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Self-sustaining vernacular habitats: The case study of Medina of Chefchaouen

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ABSTRACT: The main feature of vernacular communities is "collective living". Individuals collaborate together to deal with the challenges of everyday life and to resolve common problems such as the need for shelter and the production of food. With integrated agriculture systems, collectiveness, and their close relation with nature, vernacular settlements demonstrate numerous self-sufficient amenities. Productive activities are mainly achieved at collective and individual levels. In this case, dwellings, as the smallest units of the collective production chain, have a relevant role, while the complex production sectors gain opportunities of sharing specialized plants for production. Prevention of negative effects of human-initiated climate change makes self-sustaining urban systems more important each day. Therefore, the concept of producing and consuming locally is becoming more vital. Thus, this paper aims to analyze the self-sustaining strategies of vernacular communities through the case study of Chefchaouen and investigates the contributions of the sustainable vernacular strategies in contemporary urban systems.

1 FOREWORD

The increasing evidence of human-initiated climate change and its negative outcomes on the human habitat make "self-sufficiency" an important approach for the cities of today. The rapid consumption of natural resources and the negative effects of carbon footprint from human settlements urge to develop new concepts of city life that respect nature by generating a low environmental impact. Therefore, self-sustainability of human habitats becomes more important as it offers a series of answers to the environmental requirements of cities today.

After the industrial revolution at the end of 18th century cities grew up rapidly and became centers of population and production. The growth of modern industry led to massive urbanization and the rise of numerous large cities. The urban areas became increasingly more attractive for the population as they offered new employment opportunities, which caused massive migrations from rural to urban areas. In 1800, only 3% of the world's population lived in cities while at the beginning of the 21st century, this proportion has risen to nearly 50%.

Rapid growth brought urban problems in environmental contexts related to the increasing industrialization, required inputs of energy and transportation of commercial goods all around the world. Also climate change, globalization and demographic change are shaping future cities which have to become more resource-efficient and environmentally friendly to reduce their carbon emission and environmental degradation. A self-sustaining or self-sufficient system has the capacity to maintain itself by independent effort. The self-sustaining system is one that can sustain itself without external support. In the terms of urban design "self-sufficiency" refers to the productivity dimension of the cities and can be defined as the capacity of a city to produce sufficient food, goods and the energy for its survival without being dependent on the importation of products and energy from other cities. At the same time, however, a self-sustaining city should be sustainable and meet the needs of the present without sacrificing the ability of future generations to meet their own needs.

Vernacular settlements, which are built to meet survival needs of people, are set on self-sustaining principles as they arise as a series of responses of human beings to the natural conditions by altering them and using available resources in a rational way in order to survive. Vernacular communities meet their needs spontaneously and in a nature-friendly manner with minimum environmental impacts, as the settlements demonstrate a nature-based design with a more nature-integrated social life. Therefore, vernacular settlements and vernacular communities are especially helpful for a better understanding of the philosophy of self-sustaining habitat systems. In this context, the general purpose of this research is to investigate the self-sustaining and self-production approaches that are seen in vernacular settlements and their social and spatial analysis.

2 BACKGROUND AND RESEARCH METHOD

Vernacular architecture exists as long as mankind. As it is defined by Paul Oliver (1997): "comprises the dwellings and all other buildings of the people. Related to their environmental context and available resources, they are customarily owner or community built, utilizing traditional technologies. All forms of vernacular architecture are built to meet specific needs, accommodating the values, economies and ways of living of the cultures that produce them".

As it is mentioned before, vernacular settlements are characterized by "built to meet needs" philosophy as an instinctive response to the basic requirements of the people's survival. Vernacular communities have the necessity to live with limited resources; therefore they have the awareness that they should achieve to meet all their basic needs such as production of food and shelter by using minimum energies. This reduction of energy consumption has become possible only with the maximum adaptation to the nature by creating the most adapted building shape and envelope, using the natural energy resources like water, wind and sun power. Each vernacular habitat is also able to feed itself with minimal reliance on the surrounding settlements, has the capacity to power itself more with renewable sources of energy compared to contemporary urban areas. For these reasons vernacular settlements meet the conditions of "self-sufficiency" naturally.

