La Sapienza University of Rome
Department of Planning, Design and Technology of Architecture
Dottorato di Ricerca in Pianificazione, Design e Tecnologia dell'Architettura
XXXIV Ciclo

Agile Methodology as a Transdisciplinary Retrofitting Approach for Built Environment in Traditional Settlements in Mediterranean Region

Ph.D. Candidate: Arch. Ahmed Abouaiana
Supervisor: Prof.Arch. Alessandra Battisti
Coordinator: Prof.Arch Fabrizio Tucci

Agile Methodology as a Transdisciplinary Retrofitting Approach for Built Environment in Traditional Settlements in Mediterranean Region

Abstract.

Traditional settlements are societies and villages that emerged vernacularly; they have a distinct architectural typology and urban tissue, transferring knowledge between generations is a significant character. Their inhabitants have significant levels of agreement about their social qualities, homogeneity, solving any problem in their ways. They use the available resources, local materials, and the available technologies to form their shelters concerning the climate, security, political and religious precepts, and aesthetic values. Their buildings achieve cultural, anthropological, social, and economic needs.

Several studies found common ground between Egypt and Italy regarding the impact of Arab and Roman cultures and the influence of the Mediterranean climate. This research has chosen a common traditional settlement pattern to foster a new approach. Based on several factors, namely, adjacent to the Mediterranean sea, Mediterranean climate, population density, buildings number, predominately rural, land use is dominated by agriculture, and they have the same small-dimension economy of agricultural activities, and finally, it makes sense the author is Egyptian, and he studies in Itlay. Moreover, the comparative analysis between contexts enriches the findings, and otherwise, they could represent the Mediterranean Region.

Many studies highlighted the transformation of these traditional settlements in Egypt and Italy because of several causes, such as the socio-economic transformations that led to emerging newly built environment patterns facing environmental challenges and led to more energy consumption which contributes significantly to climate change. That requires transdisciplinary retrofitting interventions in these traditional contexts, considering evolving all stakeholders who have the interest, influence, and power of implementation, namely, the technical experts like (architects, urban planners, culture experts, and sociologists), the local community, decision-makers, and the facilitators.

Thus, this study aims to provide a transdisciplinary framework to organize the collaborative work among the stakeholders to enable to implementation of efficient strategies to retrofit the built environment. The conceptual framework was developed by the integration of the relevant theoretical concepts in three domains (software development, project management, and energy retrofitting practices).

The transdisciplinary framework will employ Agile Methodology (Agile Manifesto, 2001), which originated in 2001 under the software development domain. It efficiently organizes and manages the relations between teamwork, producing the highest-value products (services), achieving client satisfaction, and continuous acclimatization due to fluctuations and variations. Likewise, this study argues that it can provide the optimum framework to mitigate conflict, enhance communication maximize relations efficiency between the stakeholders, and provide criteria to select the teams under different circumstances and various projects.

The framework has been implemented in two similar traditional settlement case studies, Lasaifar Albalad in the Delta Region in Egypt and Pontinia in the Lazio region in Italy. It was validated using focus group techniques. The results showed that the framework had improved the participatory approach, enhanced communication, mitigated team conflict problems, supported decision-making, and it led to engaging top-down stakeholders, and it led to versatile juxtapositioning (bottom-up with top-down) stakeholders on the same influence and interest zone. Moreover, the framework led to implementing an actual retrofitting case study that benefits the local community and supports the national policies.

Keywords

Conceptual Framework; Energy Efficiency; Egypt; Evidence-Based Practice; Italy; Participatory Approach; Rural Commons; Stakeholder Analysis; Team Management; Traditional Architecture.

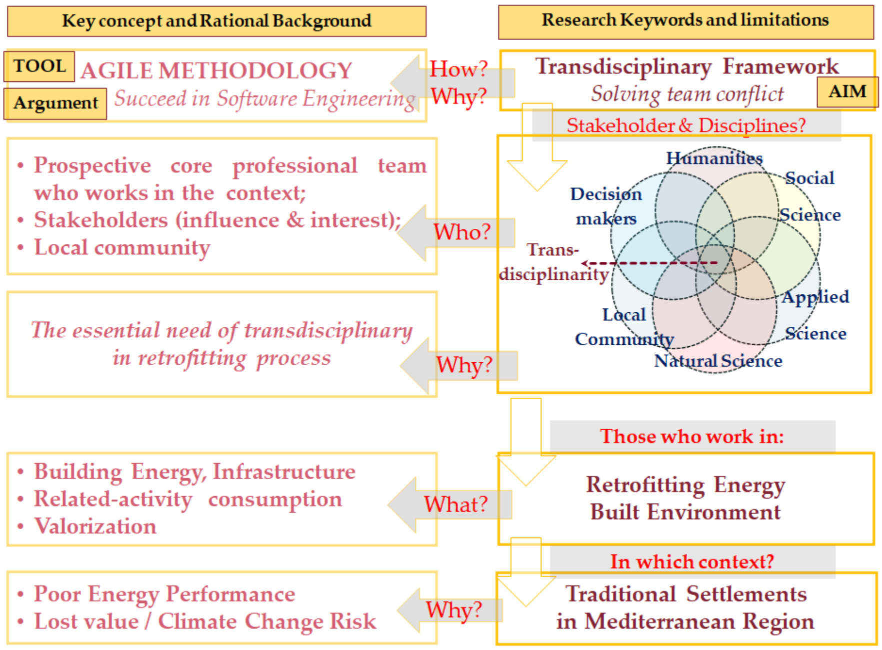
TABLE OF CONTENT

Introduction to the Research

This chapter presents an overview of the research background and research problem and how it has been tackled. The outline can be presented as follows:

- Overseeing the research keywords and key concepts (Traditional Settlements in the Mediterranean), what they are, why they are traditional, and why the Mediterranean;
- Describing the problem background and how it would be tackled by demonstrating the current challenges facing these settlements and the essential need for a transdisciplinary approach to retrofit and valorize this distinguished identity;
- Developing the research aim, objectives, and questions. Then highlighted the scientific relevance and topicality of the study to the academic community, local society, and supporting national policies;
- Illustrating the main characteristics of Egypt and Italy (as representatives of the Mediterranean region) in line with the research structure for a better understanding of the contexts, then identifying the reasons and the criteria for selecting similar micro-case studies.
- Finally, summarizing the research framework and methods, connecting the chapters, and with aim and objectives.

Visual Summary



Highlights:

- The (first study) investigates the qualitative correlation and quantitative explanations between end-use energy consumption and spatial aspects, demographic factors, and economic activities
  - Lasaifar Albalad Settlement, representing the 339 main villages in the Delta region, has been diagnosed.
  - Pontinia Settlement, representing a typical pattern of the 1930s (the fascist rule) rural villages in the Lazio region, has been diagnosed.
- Previous energy retrofitting strategies were investigated between 2011 and 2021 in the Mediterranean traditional built environment context.
- A transdisciplinary retrofitting framework based on the Scrum tool within the Agile methodology has been developed and validated.
- Novel contact and differences points between the rural built environment in Egypt and Italy have been provided.

0.1 Traditional Settlements in the Mediterranean region

0.1.1 Overview

Tradition term comes from the Latin verb "*trado-transdo*," meaning to pass to another, send, and hand over. That means giving or transmitting possession of something (Queysanne, 1989). Rapoport (1969) defined the tradition as a system that is respected and complied with by the inhabitants, who live commonly. They simply built their environment and constructed the buildings together, in a simple way, with a small number of types, the cramped streets full of life and serving social functions. Moreover, the generations handed down aesthetic quality and knowledge.

