

An Investigation of Influential Factors in the Long-Term Survival of Vernacular Architecture in the form of Cone-Shaped Dwelling: Case Studies of Kandovan and Goreme (Cappadocia)

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Abstract

In recent years sustainability and sustainable development have become widely used terms in which the environmental, economic and social aspects go hand in hand in a holistic way to meet the needs of the present without compromising the ability of future generations to meet their own needs. Although there is widespread understanding of the physical and environmental challenges involved in creating settlements, there is still much to be learnt about what makes some communities succeed and others fail. The successful communities are considered as good examples for our understanding of the role played by social, environmental and economic factors in the success of settlements and how vital they are for the communities long term success and survival. There are several examples of surviving communities and villages in various parts of the world, which have been inhabited for centuries in the form of rocky architecture. Understanding the factors that led to the survival of these villages will contribute to a practical understanding of what makes some communities succeed and others fail. This study tries to investigate the factors which have impacted on the long-term survival of some communities by focusing on two case studies of Kandovan in Iran, and Cappadocia in Turkey. Although Kandovan and Cappadocia (Gourme) have the same architectural features and structure; One of them (Kandovan) has been habitable continuously for centuries (over 40 generations), and the other has been abandoned since 19 centuries. Regarding to the similarities between environmental, economic, and architectural factors of two aforementioned villages, it can be concluded that the social dimension can be the key factor leading to communities succeed and survival.

2. Literature Review

This section will introduce Rocky architecture, two case studies and their historical backgrounds and geographical features. Sustainable development will be introduced in this section, as well.

2.1 Rocky Architecture

Two different type of cliff dwelling are classified by archeologists, the first type includes the cliff house which is actually built on the cliffs level, and second sort is Cavate, which is dug out and built into the cliff itself, thus making it became part of the natural setting. Rocky Architecture will be classified in the second type of cliff dwellings. Rocky architecture is indicative of the struggle between humans and the nature to make the maximum use of rocks and hills for human habitation (Gorji Mahlabani Yousef 2010 spring; Ghasemzadeh et al. 2013). Asadi (2008) defines Rocky Architecture as the type of structures that starts with carving a hole into a rocky surface and gradually expanding it to create various spaces to meet human needs, such as a house or a tomb(Asadi 2008). In contrast to normal building practices that use materials such brick, timber, concrete etc. Rocky Architecture utilizes the natural form of the rock and removing the materials of the rock to create habitable spaces. This type of architecture is more significant than common type of "one stone on the other" architecture.

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Emge (1992) argues, that in the Rocky Architecture it is about digging the hills and rocks and taking the material away from them and, furnishing the interior spaces with niches and shelves that result in enlargement of usable space. Rocky Architecture has been shaped specifically according to habitants' needs(Emge 1992). This type of architecture could be termed 'economic' because there is no cost involved in the transportation and use of building materials, and the low cost of heating and ventilation(Emge 1992; Mohammadreza Pourmohammadi 2014). For example, thickness of walls of these buildings act as thermal insulation, their orientation and size of the openings play a vital role in the reduction of heat exchange between internal and external spaces. All these features led to its adaptively to climate and energy resources, hence Rocky Architecture can be considered as environmentally sustainable architecture(Sepideh Yahyavi 2012). Based on the form and spaces this kind of architecture has been classified into two main types. The first type is hills and rocks with spaces for which there is no outward appearance, the best example of this type is located in Meymand (Fig. 1), Iran, which is still the habitation of 150 people. Second one refers to separated rocks in which different spaces have been curved forming residential or public spaces (Gorji Mahlabani Yousef 2010 spring). There are three existing sample of this type of architecture namely Kandovan (Iran) (Fig. 2), Cappadocia (Turkey)(Fig. 3) ,and Dakota (USA).Of these, Kandovan in Iran is considered an exceptional example because it is inhabited while Cappadocia and Dakota are ghost villages(Sevindi 2003; Sepideh Yahyavi 2012). The latest census figures indicate that 801 people live in 143 households in Kandovan.



