ücret, yeraltı, zor

Similar to the Turkish reviews, Table 4.9 shows the top words for each location for English reviews. For all locations, positive words such as “amazing”, “beautiful”, and “interesting” stand out, in combination with words such as “experience”, “place”, “tour”, “visit”, and “worth”. Unlike the Turkish case, there are no common words with obvious negative connotations.

For the Göreme National Park, additional words that stand out include "caves", "churches", and "history". These words have a defining power for the region. For Kaymaklı Underground City, additional words that stand out include "floors", "rooms", "narrow", "people", and "time". These are representative of the comments that describe the features of the underground city, with the amazement of the history that there used to be people living in this place. For Derinkuyu Underground City, differently from Kaymaklı, the word "claustrophobic" stands out.

Table 4.9. Top words for English reviews

Location	Top Words
Göreme National Park	air, amazing, area, beautiful, cappadocia, caves, churches, göreme, history, museum, open, place, tour, visit, worth
Kaymaklı Underground City	amazing, city, experience, floors, guide, interesting, narrow, people, place, rooms, time, tour, tunnels, underground, visit
Derinkuyu Underground City	city, claustrophobic, experience, guide, interesting, narrow, people, place, quite, rooms, time, tour, tunnels, underground, visit

4.3.3. **Unsupervised Analysis of Social Media Messages**

Unsupervised data analysis is about discovering latent patterns in document collection. For this purpose, we apply clustering and topic modelling to uncover latent semantic features. For clustering, firstly, the collected social media posts are encoded into n-dimensional vector space using the S-BERT method. The S-BERT model generates 768-dimensional vectors for each post. Then, the data is converted into lower-dimensional space using the t-SNE and the reduced vectors are given to the K-Means clustering.

While applying the K-Means clustering, to determine the optimum k value, validation experiments are performed to measure the silhouette score for different k values. Silhouette score is used for evaluating the quality of clusters created using clustering algorithms regarding how well the samples are clustered with other similar instances. Besides, we construct the With-in-Sum-of-Squares (WSS) chart that indicates the total distance of data points from their corresponding cluster centres. This chart is used for determining the optimal k value.

For the topic modelling, we first eliminate the stop words from the corpus and apply tokenization and lemmatization on the documents. After that, for each document, a bag-of-words representation is generated which counts the word frequency in a document without regarding the word order. The bag-of-word representation is given as input to the LDA model, which also requires the number of topics that should be discovered before assigning words to *n* distinct topics. The quality of explored topics can be examined using the metrics of perplexity and coherence.

The perplexity score measures how well a probability model such as LDA predicts a sample. Lower perplexity scores indicate better generalization performance. Moreover, the coherence metric indicates the degree of semantic similarity between high-scoring words in a topic. Higher coherence scores indicate that the terms within a topic are semantically related to each other. To determine the optimal number of topics *n*, coherence scores are examined for various topic counts.

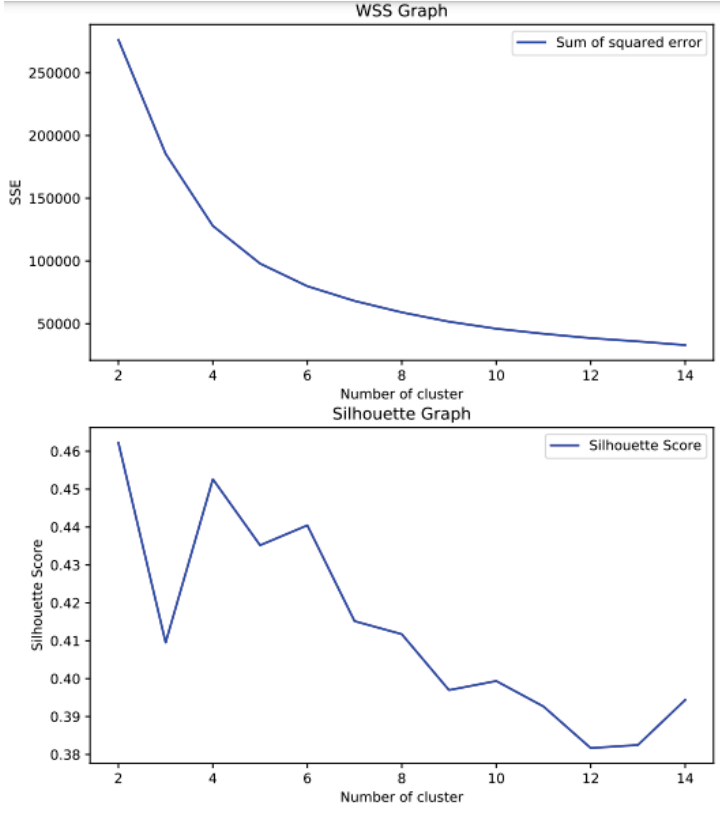


Figure 4.1: WSS and silhouette graphs of Tripadvisor data set

Figure 4.1 shows the results of the clustering validation experiments for the English TripAdvisor data set[5] to select the optimal k value using the WSS plot and the silhouette metric. According to the charts in Figure 4.1, k can be selected as 4 since there is a local maximum at k=4 in the silhouette chart, and in the WSS chart after k=4, as we increase the number of clusters, the sum of squared error decreases slowly.

After selecting the number of clusters as 4, the clusters are represented in 2-D space using the t-SNE method, as given in Figure 4.2. According to Figure 4.2, clusters can be considered as well-separated.

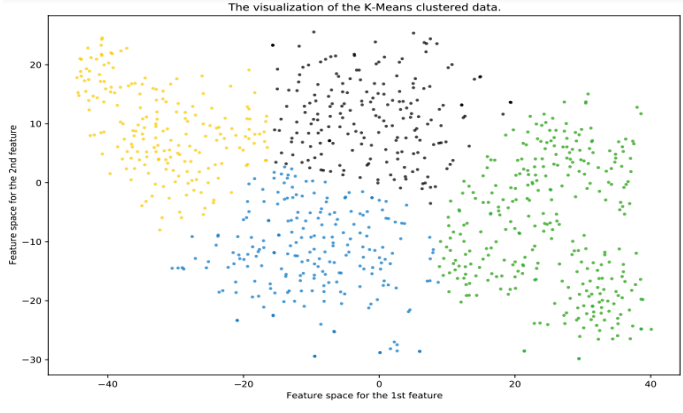


Figure 4.2: Clusters of the English TripAdvisor data set

In the topic modelling validation experiments on the same data set, as given in Figure 4.3, we consider five topic settings as a rational choice. It is a local maximum value, and as the number of topics exceeds 6, the coherence score decreases significantly.

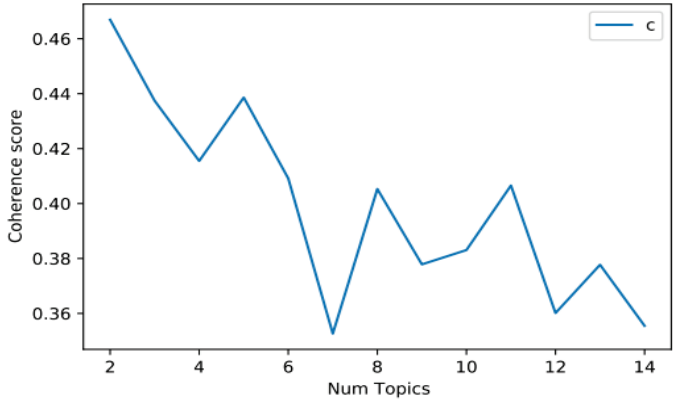
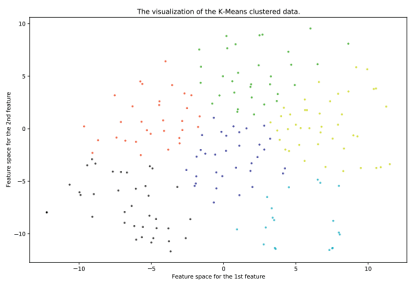
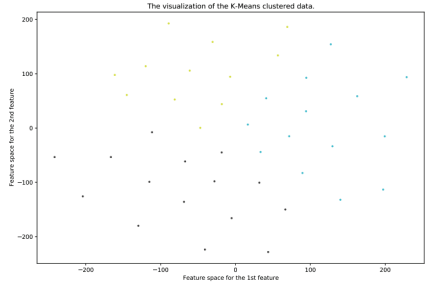


Figure 4.3: Coherence scores topic modelling on TripAdvisor data set

Both of the analyses with clustering and topic modelling result in groupings of related social media messages. As an example of groupings, Figure 4.4 presents the clusters of social media text clusters generated by the K-Means algorithm for Google Maps, Eksisozluk and Turkish Tripadvisor data sets. As seen in the figures, the size and the nature of the clusters vary depending on the data set, but on the overall clearly separated text message groups are observed. The basic motivation for applying such analysis is to extract semantically similar groupings of social media messages and to determine the sentiment orientations per latent topics.



Google Maps Data set



Eksisozluk Data set

Turkish TripAdvisor Data set

Figure 4.4: K-means clusters of Google Maps, Eksisozluk and Turkish Tripadvisor data sets

4.3.4. **Temporal Sentiment Analysis on the Grouped Messages**

In the sentiment analysis phase, before applying the VADER on the collected data set, the text data is pre-processed. To this aim, tokenization, stemming and tagging functions of the Natural Language Toolkit (NLTK) are used [28]. NLTK is an NLP library that uses a set of text processing

modules for classification, tokenization, stemming, tagging, parsing, and semantic reasoning, as well as wrappers, to work with data in natural language. Once the data is prepared for the sentiment analysis method, the VADER tool labels each review with both a sentiment label (as Positive or Negative), and a sentiment score (in the range of [-1, 1]).

It is observed that the message groupings obtained by K-Means clustering and LDA topic modelling are similar. To be able to exploit the topic representations generated by the LDA method, in the sentiment analysis phase, topics (message groupings) generated by LDA are considered. In order to determine the sentiment orientations in each of the topics extracted with LDA, the sentiment analysis results are grouped with respect to the topics determined with topic modelling. Additionally, the changes in the sentiment values are presented along the timeline on the basis of the timestamps of the posted reviews.

4.4. Utilizing Text Mining Results for UBH Analysis

In this section, we present the text analysis findings for the collected data sets. Tripadvisor data set includes posts related to Derinkuyu Underground City, Göreme Open Air Museum, Göreme National Park, and Kaymaklı Underground City. Although the titles in the review threads tell about general topics of postings, K-Means clustering and LDA topic modelling are also applied separately on the data set to find the latent grouping patterns within the collection. Figure 4.5 shows the distribution of the titles of the reviews in each cluster obtained by K-means algorithm. In the figure, *C* denotes the cluster label and the horizontal bar charts represent the number of posts from each title. According to the figure, user posts related to Derinkuyu and Kaymaklı regions are grouped in the last cluster (*C=3*). Moreover, the second cluster (*C=1*) mostly consists of Göreme National Park related comments. Likewise, more than 94% of reviews in the third cluster (*C=2*) are related to Göreme Archaeological Site and Göreme National Park comments. Finally, the first cluster (*C=0*) mainly contains comments related to Göreme Open Air Museum.

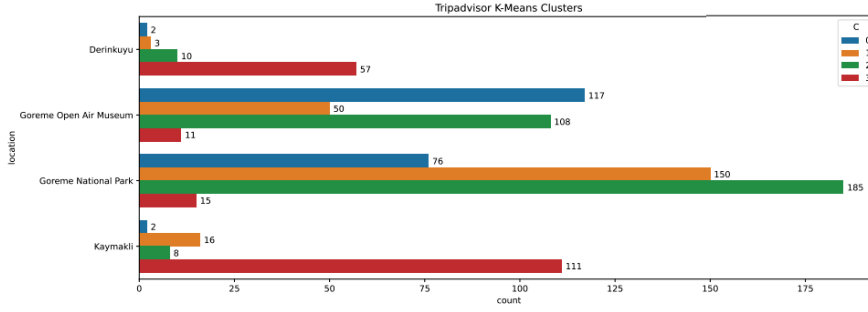


Figure 4.5: User comments by titles in each cluster (English TripAdvisor data set)

In addition, for the same data set, we illustrate the title distribution of user posts in each topic determined by LDA analysis in Figure 4.6. According to the figure, the first topic (*C=0*) mostly contains Göreme National Park related comments, and the second topic (*C=1*) includes Göreme Open Air Museum related contents. The third topic (*C=2*) is a mixture of Göreme National Park, Göreme Open Air Museum and Kaymaklı. Likewise, the fourth topic (*C=3*) is also a mixture of Göreme National Park and Göreme Open Air Museum. Finally, the majority of the fifth topic (*C=4*) consists of Derinkuyu and Kaymaklı related texts.

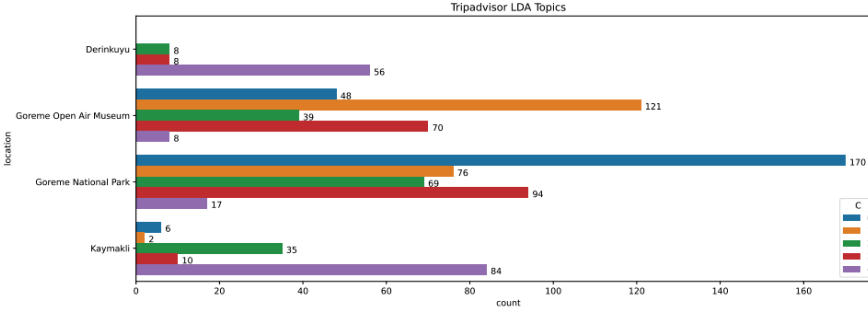


Figure 4.6: User comments by regions in each topic (English TripAdvisor data set)

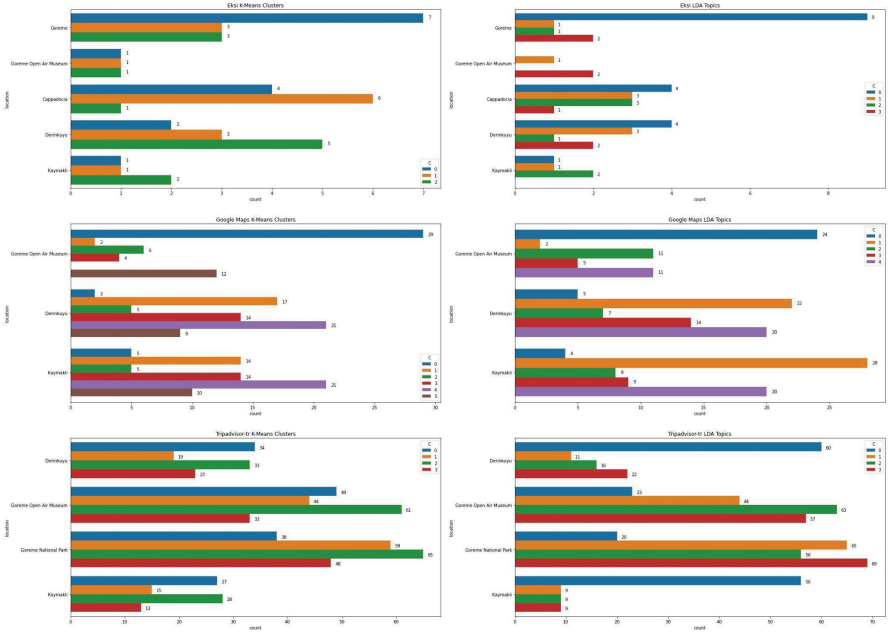
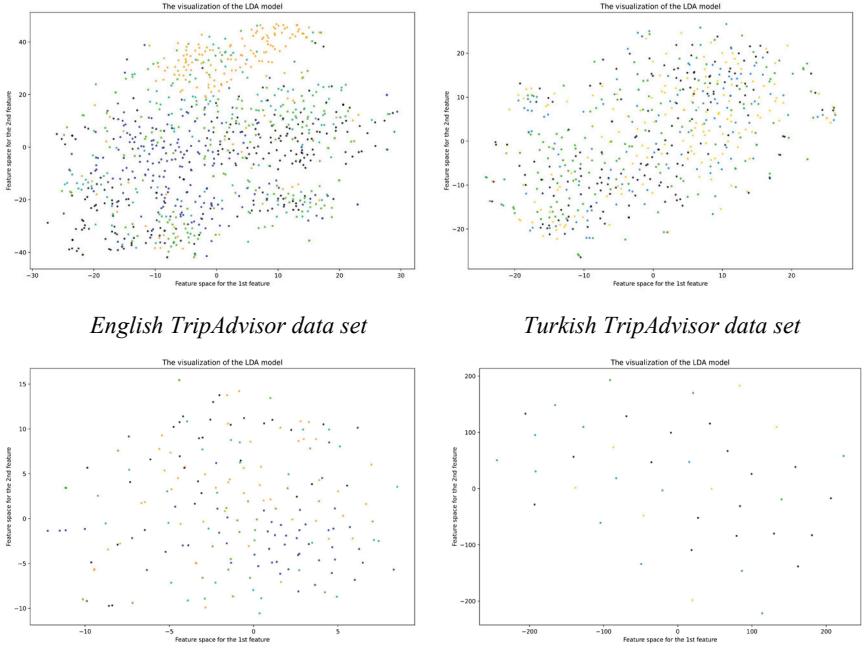


Figure 4.7: Title distributions per cluster (left graphics) and per topic (right graphics) for Eksisozluk (first row), Google Maps (second row), and Turkish TripAdvisor data sets

Title distribution for the other data sets (Eksisozluk, Google Maps, and Turkish Tripadvisor) are presented in Figure 4.7. According to the figure, in Google Maps and Turkish Tripadvisor data sets, Derinkuyu and Kaymaklı related documents are grouped together, and Göreme Open Air Museum related posts are treated as a separate group.

In Figure 4.8, the extracted topic labels are projected into 2-D using the S-BERT text encoding and t-SNE to reduce dimensionality. According to the figure, the documents with different topic labels are not separated well. In contrast, when we apply K-Means clustering, the text collections with varying clusters labels are separated clearly (Figure 4.2 and Figure 4.4). This is due to the fact that the K-Means algorithm groups the instances by considering the Euclidean distance. However, the LDA method assigns the topic labels by considering the term relevance. The groupings determined with respect to the distance can be reflected in t-SNE visualisation better, on the other hand, the semantics of the extracted groupings have considerable overlap.



English TripAdvisor data set *Turkish TripAdvisor data set*

Google Maps data set *Eksisozluk data set*

Figure 4.8: Projection of topic labels in 2-D space

Additionally, the top-10 representative terms per topic are presented for each of the data sets, in Tables 4.10-4.13, respectively. According to the presented summary, some of the representative terms indicate a specific region. For instance, "underground", "claustrophobic", "Derinkuyu" tokens are linked to Derinkuyu Underground City. Likewise, the terms "church", "painting" and "fresco" are related to Göreme Open Air Museum. On the other hand, some of the representative words are not so distinctive for the topic. This also explains why the topic labels are not well separated in Figure 4.18.

Table 4.10. Representative terms in Eksisozluk data set per topic

Topic #	**Representative Terms**
Topic 0	yeraltı, Derinkuyu, şehir, gezmek, rehber, koridor, oda, merdiven, tarih, etkilemek

Topic 1	yer, olmak, insan, Park, yapmak, mil, girmek, demek, gelmek, zaman
Topic 2	bir, etmek, gerekmek, ben, bilemek, kalmak, yan, mekân, turist, iyi
Topic 3	bura, Kapadokya, var, ilk, kilise, almak, dar, kat, vadi, gitmek

Table 4.11. Representative terms in TripAdvisor data set per topic

Topic #	Representative Terms
Topic 0	var, tl, kilise, bura, gitmek, kart, rehber, tur, demek, gelmek
Topic 1	bir, yer, olmak, insan, kesinlikle, ben, bilemek, iyi, yapı, turist
Topic 2	yer, mutlak, etmek, şehir, dar, girmek, ziyaret, zaman, gezi, biraz
Topic 3	bir, Kapadokya, tarih, yer, gezmek, ilk, yıl, mekân, yol, bulmak

Table 4.12. Representative terms in English TripAdvisor data set per topic

Topic #	Representative Terms
Topic 0	city, underground, people, room, live, tunnel, small, narrow, group, experience
Topic 1	area, walk, lot, day, beautiful, great, unique, landscape, explore, spend
Topic 2	church, cave, museum, rock, early, site, fresco, painting, dark_church, hot
Topic 3	visit, worth, interesting, museum, enjoy, hour, view, göreme, nice, tourist
Topic 4	place, guide, tour, time, amazing, history, good, make, feel, Cappadocia

Table 4.13. Representative terms in Google Maps data set per topic

Topic #	Representative Terms
Topic 0	underground, visit, city, interesting, tunnel, room, big, open, space, floor
Topic 1	tour, history, recommend, lot, good, make, claustrophobic, level, small, cool
Topic 2	people, experience, live, narrow, time, area, great, low, day, back
Topic 3	place, guide, amazing, walk, inside, entrance, impressive, pay, fun, find
Topic 4	cave, church, museum, worth, site, ticket, tourist, nice, fresco, give

For the English TripAdvisor data set, the overall sentiment analysis results on the full data set are presented in Figure 4.9. As seen in the results, the majority of the reviews are positive with scores in [0.50, 1.00].