These traditions distinguish the place in several aspects, intangible, such as socio-economic activities, or physical, like the built environment. The settlement is a place where people live and interact through activities such as trading, and entertainment, which help to understand the human being's relationship with the environment and adjust itself to attain ecological balance (He et al., 2019). This relation is reciprocal with nature; it changes through time to another, and from society to another, they have been sufficiently conscious to deal with their biological environment to achieve their needs. Figure (00-01) shows the settlement's concept.

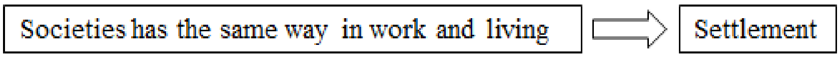


Figure (00-01) Settlements Definition.

Ramakrishnan (2001) defined traditional societies as the indigenous residents who are inuring broad environmental knowledge through their daily practices with nature and reflected in demeanors towards the surrounded natural environment in which they are perceived as an inseparable whole. Queysanne stated that the process of transferring knowledge is one of their essential characteristics.

Traditional settlements were formed to achieve anthropological and cultural needs culture, considering security, economic, political, and religious precepts. To respond to the climate enhanced thermal comfort using the available resources and local materials concerning the surrounding natural environment, culture, and social values in their buildings (Watts, 1981; Eben Saleh, 1998; Engineering et al., 2018; Lawrence & Low, 1990; Aranha, 1991; Bouchair & Dupagne, 2003; Davico & Mendonça, 2012; Mastrangelo et al., 2016; Zheng et al., 2013; Tian et al., 2019) and in open public spaces (Savvides et al., 2016).

The inhabitants derive their living from primary occupations such as agriculture, fishing, craftsmanship, and local food production (Hall-Arber, 1996; Kearney, 2001; Hall-arber & Hall-arber, 2016; (Hall-Arber, 1996)Stoffle & Minnis, 2007) and fishing (Stoffle & Minnis, 2007) or forestries activities (FAO, 2018) in a small-scale.

They can be classified by several characteristics, such as age, socio-economic factors (Alatrokjy & Fleyeh, 2014), remoteness, density, land cover, land use, infrastructures, topographic roughness (mountain, hill, plain) (Battisti, 2020), and climate-relevant (Pizzoli & Gong, 2007). Exactly like rural areas (Gobattoni et al., 2015), which are identified by minimum population size that can be less than (2000, 100, 3000) inhabitants in Turkey, Italy, and Lithuania (WYE, 2007), likewise for urban areas, the size can be (100000, 5000 and 200) inhabitants in China (DIJKSTRA et al., 2020).

0.1.2 Traditional Settlements Definition

Many previous studies defined the term "*Traditional Settlements*" as: their inhabitants have significant levels of agreement about their social qualities homogeneity, they can solve any problem by their ways, such as mobility, and firefighting, their energy efficiency, the high efficiency of space use (Rapoport, 1983). They can be in rural and urban contexts, integrating the old with the modern patterns in the urban fabric, buildings typologies, lifestyles (modern shops and traditional weekly market), farming (primitive agriculture and modern systems). Moreover, they interact with the surrounded environment, such as the positioning (coastal and mountain) (Saleh, 1999) or hill (Xu & Svetozar, 2016).

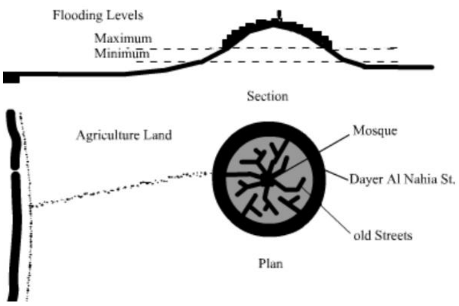
Other studies characterized them by the remaining historical and archaeological features of old-aged settlements, and their original characteristics remain with a robust relationship with the landscape. However, they are transforming due to modernization (Moughtin, 1964; Anagnostopoulos, 1977; Teixeira, 1990; AlSayyad, 1995; Mat Radzuan et al., 2015; Miao & Chiou, 2012; Pozoukidou & Papageorgiou, 2013; Byrd et al., 2018; Tsilimigkas & Derdemezi, 2020). Another definition provided by Ghonimi & Zamly (2017) is the modern neighborhoods of the 1970s in urban areas in Cairo.

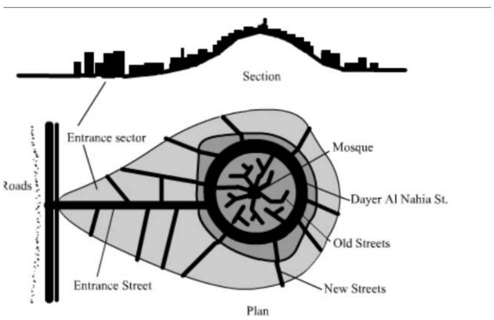
0.1.3 Built Environment of Traditional Settlements: at Glance

Focusing on buildings and built environment practices, Ragette (2003) showed numerous historical and modern buildings examples of the Arabic world. He discussed the influence of ideology, history, habits, traditions, policies, religion, and socio-economic factors on reforming traditional architecture and traditional built environment, in terms of climate (micro and macro), construction typologies (structure systems, architecture elements, and local materials), design strategies, positioning (on the hill and flat), and location (site accessibility and isolated inner areas).

In Italy, Pagano & Daniel (1936) showed the impact of the natural environment, economy, available technology on reforming old rural Italian dwellings typologies that represent aesthetic value. Queysanne provided an example of how peasants in the Black Forest positioned their dwellings on the mountain slope with sloped roofs, sheltered the wind, and avoided snow load.

In Egypt, Mahgoub (2016), based on many studies, summarized the relationship between the Nile river and traditional settlement positioned on a proper hill, "*Koum Village*," to protect it from the Nile flooding. In the center, a religious building surrounded by dwellings and a ring street, "*Dayer Al Nahya*," functioned as a public space. He described the role of the Nile control policy (establishing dams) at the beginning of the 1900s in reforming the morphology of traditional settlements in Egypt, which led to a horizontal extension of the old fabric below the flood level on a vast horizontal agrarian land. Figure (00-02) shows traditional settlements' old and new fabric in Egypt before and after the beginning of the 1900s.





(1) (2)

Figure (00-02) The plan and cross-section of the traditional Egyptian settlement (Mahgoub, 2016). Panel 1: shows the village's core, "*Al Koum*" surrounded by a ring road connected with the main street. Panel 2: shows the development of the Village in the 1900s.

That was followed by significant changes due to wars and peace agreements with Israel, socio-economic transformations, immigration to the Arabic Gulf countries, and development processes such as paving the streets in 1985, which led to a significant extension of the existing pattern of traditional and rural settlements on the akin agricultural land. Figure (00-03) illustrates the current traditional settlement pattern transformation.