Figure 1: Meymand (Shakernia 2009) Figure 2: Kandovan (gholami 2013) Figure 3: Cappadocia (Jensen 2014)

2.2 Geographical Features of Case Studies

2.2.1 Geographical Features of Kandovan

Kandovan village, with its ancient and extraordinary architectures, is one of the rare examples of rocky architecture. It is located in Sahand Rural District, in the Central District of Osku County, East Azerbaijan Province, Iran(Fig. 4). Kandovan is considered as an exception among second type of rocky architecture because, these troglodyte dwellings have been used by locals from approximately 800 years ago(Sepideh Yahyavi 2012).Kandovan is situated 62kilometers from the southwest of Tabriz and 22 kilometers southeast of Oskou (Gorji Mahlabani Yousef 2010 spring).Ashrafi (2013)states, "This stone-age lifestyle in the midst of our modern times has bestowed incomparable charms to Kandovan, turning it into a major source of wonderment and fascination"(Ashrafi 2013, p. 17). These cone shaped structures (*Karans*) were shaped by ash and debris from a volcano eruption of now-dormant Sahand Mountain (Fig. 5). New wave of volcanic activity in north-west of Iran happened as a consequence of the collision of the Arabia and Eurasia plates (Kaljahi and Birami 2014)less than 10,000,000 years ago(Pirmuhammadi F and M 2011), Asgari argues that one of these volcanic activities came from the Sahand volcano (Kaljahi and Birami 2014).Over the period of thousands of years ash and debris from volcano eruption were hardened, shaped and sculptured by natural elements such as wind, rain, snow and so on. Consequently this cone-shaped landforms which originated by tuff erosion were excavated by humans and utilized as dwelling(Kaljahi and Birami 2014). According to the Statistical Center of Iran, this village dates back to more than 850 years (Statistical center of Iran, 1375).The location of the village, 1500 meters above sea level in Oskouand 2300m in Kandovanled to its cold climate in the winters and temperate climate in summers. This village covers an area of 150 hectares. According to the latest census, the current population of Kandovanis 691 living in 208 households (Mirasfarhangi2012). This village has been registered in Iran national monuments list(Vahid 2003).

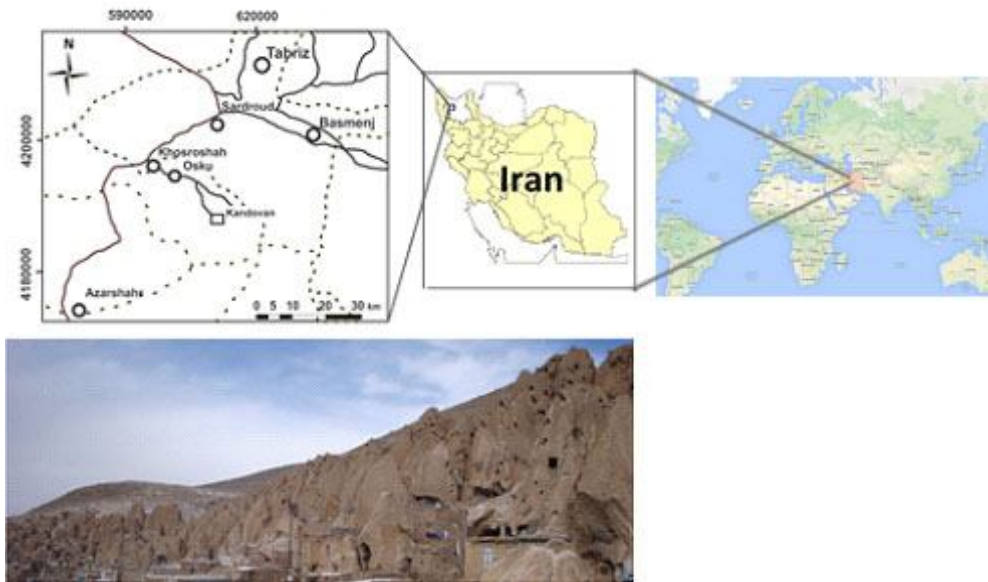


Figure 4 :The location and Panoramic view of Karans in Kandovan (Birami 2014)