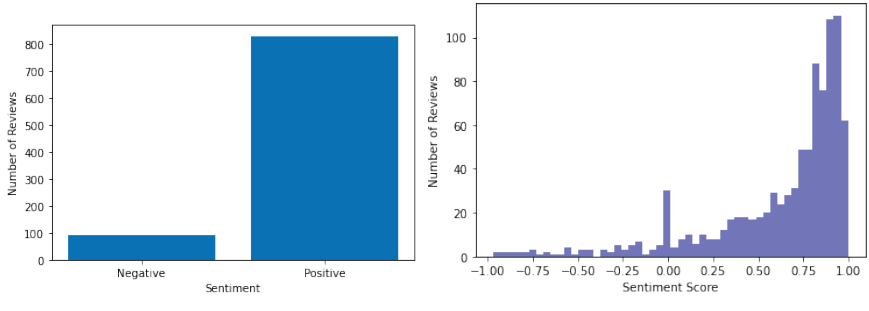
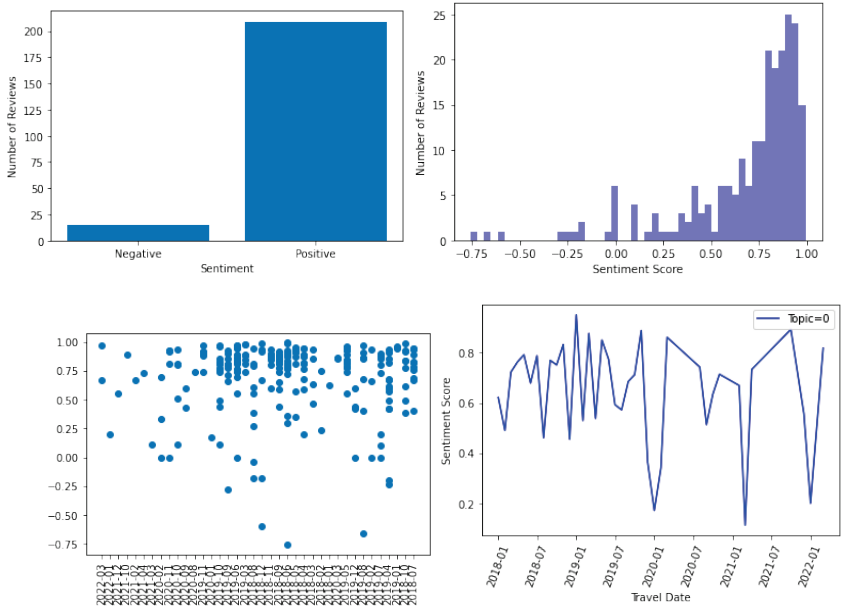
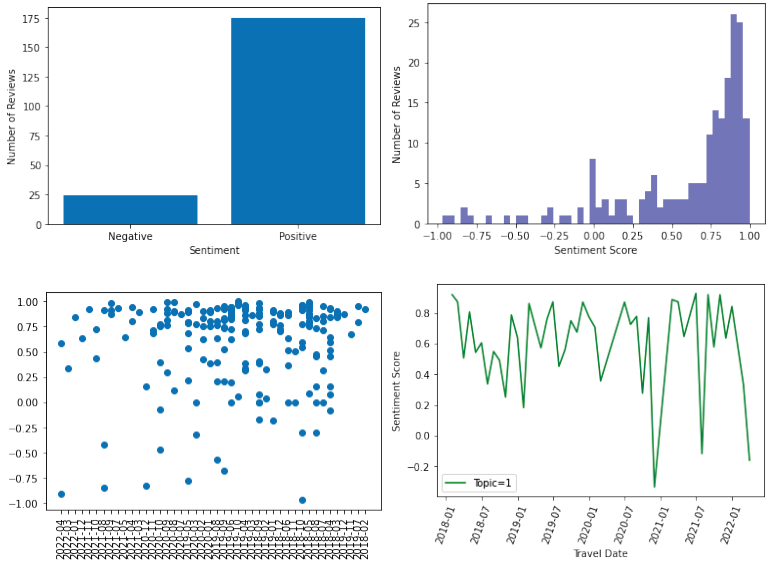


Figure 4.9: Sentiment score distribution of the English TripAdvisor user reviews. The distribution of positive and negative labels (left), the distribution of sentiment scores

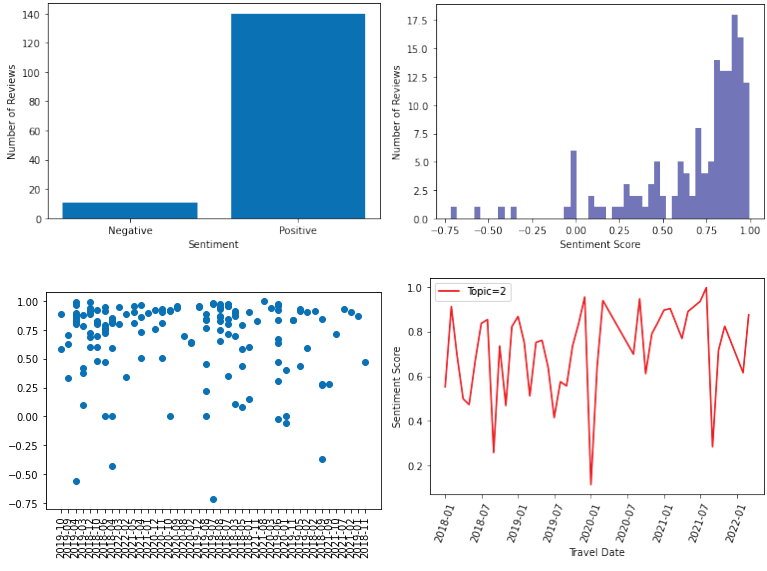
In the unsupervised analysis of the posted reviews, both clustering and topic modelling techniques are applied separately. Since both of the groupings have similar results, in the rest of the analysis we use the groupings obtained by topic modelling. In Figures 4.10 - 4.16, sentiment analysis results for each of the extracted latent topics are presented for all data sets.



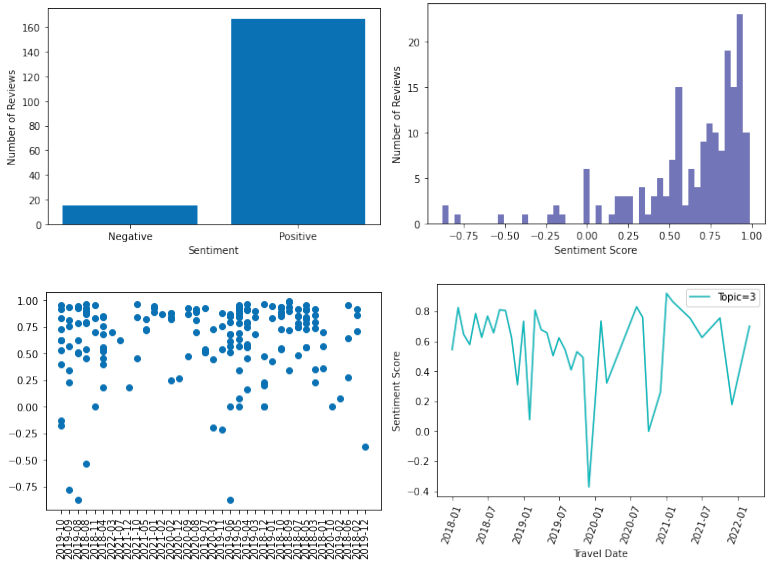
(a) Topic 0



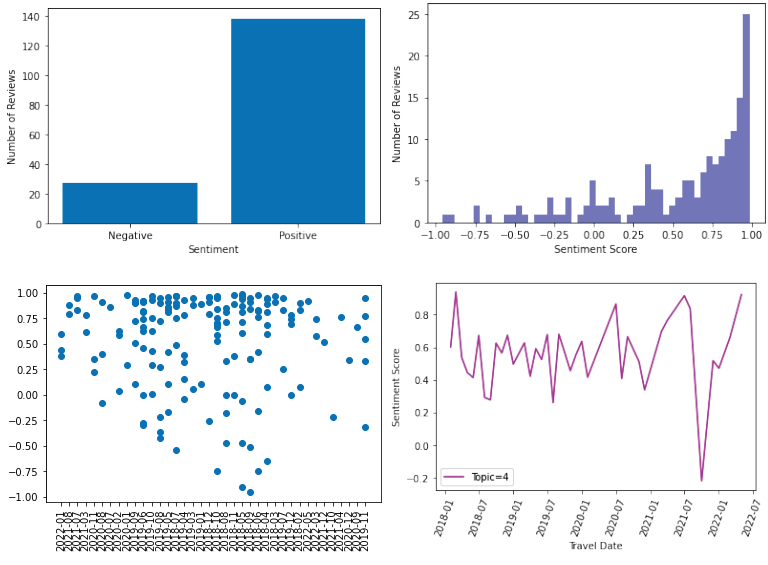
(b) Topic 1



(c) *Topic 2*



(d) *Topic 3*



(e) Topic 4

Figure 4.10: Sentiment scores for each topic of the English TripAdvisor data set

As given in Figure 4.10, for all the topics in English TripAdvisor data set, the sentiment score distribution and the change along the timeline have similar patterns, including positive reviews on the overall. The sentiment score along the timeline can be seen more clearly in Figure 4.11. For example, there is a decrease for both topic 0 and topic 1 around 2020-01 and 2021-01.

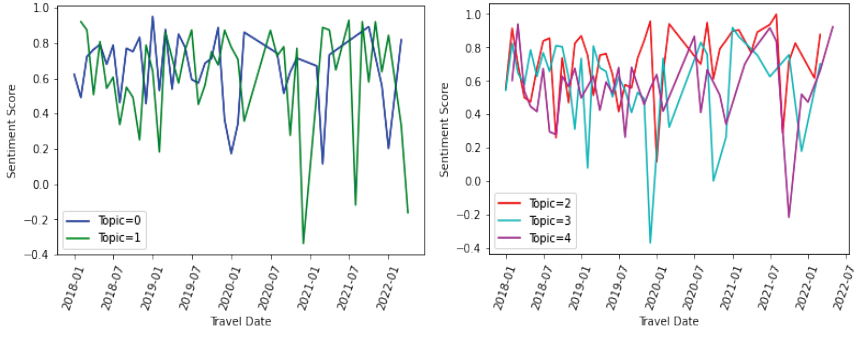


Figure 4.11: Line charts of the sentiment scores by each topic of the English TripAdvisor data set

In Figure 4.12, sentiment analysis for Turkish TripAdvisor data set is presented. The analysis conducted for the whole data set shows that the number of negative comments is lower compared to positive ones, however the ratio of negative reviews is higher with respect to English TripAdvisor collection. The time instances having decrease in sentiment scores has overlap with English TripAdvisor reviews.

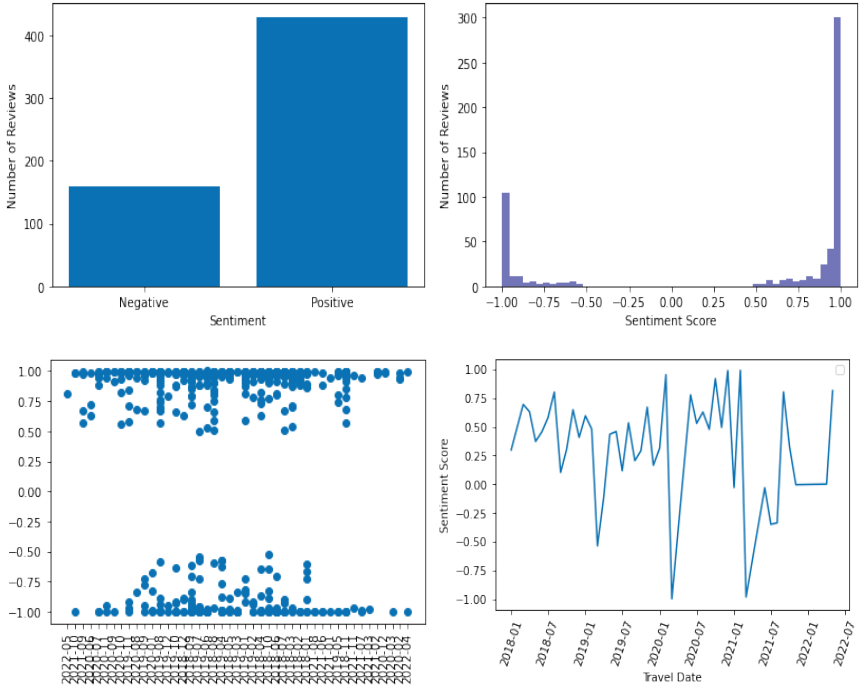


Figure 4.12: Sentiment scores of the Turkish TripAdvisor data set

Sentiment score distribution of Google Maps data set, as given in Figure 4.13, has a similar pattern having majority of positive reviews. The sentiment scores mostly show a steady behaviour except for the last part of the timeline. The sentiment breakdown and change along the timeline are also similar for the extracted topics (Figure 4.14). The sentiment scores are all above the value 0 except for Topic 3 where there exists a negative score towards the end of the timeline. This difference is more clearly seen in Figure 4.15 where the sentiment timelines for all topics are shown together.

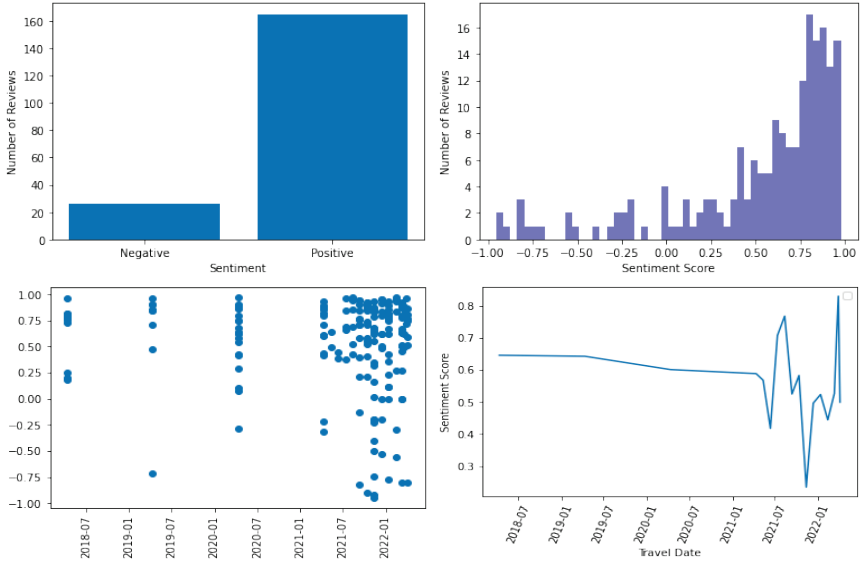
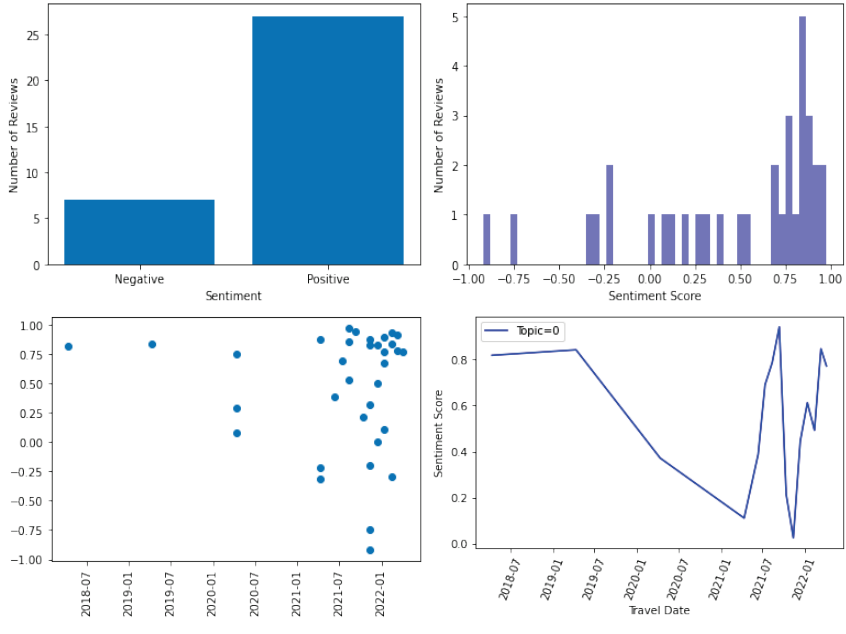
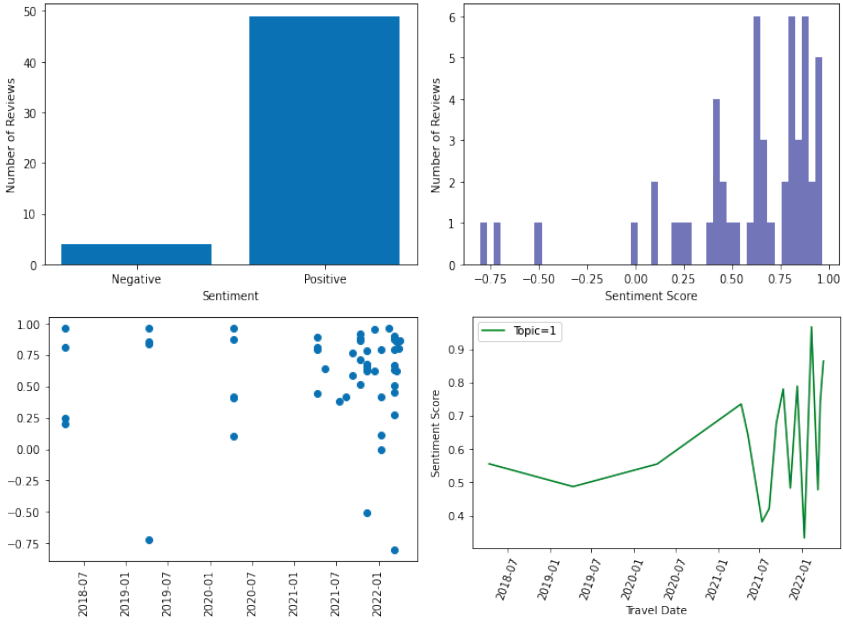


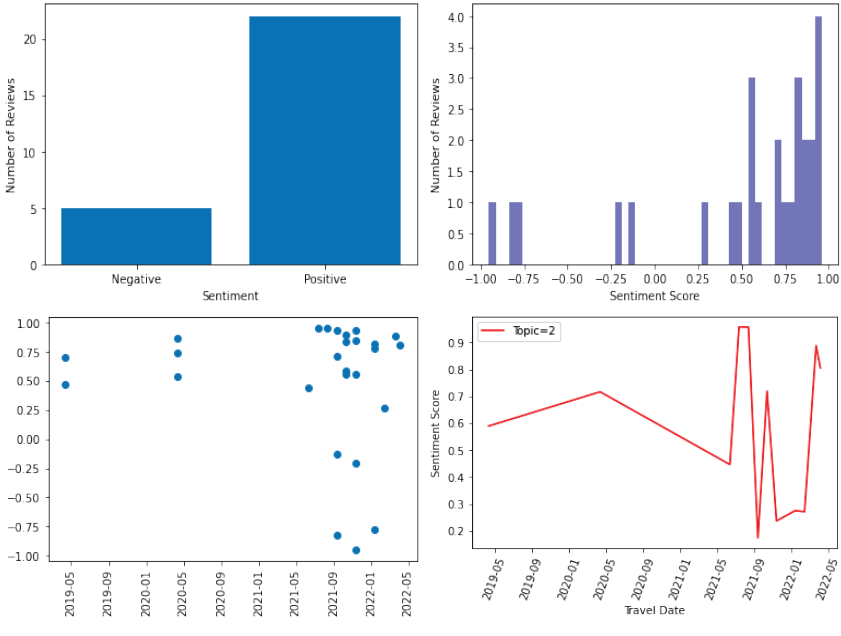
Figure 4.13: Sentiment scores of the Google Maps data set