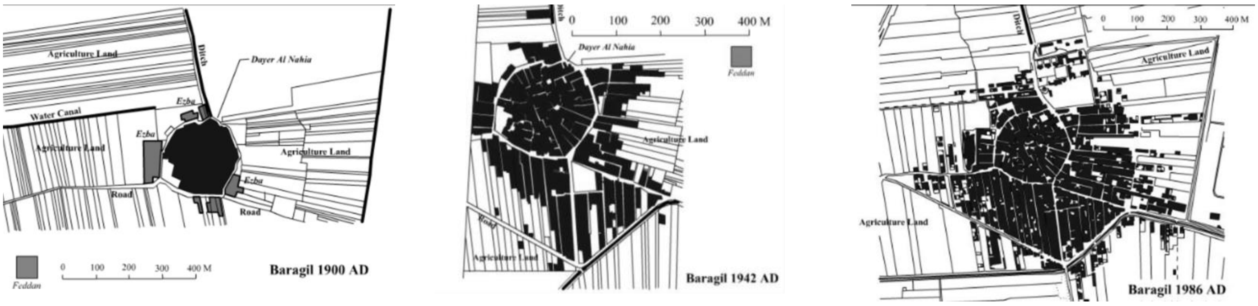


Figure (00-03) Urban Tissue Transformation of a Traditional Settlement in Egypt through time, from left to right (Mahgoub, 2016).

To conclude, many studies discussed the traditional settlement term from different perspectives. This study defines traditional settlements as the following: societies and villages emerged vernacularly (architecture without architects (May & Reid, 2010), or by architects, respecting the rural identity. They have had a distinguish architectural typology and urban tissue, achieving dwellers' satisfaction through transferred knowledge between generations. These patterns developed notably around the mid-1900s due to significant milestones. These settlements have been characterized as predominately rural in terms of high population density, relying on economic activities, such as fishing and farming, using the integration of primitive -small-scale- and modern techniques. As a result, the prevailing building typologies are contemporary, as has been emphasized recently by Abouaiana & Mendonça (Abouaiana & Mendonça, 2022). Meanwhile, the study settlements are neither historical and archeological nor touristic. Figure (00-04) summarizes the concept of traditional settlements. Figure (00-05) shows an example of fishing cultures' impact on the built environment in a traditional settlement in the north of Egypt.

Figure (00-04) Traditional settlements concept.

Figure (00-05) A warehouse shows fishing culture's Impact on the built environment in a traditional coastal settlement in Egypt (image taken by the author).

0.2 Why Egypt and Italy?

In order to generalize research findings, this study focuses on Egypt and Italy as an inductive method to represent the entire region. They were selected for many reasons, where several studies found common ground between Egypt and Italy in terms of the impact of Arab and Roman culture and Mediterranean climate (Pallini, 2006; Lejeune & Sabatino, 2009; Swetnam-Burland, 2015), and district energy efficiency practices (Calise et al., 2021). Also, both countries play a vital role in the region, where Egypt can represent the southern part of the Mediterranean Sea in terms of location, culture, religion, and as a developing country. Likewise, Italy represents European countries, and as a developed country, as well as it is acting as a stabilizer in the region and as a leader in promoting initiatives (Schiliro, 2015). Moreover, it makes sense that the author is Egyptian and preparing this study in Italy. Figure (00-06) depicts the Mediterranean countries.

Palestine	Tunisia	Greece	France	Slovenia
Lebanon	Libya	Spain	Gibraltar	Albania
Syria	Egypt	Italy	Croatia	Monaco
Cyprus	Alegria	Bosnia-Herzegovina		Malta
Israel	Morocco	Turkey	Montenegro	

Figure (00-06) List of Mediterranean countries highlighted the selected countries.

This study finds novel points of differences and contacts between the built environment in traditional rural settlements in Egypt and Italy that have been implemented in two stages. Phase one: explores the main characteristics of both countries in line with the research domain, such as administrative system hierarchy, settlements patterns, population densities, buildings, energy profile, and land use, and ended by setting unifying the criteria to select similar regions (Introductory Chapter, Section 0.6), to benchmark the results and enable the comparison (Chapter One, Section 3.4). Phase two: identifies the intimate contexts (settlements level) based on other unified detailed criteria (Chapter One, Table 01-24). Figure (00-07) summarizes the process of selecting case studies in Egypt and Italy.

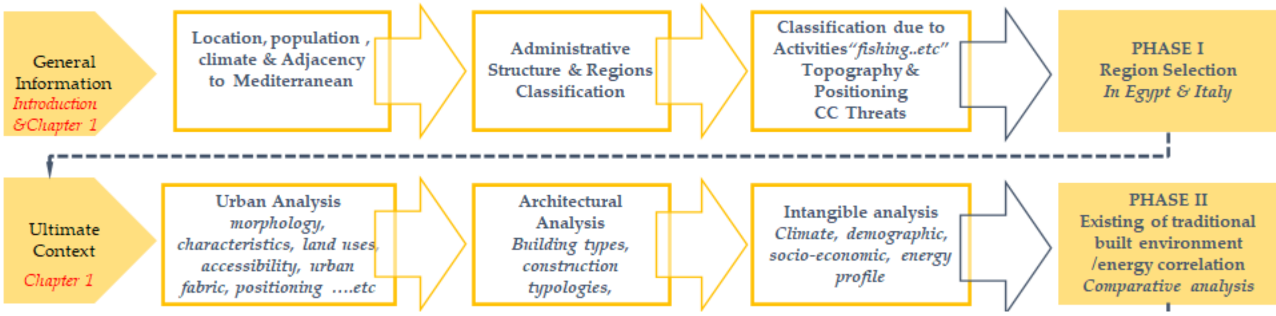


Figure (00-07) The hierarchy of selecting case studies belonging to the study.

0.2.1 TS Transformation in Egypt and Italy

Generally, rural settlements in the Mediterranean face numerous challenges, either rural population decline on Euro-Mediterranean flanks or accessibility to the productive land resources for the southern Mediterranean regions. (Nori, 2018), and (Nori & Farinella, 2020).

As described, traditional settlements patterns are being transformed in Egypt due to dwellers' socio-economic transformations. As a result, a newly built environment and buildings patterns took place which does not respect the environment (Ibrahim, n.d.-a; Ibrahim, n.d.-b; Allam & Amer, 2001; Mahgoub, 2001;

Mahgoub, 2016; Abouaiana, 2016; Abouaiana, 2021). Elsaid (2007) emphasized this meaning during her investigation of rural settlement patterns in Northern Egypt (Delta Region). In the same context, the population in rural villages is decreasing steadily, and the agricultural land (GOPP, 2008; GOPP, 2013; GOPP, 2014a; GOPP, 2014b; CAPMAS, 2018).

In the Italian context, the Italian National Institute of Statistics (ISTAT) indicated that the number of Italian farms is decreasing annually. For instance, they have decreased by 33% between 2010 and 2016 (ISTAT, 2022). Consequently, farmers' dwelling units and traditional rural buildings (Caltabiano, 2006; Picuno, 2016; Ledda et al., 2019; Daglio et al., 2020) and the current construction system is foreign to the local environment (Sangiorgi, 2008). The phenomenon occurred for many reasons: the transition from traditional agriculture to industrial society (Torreggiani & Tassinari, 2012; ZAMPERINI & CINIERI, 2014; Benni et al., 2019), the natural disasters such as earthquakes in southern Italy (Grano, 2014; East, 2017), human activities(Statuto et al., 2016), and to the new building regulations (Cillis et al., 2020)

It is a general in all Italian regions, such as Campania (Sorrentino, 2013) (De Joanna et al., 2020) Emilia-Romagna (Tassinari et al., 2008), Veneto (Tempesta, 2010), Basilicata (Forleo et al., 2017) (Cillis et al., 2020), Abruzzo (MacDonald et al., 2000), and Sardinia (Perpina Castillo et al., 2018). Di Pilla et al. (2016) mentioned that most Italian dwellings have poor energy performance. He advocated revitalizing these settlements or renovating them (Tagliabue et al., 2012), considering restoring the decayed architectural-historical values. Figure (00-08) shows the map of the abandoned traditional settlements in Italy.