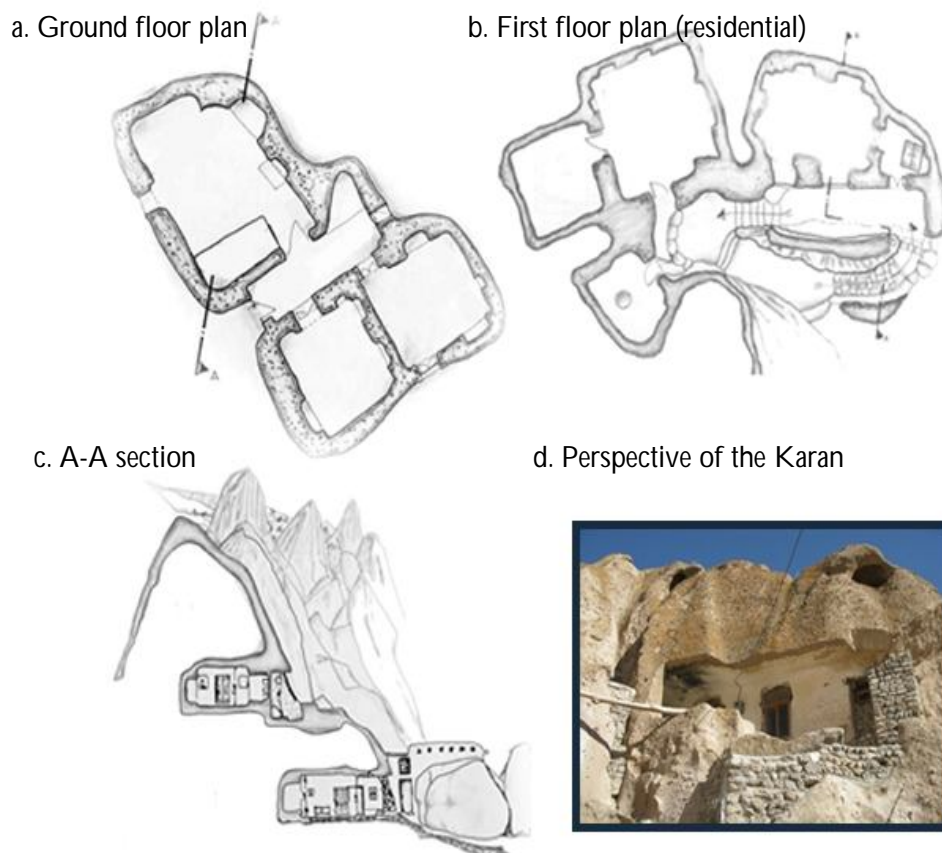


Figure 5 : (a,b,c,d) floor plans and section of a Karan in Kandovan (Gorji Mahlabani Yousef 2010 spring) (P18,19)

2.2.2 Geographical Features of Goreme (Cappadocia)

Two hundred kilometers south –east of Ankara in the center of Turkey ,Cappadocia (known as Goreme as well) with its unique and spectacular volcanic and moonlike landscape is situated in central Anatolia plateau, in the middle of a triangle formed by the three towns of Nevsehir, Urgup and Avanos , (Tucker 2003). This wide volcanic area is bounded with ErciyesDağ (3916 m) at one end and Hasan Dağ on the other end (3253 m) on south and east respectively (Emge 1992)(Fig.6). The region of Cappadocia is identified by settlements created amongst the cliffs and rocks. There are two main types of settlement in this region: Underground cities which combine of multilevel structures(Fig. 7), and semi underground cities or cliff settlements that has horizontal array of rooms (Fig. 8)(Sevindi 2003).And the focus of this study is on the second type of settlement which is, cone-shaped structure. According to Omer Aydana (2002) "This area forms a high plateau and is covered by almost horizontally layered acidic volcanic tuffs and lavas from Erciyes, Melendiz and Hasandag volcanoes in several hundred meters thick"(Omer Aydana 2002 , p.245) Tuff which forms the cones and columns in this unique landform was made by volcanic ash and debris that was hardened millions of years ago. Weathering and differential erosion sculpting the towering cones named fairy chimneys or locally called *Peribacilar* (Tucker 2003). The tuff stone can be easily dug by simple instruments such as hummer, adze, and jimmy; hence the material is ideally suitable for construction and further Expansion by local residents (Emge 1992). Cappadocia enjoys a continental climate, it has cold winters with temperature reaches as low as -35 and the summers are hot and dry ranging up to 35-40(Omer Aydana 2002) .