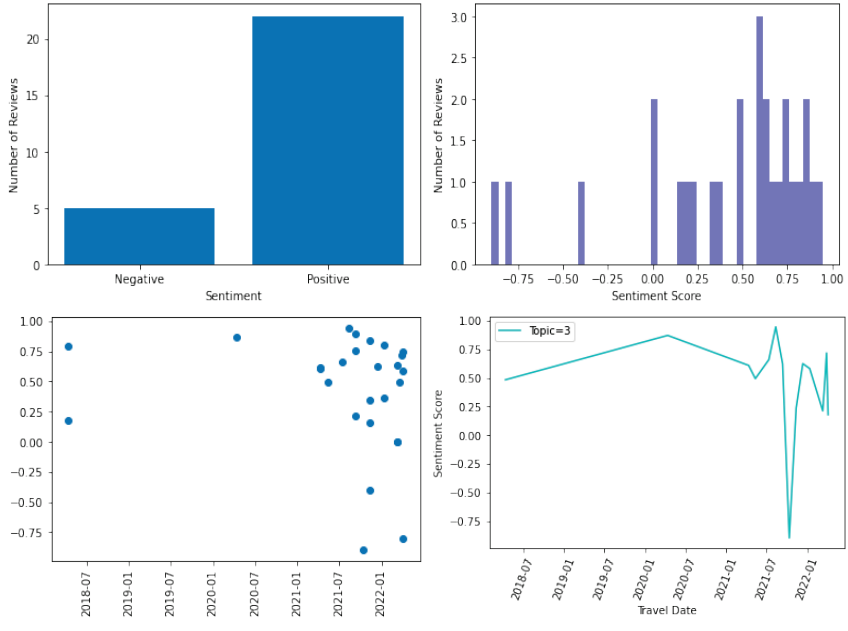
(a) Topic 0



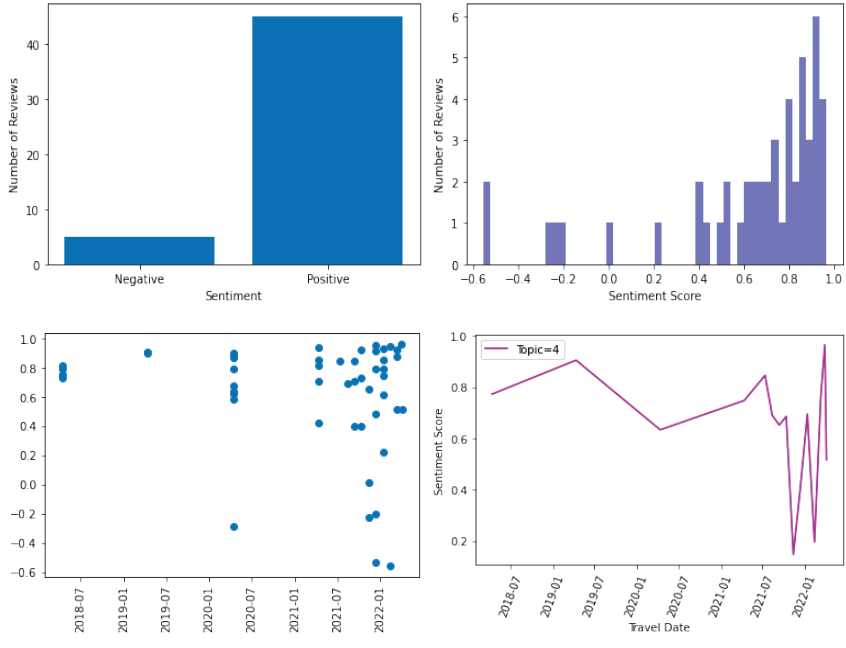
(b) Topic 1



(c) Topic 2



(d) Topic 3



(e) Topic 4

Figure 4.14: Sentiment scores for each topic of the Google Maps data set

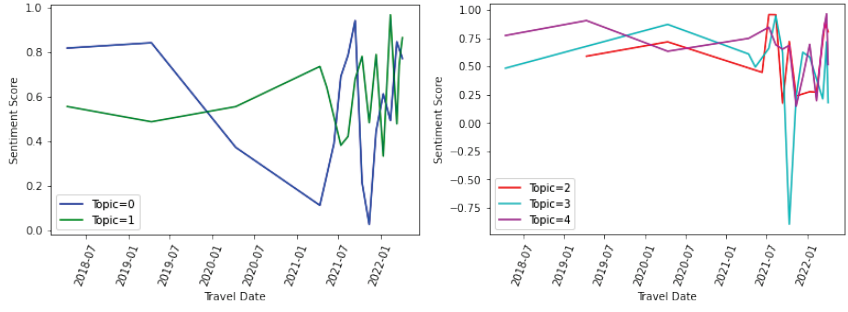


Figure 4.15: Line charts of the sentiment scores by each topic of the Google Maps data set

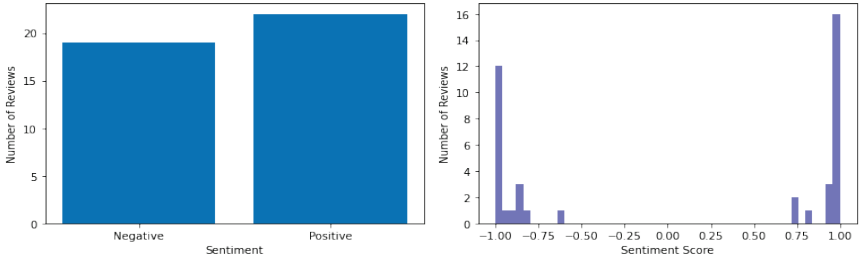


Figure 4.16: Sentiment scores of the Eksisozluk data set

The analysis on Eksisozluk data set displays a different behaviour than the other ones, possibly due to the nature of the web site which includes informal critics of users on a variety of topics reflecting positive as well as negative opinions. Therefore, in this collection, we see a higher ratio of negative postings.

As an additional analysis, extracted sentiment labels are grouped by the three titles (locations) using the data division given in Table 4.7, Göreme, Kaymakli and Derinkuyu. Figure 4.17 shows the percentage of positive comments for each location in English reviews, Turkish reviews, and both combined. It can be seen that local tourists tend to leave more negative reviews than international tourists. This is also captured in the top words for Turkish reviews, with local tourists frequently mentioning the entrance fees.

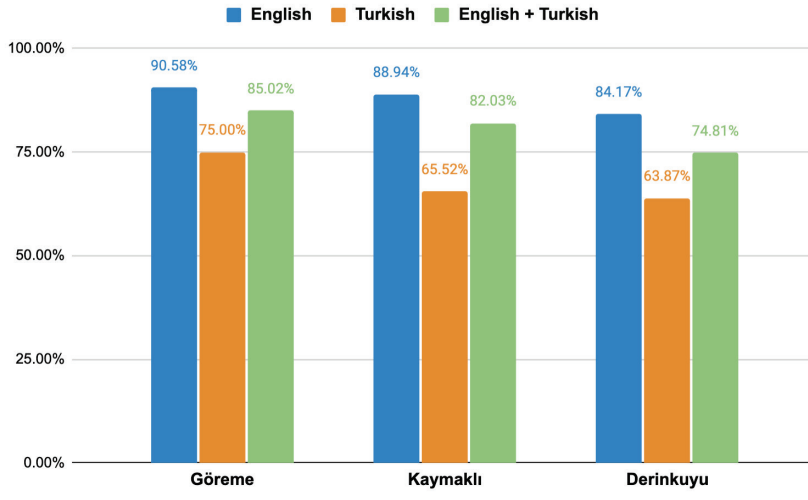


Figure 4.17: Positive review percentages of reviews by location

4.5. Utilization of Text Analysis Results by Decision Makers

As presented in the above analysis, text mining on social media posts can summarise and extract the crucial points expressed by the visitors of the UBH sites in Cappadocia. This provides a set of possibilities to enhance the management and policy development related to UBH sites in the region:

- The sentiment analysis conducted along a timeline is a useful tool to reveal the overall trend and change in the visitor satisfaction (such as given in Figure 4.11 and 4.12). Sentiment changes towards negative is a strong sign to check the process in the management of the sites. It is also a handy mechanism to track how well new procedures and policies are reacted towards. For example, shortening the time period of the sentiment analysis can be a rapid way to understand the immediate response of the public.
- Topic modelling and clustering provides tools to look into the comments more closely and to extract positive and negative aspects mentioned in the social media posts (such as given in Table 4.10, Table 4.11, Table 4.12 and Table 4.13). Topic modelling and clustering algorithms give the representative keywords of each message group. By this way, for site management or policy making, one can see a finer picture of positive and

negative aspects expressed by the visitors. Furthermore, through sentiment analysis over each topic, it is possible to see the trend in visitor satisfaction in a more detailed manner with respect to each aspect expressed (such as given in Figure 4.13 and Figure 4.14). Similarly, focusing on specific keywords can help the policymakers track the immediate response of the public towards new policies.

In addition to possibilities and improvements, there are also threats brought by social media analysis. Although social media is a useful tool to share opinions and news, there is not any guarantee that the user characteristics and the posted opinions are representative. Furthermore, it is also prone to fake news and manipulation attempts. Therefore, the suggested practice would be to apply a saliency check of the messages and the author of the messages. More importantly, these computational text analysis results need to be used as an auxiliary mechanism to extend the perspective.

4.6. Conclusions

In this study, we focus on the use of computational text analysis methods to augment and facilitate UBH studies, and perform a case study on UBH sites in Cappadocia by applying sentiment analysis on collections of related user reviews on social media.

As the data set, postings between 2018 – 2022 related with the UBH sites in Cappadocia are collected from three different social media applications. Firstly, unsupervised data analysis is applied on the data sets using K-Means clustering and LDA topic modelling technique to group similar user posts. Following this, sentiment analysis is performed on the documents to discover the public opinion on UBH sites in Cappadocia. As the last phase, the overall sentiment scores for each group of postings are determined and displayed along the timeline of 2018-2022.

As given in the results, the presented computational analysis can capture the semantically related groupings within the reviews and the orientation of user opinions reflected in the reviews. Furthermore, using posting timestamps, the change in the sentiment orientation per site or per topic can be tracked. Such results can be exploited to understand the reflection of the organizations, regulations and policies applied on UBH sites on the visitors of the sites. The changes in the sentiment along the timeline is particularly helpful how and when a change in the regulations affect the user perception. The content analysis applied on the text messages provides further clues for user opinion and perception of the sites.

Computational methods, specifically machine learning and artificial intelligence based solutions always carry a certain level of accuracy

limitation in modelling and label prediction tasks. In our analysis, due to the use of S-BERT for obtaining text encodings, semantic similarity of the texts can be captured in clustering. However, in LDA analysis and TF-IDF based term weighting schema, the capability of exploiting semantic similarity between the terms and between the messages is limited. For the sentiment analysis step, the software tool VADER is used. It is reported to give competitive results with other available sentiment analysis solutions, however its corpus based structure may cause limitation if the text includes rare sentiment terms which are not included in the corpus.

The presented analysis can be further extended in a variety of directions. The collected data sets cover the years 2018 and 2019, the years before the COVID-19 pandemic, and also 2020, 2021 and 2022, which are the era of pandemic and post-pandemic. The presented analysis shows the overall comparison of user opinion for these years along the timeline. More detailed analysis can be obtained by determining time intervals with respect to time eras of COVID-19, and conducting the analysis with respect to them. Another possible extension of the analysis is using aspect based sentiment analysis on the reviews in order to extract the expressed aspects of UBH sites more clearly, such as the entrance fee, accessibility, provided services etc. and user opinions related with such aspects.

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NOTES

[1] https://underground4value.eu/
[2] https://www.tripadvisor.com.tr/
[3] https://www.google.com/maps/
[4] https://eksisozluk.com/
[5] The process is the same for the other data sets. For illustration purpose we only present the results for English Tripadvisor data set.

CHAPTER 5

Current issues in Cappadocia World Heritage Sites within sustainable tourism management

Implications from online reviews

Akin Özen, Arif Akpinar

5.1. Introduction

The tourism industry, characterised by the annual global movement of approximately 1.4 billion individuals as per 2019 data, exhibits a consistent upward trajectory. It is observed that this population is predominantly attracted by destinations featuring World Heritage Sites (WHS). Heritage sites are registered by UNESCO and protected and transferred to future generations as a common heritage of humanity. As of the year 2022, Turkey's contribution to the heritage list encompasses nineteen distinct places. Among these, the Göreme National Park and the Rocky Sites of Cappadocia have been recognized by UNESCO for their combined natural and cultural significance since 1985. This region, along with the Aegean and Mediterranean coasts of Turkey, is one of the earliest destinations for mass tourism activities. It welcomes an estimated two million visitors on an annual basis.

Reviews of travel experiences shared by tourists in digital platforms offer valuable insights for the preservation and enhancement of WHSs. Tourists, in their role as voluntary custodians of these heritage sites, contribute unbiased and objectively crafted reports through their shared reviews. These textual content posts are referred to as user-generated content (UGC) in extent literature. The appraisal of textual content generated by tourists can be conducted using text mining methodologies, as per scientific protocols. This innovative approach allows for the identification of factors contributing to alterations and degradation in heritage sites. Conse-

quently, this crucial information paves the way for the implementation of appropriate protective measures.

Within the academic literature, there exists a limited number of studies that employ text mining methodologies to analyse tourist reviews pertaining to WHSs. For instance, one such study explored the evolving perceptions of tourists visiting Jeju Island in South Korea towards WHSs, utilizing text mining techniques [1]. In another research endeavour, text mining methods were applied to scrutinize reviews on TripAdvisor with the objective of discerning the brand personality of WHS [2]. Furthermore, Garzia et al. (2018) conducted an examination of open-source reviews about the Papal Basilica and the Holy Saint Francis Monastery in Assisi, Italy. Their analysis revealed insights into the perceived risk assessment associated with these sites [3].

ISIS as a militant jihadist group destroyed many artifacts in the lands they occupied. Using data compiled from social media (Twitter), Cunliffe and Curini conducted an emotional analysis of responses to examples of heritage destruction and re-use in the Middle East between 2015 and 2016 [4]. In another study conducted in Italy, it was aimed to guide managers by examining the reviews left by visitors on the internet about the cultural heritage areas [5].

This book chapter analyses the contents shared by tourists about underground cities, churches and open-air museums in WHSs in the Cappadocia region by using text mining methods. In this study, as an exploratory research, we discuss sustainable tourism management with tourist reviews. The results of the study are interpreted in terms of sustainable tourism.

5.2. World Heritage Sites (WHSs) of Cappadocia

5.2.1. Göreme (Maccan/Avcılar)

Göreme, which is 10 km away from Nevşehir, is a town where many fairy chimneys are intertwined with houses. In the town, formerly known as Maccan and later as Avcılar, cavities in the fairy chimneys rising from courtyards of the houses are still used as rooms and warehouses. The fact that these rock hollows are warm in winter and cool in summer, allows local people to live and store their food. There are two column Roman rock tombs, Bezirhane and Orta Mahalle churches, Durmuş Kadir and Yusuf Koç churches in Uzun Dere in the town.

5.2.2. Göreme Open-Air Museum

A significant number of Christian communities lived in Cappadocia at the end of the second century, because two diocesan regions belonging to

this period were known. One of them was Kayseri, which would be the centre of Christians in the region for a long time, and the other was Malatya. In the 3rd century, priests with strong personalities made the region a vibrant centre of religious thought and life. Cappadocia was known as the hometown of three great saints (Basil the Great, his brother Gregor of Nyssa, and Gregor of Nazianus) in the fourth century. Today's Göreme Open-Air Museum is considered by St. Basil as the place where the monastic education system was initiated. Soğanlı, Ihlara and Açıksaray are the places where the same education system was seen later in churches, chapels, dining halls and seating [6], [7].

5.2.3. **Zelve Open-Air Museum**

Zelve, two km away from Pasabağları, is established on northern slopes of Aktepe. Zelve Ruins, which consists of three valleys, is the place where the fairy chimneys are numerous. Fairy chimneys in the valley are pointed and wide-bodied. Zelve is an important settlement and religious centre of Christians in the nineth and thirteenth centuries, moreover it is one of the places where the first religious seminars were given to priests. Located at the bottom of the slopes, the 'Direkli Church' belongs to the first years of the monastery life in Zelve. Church ornaments are mostly embossed crosses and are closely related to iconoclastic thought. Balıklı, Üzümlü and Geyikli Churches dating back to the Iconoclastic Period are the most important churches of the valley. Until 1952, in the inhabited valley, there are settlements other than monasteries and churches, tunnels to two valleys, mills, mosques and dovecote [8].

5.2.4. **Derinkuyu Underground City**

Derinkuyu is located on the Nevşehir-Niğde road, 29 km away from Nevşehir. The depth of Derinkuyu underground city is approximately 85 m. This underground city has all the features (i.e., barn, cellar, dining hall, church, arsenal, etc.) in an underground city. There is also a missionary school on the second floor. The ceiling of the school, which is a large area, is covered with a tunnel vault, which is not common in underground cities. Spaces to the left of the hall are study rooms. After the third and fourth floors of the underground city, it is descended directly by stairs and reached to the church with a cross plan on the lower floor. The ventilation shaft with a depth of 55 m, which is connected to the surface, is also used as a water well. Not every floor can benefit from the wells extending to the lower floor, and in order to prevent poisoning during an invasion, the

mouth of some wells is disconnected from the surface. Only 10% of Derinkuyu underground city opened in 1965 can still be visited.

5.2.5. **Kaymaklı underground city**

It is 19 km away from Nevşehir, on the Nevşehir-Niğde road. Rising in the middle of today's Kaymakli town, it is located under a place called "Kaymaklı Castle". The underground city was opened to public in 1964.

In Kaymaklı village, people built their houses around the nearly hundred tunnels of the underground city. Local people still pass through these tunnels leading to the courtyards and use the appropriate spaces of the underground city as cellars, warehouses, barns, etc. This underground city is different from Derinkuyu Underground City in terms of both plan and establishment. Currently, four floors have been exposed, and spaces are mostly gathered around the ventilation chimneys.

Although it is said that function of the multi-pit granite stone in the part of the underground city where the warehouses are located is "spice grinding stone", as a result of recent research, it has been understood that it is the "mine melting stone" used in the last stage when the copper ore is made ready for melting. In other words, it has been used to enrich copper ore [8].

Table 5.1 and Figure 5.1 presents tourism destinations with the WHSs in Cappadocia region.

Table 5.1. UNESCO World Heritage Sites in Cappadocia

Cappadocia Map Index			
CENTERS IN CAPPADOCIA	**Map no**	**CHURCHES**	**Map no**
Uçhisar	5	Cappadocia Churches	7
Göreme	6	Göreme Churches Durmuş Kadir, Yusuf Koç Church	6
Çavuşin	23	**GÖREME OPEN AIR MUSEUM**	**12**
Avanos	25	El Nazar Church	8
Zelve	**26**	Saklı Church	9
Ürgüp	29	Kılıçlar Kuşluk Church (of Mother Mary)	10
Ortahisar	32	Kılıçlar Church	11
Mustafapaşa (Sinasos)	34	Tokalı (Buckle) Church	13
Tatlarin	36	Nunnery and Convent	14
Nevşehir	38	Chapel of St. Basil	15
Damat İbrahim Paşa Complex	39	Elmalı (Apple) Church	16

Gülşehir	40	Cahapel of St. Barbara	17
Açıksaray Ruins	41	Yılanlı (Snake) Church St. Onuphrius	18
Hacıbektaş	43	Larder/Kitchen/Refectory	19
Museum of Hacı Bektaş-ı Veli	44	Karanlık (Dark) Church	20
Ihlara Vadisi	45	Chapel of St. Catherine	21
Selime	49	Çarıklı (Sandals) Church	22
Güzelyurt	50	Çavuşin (Nicephorus Phocas) Church	24
Aksaray	51	Üzümlü (Grape) and Balıklı (Fish) Church	27
Soğanlı Valley	52	Paşabağları(Monks Valley) and The Chapel of St. Simeon	28
Eski Gümüş	56	Aziz Theodore (Tağar) Church	30
		Pancarlık Church	31
UNDERGROUND CITIES		Üzümlü (Grape) Church	33
Subterranean Settlements of Cappadocia	57	Chapel of St. Basil	35
Kaymaklı Underground City	**58**	Tatlarin Church	37
Derinkuyu Underground City	**59**	Karşı Church (of St. Jean)	42
Mazı Underground Settlement	60	Ağaçaltı (Beneath the Tree) Church	46
Özkonak Underground Settlement	61	Kokar Church	47
Tatlarin Underground Settlement	62	Yılanlı (Sanke) Church	48
		Karabaş Church	53
SELJUK REMAINS IN CAPPADOCIA	63	Kubbeli Church	54
MOSQUES		Tahtalı Church (of. St. Barbara)	55
Ürgüp/Taşkınpaşa Mosque	64		
Niğde/Alaaddin Mosque	65	**MADRASSAS**	**71**
Niğde/Sungurbey Mosque	66	Taşkınpaşa Madrassas	72
	67		
CARAVANSERAIS	68	**TURBES**	73
Aksaray Sultanhan	69	Döner Kümbet	74
Ağzıkarahan Caravanserais	70	Hüdavent Hatun Turbes	75
Saruhan Caravanserais			
		Cappadocian Dove - Cotes	77
		Sobesos Antique City	78

Source: Created by the authors.

Figure 5.1. World Heritage Sites in Cappadocia.
Source: Created by the authors.

5.3. **Method**

5.3.1. **Purpose, scope and sample**

This study aims to determine the complaints of foreign tourists visiting Göreme Open-Air Museum, Kaymaklı underground city and Derinkuyu underground annotations, which are among the WHSs in the Cappadocia region. In addition, Zelve Open-Air Museum is included even though not in the UNESCO list but very important and similar with Göreme Open-Air Museum in structure and appearance manner. Furthermore, Zelve is in the

centre of Cappadocia and has all characteristic features of its, therefore all visiting place will be recognized as heritage sites.

Once again, the purpose of this research is to examine the reviews of foreign tourists on the Google map site for the selected cases using text mining methods. The subject of this research is the heritage sites in the Cappadocia region. The research focuses on the two open-air museums and two underground cities that attract the most visitors. Tourist reviews in English about these visiting places are the sample of this research.

5.3.2. **Data collection**

During the data collection phase, the English text content consisting of customer reviews about sites was collected from Google Map website. Data was collected on the dates between 19.04.2022 – 22.04.2022 using web scraping technique. This data covers 4,533 cases between April 2019 and April 2022. Customer reviews for museums and underground cities are served on the Google Map site as open access (anonymous). Therefore, no ethics committee decision was taken for the data set.

The data set consists of 4,533 cases consisting of tourist comments. Table 5.2 shows the number of cases and their locations for the tourist reviews of two open-air museums and two underground cities in the Cappadocia region.

Table 5.2. Destination and tourist reviews

Destination	**No. Case**
Göreme Open-Air Museum	2,914
Zelve Open-Air Museum	821
Kaymaklı Underground City	429
Derinkuyu Underground City	369
COLLECTION STATISTICS Total number of cases: 4,533 Total number of paragraphs: 4,533 Total number of sentences: 13,085 Total number of words (token): 183,985 Total number of word forms (type): 8,312 Type/Token Ratio: 0.045 Total words excluded: 111,660 Percentage of words excluded: 60.7% Words per sentence: 14.1 Words per paragraph: 40.6 Words per non-empty case: 41	

Source: Created by the authors.

Data set obtained during the data collection phase was analysed through Wordstat software using text mining techniques. In the first stage of the analysis, dictionary-based sentiment analysis was applied to detect positive and negative comments for all destinations. Two different approaches are used in sentiment analysis research. These are machine learning and dictionary-based sentiment analysis approaches. In the machine learning approach, emotion classification is performed using machine learning algorithms [9]. The emotion dictionary is a database that keeps the emotion aspect of terms (negative/neutral/positive) and emotion score numerically. In dictionary-based sentiment analysis, each term in the content to be analysed is searched in the sentiment dictionary and classified according to the sentiment aspect. When performing a dictionary-based sentiment analysis, each term in the content to be analysed is searched in the sentiment dictionary. In our research, a sentiment dictionary developed by Loughran and McDonald was used via Wordstat Programme [10]. More than 9,526 negative and 4,669 positive words are used in the Wordstat sentiment dictionary [10], [11].