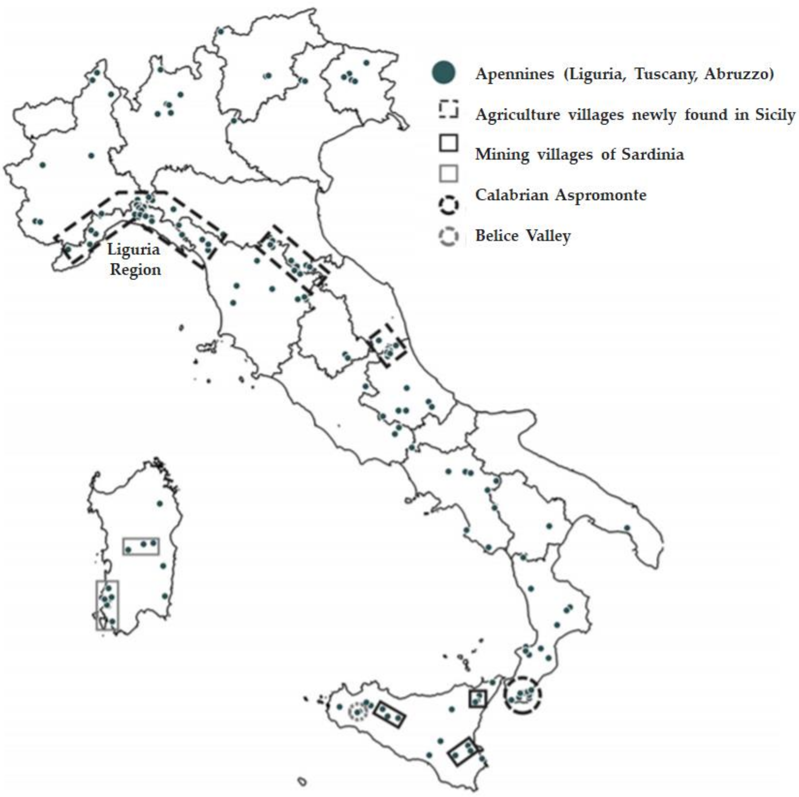


Figure (00-08) The map of the abandoned villages throughout Italy by type of village (Di Figlia, 2016).

These modern buildings typologies play an essential role in energy consumption, where this sector is responsible for 40% and 30% of global energy used and the annual greenhouse gas emissions, respectively (Sbci, 2009), and buildings are one of the major parts of the built environment, influencing most of the people's day-to-day life factors (Battisti et al., 2019). Moreover, energy transfuses all sectors of society (Hinrichs & Kleinbach, 2012). From these points: the increased energy consumption is intimately connected not only with the building itself in terms of construction and operation energy consumption but also with people's activities and needs, such as but not limited to, mobility to/from work/schools, agriculture irrigation, domestic water transport, and desalination. Figure(00-09) identifies the energy consumption items that have been investigated in (Chapters One and Two).

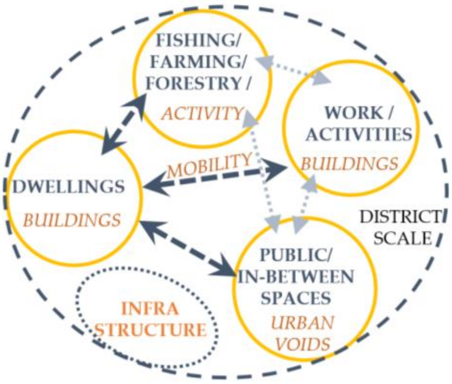


Figure (00-09) Research limitations of the considered energy consumption items.

0.2.2 Energy and Climate Change: at Glance

Energy consumption goes hand in hand with carbon dioxide (CO_2) emissions in a positive correlation (Arouri et al., 2012; Sozer, 2010). Both have a nearly similar part of emissions (Mardiana & Riffat, 2015; Abouaiana, 2021) and contribute significantly to global warming. Figure (00-10) depicts the relation between the current Mediterranean built environment patterns and global warming.

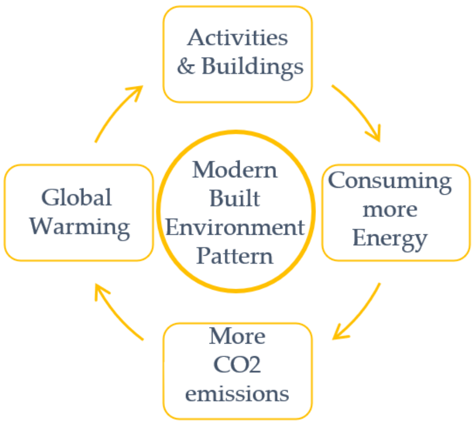


Figure (00-10) A close cycle relation between current built environment patterns and global warming in the Mediterranean Region.

The Mediterranean region's temperature increased by 20% more than the global average, by 1.5 degrees (Cramer et al., 2018) as well as that climate change has a significant devastating influence on the region's rural commons, such as migration waves, crop productivity reduction, water sensitivity, and increasing the rates of malnutrition and unemployment (Conway & Hulme, 1996; Conway & Hulme, 1996; Smith et al., 2014; Aboulnaga et al., 2019).

In Egypt, the Delta region coastal zone is one of the most vulnerable areas in the world due to sea-level rise (SLR) (Masria et al., 2014; Abdrabo & Hassaan, 2015). El-Nahry & Doluschitz (2010) anticipated that by 2100 the water would reach 30 km inside the Nile Delta. Ouda (2010) has anticipated drowned parts from the Delta in case of a one-meter SLR increase, Figure (00-11). In the same realm, the storm of Gamasa (Delta

Region) could be taken as an example of climate change impacts in 2013, Figure (00-12-1). It destroyed 400 lighting poles, 14 high-pressure towers, two factories, and dozens of acres. One of the locals described what happened as follows "*I have never seen such a hurricane. For the first time, we see sheep and goats flying in the air from the wind, which uprooted tents and demolished the walls of buildings*"(Ramadan, 2013).

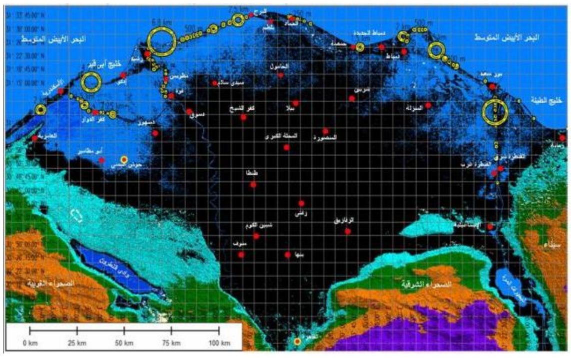


Figure (00-11) The expected situation for the northern area – in blue- if SLR increased 1 meter (Ouda, 2010)

Typically, in Italy, Stern & Stern (2007) mentioned lengthily the negative impacts of climate change, escorted by that Italy, Portugal, and Spain are the grievously affected countries due to rising water stress, heatwaves, and forest fires. In the same vein, it increases the vulnerability of rural settlements (Lacirignola, 2017), threatens food security -crop productivity of less than 36%, tourism, and local economics (Al et al., 2008; Kruse et al., 2013; Alawadi et al., 2020),. Venice flood in November 2019 could be taken as an example. It reflected some subversive impacts, such as power outages, fire outbreaks, deaths (Fulloni, 2019) (the worst in the past five decades), noting that the SLR has increased 35 cm in the past century (Baldin, Giorgio Crosato, 2017). Moreover, in August 2021, the highest temperature in Europe (48.8° C) was recorded in South Italy since the last one in the 1970s. Figure (00-12) illustrates two examples of the climate change impact on Italy and Egypt.