Figure 6 :The location and Panoramic view of Karans in Goreme (Wikimedia 2008)

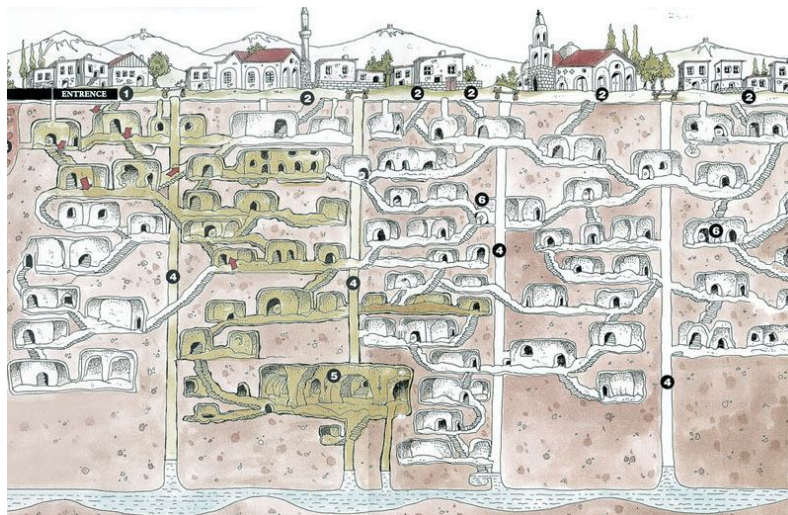
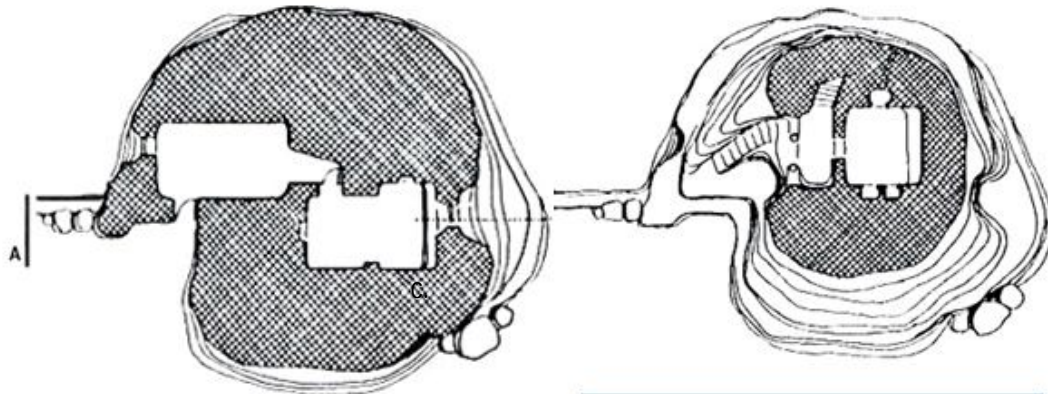


Figure 7: Underground Cities in Cappadocia Region (Maho 2014)

a. Ground floor plan

b. First floor plan (residential)