Cases belonging to negative tourist comments formed as a result of emotion analysis were excluded. Negative cases were classified and summarised.

5.4. Findings

Positive and negative distribution of tourist reviews for all destinations as a result of sentiment analysis is presented in Table 5.3. According to Table 5.3, in all of tourist reviews, 74.85% were positive in 3,393 cases and 50.17% were negative in 2,274 cases.

Table 5.3. Sentiment analysis

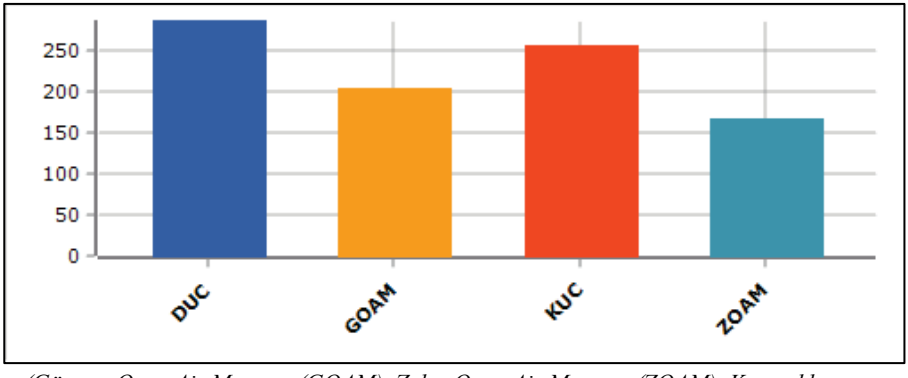
	FREQUENCY	NO. CASES	% CASES
POSITIVE	6,540	3,393	74.85%
NEGATIVE	3,729	2,274	50.17%

In tourist reviews, the distribution of negative words according to destinations was determined. Since there is an imbalance in the distribution of the number of cases according to destinations in data set, the distribution of negative words was evaluated with the ratio per 10,000 words [12]. Accordingly, Figure 5.2 presents the negative word distribution for the destinations.

According to Figure 5.2, destinations with the most negative words respectively were seen to be Derinkuyu underground city, Kaymaklı under-

ground city, Göreme Open Air Museum and Zelve open air museum. When the results were examined in detail, it was seen that high rate of negative words in underground cities was not due to the negative perspective of these destinations. It is understood that most of the reviews about negative words are due to the environment in underground cities. For this reason, negative comments were analysed again and it was understood that they were not caused by the world heritage perspective while evaluating these destinations, but by the difficulties that tourists face personally while traveling here.

Figure 5.2: Negative word distribution in 10,000 words



(Göreme Open Air Museum (GOAM), Zelve Open Air Museum (ZOAM), Kaymaklı Underground City (KUC), Derinkuyu Underground City (DUC))

In qualitative research, Creswell refers to the process from data collection to presentation and interpretation as a whole [13]. Codes revealed by content analysis are made ready for presentation with descriptive analysis. As a result of the descriptive analysis, the researchers discussed the subject with two experts and determined five main themes. These themes are divided into sub-themes. The main themes were conceptualized as "environmental regulation", "visitor management", "tourism marketing management", "vandalism and antiquities smuggling" and "issues originating from tourism employee". The themes below are explained and supported with quotes using the sample sentences of the visitors. Table 4 presents some visitor reviews with the case numbers and abbreviation of the destination.

Table 5.4: Visitor reviews with categories

Environmental regulation	
Case number	*Quotes*
GOAM-72	Nice open air museum with a lot of caves and rooms but is dirty.

	People throwing plastic, paper, cigarettes around your eyes watch. Is so sad how the visitors are careless.
DUC-133	Place is amazing, definitely! But unfortunately, I've seen a lot of used masks and personal trash like plastic water bottles on the floor. We need to respect the history, environment and need to protect this place strictly!
ZOAM-3279	We were so excited to see the fairy chimneys and it's a lovely walk around the chimneys but visitors are littering everywhere with coffee cups left in the chimneys and not respecting the history which is very sad and has sadly put my husband off recommending a visit there.
ZOAM-3720	These are located all over the area and some have been made into hotels, whilst others are too dangerous to visit as they are in danger of collapsing, so choose carefully. Others are people's homes and there are many churches.
Visitor management	
Case number	*Quotes*
GOAM-121	It is a ticketed attraction with car free parking on opposite side of road. Only downside we found was during snow it was very dangerously slippery. No preparations for pavements or salt spraying.
GOAM-1441	Where else can you find such an amazing collection of beautifully decorated early rock churches in close proximity? Pay the extra admission fee and don't miss the Dark Church. The two problems here are the crowds, since each church is very small, and a tour group overwhelms.
DUC-131	Awesome place to see. It's nice to have a guide here, to know what you are looking at. Gets a bit crowded even in Covid times. Some stairways are really narrow, so if you ran into someone going to the opposite direction, one of you have to crawl backwards.
DUC-98	Nice, but way too busy. A limit of how many people would be nice. Was in a tour, and there were so many people that six (one was me) people in the group got lost. If I wasn't in a tour, it would be cool.
Tourism marketing management	
Case number	*Quotes*
ZOAM-2990	This whole area of Cappadocia is mind blowing. So many chimneys - so many tourists! Book balloon trip in advance. Far in advance. I tried to book more than 2 weeks before coming here and haven't been able to get on a balloon as they'd cancelled lots due to bad weather.
GOAM-1626	The black church (you have to pay extra) was the highlight. The whole area is incredible. We would have liked to do a balloon trip, but the weather was poor and so they were cancelled the days we were there. A must do for next time.
GOAM -1666	This is truly worth visiting, for the fairly recently abandoned cave dwellings, and formations. Note however, that much of what you will find on the internet is outdated. This site is organized. If it sounds dangerous on the internet, it is cordoned off now.

GOAM -831	Visited with tour group and very popular attraction. The museum includes caves used as Christian churches in the early years of evangelism (e.g., 4th century). This could be done as a pilgrimage site though such things are not in vogue. Sadly, these caves are mainly in poor state.
Vandalism and antiquities smuggling	
Case number	*Quotes*
GOAM-73	The museum is home to some interesting caves carved out in the local rock formations. They include churches, dining rooms, kitchens etc. The churches have interesting paintings, but many were damaged on purpose by local people and were not restored.
GOAM-764	The saddest part is seeing all the paintings that have been defaced, presumably after the population exchange. The faces of all the angels and saints have been consistently scratched out, this is not only in the Goreme national park but in every other.
GOAM-578	Interesting place, a lot of rock churches and chapels. Unfortunately, in some caves the frescoes have been destroyed by irresponsible tourists and it is forbidden to take any photos inside.
GOAM-2028	I was so sad when I saw such a piece of world history and no care from the local authorities that made me almost call the police. People taking pieces of the caves and taking home can you believe it? Apart from it certainly it is a place to visit
Issues originating from tourism employee	
Case number	*Quotes*
ZOAM-3114	By now we had completely shut our ears to the guide for red tour! It was unbearable. His flat non interesting way of talking bored us to death. So, we decided to have some fun and were trying stunts with our camera. We overheard another guide tell his group that they are called.
KUC-4031	We enjoyed our visit to this underground city however our experience was soured by the tactics of 2 'local guides' at the entrance. Our accommodation hosts had suggested this underground city was better to visit if we preferred wider passages making it easier to pass any groups.
GOAM-2561	I went to the museum without a tour group and was very disappointed to be refused entrance into several of the churches without being part of a group. I guess this means that the tour operators are paying off the security guards to get preferential treatment.
GOAM-2654	We visited Göreme Open-Air Museum around 11am in August. The site was packed with tours groups, which made it rather unpleasant with queues to visit the churches. The fact that it is forbidden to take pictures inside the churches and that security personnel shouts at you.

5.4.1. **Environmental regulation**

Heritage sites are areas that welcome visitors from all over the world, therefore environmental regulation is important. If visitors witness that

sufficient environmental arrangements are not made in the landscapes they encounter in the common heritage of humanity, both the local image and the country's image may be adversely affected. Environment of heritage sites needs to be managed with good practices in terms of cleaning, safety and protection. The findings show that garbage such as bags, cigarette litter left in the ruins cause an uncomfortable landscape. A short and clear review describing this is as follows: "*Place is amazing definitely! But unfortunately, I've seen a lot of used masks and personal trash like plastic water bottles on the floor. We need to respect the history, environment and need to protect this place strictly!*" (DUC-133). In order to prevent such irresponsible littering behaviours, it is considered important to ensure that the local people are sensitive in this regard. Although it is a social behaviour that can be achieved by creating a sustainable total tourism culture among these stakeholders, it is recommended to take the necessary warnings and sanctions measures to prevent littering.

Since Cappadocia heritage sites cover a wide geography, difficulties can be experienced in terms of conservation. Rock churches and fairy chimneys appear to be vulnerable to the destructive effects of nature and people's incorrect actions. A review on this subject is as follows: "*Something very bad about this place is that the frescos are not being protected as they should from the weather, etc. Still, it's forbidden to take pictures. Not because flashes or anything, I guess they don't want the world to see how most…*" (GOAM-563). Technological solutions can be developed especially to prevent human-induced damages in this regard. Although natural erosion is inevitable, measures to reduce the effects of rain and wind in fresco and ornamental art intensive elements can be considered. Another issue on environmental regulation is the inadequacy of safety and health measures. Due to the fact that Cappadocia is a geography prone to natural disasters caused by rapid erosion processes and the natural structure of hiking trails, safety and health measures should be taken into consideration. As an example, this review draws attention: "*This attraction is must to do when in Cappadocia with amazing caves, churches. It is a ticketed attraction with car free parking on opposite side of road. Only downside we found was during snow it was very dangerously slippery. No preparations for pavements or salt spraying.*"(GOAM-121). Health teams can be kept available at all times in busy areas by eliminating the potential danger on the trip routes.

5.4.2. **Visitor management**

Visitor is the most important stakeholder of the destination that needs to be managed and directed everywhere. Cappadocia is a geography that is

not easy to understand and experience with its nature, history and cultural richness. In order to meet the expectations of the visitors and to accommodate them in the best way, the heritage needs to be interpreted correctly and effectively. This task belongs to tourist guides. Various campaigns and awareness can be created for visitors to make regional trips accompanied by a guide. However, the use of audio guide tools should be improved as a result of the digitalizing world. Here are the two reviews that touched on this subject: "*...definitely get a guide and do read on your own prior to visiting the place otherwise you'll get bored.*"(GOAM-2816) and "*I used audio guide, got bored with plenty of information about Christian iconography, which is of no interest to me, and was disappointed there was absolutely nothing about geology or social life for example.*"(GOAM-2568). Heritage sites can be made a less negatively impacted visiting centre with an effective visitor management.

Signs to be used to better convey certain phenomena and directions may be useful in places of visit where unknown elements such as underground cities are intense. As the visitor comment points out "*Some stairways are really narrow, so if you ran into someone going to the opposite direction, one of you have to crawl backwards,*" (DUC-131), since underground cities are closed spaces with narrow corridors, they can cause claustrophobia experience when crowded groups are busy. In order to regulate this intensity, perhaps the visitor limit may be extended. Since underground cities are not places visited by taking advantage of daylight and have good lighting, they are also suitable for afternoon and night visits. In addition, the time for smart technologies to be used in visitor management is long overdue. The main component of smart cities is also an ideal tool for directing smart applications to alternative visiting centres with less crowds than busy regions. For instance, a visitor mentioned in his review: "*Smaller settlement and easier to visit. A good choice to avoid crowded tourist groups.*" (ZOAM-475). Visiting places such as Göreme and Kaymaklı in Cappadocia are the centres where there are periodic concentrations. A sustainable destination visitor management program can be implemented by using geographical information systems and information communication technologies to prevent this intensity. Finally, tools such as signs and kiosks that will contribute to informing visitors about the region should be used more effectively and accurately.

5.4.3. **Tourism marketing management**

Studies should be carried out to increase the number of overnight stays in the region. Recently, the number of people who want to do a balloon tour is quite high, but the changing weather conditions in the region cause the can-

cellation of balloon flights and thus disappointment in the guests. A visitor to this situation says: "*Book balloon trip in advance. Far in advance. I tried to book more than 2 weeks before coming here and haven't been able to get on a balloon as they'd cancelled lots due to bad weather.*" (ZOAM-2990). Considering diversity of the areas to be visited and the abundance of activities to be carried out in the region where average stay is 2 nights, promotions should be carried out for longer visit periods and stays.

In order to promote the region effectively and accurately, an official website should be prepared to strengthen the image of the destination. Visitors cannot be included in an accurate and effective marketing process with the information they obtain from the websites of agencies and companies providing tourism services. A review on this subject is as follows: "*Note however, that much of what you will find on the internet is outdated.*" (GOAM-1666). In addition, in Cappadocia, which has a great importance for the history of Early Christianity, especially areas with religious values such as GOAM can be promoted for faith tourism. Finally, visitors generally consider archaeological site entrances and tourism activity fees to be cheap. A review of this is as follows: "*Amazing moments because we can ride camel and horse too. Camel ride quiet cheap instead of horse but never mind as long my son happy.*" (ZOAM-3009). This continues to contribute negatively to image of the cheap country.

5.4.4. **Vandalism and antiquities smuggling**

Vandalism, which is frequently exposed to historical monuments and heritage sites, is a phenomenon encountered in many places in Cappadocia. It is necessary to prevent visitors from knowingly and wilfully damaging the work, product, property or place [14]. A review of this is as follows: "*Interesting place, a lot of rock churches and chapels. Unfortunately, in some caves the frescoes have been destroyed by irresponsible tourists and it is forbidden to take any photos inside.*" (GOAM-578). Although it is known that church frescoes in Cappadocia have been damaged since ancient times, it is necessary to remember the fact that they are still deliberately damaged by tourists today.

Historical places and especially those with religious value are privileged places that people attribute sanctity to. Visitors may want to take a large and small piece of the artifacts in these places from where they belong with them. This is the greatest damage that can be done to the heritage element. A review summarizing this situation is as follows: "*I was so sad when I saw such a piece of world history and no care from the local authorities that made me almost call the police. People taking pieces of the caves and taking home can you believe it?*" (GOAM-2028). Closed circuit camera systems already installed are a deterrent in this regard, but can also be used to

detect the crime. Historical artifact smuggling can be overcome by the adoption of smart technologies and making cameras widespread. Image analysis through artificial intelligence technology can be used to detect and track visitors who commit crimes or have the potential to commit crimes.

5.4.5. **Issues originating from tourism employee**

Heritage elements should be interpreted and conveyed at a good level for the visitor to experience. This is possible through qualified tourist guides. Cappadocia needs guides that provide unforgettable experiences to the visitor with their wide history, a wide variety of tangible and intangible cultural values and natural beauties. Several reviews point to the inadequacy of guides in providing tour experience in the region: "*by now we had completely shut our ears to the guide for red tour! it was unbearable. his flat non interesting way of talking bored us to death. so, we decided to have some fun and were trying stunts with our camera. we overheard another guide tell his group that they are called*." (ZOAM-3114). In order to prevent possible negativities in this regard, the regional guide association can organize training programs in order to increase the qualifications of guides who want to work in the region. Guides are expected to have a versatile intellectual personality of a well-educated intercultural nature. However, not all guides can be expected to have the same characteristics. A guest review gives a hint that guests are disturbed by inappropriate approaches: "*We enjoyed our visit to this underground city however our experience was soured by the tactics of 2 'local guides' at the entrance. Our accommodation hosts had suggested this underground city was better to visit if we preferred wider passages making it easier to pass any groups.*" (KUC-4031). Similarly, it is seen that security guards exhibit some inappropriate behaviours: "*It's always jam packed with people, security personal and annoying tour guides who can follow you for 100 meters or more.*" (GOAM-1662). It is essential to improve the image for destinations, provide good service for revisiting guests and advising others, and satisfy the guest on all things. In order to train trained and qualified tourism personnel, seminars should be organized for all personnel working in the region and steps should be taken to internalize the tourism culture [15].

5.5. **Conclusions**

This study, which focuses on the UNESCO heritage sites and surroundings of Cappadocia region as case studies, examines online reviews through text mining. The region, which welcomes visitors from all over the world, is a unique geography for natural and cultural tourism activities

with its heritage elements. Tourism destinations have to keep up with the new realities of the changing world and then plan the visitor management well. Cappadocia, one of the important tourism destinations of Turkey, should manage its natural and cultural richness by adopting a sustainable approach. As one of the important tourism destinations of Turkey, Cappadocia should manage its natural and cultural richness by adopting a sustainable approach [16]. Management should be based on the cooperation of local people and other stakeholders. Just as tourist guides are the business cards of their countries, heritage sites are the showcases of countries. If the visitors get negative impressions such as pollution, insecurity, neglect or danger, etc. where they go, they will tend to share these impressions with their families and close environment when they return to their country. This is the process of transferring experience to close ones which is called word of mouth (WOM) in the literature and it has been known for years that the negative experience is told much more than the positive one [17]. Therefore, education is essential at first in order to prevent pollution that will disturb the guests and adversely affect the image of the country. While the awareness of the local people will increase with education, it will also ensure respect in tourists. Since tourism culture and environmental culture cannot be considered separately from each other, both visitors and local people should pay maximum attention to these issues. Education and sanctions are the two most important steps in the internalization of this culture. Reducing and eliminating the behaviours of tourism employees that disturb visitor is also related to adoption of the tourism culture. Since the concepts of tolerance, peace and convenience are intrinsic to tourism, tourism personnel working at all levels need to understand well how to treat tourism.

The findings show that there is a need for a holistic management and marketing approach with understanding of sustainability in heritage areas. Visitor management will contribute to minimizing intensities and creating a balanced circulation between visit points. Planning this work with smart technologies is very easy and effective. It is recommended that destination management organizations cooperate with technology companies that are already operating. It is thought that the number of overnight stays is another important issue. Destinations should target guests who stay in the market department for a long time and have a high tendency to spend. Each destination may need a different marketing mix in this regard. As a matter of fact, Yetiş et al., in their study for Cappadocia, suggested that destination management and marketing activities should be carried out regionally [18]. Vandalism, which means deliberately and wilfully damaging a property or artifact, is another big problem of heritage sites. Although this behaviour, especially in the areas attributed to holiness, seems to contain innocence for the individual, it causes the disappearance of thousands of

years of historical artifacts and the disappearance of their reality/integrity. Smart technologies are also the way to prevent this damage. Artificial intelligence supported software can now work proactively in preventing crime and detecting the criminal with image analysis.

This study, which analyses visitor reviews left on the Internet about heritage sites in Cappadocia and its surroundings, has some limitations. Firstly, the study deals with visiting places close to the centre called rocky Cappadocia and more preferred than others as a sample. Future studies may also include the heritage properties "Karlık Church, Karain Dovecot, Yeşilöz Theodoro Church and Soğanlı Archaeological Site", which are not often visited by visitors and whose name is not even known, but these UBH sites are included in the UNESCO heritage list as unique properties. Secondly, this study is reliable because it is based on the experiences of visitors who share their experiences voluntarily. However, such studies can also be carried out by enriching them with, for example, face-to-face interviews or survey techniques where other stakeholders are involved. Last but not least, opinions of the destination managers can be taken in order to understand what can be done to ensure the sustainable management of cultural and natural heritage properties in Cappadocia and their devaluation in the face of changing tourism consumer behaviours.

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CHAPTER 6

Living Lab Actions in Göreme, Cappadocia

Yunus Sacid YILDIZ

6.1. Ahiler Development Agency and its Approach to Underground Cultural Heritage in Cappadocia Region

Ahiler Development Agency (AHIKA) covers the TR71 Level 2 Region consisting of the provinces of Aksaray, Kırıkkale, Kırşehir, Nevşehir, and Niğde and its headquarter is in Nevşehir, which is located in the Cappadocia Region.

The primary duties of the AHIKA include accelerating regional and local development in the TR71 Level 2 Region, adopting sustainable development approaches, preparing regional plans to reduce inter-regional and intra-regional development disparities, and contributing to the projects enabling the implementation of these plans, providing the incentive to form the basis for regional development among all stakeholders in the region, and helping increase the institutional capacity of the stakeholders [1].

In the TR71 Region, the aim of "making tourism a leading sector in regional development and making the region an important destination and an international brand" has been adopted. To achieve this aim, four targets have been determined;

- Ensuring tourism diversity in the region to increase tourism revenues,
- Ensuring the region to be an important destination point,
- Developing alternative promotional activities to increase the recognition of the region,
- Ensuring the spread of tourism activities in the region.

On the other hand, these targets have priority areas such as preserving and maintaining the region's unique historical, natural, and cultural values and improving the living spaces.

The unique geographical structure of Cappadocia, which was formed as a result of the eruption of the volcanic mountains in the region millions of years ago, and the fact that many civilizations from the Assyrians to the Ottomans, have lived in this unique geography throughout history and its cultural heritage greatly help the Agency to achieve these goals [2].

6.2. Support for the Protection of Cultural Heritage

AHIKA provides many support, from financial support to technical support to sector representatives and regional public institutions. Until today, many supports were given to tourism and cultural heritage areas under financial support.

6.2.1. Completed Projects

Supports for protecting and valorizing of cultural heritage between 2011 and 2018 were given to projects prepared by public institutions. The requested support amount was 655,636.00 US Dollars, and AHIKA supported 566,862.00 US Dollars of the requested amount [3].