"*…Italy will be the first country in the world where the study of climate change and sustainable development will be mandatory,*" Italian Education Minister Lorenzo Fioramonti said.[1]

Figure (00-12) Examples of the impact of climate change in Egypt and Italy. Panel 1: shows one of the impacts of the Gamasa storm on outdoor space in Egypt (Elsayed & Eldeeb, 2013). Panel 2: shows one of the influences of the Venice flood on an indoor space in Italy (ilgazzettino, 2020).

[1]https://www.repubblica.it/ambiente/2019/11/05/news/fioramonti_da_settembre_il_clima_sara_materia_di_studio_a_scuola-240307556/ [In Italian] (Accessed 15 August 2020). What reflects the considerable attention of Italian government towards climate change.

In this domain, the United Nations paid noticeable attention to this issue represented in the 17-goal of Sustainable Development in 2015 (United Nations, 2021). Namely, goal 3, “Affordable and Clean Energy,” goal 12, “Responsible Consumption and Production,” goal 13, “Climate Action,” and goal 11, “Sustainable Cities and Communities,” as an extension of the previous international community extensive moves started from mid the 1900s. Figure (00-13) depicts some of the global effort milestones towards sustainable development in the past semi-century.

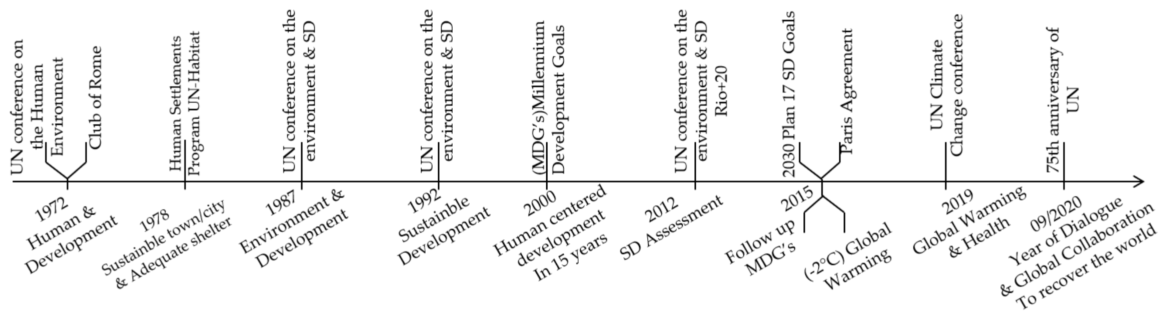


Figure (00-13) Some of the universal endeavors towards sustainable development and climate change in five decades.

Moving a few steps forward, local efforts in Egypt and Italy pay considerable attention to the energy issue. It is one of the major strategic objectives of the Italian National Energy and Climate Plan (NECAP)2 (MISE, 2019) and the Egyptian National Energy Efficiency Action Plan (NEEAP) (NEEAP Egypt, 2012). In line with the sustainable development goals and EU directives (European Commission, 2018a; European Commission, 2020). Simultaneously energy issues touch the Egyptian’s daily life because of subsidies removal in parallel to the dramatic well-known economic policies in the aftermath of The Egyptian Pound Devaluation at the end of 20163. Likewise, in Italy, in the aftermath of the notable increase in September 2021 in energy bills (30% for electricity and 14% for gas) (ARERA, 2021) (discussed in Chapter Two, sections 2.1.1 and 2.1..2). Figures (00-14) highlight this problem in Egypt.

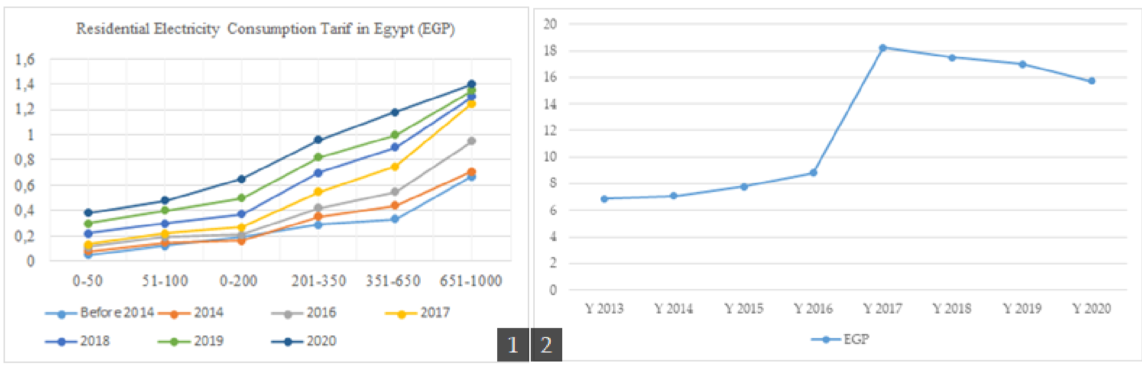


Figure (00-14) Panel 1: Household consumption segment gradual increase through past. Panel 2: the EGP value against USD prices (the author) based on official reports and Egypt's Government Budget.

[2] Exmplainatory document that shows how to achiveve the 2030 by the Italian Government to the European Commission (Bianco & Marmori, 2022).

[3] https://infomineo.com/egyptian-devaluation-one-year-later/ (Accessed 05 September 2020).

0.2.3 Built Environment Retrofitting

Retrofitting refers to such addition to older systems that did not have from the beginning or fitting during manufacturing. It has also been used with other terms such as refurbishment, renovation, and refit. For instance, Allam & Amer referred to governmental and architects' initiatives to develop and retrofit traditional rural settlements in Egypt to increase environmental performance and achieve dwellers' needs. Also, many studies provided retrofitting solutions for rural dwellings envelopes in the Delta region (Abouaiana, 2016; Abouaiana, 2021; Abouaiana & Mendonça, 2022), building orientation to achieve dwellers' thermal comfort (Al-hagla & El-sayad, 2019) investigated the relationship between rural dwelling's form and energy consumption, besides harvesting solar energy (Ahmad, 2002; Dabaieh et al., 2016). In Italy, Battisti & Cimini advocated considering restoring decayed architectural-historical values of traditional rural Italian villages.

In terms of retrofitting methodology, Architect Hassan Fathy provided a role model to Al-Gourna in the 1960s when he advocated harvesting renewable energy and local materials to improve environmental performance considering social, economic, and cultural aspects, but this experience failed to achieve its aims, simply because people left the village as he said himself, however, he promoted his participatory approach *".One man cannot build one house, but ten men can build ten houses"* (Fathy, 1989), what showed the importance of engaging locals into the development process.

In view of this, Battisti (2017) and Almeida et al. (2014) emphasized the involvement concept of state bodies, consultants, construction firms and architects, and different stakeholders (Mehibel et al., 2014; Gao, 2016). Eisermann et al. (2019) pointed out that the local authorities are responsible for employing affordable retrofitting strategies for buildings. Furthermore, the European Regulation (EU) 2018/1999 advocated involving all stakeholders in any development (European Commission, 2018b). On the other hand, Aboulnaga et al. referred to that the majority of retrofitting and development process in Egypt happened from a top-down approach.