A-A section

c. Perspective of the Chimney

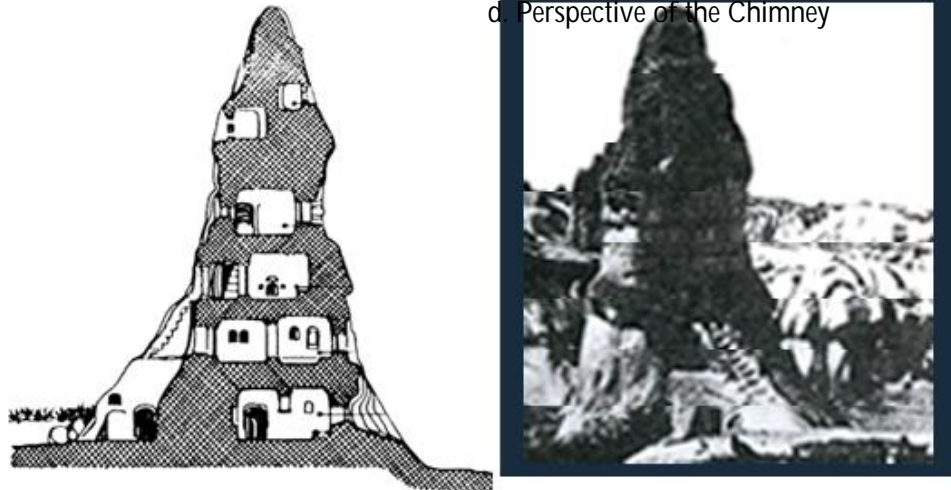


Figure 8: (a, b, c, d) Floor plans and section of a Chimney in Goreme, Cappadocia(Gorji Mahlabani Yousef 2010 spring)(P.9)

3. Historical Background of Case Studies

3.1 Historical Background of Kandovan

There has been considerable debate over the history of Kandovan among experts and Kandovan's residents, and there is no exact date and evidence regarding the ancient history of Kandovan. Gorgi Mahlabani argue that, early inhabitants were nomads who used Kandovan as their winter settlement (*Eylagh*) and they utilized the hand dug dwellings as their temporary residences, years later they stopped migrating and settled in Kandovan permanently (Gorji Mahlabani Yousef 2010 spring). Present Residents of Kandovan, on the other hand, claim that in the old ages (800 years ago) a group of soldiers and martials hid in the caves during the military campaign due to its geographical and topographical location (Gorji Mahlabani Yousef 2010 spring). According to David Roll and Peter Martini (2007) Kandovan is the Garden of Eden, the habitation of Adam and Eve (Moghimi Oskoei 2007). *Bagh* is the term for garden in Persian language and they are renowned because of their picturesque and spectacular beauty. *Pairidaeza* was another synonym for *Bagh* in ancient Persian and it became the English word paradise. The *Bagh* was paradise on earth (Daneshpour Seyed Abdolhadi 2013). In addition, Khamanchi believes that Kandovan community was formed by people from Hilevar village (which is located 2 km far from Kandovan), who were escaping from Mongols, utilized the *Karans* (cone shaped structure) as a place to hide from them (Khamanchi 1991). However K. E. Eduljee, in his article called *Zoroastrian Heritage*, (2005) advocates that, there are some evidences that the *Karans* of Kandovan have been utilized as settlement for 3000 years, when the Zoroastrian Medes and Persians inhabited the region. (Eduljee 2005).

3.2 Historical background of Cappadocia

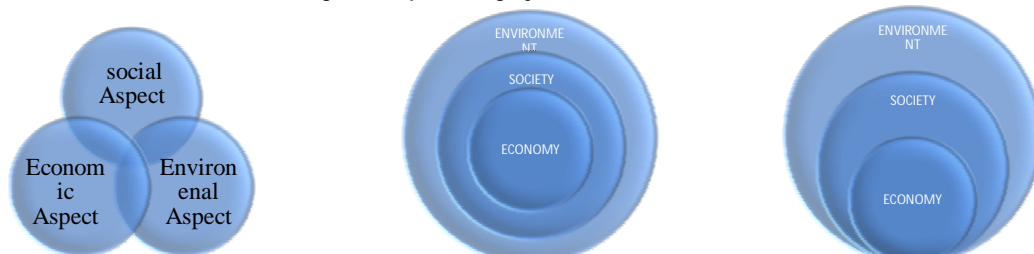
According to recorded history, Cappadocia has always been utilized as hideaways from persecutors, tormenters, and bandit tribes. The earliest historic explanation that has been found about Cappadocia dates back to Zoroastrian Era when people who worshiped fire-cult lived on the hill side of the volcano Erciyas Dagi, however, they didn't expand the cave dwelling system and it was settled temporarily (Emge 1992). According to Brockman, "These places served as secure hideaways from persecutors and bandit tribes" (Brockman 2011, P.192). The region of Cappadocia was permanently inhabited as early as the first century AD. Emge argues .When the hermits were hiding from persecution by the Roman troops (Brockman 2011). More and more Christians and hermits who were encouraged by St. Basil the Great (one of the theological giants of Byzantine Christianity) moved to Cappadocia and settled there during the following centuries(329-379 AD)(Emge 1992; Brockman 2011). Seventh century was the next period that the underground towns and troglodyte villages came into use as a refuge again in order to resist Arab Muslim's and invasion and attacks by radicals(Emge 1992). However, contrary to this Rodley argues that "the Arab invasions, which began in the seventh century, caused the Byzantine frontier to retreat westwards across Asia Minor and left Cappadocia as an insecure and often embattled border zone"(Rodley 2010)P.4. Emge claims that the degradation of the Byzantine Empire resulted in the deterioration of the highly developed sacral-cave-culture in the 11th century; However in that time practicing Christianity by locals and hermits were permitted and there were no fear from persecution of Christians by Romans, Arabs or Persians military. It has been argued by Brockman that eventually the occupation of man-dug dwellings and settlements slowed down in 1920s due to the Greco-Turkish War (1919-1922) according to the Lausanne Convention two million Greeks were exchanged from Turkey to Greek .Finally The Goreme dwellings were abandoned and it is utilized as an tourism object today(Brockman 2011).