6.2.2. Rearrangement of Trekking Routes and Churches in Ihlara Valley

Ihlara Valley, located in Aksaray and about 18 km long, is one of the rare places that brings nature and art together with its natural vegetation and historical buildings. It has an average depth of 150 meters and a width of 200 meters. Ihlara Valley, where people lived in the past, is distinguished from other canyons with this feature. The biggest reason it is suitable for human life is that the Melendiz River gives life to the region. There are many churches from the past and living areas carved into the rocks.

Within the scope of the project, the stairs leading to the churches in the valley, the 3 km long walkway, and the stair steps were covered with wood. Necessary studies have been carried out for the safety of rock fragments in danger of falling. Direction and information signs have been placed in the valley. Ihlara Valley was promoted at international fairs by making promotional films [3].

6.2.3. Improvement of the Current Status of Göreme Open Air Museum in Tourism

1000-year-old Tokali Church, the largest rock church in Cappadocia, is located in Göreme Open Air Museum. The structure is quite interesting and consists of 4 separate sections. It amazes people with its frescoes and architectural features that are still alive. Many scenes, such as the

Ascension of the Prophet Jesus and the Descent into Hell, decorate the church walls.

Figure 6.1: Ihlara Valley Cave Churches
Source: Orhan Altındal

Figure 6.2: Tokali Church
Source: Gürsoy Olca

Within the scope of the project, this church was restored, and worked with the restorers of Tuscia University from Italy during the restoration process. Moreover, these restorers trained Turkish restorers. Wooden walkways were built to the floors of the churches in the Göreme open-air museum. Furthermore, churches were illuminated [3].

6.2.4. **Reintroduce Ortahisar Castle to Tourism**

Ortahisar Castle, also known as Cappadocia's most spectacular fairy chimney, is located in Ortahisar town of Nevşehir. Said to be one of the first multi-story settlements in the world, steep valleys on three sides surround this castle. Its geography enabled the castle to be used for protection and shelter in ancient times.

Within the scope of the project, the dangerous walking path of Ortahisar Castle, which was closed to visitors before, was strengthened. Walkways and stairs were built and the castle's security was increased with steel nets. In this way, Ortahisar tourism was revived, and Ortahisar has become a center of attraction in tourism today [3].

Figure 6.3: Ortahisar Castle
Source: Mustafa Karakaya

6.2.5. Gomeda Valley Calls: Reintroduce Ortahisar Castle to Tourism

Gomeda Valley is famous for its dovecotes carved into the rocks. Gomeda Valley, also known as the "Small Ihlara Valley" due to its geomorphological similarity with Ihlara Valley, has a walking area of 7,200 meters. With the project, works such as cleaning, marking, placing direction signs, and building wooden and stone bridges were carried out while preserving the natural shape of the Gomeda Valley and its surroundings. Thus, it is planned to include the Gomeda Valley in the tour programs of international and local travel agencies and to keep the region under control and protect it by creating a new tourism route [3].

Figure 6.4: Gomeda Valley
Source: Mustafa Karakaya

6.3. Ongoing Projects

There are currently three ongoing projects. One of these three projects is a Guided Project, and the amount of support is higher than the others. So, the total requested support amount for these projects is 520,518.00 USD [3].

6.3.1. **Restoration of St. Theodoros Trion Church**

The Church of St. Theodoros Tirion, also known as the Üzümlü (Grape) Church, was built in the nineth century and is the largest existing church in the region. The Grape Church takes its name from the engraved grape motifs on its door. Although it is 150 meters away from Derinkuyu underground city, it has not been able to get the share it deserves from tourism because it has been closed for years and idle. Within the scope of the project, it is planned that the church will be restored and it will both gain the value it deserves, and be reintroduced to tourism [3].

Figure 6.5: St. Theodoros Trion Church
Credit: Mustafa Karakaya

6.3.2. **Route Cappadocia**

With this project, it is planned to create a travel route of approximately 40 kilometers, which will be between Şahinefendi Village and Çavuşin Village. Within the scope of the project, it is planned to rehabilitate cultural, architectural, and historical values and promote them through digital platforms. 250 Direction Signs, 50 Information Signs, 4 Camping Sites, 100 Garbage Containers, 15 Info Areas, 400 sitting benches, and 20 Fountains will be implemented and built to reach historical and cultural areas on the Cappadocia Cultural Road route [3].

6.3.3. **Reintroduce the Monastery Valley to Tourism (Guided Project)**

This project aims to make the Mustafapasa Village, declared as “Best Tourism Village” in 2022 by the World Tourism Organization, one of the

important stops of Cappadocia tourism by rehabilitating the cultural, architectural, and historical values in the Monastery Valley.

The scope of the Project include several phases, such as the construction of an entrance gate suitable for the natural structure, the restoration of St. Stefanos Church, St. Yuhannis Theologos Church, St. Yuhannis Prodromos Church, St. Nicholas Monastery, the restoration of the underground city, and Monastery Cookhouse, botanical and landscaping activities [3].

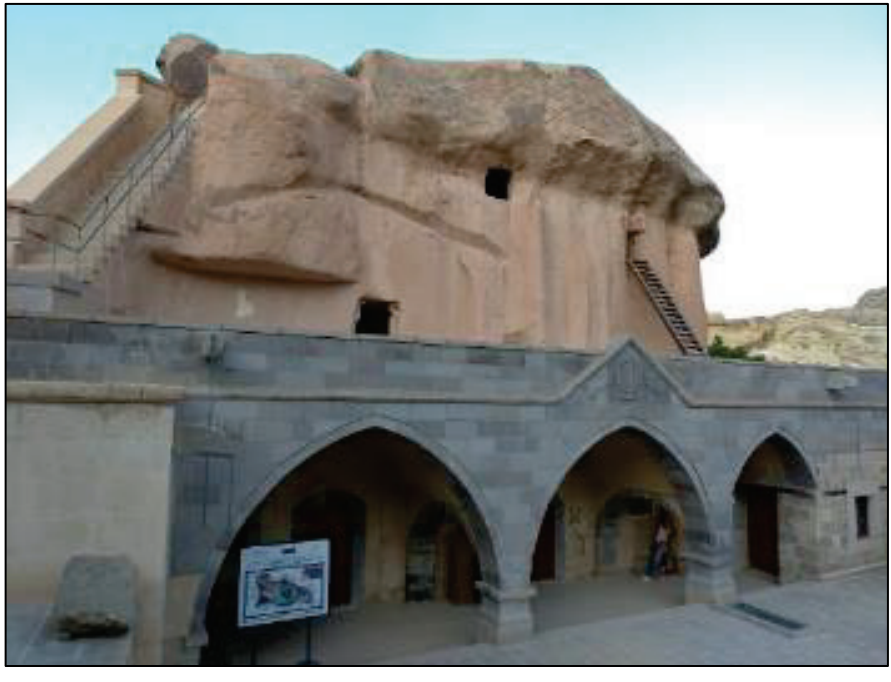

Figure 6.6: St. Nicholas Church
Credit: Yunus Sacid Yıldız

6.4. **AHIKA and its Place in CA18110 Underground4Value Project**

AHIKA continues its support for protecting cultural heritage in the Cappadocia Region, together with its collaborations with different institutions. AHIKA's connection with the CA18110 Underground4value Project started with the invitation of Prof. Dr. Müge Akkar Ercan from the Department of City and Regional Planning at Middle East Technical University. Firstly, two online meetings were held in October 2019 with the participation of Prof. Dr. Müge Akkar Ercan, Prof. Dr. Pınar Karagöz, Prof. Dr. Yasemin Yardımcı from METU and Pelin Aytekin Aslaner, Mustafa Aydoğan and Yunus Sacid Yıldız from AHIKA. In the meetings,

information was exchanged about the problems in the region to have a common idea about how and where the "Göreme Living Lab" study could be carried out in the region defined in the project. After the online meetings, in the first week of December 2019, a meeting was held at METU MODSIMMER with the participation of Daniela de Gregorio, Müge Akkar Ercan, Pinar Karagöz, Pelin Aytekin Aslaner, Yunus Sacid Yıldız, Mustafa Aydoğan, Vedat Karaarslan. The problematic areas in Göreme were determined at the meeting, and these problems were discussed. The working methodology was also determined, with whom the interviews would be conducted, and which stakeholders would be invited to the meetings.

6.4.1. **Methodology**

As a result of the meetings, it was planned to hold meetings with the stakeholders, primarily in the Cappadocia Region, gather information during these meetings, and hold stakeholder meetings according to the information obtained.

i. Interviews with Stakeholders

Interviews were held with representatives of many stakeholders to work on the reuse of different underground built heritages in the Cappadocia region and to produce innovative social and environmental solutions. The interviews consist of 16 questions (Annex 1) to gather information from the stakeholders about the cultural heritage values and assets of Cappadocia. Interviews were held with representatives of Nevşehir Culture and Tourism Directorate, Nevşehir Museum Directorate, Cappadocia Cultural Heritage Conservation Board, Environment and Urbanization Directorate, and AHIKA [4]. The information obtained as a result of the interviews with the representatives can be listed as follows;

- Tourism activities positively and negatively affect the region's social, economic, and physical environment. Such environmental effects caused by tourism activities are an essential issue to be considered.
- Sustainable tourism and eco-tourism understanding are not included in the tourism understanding of the Cappadocia region.
- The people of the region have a lack of environmental awareness and interest in sustainable conservation measures.
- There is a lack of a master plan for protecting natural and cultural resources and sustainable tourism, and we can say that this master plan should be made as the first step to be taken in the region.

- Since fairy chimneys are natural formations, they are subject to physical and geological deterioration, and protecting them from this deterioration is impossible. However, we can reduce the human impacts that accelerate the degradation of these geological structures by managing them.
- With tourism development in the Cappadocia region, the number of tourism facilities increases, the existing residences turn into tourism facilities, the local population decreases over time, and the remaining population feels lonely, which leads to the migration and displacement of the remaining local population. In order to keep the cultural, social, and historical identity of the region alive, policies that will prevent this transformation should be implemented.
- Education and training courses should be developed, and tourism business personnel should be encouraged to receive this training.
- Further alignment is needed between public institutions responsible for regional administration.

Ultimately, all the representatives interviewed were invited to the stakeholder meetings to be held later [4].

Figure 6.7: Interview with AHIKA Representative
Source: Yunus Sacid Yıldız

ii. Stakeholder Meetings

A “Living Lab” meeting was held with the active participation of local stakeholders throughout Göreme and Nevşehir. Nevşehir Culture and Tourism Directorate, Nevşehir Museum Directorate, Cappadocia Cultural Heritage Conservation Board, Environment and Urbanization Directorate, Nevşehir Restoration and Conservation Regional Laboratory Directorate, Argos Yapı, Middle Earth Travel, Kelebek Hotel, Indigo Group, Nevşehir Hacı Bektaş Veli University, CNR and AHIKA representatives attended the meeting. With the "Living Lab" meeting hosted and moderated by AHIKA, the local partner of the Underground4Value project, it was decided to focus on the problems in the conservation-utilization balance in the region and to work on preserving the cultural and natural structure of historical heritage sites that have lost their function and bringing them into tourism.

As a result of brainstorming and problem tree techniques, Karaya Region, where people from Göreme lived and later abandoned, was chosen as the project area. Another important factor in choosing this place as the project area is the presence of Andrew Rogers Land Art Park near the valley.

After the Karaya Region was determined as the project area, a site visit was made by going to the Karaya Valley with the stakeholders. Many idle caves, churches, wineries, and food storage areas were seen in the valley.

The second Stakeholder Meeting was held at the headquarters of the AHIKA. The half-day meeting started with introducing the Project to new stakeholders (who did not attend the first meeting). It proceeded with explaining the system of the first meeting, the process of choosing Karaya as the Project area, and conveying the Karaya field research.

Values of Karaya, such as its location, land structure, quarry, wineries, spring water, etc., were shown in photos and videos.

The second part of the meeting continued with the question: What sorts of projects can be implemented in the Karaya Region?

All stakeholders expressed their opinion on the post-it system. Stakeholders discussed preliminary preparations like surface research, history research, layout plan, and reclamation, and as a result of these discussions, project ideas were creating a hiking/trekking route in the valley and combining it with the museum in Avanos and Andrew Rogers’ Land Art Park, Ethnographic Museum (performing local culture, serving local products, etc.). The general idea was that the Project needed to be sustainable and contribute to the regional economy. After a long discussion, the “Agro Tourism/Ethnographic Museum in Karaya Region” is decided as Project.

The last and most important part of the meeting continued with deeply discussing the idea on Business Model Canvas.

Figure 6.8: 1st Stakeholders Meeting
Source: Yunus Sacid Yıldız

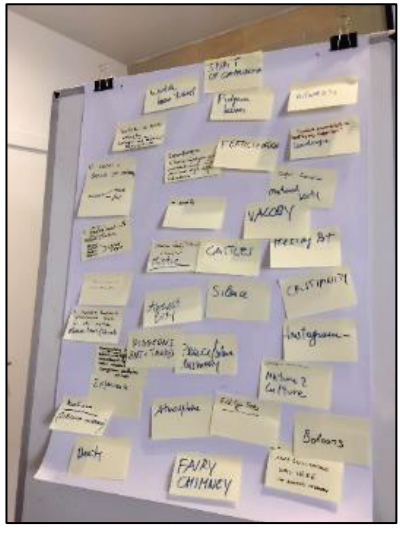

Figure 6.9: Problem Tree
Source: Yunus Sacid Yıldız

Figure 6.10: Karaya Valley
Source: Yunus Sacid Yıldız

Figure 6.11: Andrew Rogers' Land Art Park
Source: Mustafa Karakaya

6.4.2. **Training School in Naples**

Underground4Value 1st Training School carried out an intensive 6-day program with 26 trainers and 30 trainees from 15 countries in Naples, Italy, between 10-15 February 2020. During the 6-day training, the trainers gave training on scientific underground studies in the morning program. In the afternoon program, group studies were carried out with the trainers and

trainees in groups of 6 on Göreme Karaya, Fontanelle Cemetery, Green Kaarst, and La Union Regions. The purpose of group work is to bring together different ideas about the project by bringing together different trainees from different countries and making the project more applicable. On the last day of the training, the projects that the trainees worked on were examined by the committee.

Figure 6.12: 1st Training School in Naples
Source: Yunus Sacid Yıldız

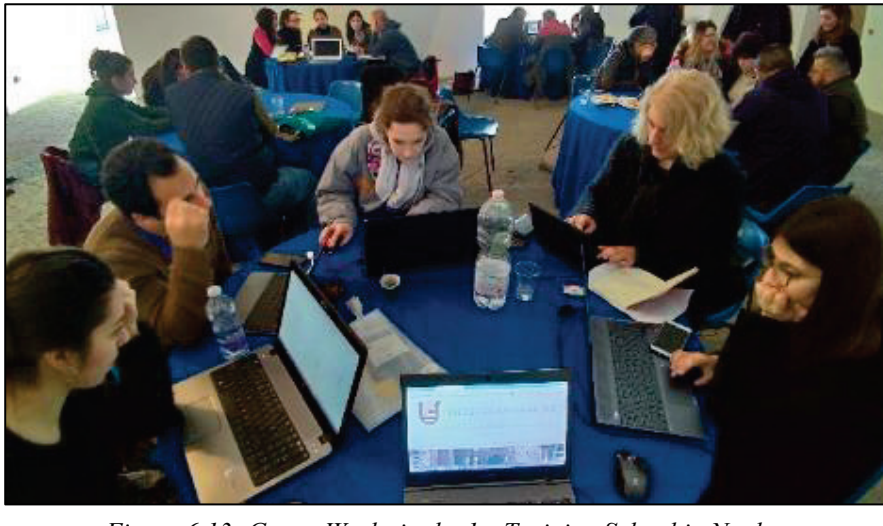

Figure 6.13: Group Works in the 1st Training School in Naples
Source: Yunus Sacid Yıldız

The project “Karaya is Calling: Business Model Canvas for developing Eco-Tourism Project in Karaya” won the Special Jury Award, and the project “Approaches for developing knowledge, meaning, and community identity in Karaya” won the Best Visual Impact Award. The "H2H: Heritagisation of a place of worship: frictions and solutions" project, which Yunus Sacid Yıldız, the representative of AHIKA, worked on during his education, received the Best Presentation Award [5].

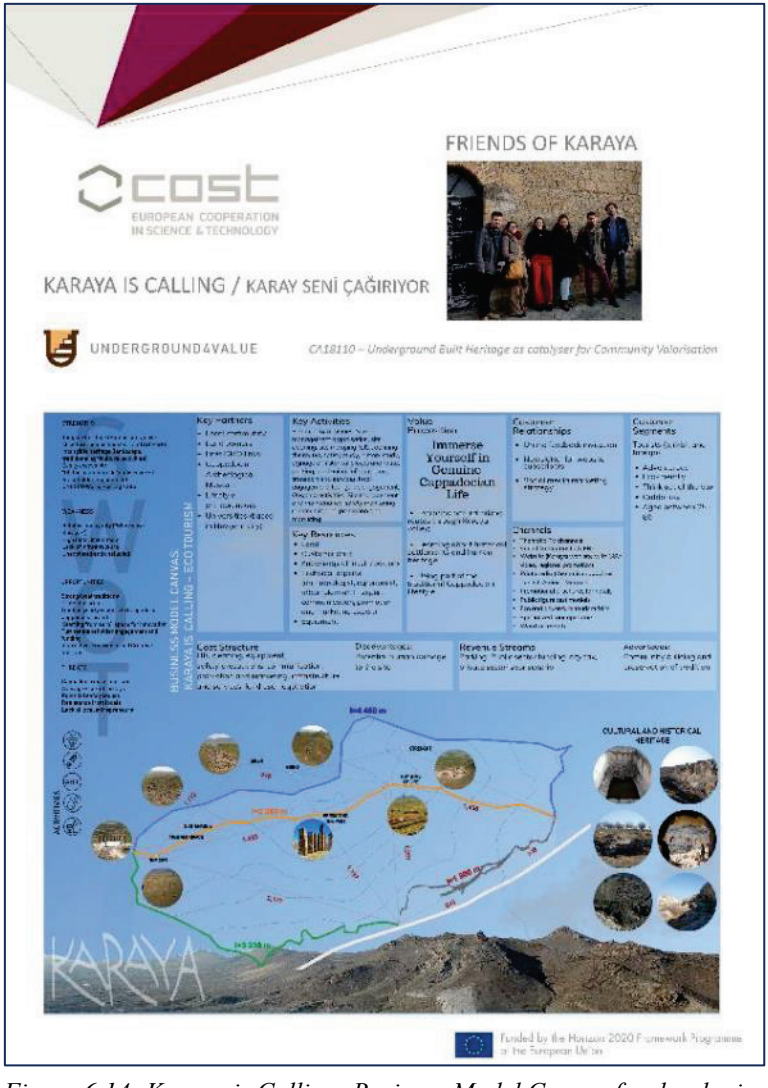

Figure 6.14: Karaya is Calling: Business Model Canvas for developing Eco-Tourism Project in Karaya [6]

Thanks to the training school, the visions of the Development Agency employees developed, studies on the protection of underground heritage in different European countries were examined, and these studies inspired possible future conservation policies in Cappadocia. In addition, agency employees contributed to developing other projects by sharing their experiences with other participants.

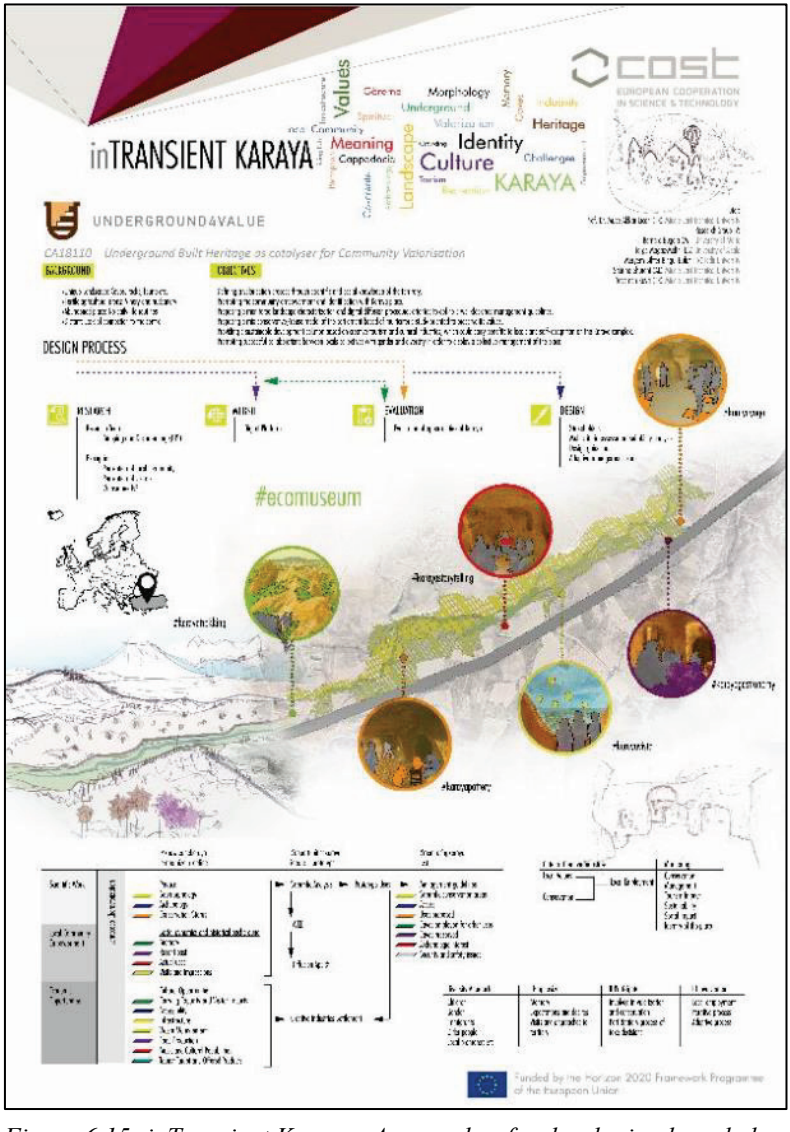

Figure 6.15: inTransient Karaya: Approaches for developing knowledge, meaning, and community identity in Karaya [7]

6.5. Conclusions

Ahiler Development Agency has participated in CA18110 Underground4Value Action to promote the business and investment opportunities of the region at the national and international level in cooperation with the relevant institutions, to promote the activities of bilateral or multilateral international programs in the region, and to contribute to the development of projects within the scope of these programs, to promote the TR71 Level 2 Region nationally and internationally, to reveal the potential of underground heritage for regeneration policies in urban and rural areas, and to develop cooperation with relevant institutions and organizations in the international arena. Many different public institutions and private sector representatives were interviewed and cooperated during the project, and new domestic and foreign networks were created. As a result of the meetings held with the stakeholders, the awareness of sustainable tourism, eco-tourism, and protection of underground heritage was created, especially among the representatives of the tourism sector, and the importance of environmental awareness and sustainable protection measures was conveyed to the people of the region by these people.