As a result, in order to fulfill affordable and efficient retrofitting strategies, it is inevitable that the collaboration between the different stakeholders, namely, the local community who will receive the benefit of retrofitting, technical experts like (architects, urban planners, economists, environmentalists, sociologists), and policymakers who have the power to implement. Figure (00-15) shows the stakeholders' relations in terms of influence and interest.

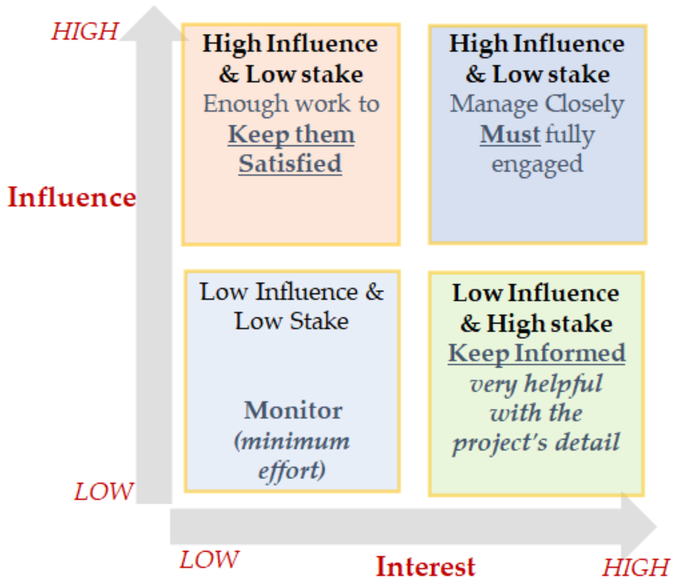


Figure (00-15) Stakeholders matrix of interest and influence (the author).

0.3 Transdisciplinarity and Team Management

Transdisciplinarity appeared as a result of the linear development of scientific activity into more new overlapped disciplines (Ramadier, 2004). In which the researchers with the actors are collaborating generating knowledge (Wickson et al., 2006). This is an essential way to resolve complex real-world problems, including the challenge of energy retrofitting practices (Okorafor et al., 2021), which suffer from the lack of relevant research (Schmidt & Weigt, 2015) and engaging the right stakeholders. The study has investigated stakeholder management to identify and classify the selected team integrated four steps, the rational background from the project management perspective and synthesizing the literature review results of the energy retrofitting practices, with a particular reference to similar contexts (discussed in Chapter Three, Section 3.3), integrated with the on-site surveys in specific case studies (Chapter One).

Therefore, the study has promoted integrated approaches, the Bottom-Up (research interventions) and Top-Down (in line with the national initiatives and engaging the decision-makers). Transdisciplinary core teams representing versatile stakeholders have been proposed. The teams have been identified and classified based on the stakeholder management analysis, resulting from the rational background, namely, from the project management perspective and nd synthesizing the literature review results of the energy retrofitting practices, with a particular reference to similar contexts (Chapter Three, Section 3.3). They consist of academic bodies with high interest. Local authorities (who have the influence), experts (who have the interest), such as architects, urban planners, and culture experts. The local community and private sector (who will be a benefit from the intervention), and finally, sponsors (who can facilitate the interventions), such as the NGOs. Figure (00-16) illustrates the proposed transdisciplinary collaboration.

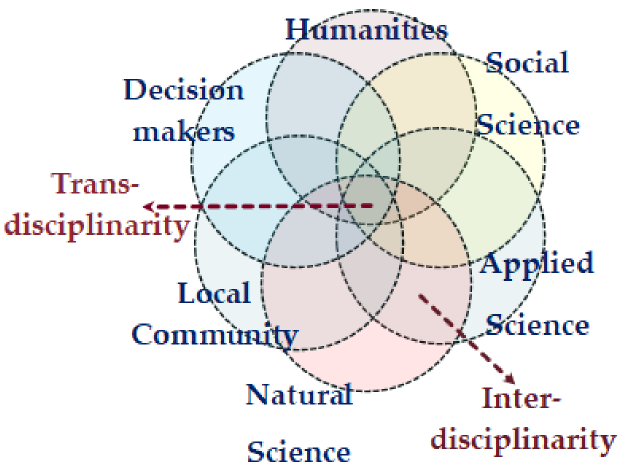


Figure (00-16) The proposed transdisciplinary concept in the retrofitting process (disciplines and stakeholders) (the author).

Collaborative team works are investigated from several perspectives such as health care, project management, economics, and education. Conflict is inevitable in each aspect of life, including collaborative work and projects (A., 1994; PMI, 2017a). Many studies discussed some conflicts that affect the team, such as cultural diversity (Jackson, 1991; Millhous, 1999), members satisfaction (De Dreu & Weingart, 2003), poor communications and work allocation (Chan & Chen, 2010), trust (Bagshaw et al., 2007), vagueness and authority (Tosi, 1994) and lack of team coordination (Nunkoo & Sungkur, 2021).

As proposed in the transdisciplinary collaboration in traditional settlement retrofitting, it is evident that the complex and interlocking relations among the stakeholders are a real challenge. Solving conflict is one of the most critical aspects that consumes time (Madalina, 2016). Therefore, this study argues that Agile Methodology will provide a successful framework for solving the anticipated problem and organizing their relation.

0.3.1 Why Agile Methodology as Participatory Approach?

"Agile" term refers to "*moving quickly*" (Balaji & Murugaiyan, 2012). Agile Manifesto is a document, formally called the "Manifesto for Agile Software Development," originated in 2001 by 17 software developers, the so-called "Agile Alliance," who sought an amendment to the software development processes that they saw as cumbersome unresponsive, and too focused on documentation requirements. The manifesto consists of four pillars (people, communications, deliverables, flexibility). In addition, it includes several practices which are rooted in the organizes and managing the relations between teamwork efficiently, producing products with the highest priority in the highest value, client satisfaction, and continuous acclimatization due to inputs fluctuations and variations (Chapter Three, Section 3.5) (Agile Manifesto, 2021; APM, 2021; Beck, Beedle, et al., 2001; Highsmith & Cockburn, 2001). Figure (00-17) illustrates the agile methodology basics and disciplines.

It is a justified, engineering-based approach and a mindset in every aspect of life, "*the capability to creation and reaction to change*." Agile methodologies area group of project management approach. That is indicated by a massive collaboration where the stakeholders work together thoroughly toward a common objective while taking full responsibility for the outcome. (Dybå & Dingsøyr, 2008; Inayat et al., 2015; Theocharis et al., 2015). Efficient participation will lead to efficient and resilient projects. Agile tools are proved a success in some domains, such as software engineering (Digital.ai, 2020), construction industry (Streule et al., 2016), education (Hicks & Foster, 2010). This study will utilize the agile method to foster a new domain in line with the study context.

BASICS	**organizes& manages teamwork relations efficiently**	**producing products highest priority value**	**client satisfaction**	**acclimatization due fluctuations & variations**
12 PRINCIPLES	highest priority is to satisfy the customer	Business, people & developers must work together daily	Working software is the primary measure of progress.	Simplicity--the art of maximizing the amount of work not done--is essential.
	Welcome requirements change even late development.	Build projects around motivated individuals. Give them environment, support & trust	Promotes SD. (sponsors, users& developers, should maintain a constant pace indefinitely.	The best designs & requirements, emerge from self-organizing teams.
	Deliver working software frequently, 2weeks ~ 2 months, (preference to the shorter timescale).	face-to-face the most effective method conversation to convey information	Continuous attention to technical excellence & good design enhances agility.	team reflects on how to become more effective, then adjusts its behavior accordingly.