4. Sustainability

4.1 Sustainable Development

The concept of sustainability emerged over 30 years ago, and was widely accepted, in response to the ecological and environmental destruction resulting from poor resource management (McKenzie 2004) . As a consequence, the term of sustainable development was defined by The World Commission on Environment and Development, (known as the Brundtland definition) in 1987as, "development that meets the need of the present without compromising the ability of future generations to meet their own needs"(Nations 1987)p.5 However, "Sustainable development has been interpreted as an ecological vision" (Åhman et al. 2013, 1154), in recent years it has become (a) more multi-focal agenda and various terms such as: triple bottom line, and sustainable development, is being utilized interchangeably in order to its description. (McKenzie 2004) Triple bottom line was defined by economist and environmentalist John Elkington in 1997, in which equal emphasis has been given to ecological, social, and economic component.(Elkington 2004) The three commonly agreed model for representing the interrelationship between environmental, social, and economic aspects of suitability are as follow: Venn diagram, three concentric circles ,and Planning Hexagon.(Lozano 2008)(Fig 1)

1. Venn diagram also known as (overlapping circles model), in this model there are three inter-connected circle , where the resulting overlap represents sustainability can be misleading;
2. This model features three concentric circles, in which the outer and main circle is environmental sphere and economic and social circles are characterized as dependent on it.
- 3.Eventually the "Planning Hexagon, showing the relationships among economy, environment, the individual, group norms, technical skills, and legal and planning systems".(Lozano 2008)



a. Venn diagram (McKenzie 2004, 5) b.concentric circles (McKenzie 2004, 4) c.non-concentric adjacent circles(Lozano 2008, 1839)

Figure 9: Three Commonly Agreed Model of the Interrelation Ship between three Pillars of Sustainable Development

4.2 Definition of Social Sustainability

Despite the enormous amount of works that has been done on the definition of sustainability so far, the social aspect has received less attention systematically (Vallance, Perkins and Dixon 2011; Dempsey et al. 2011) and this aspect of sustainability is “largely neglected in mainstream sustainability debates” (Caistor-Arendar 2011, p. 15). Various definitions have been suggested regarding to social sustainability. For example, according to The Western Australian Council of Social Services (WACOSS) social sustainability can be defined as “The impact of formal and informal systems, structures, processes and relationships on the current and future livability and health of communities” (Barron and Gauntlet 2002) p. 4). Five different principles are developed by this definition. They are: equity, diversity, quality of life, interconnectedness and eventually democracy and government. The Young Foundation has put forward the following definition of social sustainability: “A process for creating sustainable, successful places that promote wellbeing, by understanding what people need from the places they live and work. Social sustainability combines design of the physical realm with design of the social world– infrastructure to support social and cultural life, social amenities, systems for citizen engagement and space for people and places to evolve” (Caistor-Arendar 2011) p. 16). Sachs argues about the importance of different elements such as equitable incomes, social homogeneity, and access to goods, services and employment in the (sustainable society) definition of social sustainability. It will also be identified in his article of ‘social sustainability and whole development’ that the factors like cultural sustainability, political sustainability, and de-commodification of science and technology, have a vital role in this regard (Sachs 1999). Although the definition of social sustainability developed at Hawke Research and headed by Stephen McKenzie Institute, seems to be the most appropriate definition in regard of this research. In McKenzie’s study the social sustainability has been defined as “a positive condition within communities and a process within communities that can achieve that condition” (McKenzie 2004) p. 23). The situation and condition will be indicated by “equity of access to key services ,equity between generations, a system of cultural relations in which the positive aspects of disparate cultures are valued and protected ,the widespread political participation of citizens ,a sense of community ownership, a system for transmitting awareness of social sustainability from one generation to the next, a sense of community responsibility for maintaining that system of transmission , mechanisms for a community to collectively identify its strengths and needs , mechanisms for a community to fulfil its own needs where possible through community action and finally mechanisms for political advocacy to meet needs that cannot be met by community action’ are indicators of the condition ,and steps towards their establishment and implementation are aspects of the process” (McKenzie 2004) p. 23-24).