One of the main features of vernacular communities is undoubtedly "collective living" where individuals collaborate together to deal with the living challenges and resolve the common problems. This characteristic of vernacular communities allows them to have a human chain of productivity that facilitates to create a self-sufficient community.

2.1 *Principles of a self-sustaining urban habitat*

The main features of self-sustaining habitats base on "proximity" and "accessibility" of the goods and food. These systems accommodate the needs of the communities within little distances, often comfortable walking distances. Therefore, self-sustaining habitats help to reduce carbon emission due to the transportation of the goods. It also allows reducing transportation and infrastructure costs. This fact evidences that another main feature of self-sustainability requires a well-determined territorial limit. For example, a self-sustaining urban habitat shall define the extents of its territory by a radius of low distances that can be easily accessed by walking or light vehicles like bicycles.

Self-sufficiency features also increase the "resilience capacity" of the urban areas as it rise the know-how about local food production of the societies and made them capable of producing their own food in case of emergency.

2.2 *Research method*

This paper is articulated by two phases; the first part includes state-of-the-art research on the production culture of vernacular communities in Mediterranean regions. In the second part, the medina of Chefchaouen, a Mediterranean Moroccan city has been analyzed in the terms of the levels of production and its effects on urban and building morphologies. Specific spatial analysis has been done on the single dwelling, patio house, which is the smallest compound of the productive urban system of Medina.

The general aim of this research consists in the comprehension and the valorization of vernacular production systems and their contributions to the understanding of self-sufficiency of today. One of the specific purposes of this work has been the definition of the self-sustaining principles that vernacular communities used to deal with the food security and auto-sufficiency.

3 PRODUCTIVITY AND VERNACULAR COMMUNITIES

Production in vernacular communities relies predominantly on agriculture and artisanship providing the population's common needs at survival levels. Methods of cultivation and agricultural implements mainly base on manpower; therefore the productivity is at an essential level in comparison with industrial societies. In practice it was the community who had to adapt itself to the productive capacity and not the other way round as it happens in the industrial societies.

The production is usually handed down from father to son or from master to apprentice in the vernacular communities. The artisanship sectors are grouped around separated districts so only district in the city had a productive characteristic according to the artisanship activity done. The districts and the streets were mainly called with the names related to the artisanship productions that took place in that determinate area (Carr et al. 2009).

The agriculture was mainly done within the city walls at the margins of the cities. The grain storages were used to be placed closer to the city center for security reasons in case of wars and disasters.

The production is done sufficiently at essential rates, therefore all settlements are substantially autonomous and close to the self-sufficiency.

3.1 *Attributes of vernacular production system*

As it is mentioned before, the "proximity" and "accessibility" are the most important characteristics of the self-sustaining cities. In this context the urban layout of the vernacular settlements meet morphological requirements of self-sustainability as it offers a compact urban pattern enclosed by city walls, which also help to determine the city margins and limit the extension of its territory.

Most vernacular settlements are founded on the geographically advantageous places such as riverside, mountain slopes in order to profit better the natural resources. Another reason that has a great effect on the selection of the area is to provide protection from natural hazards and enemy attacks. The productive activities within the cities have a relevant role on shaping the urban structure. If a determined production has requirements like rapid access to water or wind energy, this type of productions is set near the resources that they need. In this way the majority of the energy demands for the production is ensured from natural energy resources. Whereas the productions that serve to the everyday life are formed close to the city center in order to facilitate the accessibility from the dwellings.

3.2 *Scales of productivity in vernacular settlements*

The production facilities can be classified in two main scales; the first scale, which has a major dimension in comparison with the second one, is "collective production" and it also has a commercial side. Collective scale has also a great dimension of productivity such as agricultural cultivation, textile manufacturing, grain processing and several sectors of artisanship. Principally the sectors that need specific requirements are part of the collective production so the "collectiveness" gives the opportunity of sharing specialized installations needed for production. One of the characteristics of these sectors is being uniformly diffused within the urban pattern but well grouped between themselves (Scott 1997). Therefore they are accessible from dwellers and have the advantages of sale at km 0. With this feature, the sectors of collective production eliminate the transportation needs of goods and its costs.