Figure (00-17) summarizes the agile methodology basics and disciplines (the author).

0.4 State-of-the-art

Traditional settlements in the Mediterranean region face many challenges in terms of high energy consumption due to the relation between the built environment and daily life aspects with buildings operations energy consumption, considering stakeholders and actors and their connections to achieve efficient and optimal retrofitting. Therefore, there is an essential need for transdisciplinary collaboration between stakeholders who are involved in the retrofitting process. Meanwhile, this type of collaboration is characterized by high conflicts.

Thus, this study aims to provide a novel transdisciplinary framework to organize the collaboration work among stakeholders, which will lead to implementing efficient strategies to retrofit the built environment. The integration of the energy retrofitting and project management practice with the agile methodology practices (software development) proved the success of the projects.

0.5 Research Question

A set of primary and secondary research questions were set to address this gap:

- What is the possibility of using agile methodology as a transdisciplinary retrofitting approach for the built environment of traditional settlements in the Mediterranean Region?

0.5.1 Research sub-questions

- To what extent this framework will enhance the traditional identity and valorize the place.
- To what extent this framework will contribute to solving real-world problems.
- What are the differences between each context outcome?

0.5.2 Research aim

The main aim was outlined to answer the research question as follows:

- ***Provide a framework to organize the relation between collaborators, increase their effectiveness as teamwork, avoid the expected conflicts, and retrofit the built environment in traditional settlements in the Mediterranean region.***

0.5.3 Research Objectives

- Reduce energy consumption mitigate CO_2;
- Investigating the existing energy retrofitting practices in the past decade;
- Provide criteria to select and form stakeholders for each project;
- Enhance harvesting renewable energy using emerging technologies;
- Preserve and enhance traditional settlements' identity and values.

0.5.4 Hypothesis

The agile methodology will be a framework that enhances the success of retrofitting the built environment in each context.

0.5.5 Research limitations:

- The case studies in Egypt and Italy are two (similar) agriculture-based rural settlements (Section 0.6);
- The energy consumption of buildings and socio-economic factors in traditional settlements in the Mediterranean Region is represented in Egypt and Italy;
- The conceptual framework is limited to the micro contexts (Lasaifar Albalad and Pontinia Settlements);
- The practice is limited to the planning, decision-making, and early implementation of the framework.

0.5.6 Research Scientific Relevance and Topicality:

The study conceptuality was conducted by an intensive literature review within the relevant notional concepts about the trends related to cross-disciplinarity energy retrofitting practices, focusing on the rural built environment. That is associated with the agile methodology practices of project management and software development domains, resulting in a framework that helped organize collaboration, enhance communication, and support planning and decision-making to retrofit the rural built environment in traditional settlements in the Mediterranean region. As a result, the study has achieved three main contributions that positively impact the scientific community local society and support the national policies as follows:

<u>The scientific community</u>:

- To pave the way to further studies based on the study findings by investigating (for the first time) two specific case studies as an inductive method that can be applied in other Mediterranean traditional settlements;
- To provide new techniques to implement the on-site studies in similar contexts;
- To provide criteria for engaging stakeholders, forming the team works, managing their collaboration, and providing detailed procedures.

The local community:

- By effectively engaging them to retrofit their built environment, which enhanced belonging to the place, leading to place valorization and putting them with the decision-makers on the same page;
- They contributed to validating the framework and had the opportunity to decide through focus groups;
- The pilot project (the first zero-energy building in the Egyptian case study) (Chapter Four) contributed to saving the monthly electricity bills, raising the awareness of the local community, and enhancing building capacity.

The national policies:

- This study contributed to the Italian context, as it is in line with the national and European strategic plans for reducing energy consumption, climate mitigation, carbon neutrality, and environmental improvement strategies of the rural areas;
- Likewise, it supports the national energy action plan and the recent presidential initiative Decent Life in Egypt.

0.5.7 Motivation of Research

- A 20-year experience includes managerial experience, cooperation with different disciplines in various contexts, and enthusiasm for the researcher.
- On the other side, the researcher has a rural background, and he witnessed the transformation of a traditional settlement located in the Delta Region in Egypt in the last two decades, which helped him understand users' needs. At the same time, the author is passionate about Italian culture and working in similar Italian contexts.
- Retrofitting and dealing with the stakeholders are the interest areas.

0.6 Case Studies Selection Criteria

The selection criteria of the case studies are:

- Predominates by the agricultural activities;
- Their dwellers have a similar cultural background in farming;
- Both are predominate by rural;
- Both are adjacent to the Mediterranean coast and characterized by the Mediterranean climate;
- They are reformed in terms of the built environment pattern (modern) around the 1950s;
- Building age and building morphology are similar;
- They have a similar population and area;
- Geographical morphology;
- Elevation above sea level;
- High energy consumption and threat to climate change;
- They are neither historical nor cultural heritage areas.

Figure (00-18) illustrates the selection criteria of similar region patterns in Egypt and Italy.

In this section, the main characteristics of Egypt and Italy have been presented to enable a better understanding of the study's context.

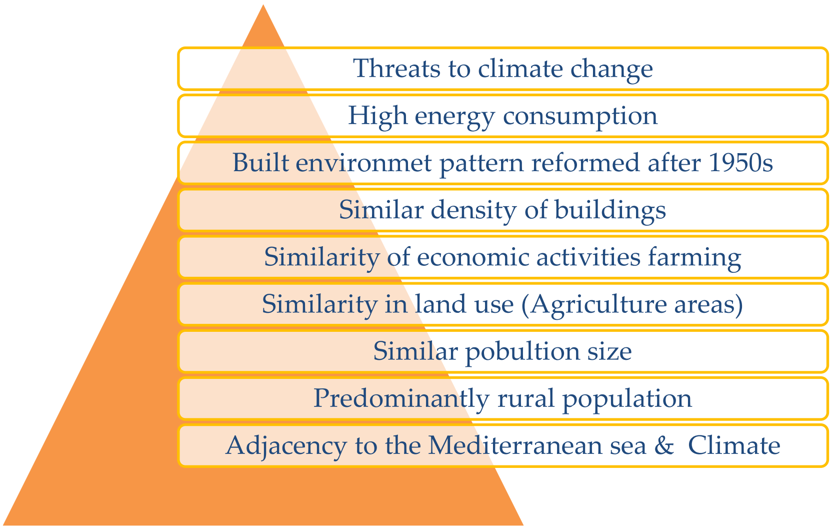


Figure (00-18) The limitations of selecting the case-study-region in Egypt and Italy (the author).

0.6.1 Administrative Systems and Settlements Patterns in Egypt: Overview

Regions in Egypt are classified for many purposes regarding the existing physical planning regions, consisting of seven regional units: Greater Cairo, Alexandria, Delta, Suez Canal, North Upper Egypt (NUE), Asyut, or Middle-Upper Egypt (MUE), and South Upper Egypt (SUE). Each region consists of three levels, governorates, districts, and villages (with satellite villages). Figure (00-19) shows the hierarchy of the administrative system in Egypt.