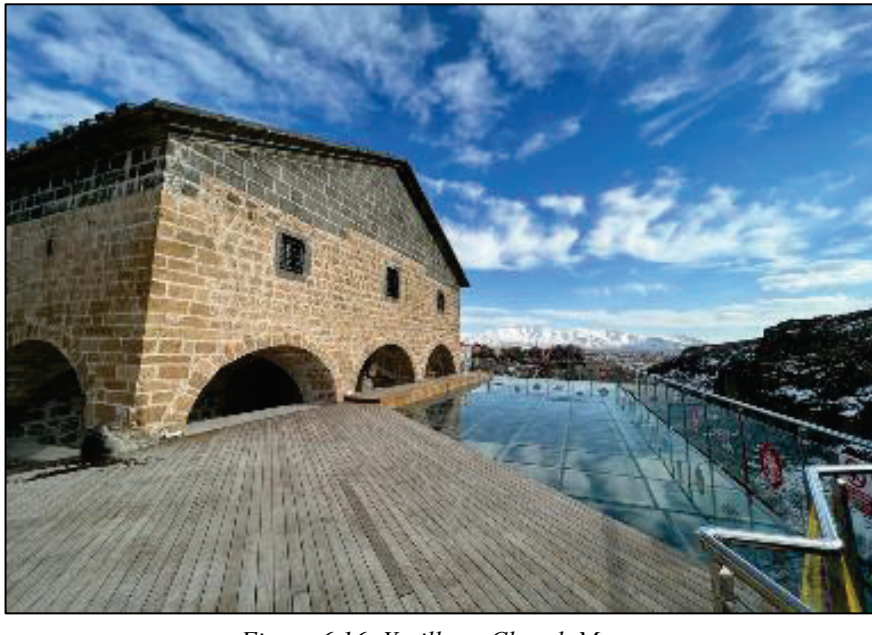

Figure 6.16: Yeşilburç Church Mosque
Source: Kerim Adikti

With the selection of the Karaya Region as the project area, the recognition of the Karaya Region has increased, horseback riding tours have started to be organized in the valley, and it has been included in the digital tourism routes made by the Ahiler Development Agency and presented to the tourists. With the awareness of sustainable protection measures, new projects in this field were supported. Conservation, maintenance-repair, and observation deck construction works of Yeşilburç Church Mosque have been completed in the project " Yeşilburç is Bringing Tourism to Tourism" supported by the Ahiler Development Agency within the scope of the Financial Support Program for Strengthening the Tourism Infrastructure for the Year 2020 and of which Niğde Special Provincial Administration is the beneficiary, and Yeşilburç Church Mosque is opened to visitors [3].

Thanks to the new collaborations of Underground4value, the "Support Environmental Education for Sustainable Development Tourism for Tomorrow (SEEDS FOR TOMORROW)" project, prepared in cooperation with Ahiler Development Agency, Cappadocia Touristic Hoteliers and Operators Association and Italian Agency Consorzio Promos Ricerche, is being carried out. With the project, it is aimed that SMEs operating in the tourism sector in Turkey and Italy to learn about green skills and adapt to more sustainable, low-carbon, and resource-efficient business models.

Underground4value has significantly contributed to regional development in terms of giving ideas to the projects that the Ahiler Development Agency is currently carrying out and that it will carry out in the future, expanding the knowledge of the Agency personnel in its areas of expertise, protecting underground heritage, establishing a sustainable tourism understanding, and participating in organizations such as International Meetings, Conferences, Training Schools.

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ANNEX 1

		Institution
	Name	
	WEB SITE	
1	Can you briefly narrate the history of management of Göreme Open-Air Museum and the Göreme National Park after and before the inclusion of UNESCO World Heritage Site (WHS) list?	
2	Can you provide information about the management of the Göreme Open-Air Museum and the Göreme National Park and the organization of activities within your institution? Which are the main financial (e.g. sources of revenues), material (e.g. IT systems) and human capital (e.g. competences) resources?	
3	Who is responsible for the monitoring activities of Goreme "fairy chimneys"? What technologies are used? Currently, are there further technological needs to fulfil?	
4	What kind of tools do you use for supporting site development and decision-making (e.g. GIS, heritage/social and environmental impact/vulnerability assessment, technical reports, statistics, policy assessment)?	
5	Which are the main strategies for the re-use, valorization and promotion hitherto adopted for Goreme "fairy chimneys"? Which are the main trade-offs between conservation and valorization?	
6	Do you have data on economic impacts deriving from the re-use and valorization of Goreme "fairy chimneys"and in particular of tourism activities (e.g. new businesses, entrepreneurship, new jobs, etc.)? Which are future expectations?	
7	Do you have data on the social and cultural impacts deriving from the re-use and valorization of Goreme "fairy chimneys"? Which are future expectations?	
8	Do you monitor the environmental impacts deriving from Goreme "fairy chimneys"? Which are future expectations?	

9	What is your commitment (and of other stakeholders) for developing a sustainable tourism approach in Goreme "fairy chimneys"?	
10	Which are the current challenges? Are there any obstacles and bottlenecks (in terms of regulations, funds, technologies, competences, cultural factors, relational factors, environmental factors, economic factors, missing human resources, etc.) to the further/successful re-use and valorization of Goreme "fairy chimneys"?	
11	Which role has "community engagement" in the planning/development activities of Goreme "fairy chimneys"?	
12	Which is the attitude towards collaboration of your organization? Which are the bottlenecks and constraints to collaboration among multiple stakeholders, including local people?	
13	According to you, which are the relevant stakeholders that should be engaged in future plans and projects for the protection and re-use/valorization of the UBH of Goreme "fairy chimneys"?	
14	In your point of view, what is the role and action that should be done by the stakeholders (such as decision-makers, tourism businesses, non-governmental organizations, educational institutes and the local people) in the region to maintain a sustainable tourism approach in the region.	
15	According to your opinion what are the fundamental problems of tourism development in Cappadocia?	
16	According to your opinion what are the impacts of tourism development in Cappadocia on natural attractions, on cultural resources, on historical resources ? What are your suggestions?	

CHAPTER 7

Reintroducing Karaya: Knowledge, Meaning, and Community Identity of an Abandoned UBH Landscape

Jorge Magaz-Molina, Meryem Bihter Bingül Bulut, Bernard Bugeja

7.1 Introduction

Karaya is a semi-abandoned Underground Built Heritage (UBH) settlement in Cappadocia (Turkey) located in the proximity of the UNESCO site of the *Valley of Göreme*. This place had been proposed as a case study in the *First Training School* held in Naples in February 2020 within the scope of COST Action CA18110 *Underground4Value* (U4V).

First Training School offered to authors' trainee group the statement of *Knowledge, Meaning and Identity of Karaya.* To explore this concept and draw out planning and design ideas for this derelict UBH, a conceptual framework was developed based on previous studies [1] and the results of the U4V Short Term Scientific Mission [2]. The trainee group's proposal called for the enhancement of the underground settlement and its surroundings, by proposing a scientific itinerary focused on the rescue of local meanings and memory based on a multiscale and multi-disciplinary analysis. In the opinion of the trainee group, a key aspect of the case of Karaya was the territorial dimension of the UBH in Cappadocia and the particular landscape significance of the site linked with the relations of its former inhabitants and current visitors with the environment. The analysis of the historical landscape and its relationship with the UBH site, its scientific recording and interpretation, its local dissemination and tourist diffusion, and its cultural management were at the core of the proposal. A participatory process of recovery of the memory of the place and re-signification of the space considering GIS technologies and social media

real-time interactions was then included too. Participatory strategies for the design and cultural exploitation of the space in accordance with the scientific itinerary and UBH conservation were also proposed.

The final proposal was aimed at recovering the site as a cultural and educational infrastructure aligned as an eco-museum oriented towards domestic tourism and based on principles of environmental sustainability. The results of the Naples workshop were collected in a publication [3] which detailed the proposals contained in the first poster.

This chapter derives from the initial teamwork developed in Naples and aims to study the framework and possibilities for the implementation of actions for the enhancement of the UBH of Cappadocia as a sustainable tourist resource considering heritage conservation, local development, and environmental impacts. The chapter gathers and deepens the reflections developed on Naples around the heritage, community, and identity considerations attributable to the abandoned underground built heritage sites and the strategies of knowledge and re-signification of these spaces. We have tried to synthesise the territorial and regulatory context of the proposed case study, to analyse the problems that affect it, to explore the strategies to implement its enhancement and to outline a general itinerary.

7.1.1 Cappadocia: An Underground Built Heritage Network

Underground towns are a characteristic element of Anatolian landscapes. More precisely, the region of Cappadocia is a relevant area of excavated towns that could be explored as a network of Underground Built Heritage (UBH) due to their historical values, geomorphological uniqueness, and established tourist attractiveness. It is known that there are around 200 carved towns in the region, so Cappadocia offers multiple cases in which to study the different casuistry regarding underground cities in the 21st century: opportunities and conflicts on their conservation and integration into contemporary life, their potential as a tourist resource or the preservation policies and use strategies proposed. Among these sites, the Valley of Göreme and its adjacent area of the Nevşehir province, raises one of the most interesting cases, as it is one of UBH's main global attractions and has been declared a World Heritage Site.

Cappadocia owes its fascinating geological forms to numerous (now extinct) volcanoes which created a huge plateau, made of soft stone, grooved by deep torrential incisions that alternate with vast undulating plains disseminated by tabular reliefs (Fig. 7.1). The particular geological substratum of Cappadocia's landscape resulted from natural erosion to form a series of mountain ridges, valleys and pinnacles. Under semi-arid and arid-semi-humid climatic conditions, the dominant vegetation

formation of the Cappadocia Region is steppe associated with the "dry forest" and "anthropogenic steppe section" ecological regions of the Central Anatolian area [4].

This steppe landscape has been the scenario for centuries of a particular human occupation in the form of excavated settlements that, many of them, have remained inhabited until today. The permanence of "troglodyte" communities until recent times can be explained as a response to the limitations of the environment, the ease of excavating tuff (the local rock) and the favourable factors offered by these dwellings in steppe conditions [5, p. 149]. It is believed that the origin of the subterranean cities of Cappadocia, like Kaymaklı and Derinkuyu, are the settlements that were initially dug out by Hittites during the Phygians attacks around the 12th century BC [6, p. 106]. The concept behind these hidden cities was to protect the population from any form of invasion, enabling thousands to reside in total secrecy. However, this form of habitat continued beyond the conflicts and expanded considerably and acquired more elaborate and visible accesses, coinciding with periods of prosperity. In this sense, the architectural dimension of underground settlements during the Byzantine Empire is remarkable [5, p. 149]. In the Late Antiquity and Early Middle Ages, besides defensive, domestic or utilitarian spaces, places of worship and retreat were excavated in the rock of the region. The Byzantine underground churches and monasteries of the Valley of Göreme are outstanding examples of the sophistication of underground rock-cut architecture.

Figure 7.1: Cappadocia landscape close to Nevşehir: farmland, plateaus and Erciyes Mountain on the horizon. Source: M. Bingül Bulut (2022).

These valued underground structures of Valley of Göreme, together with four archaeological sites of Cappadocia and the underground cities of Kaymaklı and Derinkuyu, were inscribed on the UNESCO World Heritage List in 1985, as a multi-location site (Fig. 7.2). This World Heritage Site was added onto the World Heritage List under criteria (i), (iii), (v) and (vii). The addition was mainly down to the irreplaceability of the post-iconoclastic Byzantine art, the fossilised image the structures create of past civilizations, the outstanding example of a traditional human settlement. However, this site and its singular landscape has become vulnerable due to aggravated natural erosion and increasing anthropic affectations.

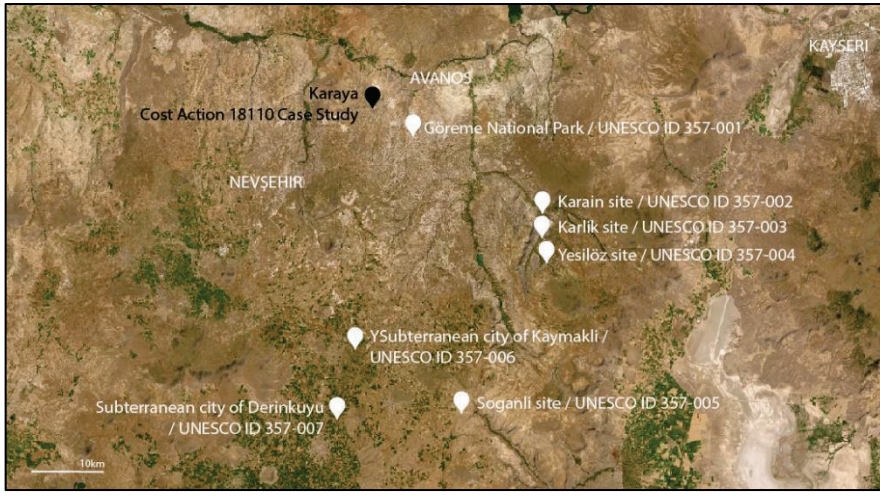

Figure 7.2: Sites included in the UNESCO World Heritage ensemble "Göreme National Park and the Rock Sites of Cappadocia" with ID357, according to the UNESCO website

Source: J. Magaz-Molina 2022. Diagram drawn on an orthophoto of the UNESCO Visor.

7.1.2 **The Valley of Göreme**

The Göreme municipality is one of the best examples of opportunities and threats presented by the UBH sites (Tab. 7.1). This underground town of 2000 inhabitants, formerly known as Avcılar, preserves one of the most artistic, geological and landscape ensembles of the UBH. It houses geological formations of the so-called "fairy chimneys" which, over the centuries, different communities developed in its cavities. The Byzantine communities had an important cultural centre in the nearby Valley of Göreme, whose testimonies are of great artistic value. From the abandonment of the Christian communities until the 1970s, when it

became a relevant tourist attraction, the area remained a rural settlement, with the last settlers being the Turks. Part of this Byzantine archaeological site was enlisted in 1950 (Göreme Open-Air Museum).

Göreme Open-Air Museum, as well as the geological formations (Rock Sites) and the surrounding areas, were declared National Park in 1986 (Göreme Vadisi ve çevresi) to guarantee its preservation as a buffer zone of the archaeological sites. According to Akkar Ercan [1, p. 260], it was the inscription of the Göreme National Park and the Rock Sites of Cappadocia as UNESCO World Heritage that boosted its development as a world tourist attraction.

Table 7.1. Opportunities and threats of the tourism offer around the Cappadocia UBH

Opportunities	Threats
Renowned place on the global map thanks to the listing on the WH List; easily accessible	Concentration of excursion routes, mass tourism; loss of positioning due to overexploitation
Accumulation of many historical and cultural assets	Lack of sustainable action plan and protection figures
High tourism potential	Heritage damage
All year-round visitors	Depletion of resources (eg: water)
Supporting tourism with complimentary activities	Gentrification, tourist thematization and display of historical falses
Immediate area with significant untapped cultural resources	Increase in waste and vehicular traffic, overbuilding

Protection figures applied on this site had limited results, due to the lack of supervision by permissive local administrations. Uncontrolled real estate development and touristic activities had a consequential impact on the landscape, environment, fertile soil and the UBH itself [1, p. 264], [2, p. 271]. For this reason, the National Park was suppressed by presidential order in 2019 to reformulate the protection and management of the area. However, this measure raised doubts about the possible detrimental effects it could have on cultural heritage. In any case, the area monitored by UNESCO maintains the boundaries of the former National Park, but it should be noted that the remaining perimeter of the archaeological site of the Open-Air Museum is very limited. This means that the effective protection boundary is reduced to the core area with representative underground enclaves and geosites.

Although tourism is an efficient instrument for sustaining geographically disadvantaged communities, it has also been shown to be a factor of social, environmental and heritage risk when it is not properly managed [7]. As highlighted in the Action's case study, the concentration of activities and the lack of a master plan for the museum and its environs (guiding environmentally, socially and heritage sustainable tourism) has resulted in the displacement of the local community and the lack of sustainable perspectives, thus threatening the integrity of the archaeological sites. Like other well-known cities and heritage sites which have become tourist destinations, the town of Göreme and the nearby archaeological sites were, until February 2020, suffering from a problem of mass tourism, which had a negative impact on several aspects [1, p. 263], [2, p. 271]. According to De Gregorio's diagnosis, this has resulted in degeneration and loss of local values derived from the over-commercialisation of the site and the sale of traditional cave residences to investors for tourist accommodation. While the need for a territorial master plan regulating the exploitation of the different areas and the control of the landscape transformation is an urgent need, the Action case study also concluded that it is vital to explore tourism solutions based on sustainability. In the framework of studies carried out by the Action, local stakeholders identified the nearby UBH enclave of Karaya as an area of opportunity for developing a pilot project of eco-tourism.

This site was another excavated settlement that used to host the villagers until the 1960s before moving to Göreme, according to local memory. Today the site is semi-abandoned, thus offering the possibility for the exploration of sustainable tourism management strategies and planning, enabling the decentralisation of the tourist masses in Göreme.

7.2 Karaya as a Site of Opportunity

Karaya is within the boundaries of Nevşehir municipality, and it is located near the borders of the former Göreme Valley and Surrounding Areas National Park that remains as UNESCO perimeter (Fig. 7.3) and is strategically placed north of the highway connecting the cities of Nevşehir and Avanos. No known archaeological records point to this enclave as being particularly unique, but it offers a scarcely altered example of the underground living and working spaces of the communities that inhabited the cave dwellings. The settlement is hidden in a canyon that carves the plain carpeted with vineyards, fruit trees and crop fields that draw the agricultural pattern of the plateau bordered by the hills. The caves preserve rooms, cellars, wineries, dovecotes and stables that reflect a way of life closely connected with the territory.

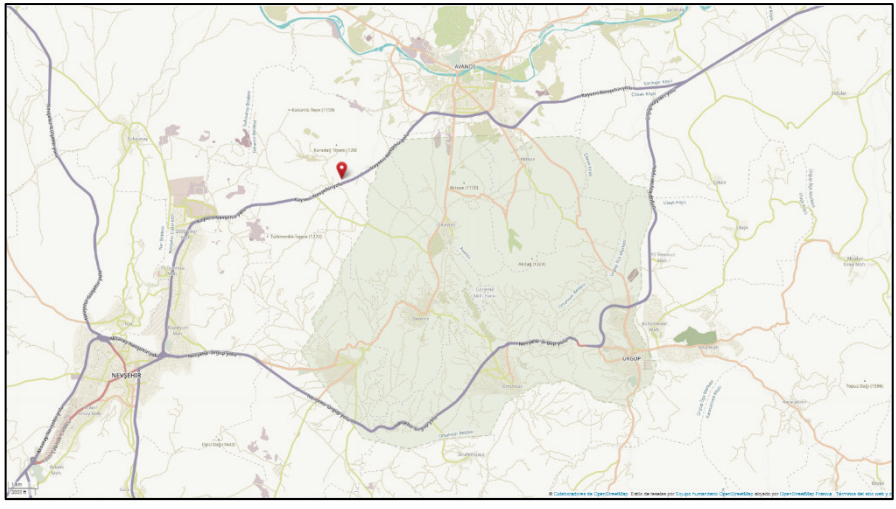

Figure 7.3: Location of Karaya site (red point) close to the boundaries of the former Göreme Valley National Park.
Source: OpenStreetMap

This enclave has been known by several names: Karakaya and Acısu, due to water resources in it which is a well-known spring of sodium bicarbonate and alkaline waters locally used in the treatment of stomach and intestinal disorders and travertines formed by calcium bicarbonate cold waters. According to local knowledge, this part of the canyon was the most important recreational and picnic area of Avanos for many years. The fieldwork carried out by the authors in mid-April 2022 (Fig. 7.4) has identified the presence of several residents and the development of farming activities linked to tourism activities displayed in the area of Göreme.

This area is outside the main tourist routes, which go at most as far as Avanos. However, Karaya is actually within easy access: 6 km from the site of the Fairy Chimneys and 9 km from the Göreme Open-Air Museum. It is also 6 km from Avanos, into which the river Kızılırmak flows through the Karaya valley itself. Nevşehir is 14 km from Karaya, and although the ancient subterranean city is not among the attractions of the zone, the agricultural valley in which it is located has other underground towns, such as Nar or Sulusaray, easily accessible from Karaya.