The second scale of the production facilities in vernacular settlements is "individual production" which has a minor dimension compared to "collective production". This term refers to the domestic productions that can be carried out within a residential unit. This scale of production doesn't have commercial features. It generally meets the nutritional needs of the single families such as garden cultivation, livestock, drying fruits and storages.

In the vernacular communities the production is diffused in all over the urban area and as a production chain created by different scaled activities.

4 COLLECTIVE LIVING AND PRODUCTION: CASE STUDY OF THE MEDINA OF CHEFCHAOUEN

The province of Chefchaouen is located on the chain of the Rif Mountains in north-west of Morocco. At the time of its foundation (1471), Chefchaouen was used as a defensive base, protected by the walls of the ridge and a bastion (AA. VV. 2001). The relatively confined location has a double advantage: it ensures the defense and, at the same time, enhancing the dominance of routes to extend far its area of influence.

On the geological features, the different structural elements have created the conditions for the formation of a real reservoir of natural water. Chefchaouen was probably founded on the current site not only due to its sheltered position that naturally defended it against all attacks, but also mainly due to the abundance of water rising from a crack in the limestone ridge (Figs. 1, 2).

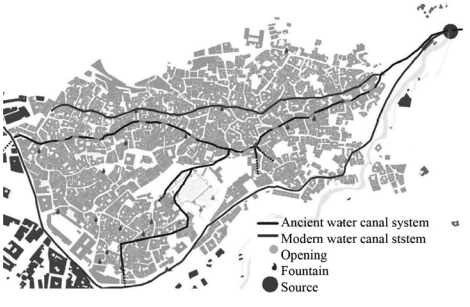

Figure 1. Distribution of water courses in Chefchaouen (L. Dipasquale).

Figure 2. Water course and mill in Sebanine district, Chefchaouen (L. Dipasquale).

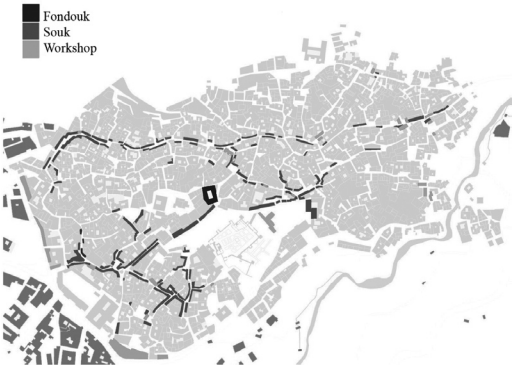

Figure 3. Distribution of productive activities in Chefchaouen (L. Dipasquale).

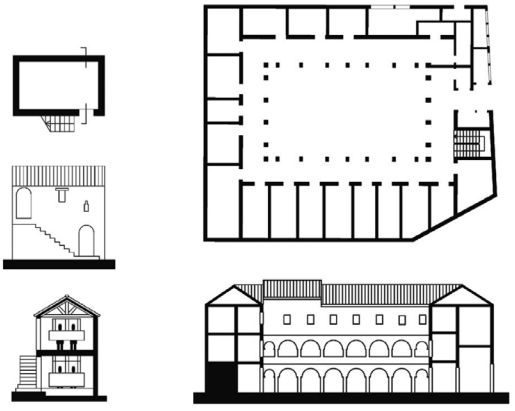

Figure 4. Elements of the collective production: the textiles laboratory and the *foundouk* (L. Dipasquale & V. Volpi).

4.1 *Characteristics of urban structure*

The medina of Chefchaouen has developed spontaneously and in the absence of a pre-established pattern: its structure is a cityscape clear synthesis of cultures, social traditions and topography of the area. The morphology of the medina seems to be the result of a purely aggregative, devoid of tracks regulators, strictly adhering to the site characterized by complex geography, but according to the rules of an Islamic city. The different modes of aggregation of houses, squares and services have given rise to the urban fabric and the articulation of the spaces of the city (Dipasquale et al. 2013).

4.2 *Elements of the collective production*

The productive and commercial activities are gathering in the center of the medina, around the square of Outa el Hammam and along the main axes of distribution through the gates of the medina (Fig. 3). The streets between residential units are very narrow and have a tortuous course, the squares are non-existent; the relationship spaces are formed only by widening the crossroads.