4.3 Sustainability Features in Kandovan and Goreme (Cappadocia)

4.3.1 Environmental Sustainability

Numerous research and work has been done in regard to environmental sustainability in the villages of Kandovan and Goreme (Cappadocia), followings are the result of this studies:

- Density of the villages: the context of the dwellings in the villages is dense and the houses were placed next to each other, which is considered proper for cold climate as it cause to wind breaking.
- Material and thermal performance of buildings:
 - 1) High porosity of tuff rocks acts as thermal insulation, and the large thickness of the walls, which sometimes reaches to two or three meters, prevents the heat exchange between inner and outer space of dwellings. (Ghobadian 2003)
 - 2) The cone-shaped structures present excellent stability against environmental factors such as, sunlight, wind, rain, humidity, snow, and earthquake.
 - 3) The conjunction of the fairy chimneys or Karans with earth caused the resistance against earthquake in this region.
- Composition and combination of plan and façade: the ground floors of the cone-shaped structures are spacious which suffer from lack of proper natural lighting; hence they are usually utilized as barns. And the second floor is used as a residential unit. (Ameri Syahvy 2014) By utilizing the ground floor as sheep hold the residents benefit from the heating, produced by animals as well. (Gorji and Sanaee 2009)
- All openings were curved into the walls to prevent the penetration of snow and rain into the *Karans*. (Ameri Syahvy 2014; Sepideh Yahyavi 2012)

- Short ceiling , small openings and small interior spaces led to minimal loss of thermal exchange .(Sepideh Yahyavi 2012)
- Since the buildings were curved out of natural rock, the building material is organic and renewable; furthermore there is no need for production and transporting building materials.

It will be concluded from all these features that Kandovan and Göreme (Cappadocia) are environmentally, sustainable.

4.3.2 Economic Sustainability

Both regions maintained on agricultural economy because of their sporadic and frequent rains in winter and spring, in addition to their fertile soil condition. Based on the definition of economic sustainability, provided by United Nation Department of Economic and Social Affairs (2011) survey, that recognize the green economy as, an economical arrangement which upgrades the ecological stewardship, growth, and social progress (United Nations Department of Economic and Social Affairs 2011), and also Bartelmus definition in which he believes that " maintenance of produced and natural capital is an operational concept of economic sustainability"(Bartelmus 2012, 65), it can be concluded that Cappadocia used to have, and kandovan still has sustainable and green economic.

5. Conclusion

The existing literature confirms that Cappadocia and Kandovan are economic, and environmentally sustainable. And despite the major studies which have been done in regard of environmental and economic dimensions of sustainability in Kandovan, and Cappadocia it remains still unclear which factors contributed to the long-term survival of Kandovan and which one led to abandonment of hand-dug caves of Cappadocia region.(Sepideh Yahyavi 2012; ASHRAFI, 2013).Hence it can be hypothesized that the notion of social sustainability is the key factor which results in the survival of kandovan and abundance of Göreme (Cappadocia). This hypothesis will be proven in further studies, by investigating what exactly the social and cultural sustainability means in the context of rocky architecture, and particularly in the villages of kandovan and Goreme.

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