In terms of tourism, Karaya's surroundings are well-known thanks to the Cappadocia Landart Sculpture Park, designed by Andrew Rogers and installed between 2007 and 2009. Among the pieces displayed, 'The Gift' should be highlighted, as a stone profile of a giant horse related to the historical horse-breeding activity of the area.

A view from the Karaya Valley

Karakaya İçmesi (Mineral Water Source)

Karakaya Traverterns

Unregulated buildings in Karaya

Horse Farm in Karaya Caves

Dovecotes (Pigeon Houses)

Figure 7.4: Album of the fieldwork in Karaya. Source: M. Bingül Bulut 2022.

Although the area's industrial mining activities represent a limiting factor in the pedestrian and cycling network expansion strategy (aiming to decentralise the Göreme area), it can be argued that proper land-use planning could make them compatible. Even though the Avanos-Nevşehir highway is a major barrier, it can be easily overcome. An interesting idea would be to explore the possibility of the creation of a pedestrian connection between the Avanos and Nevşehir valleys, thus taking advantage of the valleys and fluvial corridors. This could serve as an axis

for a metropolitan park, as was proposed by the Action case study of the 3 Country Parks (Fig.7.5).

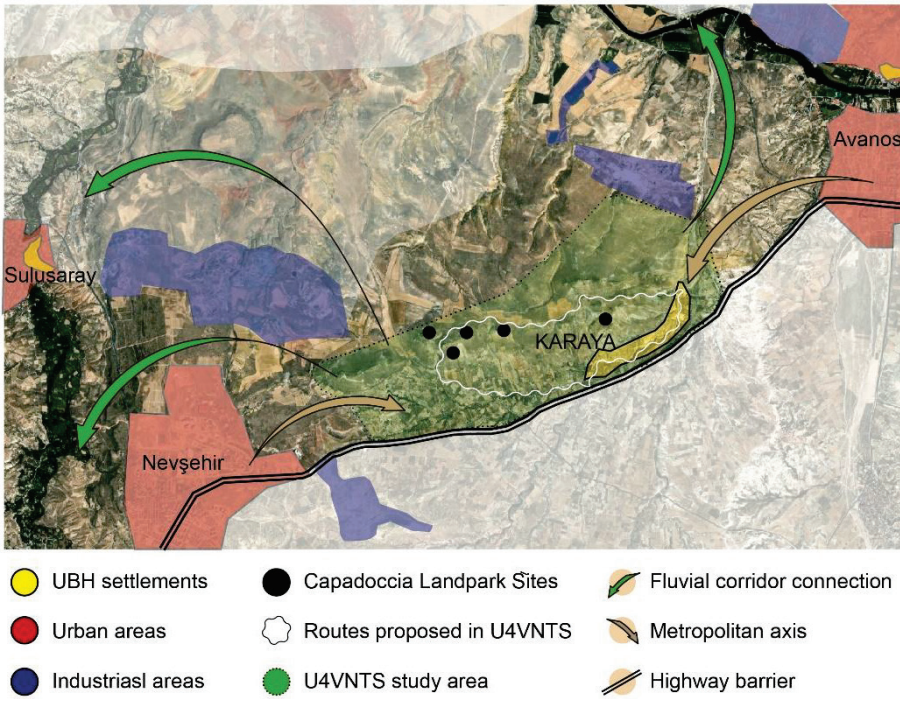

Figure 7.5: Study of possibilities for Karaya. Source: J. Magaz-Molina 2022. Diagram drawn on an orthophoto of the UNESCO Visor

As already mentioned, within the framework of the First Underground4Value Training School, it was considered that the values surrounding the UBH settlement of Karaya extended to its immediate environment and the intangible aspects of the traditional use of the territory and its present-day experience. For this reason, it was advisable to plan an eco-museum of territorial scope structured by pedestrian and cycling routes that would link different aspects of the culture of Cappadocia. Along with the elements surrounding the UBH site, the authors considered: the cultivated fields of fruit trees and vineyards and their relationship with the gastronomy, the clay deposits and the local crafts, the horse breeding, the hills that defined its horizon and in which artistic action of land art by Andrew Rogers was displayed. Besides, the trainee group proposed to integrate the memories and expectations of the local communities into a multidisciplinary study itinerary of the site's characteristics to provide content and meaning to an eco-museum that

would relate the landscape, the traditional uses of the communities and the historical site of Karaya.

7.2.1 Local Identity and Intangible Heritage as a Resource for Sustainable Development

As a semi-abandoned space, Karaya highlights the demographic and opportunity imbalances surrounding Göreme but also offers many variables for analysis in the general framework of the U4V Action. In this rereading of our initial proposal, we have been able to confirm that identity and meaning are powerful concepts closely linked to heritage and landscape. As it has been pointed out, "identity" and "heritage" are contingent concepts upon one another: "no identity without an act of remembrance of some origin(s) and that, which is remembered as origin(s), is constructed into the identity's heritage" [8, p.17]. However, this act of remembrance should be focused on local communities' everyday life recognition and shared common values promotion. According to the Recommendations of the Council of Europe, heritage enhancement should be oriented towards the support of local communities and as a vehicle for promoting respect for human rights [9]. Similar orientations have been put forward by UNESCO. Moreover, the protection of tangible and intangible heritage and the preservation of the cultural expressions of local communities have already been included in Agenda 2030 as catalysts for environmentally sustainable social cohesion and economic development. The perception of the territory by the local communities is also the central argument of the European Landscape Convention [10], which also establishes an operational framework for its planning and management with a view to harmonising its transformations and maintaining its characteristic elements through participatory processes.

Therefore, the process of redefining Karaya's identity to position it as a pole for the dissemination of local culture requires an itinerary of multidisciplinary knowledge to record the community meanings, the characterization of the landscape in which it is inscribed, reconstructing the history of the enclave and defining its archaeological or geomorphological characteristics. All these stages are an opportunity to gather around Karaya's technical and scientific staff, former neighbours, inhabitants of nearby towns, and visitors and make the study process itself an attractive and accessible event to relocate Karaya in the circuit.

Figure 7.6: General view of the canyon of Karaya. At the top of the hills, the Land Art sculptures of Andrew Rogers are recognisable. In the foreground, the excavated caves of the town can be seen, some of them are inhabited, and solar panels have been installed.

Source: M. Bingül Bulut 2022.

7.2.2 **Regulatory Framework**

"Cappadocia" region is not an administratively defined or clarified area in Turkey [11], but in the research on the cultural landscape character of the region by Tuna Yüncü [12], the borders of the Cappadocia Region are known as the area between Salt Lake in the west, Erciyes Mountain in the east, Seyfe Lake in the north and Hasan Mountain in the south. The region covers Nevşehir, Ürgüp, Avanos, Karain, Karlık, Yeşilöz, Soğanlı areas and Kaymaklı and Derinkuyu underground cities, the area bordered by Hasan Mountain, one of the extinct volcanic mountains, to the south, and Erciyes Mountain to the east. As already mentioned, singular parts of Cappadocia were included in the UNESCO World Heritage List in 1985 with the name "Göreme National Park and the Rock Sites of Cappadocia". UNESCO enlistment meant the Valley of Göreme and the surrounding area were declared as "Göreme National Park" with the decision of the Council of Ministers, which was published in the Official Gazette dated 25/11/1986 and numbered 19292 [1]. Within the area defined as Göreme National Park, there are settlements with historical and cultural values such as Ürgüp, Göreme, Uçhisar and Ortahisar, including the so-called fairy chimneys geosite.

The area, including the Göreme National Park, Karain, Karlık and Yeşilöz areas defined within the scope of the World Heritage Site, was

declared as the "Cappadocia Culture and Tourism Conservation and Development Zone" (Fig. 7.7) simultaneously with the decision of the Council of Ministers dated 22/10/2004 and numbered 2004/8328. Therefore, both the national park protection status was brought within the area defined as the World Heritage Site and the Culture and Tourism Conservation and Development Zone status.

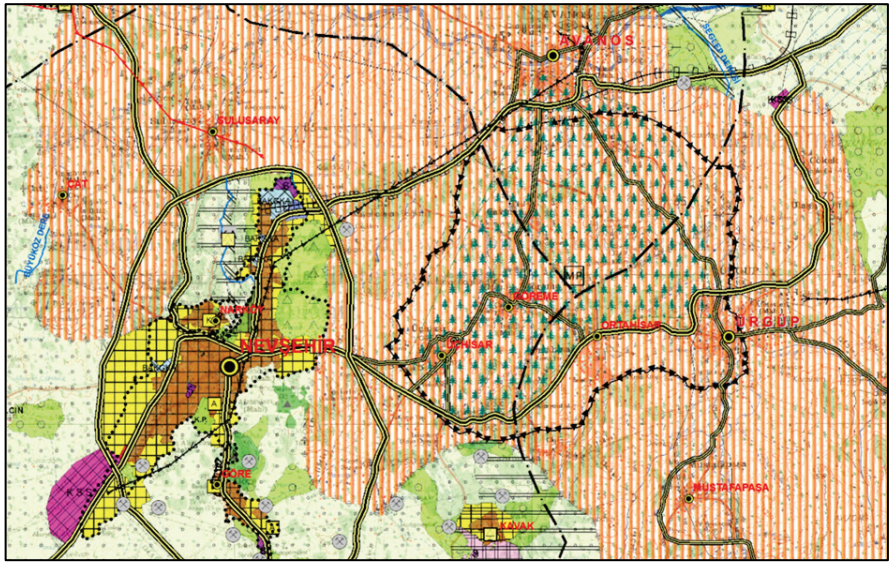

Figure 7.7: Map of Kırşehir-Nevşehir-Niğde-Aksaray Planning Region. Red-Stripped Pattern shows the Culture and Tourism Conservation and Development Zone
Source: https://webdosya.csb.gov.tr/db/mpgm/editor-dosya/file/CDP_100000/knna/K33_29042016.jpg

Considering that there are many settlements and protection status affiliated with different central and local administrative units, it was deemed necessary to establish a special management model within this cultural and heritage area by the Turkish Authority. In 2019, a new era began in terms of protection in the Cappadocia region. In this context, the Law No. 7174 on the Cappadocia Area entered into force in June 2019, and subsequently, the Presidential Decision No. 1673 on 21.10.2019 and the decision of the Council of Ministers no. 86/11135 dated 30.10.1986 was repealed and the status of "Göreme National Park" was cancelled [1]. The Cappadocia Area Presidency was also established within the scope of the relevant law [1]. In the coordinates given in the annex of this Law, the boundaries of the "Cappadocia Area'' were drawn and the definitions

related to the area were made (Fig. 7.8). The area boundaries have been determined to include the protected areas within the provincial borders of Nevşehir and the perimeter of the Culture and Tourism Conservation and Development Zone. The law aims to regulate the issues related to the protection, survival, development, promotion, transfer to future generations, planning, management and inspection of the historical and cultural values, geological/geomorphological texture and natural resource values of the Cappadocia Area.

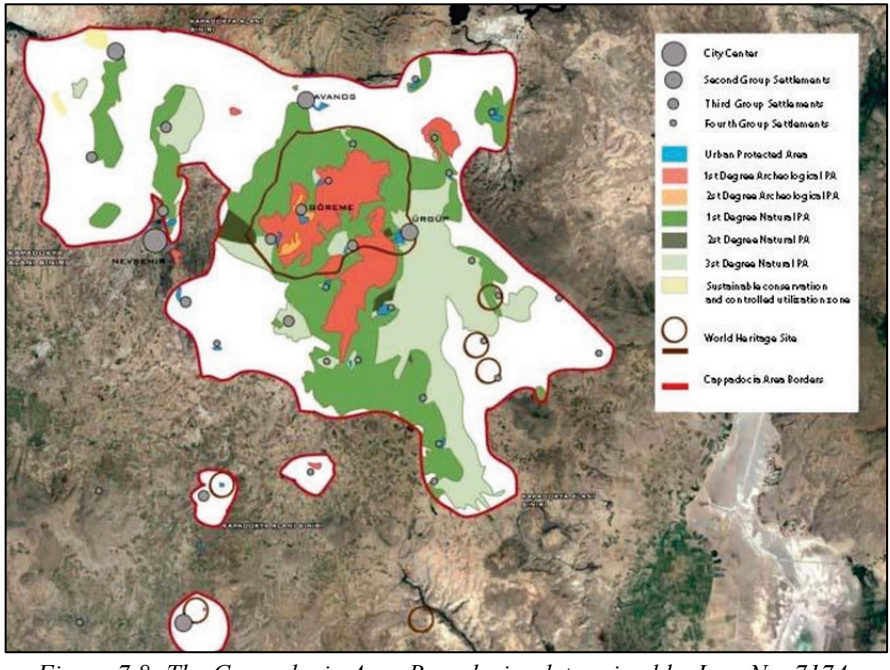

Figure 7.8: The Cappadocia Area Boundaries determined by Law No. 7174. Source: Şakar, 2020) [9]

For a more detailed study, we refer to Solmaz Şakar [13], who studies the planning, legal and administrative measures applied within the protection area. This work offers an interpretation of the constraints that have influenced the conservation of cultural heritage in Cappadocia from 1960 to 2020 and offers a focused case study on Göreme.

7.2.3 **SWOT Analysis**

In order to synthesise the possibilities of proposing an action to enhance the value and sustainable exploitation of Karaya for tourism, a SWOT analysis has been carried out. In the analysis, strengths, weaknesses,

opportunities, and threats are determined. A strategic view of the area can be put forward by examining the analyses published about Cappadocia tourism. In addition, field observations and previous work done by the First UBH Training School groups were also considered. By considering this data and the current situation, this exploration seeks to draw possible futures for this tourism resource.

Table 7.2. SWOT Analysis of Karaya

Strengths	Weaknesses
Consolidated tourist area	Expensive destination for domestic tourism
Cappadocia panorama viewpoint	Lack of certain legal protection status
Land Art intervention	Hard connectivity by pedestrian and cycle routes with the area of Göreme due to highway
Relics of old-style life routines Closeness to the roadway	
Interesting geo-formations, habitats and well-preserved cave-houses	Need for investment to provide access, security, and sanitation networks
Testimony to the relationship of humankind with its environment	Need of coordination between stakeholders
Opportunities	**Threats**
Nearby cities could be interested on an agro-natural metropolitan park	Erosion risk due to vehicle, bicycle and pedestrian traffic flows.
Easy access by pedestrian and cyclable routes from cities close by	Risk of tourist theming of the site and display of historical falses
Existing environmental connections through fluvial corridors	Irreparable transformation of underground structures
Unexplored archaeological site	Erosion of caves and stability risks
Possibilities of implementing an interdisciplinary scientific research program	Possible impact on the habitat and heritage of actions to adapt the site to tourism
Site to satisfy local stakeholders' desire of outlining a local culture, gastronomy, and manufactures	Landscape impacts provoked by nearby mining activities, industrial poles, or solar parks

Table 7.2 shows that Karaya's strengths and weaknesses arise from internal factors, while threats and opportunities are created by external environmental conditions to increase the value and sustainable use of Karaya for tourism.

As internal factors: Karaya's logistics is very easy-to-integrate into current tourist destinations of the region as it is easily accessible by the Nevşehir - Avanos Road. However, access by bike or on foot is harder and makes the area disconnected. Natural geoformations of the valley make the area attractive and give a chance to discover land art on the hills where the scenic view of the region is well known. Also, relics of former-style life routines in the valley are one of the main strengths, such as farming activities, live stocking, grape crops, and pigeon houses. In Karaya, there is an opportunity to experience human-nature interactions, but at the same time, there is a need for investment to provide basic requirements such as security, access, and sanitation networks nowadays.

As external factors: opportunities development of an agro-natural metropolitan park by the participation of nearby cities, existing environmental connections through fluvial corridors and being a site to satisfy local stakeholders' desire to outline a cultural approach to local heritage like gastronomy, traditions, and local manufactures can be listed. But it should be noted that mass tourism in the region can have an impact on the site and on the habitat, specifically land leasing for balloon business, nearby mining activities, industrial poles, and solar parks.

The following needs have been identified:

- Defining a community decision-making process
- Articulation of a monitoring and evaluation organisation combining different actors for the implementation of a programme of study and heritage enhancement, environmental evaluation, and tourism exploitation.
- Drafting of a master plan bringing together the measures envisaged for the conservation of the values identified in the previous stages at different scales.
- Defining areas of protection: protected areas/core areas/buffer areas

Three issues of great complexity and relevance arise when considering the enhancement of Karaya:

- Its status as a semi-abandoned settlement, which places this enclave midway between an archaeological site and a ruin and a living urban ensemble.
- The "acceptable limits of change" that should be defined when considering any intervention. Exploring the possible elevations resulting from the recovery of the settlement, the protection of unique panoramas and the drafting of a view management plan are necessary studies. These tasks are particularly relevant with

regard to the insertion of contemporary elements or technological installations and devices as could be carpenters, flooring, solar panels or supplies networks. Removable structures that do not alter the heritage and habitat are recommended.

– The question of guaranteeing "authenticity" to ensure that the space is not thematised or falsely historical. Ethnographic, historical and archaeological studies and the scientific monitoring of the museum programme proposed for this, and any other similar space, can offer the appropriate resources to implement reliable and interpretative historical recreations.

7.3 Towards a Heritage Management Proposal for Karaya

De Gregorio's draft of the assets of Karaya with potential for heritage enhancement includes geomorphological elements (sulphurous water springs, cones, canyons), urban and architectural elements (dwellings, cisterns, cellars and dovecotes excavated in the caves), cultivation areas (vineyards) and recent artistic interventions in the territory (Andrew Rogers Land Art Park). The heritage value of Karaya is, therefore, not limited to the underground inhabited enclave. The area of Karaya, as a whole, offers a unitary system of meanings of the relationship between human communities and the environment, and whose anthropic testimonies characterise this enclave in a singular way. A question relevant to the interests of the Action arises here: how can the cultural planning of the UBH address the relationships of meaning and functionality of an asset with its immediate surroundings? Heritage enhancement operative framework review could offer methodological guidance for a master plan for the Karaya site.

According to Varriale's definition of "underground built heritage" [14], UBH is understood as human-excavated underground sites that have material or immaterial cultural significance, capable of fostering socio-economic regeneration initiatives. Varriale also includes in this concept those aboveground structures she defines as "UBH annexes", which explain and give meaning to the underground ensemble, such as mining installations. To delimit the scope of this definition, Varriale proposed the following general rule: "aboveground annexes of UBH structures can be regarded as belonging to the same class as the main part of the structure only if they do not significantly characterise the structure itself and do not play a major role in its main function". Considering the large presence of underground cities in Cappadocia, it is interesting Genovese's approach [15] for underground cities. With the goal of providing operational actions for interventions on urban districts or entire cities carved in the rock, Laura

Genovese has formulated the term "Underground Historic Landscape", based on the UNESCO framework of the "Historic Urban Landscape". This conceptual framework offers broader perspectives for the analysis of the UBH and for exploring urban strategies of conservation. The figure of the Historic Urban Landscape has acquired considerable currency by incorporating the paradigm of sustainability - economic, social and environmental - into the framework of urban heritage conservation strategies for UNESCO sites. However, as Lalana Soto [16, pp. 24-26] points out, this figure arises to respond to the problems of urban heritage, understanding the city from a broad and dynamic conception, as an environment in a permanent process of change. Guidelines and recommendations proposed by UNESCO for the UHL can be a reference for addressing the heritage management of Anatolian underground cities and towns such as Göreme, Kaymakli, Uçhisar or Avanos. However, it is questionable whether the case of Karaya could fit the figure of a "Historic Urban Landscape", as it is a semi-abandoned settlement whose enhancement is influenced by the rural component of its surroundings and its condition as a scarcely altered enclave.

Seeking operational frames of reference for developing a master plan in Karaya, it would be worth considering other categories established by UNESCO that could attend to this component of anthropized territory in which the cultural legacy of the communities is recognised in the landscape patterns. Karaya's Master Plan could be conceived as a historic town - (I) no longer inhabited, which provides archaeological evidence and satisfies the criteria of authenticity and conservation that can be easily controlled. However, the territorial component could be better aligned to the requirements of a cultural landscape site, as it represents a combined work of nature and human activities in which a sustainable traditional exploitation of the resources of the area and a spiritual relationship of the communities with nature can be interpreted. In this sense, its interpretation as a "cultural landscape" would contribute to the establishment of a modern sustainable exploitation of the territory aligned with the objectives set by the Council of Europe [10], [17] with the implementation of the European Landscape Convention.

Attending to the exceptional geomorphological values that Karaya, in particular, and Anatolia, in general, enjoy, it might even be interesting studying the operative solutions developed for the implementation of the Geoparks, as it has been promoted in Kula (Turkey). The Geopark tends to promote an integrative approach to geology, biodiversity and heritage and a sensitive approach to the needs of local communities. But above all, Geopark promotes the sustainable development of these territories. Management solutions applied in territories endowed with relevant UBH

sites, such as the Cave Houses of Guadix (Spain), the mining territory of the Colline Metallifere (Italy) or Les Causes du Quercy (France) have opted for this strategy to promote sustainable tourism.

In case of enhancing the food production dimension of the landscape of Karaya, another more flexible reference in terms of tangible heritage integrity to consider in the operational design of a strategic plan could be the management plans of the Globally Important Agricultural Heritage Systems (GIAHS) monitored by FAO. FAO states that a GIAHS is a living and evolving system of human communities in an intricate relationship with their territory, cultural or agricultural landscape or broader biophysical and social environment. From this perspective, it is valued how the accumulation of knowledge transferred between generations responds to the potentialities and limitations of the biological and geological environment, shaping an evolutive landscape. In contrast to other heritage approaches, GIAHS are based on dynamic conservation strategies that allow landscapes and communities to evolve and respond to new challenges.