The production in Chefchaouen is characterized by the sectors that require the use of water such as weaving workshops and the mills. The *Sebanine district* was born in the mid-sixteenth century and is in close relationship with the river. It is also known as "the mill's district". The mills found in this place have a relevant role in flour supplying for the furnaces of medina. The mills are located on the river Ras el Maa, their construction was made by Spanish Andalusian, from the foundation of the city, organized an ingenious hydraulic system. Their architecture is very simple, consisting of a rectangular room, divided into two levels: the ground floor and the wheel located at the bottom where there is a cellar that holds the blades that operate the mill and whose side walls have openings to allow passage of water. The river water is channeled from the main tank to the load of the mill; falling under high pressure, the water drives a wheel fitted with a metal blade, through which a pin vertical wood transmits the movement to the grindstone placed horizontally on top of another mill fixed. The grain is poured into a funnel of wood that surmounts the grinding stone; flour then is collected in a hopper below.

Among the productive activities of the medina occupy a prominent place the production of textiles. The Al Onsar district is characterized by weaving workshops. Mainly there are woven of wool (with which the inhabitants of the Rif tailor the *gillaba*, traditional dress consists of a kind of tunic with hood), woolen carpets, linen cloth and cotton striped red and white, that the Berber women place over the shoulders and wrap around the waist.

The laboratories in which the fabrics are manufactured generally occupy a rectangular area of 8 m long and 2.50 m wide, and are covered by a gabled roof with red tiles.

They are divided into two overlapping rooms, with separate doors that open up on the same side: the access to the upper room is by means of a stone staircase against the outer wall. Each room has two frames. The light, low, comes only from the door, and the room is small area through open holes in the wall. The walls are generally made of stone not square, to reinforce the corners and piers of the gates and small oil lamps using solid bricks (Fig. 4).

The commercial spaces spread along the narrow streets of the neighborhood, where they are thickly lined shops that distribute products of all sorts. The shops, very small (typically 1.20–2.00 m wide by 2.00–3.00 m in length) have a double door of wood

as the only opening. The district of Souika which literally means "small market" is characterized by shops along its streets in the core of the urban pattern of Chefchaouen (Mecca et al. 2009).

On the other hand, trade relations between the city and the mountains take place in a special commercial space, called *fondouk*, which is one of the oldest institutions of the medina. The *fondouk* is a large structure able to provide accommodation to travelers, traders and farmers who come to Chefchaouen to sell their agricultural products and to buy handmade goods. It is also designed to shelter animals and to store produce. The structure of the *fondouk* normally consists of a square or rectangular space, with a monumental entrance. The central courtyard is surrounded by portico s with rooms on the first floor reserved for the accommodation of travelers, while the ground floor rooms are used for the storage of produce, and sometimes as stables. In the past there were four *fondouks* in the city of Chefchaouen, however now only one continues to be operative. It is located in the northwest corner of Uta el-Hammam square, and it is the largest one, with an area of about 596 m^2, fifty rooms distributed between the ground floor and the first floor, storage rooms, warehouses and latrines.

4.3 *Elements of collective living*

In the traditional structure of the medina, each district (called in *hawma*) provides the basic facilities, which are essential to the conduct of everyday life of the community.

The district is an area intensely lived and perfectly perceived by its inhabitants, and all the daily needs are met by collective facilities: bread ovens, public baths (*hammam*), fountains, places for collective worship (mosques), Koranic schools (*zaouias*), and shops to supply daily household (Fig. 5, 6).

The complex system of relationships that is created in a collecting living are regulated by a strict social mutual control; the respect for the rules of good behavior is a very important value in the social structure of Islam, and it regulate the antagonisms among the inhabitants.

Until the end of the nineteenth century the districts of the medina were very closed organisms, possessing its own walls. Today, the sense of belonging to their neighborhood is still very strong, but the different districts communicate with each other through economic and social relations.

Among the collective facilities, ovens help to meet the needs for a self-sustaining production.

There are 15 collective ovens still active in Chefchaouen. They are generally located at the intersection of the district main streets and are needed to the families who knead the bread in their homes, and need an oven to cook it.

Figure 5. Distribution of urban facilities in Chefchaouen (L. Dipasquale).

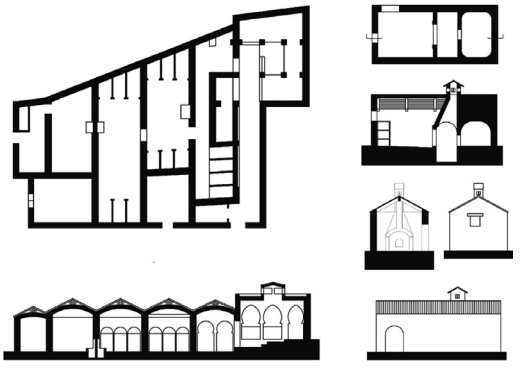

Figure 6. Elements of the collective living: the hamam and the collective oven (L. Dipasquale & V. Volpi).

The structure is simple: it is a room small rectangular and not very high (between 2 and 3.5 m), covered with a gable roof of red tiles from which he chimney emerges. In the room there is the furnace, composed by a vaulted brick structure, and a platform where are arranged the planks with the uncooked bread, and a space for the firewood storing.

The hamam is another collective facility that has always played a key role in Muslim society.

As well as supplying the hygienic needs, its main function is linked to the ritual greater ablution, so that the faithful can regain a state of purity necessary to approach to the prayer; for this reason is it often built near the mosque. The bath is not only an Islamic religious practice, but also a distraction and a pleasure: the hamam is almost all an important socializing and meeting collective space (Mecca et al., 2009).

4.4 *Elements of the individual production; the role of "patio"*

In this context, the dwellings, as the smallest units of the collective production, have a relevant role in the individual production chain. For vernacular dwellings, the "patio" has a fundamental function as it offers privacy with a semi-open introverted form. Furthermore, the patio, with its great capacity to provide a central organization for the production facilities becomes a phenomenon in the vernacular habitat units. As observed in numerous traditional settlements in different Mediterranean regions such as in Italy in Sardinia region, stalls, domestic laboratories, wells, furnace and storages of the cultivated products are mostly organized around the patio. Morphology of patio constitutes a relevant role in the medina of Chefchaouen as well. Patio houses are principally built on 2–3 floors where at the ground floor the spaces with production facilities take place. Apart from a spatial organizing of the production activities, the patio sometimes may contain a garden with fruit trees and contribute domestic food production. In addition, some patio houses have water wells under the central atrium, which helps to collect rainwater in the collection tanks.

5 CONTRIBUTIONS OF SELF-SUSTAINING STRATEGIES FROM VERNACULAR SETTLEMENTS FOR CITIES OF FUTURE

In terms of urban design and building cultures vernacular settlements establish an adaptable architecture to the different dimensions of production activities. With the land use strategies, the cleverness of integration to the place, the smart way of utilizing natural renewable energy resources and the reduction of pollution and costs of transportation, vernacular communities, with their way of living, become important cases to analyze for a better understanding and valorization of their self-sustaining principles.

Rapid urbanization means that the conditions of urban areas need to change rapidly. The previsions say that by 2030 there will be many cities with 30 million people. The self-production of food is getting more vital each day. The cultural heritage of vernacular settlements will provide us basic strategies of self-sustainability in order to develop them with the possibilities of contemporary technologies.

6 CONCLUSIONS

The way of living of vernacular communities is based on "collectiveness" and "optimal use of natural resources" so it is inherently self-sustaining and environment-friendly. They are also economically convenient.

As it is seen in the case study of Chefchaouen, a vernacular city can include all sorts of production sectors that the community needs by placing them in the functionally appropriate places to reduce energy needs. Vernacular communities for long years have experienced and developed both urban and architectural self-sustaining strategies. Our research aims to underline how it is achieved to live more sustainable within the social and economic terms in the vernacular settlements.

Our case study and other examples of vernacular settlements offer approved solutions for meeting the human's basic needs and they all resisted and evolved through the social, economic and climate changes for many years. One of the purposes of this research is to help decision makers and urban planners notice the importance of the heritage of vernacular architecture in identifying the principles of sustainable urbanization.

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