7.3.1 Scientific Itinerary for the Knowledge of the Abandoned Underground Built Heritage Landscape

As a methodological approach to the knowledge on the identity and meaning of Karaya, already in the Naples teamwork, it was suggested the implementation of "Landscape Character Assessment". This methodology [18] offers a description and classification of the landscape character, through which the differentiating elements and patterns of one area from another can be pointed out, which does not necessarily make it more valuable, but allows for the identification of singular areas at different scales. In this methodology, historical, regional, symbolic and social sensitivity is condensed, while multidisciplinarity is also a priority. Landscape assessment is particularly suited to protect views of heritage sites, as well as to articulate participatory processes through which to gather community meanings.

The recording of geospatial data and its uploading to the web allows solutions such as the Landmap of the Kingdom of Wales, which offers a record of the characteristics, qualities and influences on the landscape through five thematic layers of spatial information: geological characteristics; habitats, visual and sensory, history, culture. The characterisation of the recognizable elements of Karaya in particular, and the Göreme area in general, should be wide. The individualization of the different cultural assets should not be limited to recording buildings or underground spaces, but should also take into account unique geological

formations, monumental trees, vegetation and ecosystems or crop fields. Attention should also be paid to intangible heritage, recording traditions and oral expressions, performing arts, spaces of social use, rituals or festivals, and trying to geo-reference spaces and uses linked to the relationship between humankind and nature, or spaces where traditional handcraft techniques can be identified. This cultural approach to the landscape offers a link to relate aesthetic, morphological, and intangible values and recognition of the local community. In this sense, the experiences on the study and management of the cultural landscape proposed by the Andalusian Institute of Historical Heritage can be taken as a reference. These tasks are already being taken by different institutions across the world, not only to have a historical record accessible to researchers, but also to offer an online resource for dissemination among its inhabitants. But in addition, these actions help to generate interactive materials that add value to a tourist destination as they facilitate the discovery of the territory by visitors. It is unnecessary to generate differentiated products: the heritage agency of the province of Barcelona, for example, has a georeferenced heritage inventory of general access useful for discovering scattered assets in the territory.

Palimpsest territories such as Karaya offers the ideal substrate for historical and archaeological studies of the landscape through methodologies such as Historic Landscape Character that propose an analysis of field patterns, historical map records, documentary evidence, current land use records, archaeological interpretation, aerial photography, assessment of previous land use, among others. In the same line is the Landscape Biography conceptualised as a method of registering and managing historic landscapes. Knowledge about landscape multidimensionally changes, as cultural, social and economic aspects, is also needed. In Karaya's case, this type of analysis might be an exploratory tool to highlight practices, memories and stories of the site.

In addition to the studies that a historical landscape and its management require, the enhancement of a UBH also demands a specific study as a singular structure. It would be advisable to detail the characteristics of the different caves in Karaya, to specify their origin and nature, to evaluate their potential threats, and to explore the possibilities for adapting to the changes required for their safe use today.

7.3.2 **Management Roadmap Proposal**

As noted at the beginning, this contribution was intended to outline a proposal for Karaya as a sustainable tourist resource considering heritage conservation, local development and environmental impacts. To this end,

an approach has been made to bring together the actions that should be considered to develop a sustainable open-air museum in Karaya that would allow the economic development of local communities, the conservation of heritage and the preservation of the environment. This open-air museum or eco-museum is conceived as a territorial cultural management tool capable of integrating built assets, nature and intangible heritage and encouraging the participation and recognition of local communities.

In line with the initial proposal, this contribution involves technological solutions and an operational itinerary that integrates researchers from different disciplines, management professionals, entrepreneurs, local administrations, managers and representatives of civil society. It is considered appropriate to program a transparent development of the project through the dissemination of reports and the promotion of hearings, the organisation of meetings or field visits, and the dissemination of scientific results. As mentioned above, the information and data generated in the framework of this initiative could feed a spatial data infrastructure.

To implement this action, it would be advisable to set up a coordinating office to lead the initiatives, with economic and administrative capacity. This body will be able to organise actions and reach agreements with other local and regional administrations, local agents and landowners. Among the first tasks envisaged in a hypothetical roadmap, the following could be considered:

i. Delimitation of the perimeters of the area of action and the definition of protected areas for their natural or cultural and archaeological values, immediate buffer zones.
ii. Defining the general planning guidelines and establishing pedestrian and road access.
iii. Setting the appropriate legal figures for the development of the project in this area.
iv. Reaching agreements with landowners who may be affected by the initiative.
v. The identification of stakeholders interested in participating in a sustainable programme of food production or service provision farmers, livestock breeders, craftsmen, hostellers, etc. Artisans, entrepreneurs or companies can enrich the environment of Karaya with contents and activities and make this space a place of production and consumption of km 0 products.
vi. Dissemination of the actions carried out: publication of studies, dissemination of the geolocalized registers on the network, cultural and environmental awareness campaigns, and tourism promotion.

vii. Creation of a brand image and promotion of services and products under sustainable quality seals, dissemination of activities on social networks.
viii. Organise a project implementation itinerary that includes several phases, and that integrates the knowledge of researchers and universities, the interests of local agents and facilitates community decision-making processes.

This study should be carried out in the first phase, together with a major analysis of possibilities and limitations. Among the actions to be considered are the following:

i. Landscape Character Assessment (LCA) of the Karaya site. As mentioned, LCA is recommended as it attends to natural elements (geology and geomorphology, climate, soils, flora and fauna), cultural elements (land use, settlement patterns, parcelling), social elements (meanings and memory), perceptual elements (preference, sounds, visual touch - form, pattern, texture, colour). From the results of this study, it is possible to identify the visuals and panoramas that are susceptible to protection.
ii. LCA data can be supported by a complementary flora and fauna survey. This study could identify elements and areas of environmental, geological or agro-cultural value to define guidelines for the delimitation of access areas and protected zones. It could also provide a census of species and specimens.
iii. Historical, cultural and archaeological study of the area also supports an LCA and could provide an inventory of elements and a catalogue of assets to be protected. This data would also suggest recommended boundaries for protected and accessible areas.
iv. A comprehensive study of the UBH is recommended. Essential actions could be the graphic and cartographic description, identification of elements and spaces, ensuring their stability, cave monitoring and studying their possibilities to adapt to the needs.
v. The search for the identity, meanings and memory attributed to Karaya requires social-community work. In nearby localities, the recording of oral memory, experiences and collective meaning is suggested. Intergenerational community meetings and workshops on traditional activities could be tasks for searching for intangible assets and values. These studies can help identify recoverable activities or workshops that could give life and shared meanings to the space.

vi. Study the tolerable margins of visitors to ensure the preservation of heritage and habitat.
vii. Raising awareness of the actions carried out: guided visits to Karaya, meetings with local communities, and planned tourist visits to the archaeological excavations.
viii. A community process requires providing the tools for citizen participation. Transparency in itineraries, actions and results is recommended.

A second phase of the project would be aimed at defining action guidelines for the definition of an Eco-museum based on the results of the scientific study developed in the previous phase:

i. Administrative procedures to obtain cultural and natural protection for the singular elements identified.
ii. Holding meetings with different local groups, administrations, researchers and entrepreneurs to agree on activities, contents and meanings for the museum space.
iii. Drafting of a master plan for an open-air museum that guarantees the conservation of the unique elements and allows for sustainable exploitation of the settlement and the surrounding landscape. This document should be the result of a community decision-making process, and it should include the definition of perimeters, access and circuits and accessible or restricted areas; specify protected areas and heritage elements, tolerable margins of change and design principles for new actions; detail the caves likely to integrate new activities or accommodate cultural uses and visits or new residences; identify actions aimed at guaranteeing the safety of visitors or inhabitants; concretise areas and routes restricted to the passage of motorised vehicles not involved in the management of the space; specify land uses of immediate areas and precise zones susceptible to alteration by industrial activities; define tolerable visitor volumes conditioned on the outcome of impact studies; list of activities that may be carried out in the ecomuseum area and specify those that are prohibited; to specify eco-friendly integration solutions for energy, water and sewerage supplies, etc.
iv. Implementation of pedestrian and cycling connection networks with surrounding enclaves.
Promotion of dissemination activities of the initiative to introduce the project to tour operators and visitors.

As pointed out, this proposal seeks to bring together a community decision-making process with the operational guidelines and knowledge obtained from a process of scientific study and recording of the memory and expectations of the local communities to make this space an area of local recognition and a pole of cultural dissemination. A more detailed analysis of the casuistry would offer more precise guidelines and notions to outline the possibilities of this initiative.

7.4 Some Final Remarks

The exploratory work developed around the Karaya case study opens up potential research topics on the role of UBH as a characterising element of the cultural landscape. It also outlines the scientific and management challenges raised by the enhancement of abandoned UBH sites and the subsequent defiance of the reconfiguration of meanings for local communities. Both issues are relevant in planning participatory decision-making processes aimed at heritage enhancement and centred on the people who live in, remember and know the territory.

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CHAPTER 8

Conclusions

Müge Akkar Ercan, Kerim Aydiner

The UBH sites and artefacts are precious resources with multiple values. They should be protected for now and future. With their generative potentials and roles, the UBH sites and artefacts can be effectively used as catalysts for attaining community valorisation, achieving sustainable regeneration and development, and improving the quality of life in different localities. They can also help the local governments to consider their UBH potentials for developing sustainable tourism, innovative sectors and a circular economy in these sites. Developing a knowledge-based planning and management approach is essential for using the UBH as a catalyst for community valorisation. Additionally, acquiring knowledge about the HUL, Stakeholder Dialogue and Transition Management approaches are relevant for using the UBH as a catalyst for sustainable protection and conservation and attaining sustainable economic, social, environmental, and cultural development in localities.

Cappadocia is one of the rarest UBH sites in Turkey. Within the COST Action CA18110 Underground4Value framework, Göreme in Cappadocia is selected as the case study site. This book, focusing on the UBH potentials of Göreme and the Cappadocia region, documents the studies and living lab experience conducted within the COST Action CA18110 Underground4Value framework between 2019 and 2023. It develops a reliable knowledge base concerning the UBH as the primary driver of heritage conservation, urban and rural regeneration and sustainable development of Cappadocia and Göreme.

As Akkar Ercan presents in Chapter 2, Cappadocia and Göreme acquire unique UBH resources with their geological and geomorphological features and a wide variety of UBH sites which become much more remarkable with this region's history. With the Göreme's history, UBH resources and specificities, and the UNESCO World Heritage Site, Akkar Ercan explains how the central and local governments could use the UBH potential for the spatial, economic, social and cultural development of the town and

the region over the last 40 years. Although the changes in Göreme and Cappadocia have been immense over the years, she points out the rising problems and challenges in Göreme and Cappadocia, which have started to endanger the sustainable conservation and management of UBH and other heritage assets in this specific site. Therefore, establishing a systematic monitoring system is vital for planning and managing natural, cultural and historical heritage conservation and sustainable local development in Göreme and Cappadocia. By posing several questions at the end of the chapter, Akkar Ercan emphasises the essential topics before identifying the steps towards developing integrated sustainable heritage conservation and tourism management plans and programs by using the UBH as the catalyst. Hence, she points out the critical importance of evidence-based systematic documentation and monitoring system for first assessing the existing situation of Göreme and Cappadocia in terms of sustainable conservation planning and management and sustainable development. A monitoring system is also critical for developing spatial, economic, social regeneration and conservation planning policies based on evidence and monitoring the changes to assess the performance of the policies and the success level of sustainable transition processes in both Cappadocia and Göreme. Besides, in the Chapter, Akkar Ercan presents a wide range of stakeholders playing active or passive, direct or indirect roles in the UBH conservation planning and management and the tourism and other economic sectors. Indeed, this long list of stakeholders shows us the region's complexity of spatial and sectoral planning when inclusive and participatory planning is to be implemented in Cappadocia. The size of the region and the Göreme town also complicates the conservation planning and management of the UBH and other heritage values, as many state institutions at the municipal, provincial, regional and central levels are responsible for this large area. Additionally, different legislative regulations need to be considered when planning and management decisions are taken related to the area's UBH conservation, tourism development and heritage and culture-led regeneration. In the chapter, finally, Akkar Ercan emphasises the importance of carefully conducting bottom-up and top-down approaches.

Digitalisation has the potential to be an approach/tool that offers options for different stakeholder needs in heritage management. This potential ranges from fundamental issues such as collecting, processing and presenting structural/spatial information (even historical), scientific research, measuring visitor trends, investment planning, marketing and conservation/maintenance planning to more specific areas. Digitalisation, therefore, provides a basis for efforts to sustain and evaluate heritage sites. This will be even more important in the future. Cappadocia is an essential attraction for cultural, entertainment, sports/adventure and recreational visits. The in-

creasing visitor traffic and the number of events yearly make digitalisation a priority for Cappadocia. This book includes studies that point to this priority. In Chapter 3, Kerim Aydiner attracts readers' attention to security and sustainability risks in the UBH sites of Cappadocia. For Aydiner, underground heritage structures carry both security/sustainability risks associated with being constructed in a rock/soil environment and the risks posed by the ageing of materials. In addition to these two risks, being located close to the region, the recent earthquakes now pose new risks to the Cappadocia heritage area. Kerim Aydiner, in Chapter 3, focuses on the importance of developing preventive measures or risk reduction strategies for all three risks in the region. In this regard, the region's digital transformation would be a good starting point. The study indicates that, through digital transformation, a virtual Cappadocia could be created as an integrated environment that can be utilised for both information and protection/sustainability purposes, encompassing a broad range of information from its history and structural health.

As seen in Chapter 4, Karagöz and others describe their meticulous text-mining and sentiment analysis methodologies. By taking Göreme National Park, Derinkuyu Underground City and Kaymakli Underground City in Cappadocia as the UBH cases, they analysed two types of Artificial Intelligence-based text analysis on the collection of social media posts from three different social media applications. This knowledge-based approach of the UBH, becoming a crucial part of research in various domains, shows that a comprehensive understanding of public opinion is vital for stakeholders or policymakers. In their study, Karagöz and others examine the visitors' sentiments of the four UBH sites in Cappadocia. They conclude that this sentiment analysis approach, which can be conducted along a timeline, helps reveal the overall trend and change in visitor satisfaction. Hence, such temporal sentiment analyses on the UBH sites can provide us with direct input to revise the existing policies. Besides, they also emphasise the importance of topic modelling and clustering algorithms for site management or policy making. Using negative and positive visitor feelings of such sentiment analysis makes it possible to make immediate modifications to the quality of the existing services. Likewise, Karagöz and others also underline this methodology's significance in assessing the potential impact of a new policy based on the immediate visitors' response through such social media posts' analyses. On the other hand, the authors also stress the limitations of such social media analysis, as shared opinions and news cannot guarantee the reliability and validity of the data due to fake news, manipulation attempts, etc. They conclude that such computational text analysis results must be an auxiliary mechanism to extend the perspective.

In Chapter 5, Özen and Akpınar examine the views of tourists on the World Heritage Sites (WHS) of Cappadocia, using the textual content posted by tourists in online environments through text mining methods, and assesses how far tourism management in the region is seen as sustainable. Based on the views of international and domestic tourists who visited four UBH sites in the Cappadocia region, i.e., Göreme Open-air Museum, Zelve Open-air Museum, Derinkuyu Underground City and Kaymakli Underground City, they discuss these opinions in terms of sustainable tourism development. Özen and Akpınar analyse visitors' sentiments through text mining methods and classify the problems raised by visitors on five themes: environmental regulation, visitor management, tourism marketing management, vandalism and antiquities smuggling and issues originating from employees. Based on the findings, they suggest that a sustainable tourism management approach should be adopted to conserve and manage the natural and cultural heritage in Cappadocia. While tourism is the most advanced sector in this region, the authors recommend improving tourism management and service quality, educating and raising awareness of local people about their heritage values, reducing vandalism on heritage sites by adopting sanctions, promoting sustainable tourism management and using smart technologies to improve the quality of tourism services. They finally suggest using face-to-face interviews or surveys to validate sentiment analysis and text mining methods.

Within the COST Action Underground4Value framework, which promoted and supported Stakeholder Dialogue and Transition Management approaches through the Living Lab on Göreme, particular attention and effort were given to promote a dialogue with the local and non-local stakeholders and the community by implementing a participatory and inclusive Living Lab process, based on the Strategic Transition Practice (STP). AHIKA, METU and CNR launched the Living Lab on Göreme in 2019 and held two subsequent stakeholder meetings using online and face-to-face communication tools. As a result of these meetings, the local stakeholders selected Karaya as the UBH site for community valorisation. The possible future scenario of this valley became the subject of discussion among the expert groups and the local stakeholders. Young trainees, the senior trainers and the STSM grantees widely discussed the outcomes of the Göreme Living Lab in the Naples Training School of 2020. Although the COVID-19 outbreak halted the dynamic progress of the Living Lab, the senior researchers and young trainees of the Training School worked collaboratively to develop a plan for the UBH conservation and sustainable local development of Karaya. With the Göreme Living Lab, a small multidisciplinary team was set up to work with the local stakeholders. In Chapter 6, Sacid Yildiz, the representative of one of the Living Lab's organising

agencies, first presents the mission and completed and ongoing projects of AHIKA and its conservation approach to the UBH and sectoral development in Cappadocia. He explains the experience of Göreme Living Lab by using a storytelling technique from the development agency's perspective. Ultimately, it is possible to observe how this living lab experience was rich for the development agency. Yildiz states that their involvement in the Underground4Value project was helpful in terms of promoting the business and investment opportunities of the region at the national and international levels, opening up new opportunities for the bilateral or multilateral international grant programs, revealing the new UBH potential for regeneration projects. He adds that the Underground4Value project helped them establish a new global and national network, participate in the Training School, conference and international meetings, and gain new knowledge and skills. In various ways, the Göreme Living Lab provided many opportunities for learning and developing new knowledge and practices for all parties which organised and participated in the process. In this sense, it provided a precious, generative and exemplary experience for participatory and inclusive planning.

This rich Living Lab experience was continued by the academics - young and senior, local and international- who worked on developing policies based on the findings of the Living Lab in the Training School. Young trainees, Jorge Magaz-Molina, Meryem Bihter Bulut and Bernard Bugeja, who first worked together with Müge Akkar Ercan, Sabrina Shurdi, and Yasemen Kaya during the Naples Training School in 2020, produced a future development scenario for abandoned UBH site in Göreme. They envisaged a development scenario for Karaya and its immediate environment, by incorporating tangible and intangible values of this UBH site and its present-day potential and needs. They suggested the development of an eco-museum in the valley to be designed with pedestrian and cycling routes that would link different aspects of the Cappadocia culture and the protection of the caves along the valley. They also suggested establishing spatial links between the eco-museum and the cultivated fields of fruit trees and vineyards where tourists and visitors could pick and buy fruits, taste local wine, and eat some local traditional foods on the farms. In the same area, there could be other activities, such as clay deposits and pottery making, horse breeding, and the hills where tourists and visitors can experience the land art of the Australian artist Andrew Rogers. Jorge Magaz-Molina, Meryem Bihter Bulut and Bernard Bugeja -the three young authors from Spain, Turkey and Malta- advanced the framework and possibilities for the implementation of actions for the enhancement of the UBH of Cappadocia as a sustainable tourism resource, considering sustainable local development, heritage conservation and sustainable environmental

development. In the last chapter, Magaz-Molina, Bulut and Bugeja deepen their reflections developed on Naples around the heritage, community, and identity considerations attributable to the abandoned UBH sites and the strategies of knowledge and re-signification of these spaces. They synthesise the territorial and regulatory context of the proposed case study, analyse the problems that affect it, explore the strategies to implement its enhancement and outline a general itinerary. After exploring the details of the potential development scenario of a sustainable eco-museum in Karaya, the authors claim that new research topics on the role of UBH as a characterising element of cultural landscape emerge, such as the scientific and management challenges, enhancement of abandoned UBH sites, and subsequent defiance of the reconfiguration of meanings for local communities.

In preparing this book, a special session was organised within the framework of the Fifth Underground4Value Meetings at Middle East Technical University in Ankara on 23-25 May 2022. It allowed the expert team (authors of this book) to present their contributions and findings to the knowledge base and discuss it with the participants of the COST Action meeting. Overall, the COST Action Underground4Value provided great opportunities for exploring the potentials, necessities and requirements for the sustainable UBH conservation and local development of Göreme and Cappadocia. In this time of uncertainties and multiple crises, it is possible to recognise the importance of a knowledge base, as well as participatory approaches for developing sustainable UBH conservation policies and local development plans to a better future for Cappadocia and Göreme.

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UNDERGROUND4VALUE

HERITAGE AND COMMUNITY IDENTITY, 5

Valorising Underground Built Heritage in Cappadocia

With their multiple values, Underground Built Heritage sites and artefacts are precious resources that should be protected for now and future. With their generative potential, the UBH sites and artefacts can be effectively used as catalysts for attaining community valorisation, achieving sustainable regeneration and development, and improving the quality of life in different localities. This book, focusing on the UBH potentials of Göreme and the Cappadocia region in Turkey, documents the research and living lab experience conducted within the COST Action CA18110 Underground4Value framework between 2019 and 2023. It develops a reliable knowledge base concerning the UBH as the catalyst for community valorisation, heritage conservation, urban and rural regeneration, and sustainable community development in Cappadocia. Within the framework of the COST Action, a participatory and inclusive planning process was followed to cooperate with the local stakeholders and the community. Hence, the book presents this participatory and inclusive process and outcomes of the living lab and Strategic Transition Practice approach. Besides, it presents studies on stability monitoring and controlling, geological and geomorphological mapping and visualisation of the UBH, artificial intelligence text-mining, and sentiment analysis methodologies for discovering tourist views and the complexity of heritage conservation, sustainable regeneration, and tourism development in Göreme and Cappadocia.

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