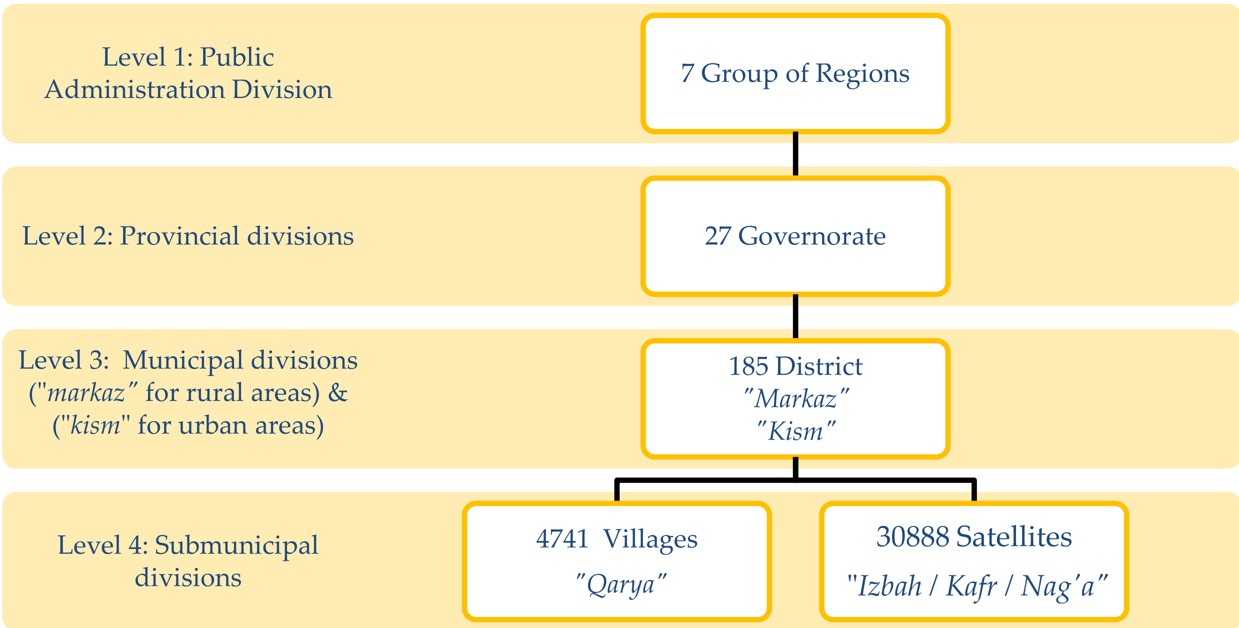


Figure (00-19) Administrative System Hierarchy in Egypt.

While Egypt 2052 Urban Development Plan proposes dividing Egypt into new developmental regions to be ten regions -instead of seven, relying on criteria such as direct accessibility for the region to a seafront as possible and economic resources diversity (GOPP, 2012; GOPP, 2014a). Geographically, Egypt is divided into six territories (Great Cairo, Upper Egypt, Middle Egypt, East Delta, West Delta, and Middle Delta)

(Elmenofi et al., 2014). In terms of climate, it is classified into eight zones based on physical topography, altitude and solar radiation, rainfall, operating temperature, humidity, and wind speed (HBRC, 2008). Figure (00-20) illustrates the regions' division by purpose.

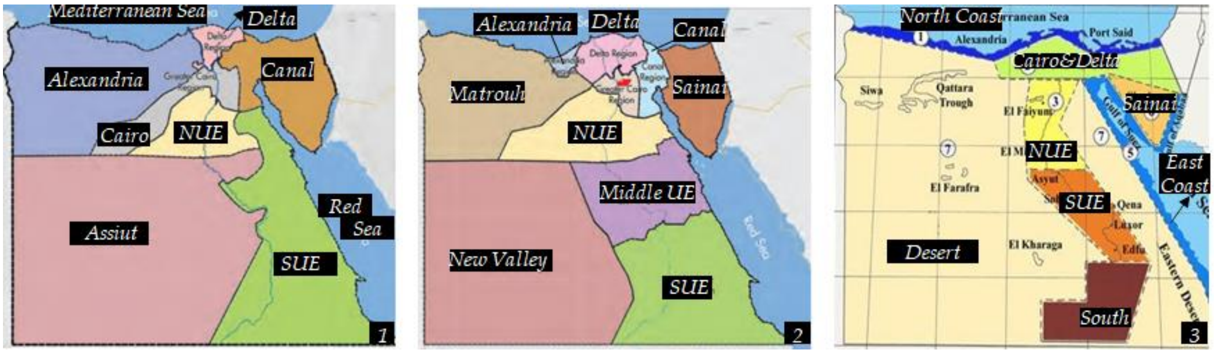


Figure (00-20) The classifications of the Egyptian Region. Panel 1: shows the Existing Division of Egyptian Regions (UN-Habitat, 2016). Panel 2: shows Egypt 2052 proposed division of the regions (UN-Habitat, 2016). Panel 3: Egypt Climatic Zones Map of Egypt (Saleem et al., 2016).

Another classification is based on the territory, which is divided into four parts, Nile Valley and Delta, and Delta. It extends along the Nile River from south to north; it is divided into Upper Egypt and Lower Egypt, with a plan surface. The Western Desert covers two-thirds of Egypt. It consists of vast plains, sand dunes, plateaus, and depressions. The Eastern Desert covers about a quarter of Egypt, mountains dominate its landscape, and the Sinai Peninsula, which covers 6% of the total area, is characterized by three features high altitude mountains in the south, plateaus in the center that are sloped towards the Mediterranean sea, and the plain surface in the northern part (SISGOV, 2009; Embabi, 2018; Embabi, 2020). Figure (00-21) shows the distribution of geographic regions and their morphological characteristics.

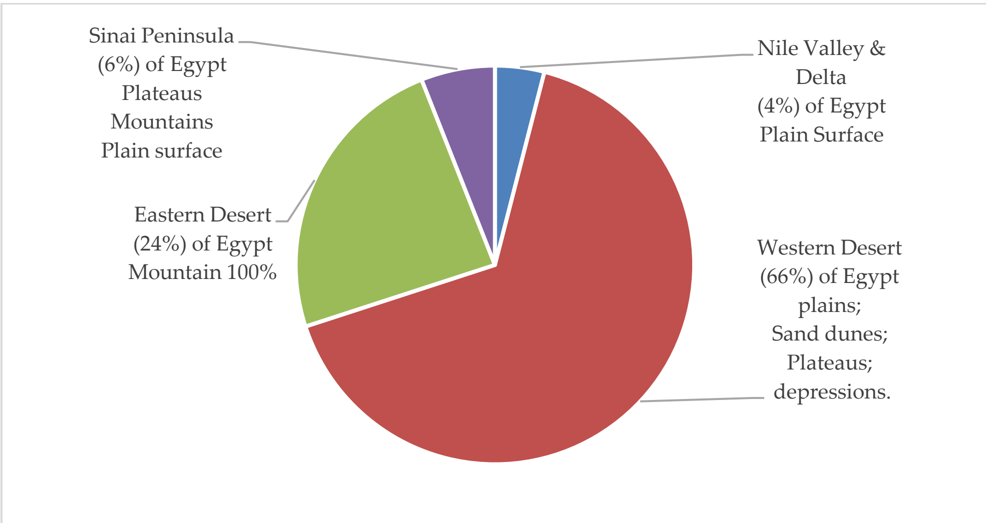


Figure (00-21) Morphological characteristics of the geographical regions and their area distribution (the author).

In terms of urban patterns, the sizes of cities vary, containing only three cities with more than one million inhabitants, namely Cairo, Alexandria, and Giza. The cities of population size (25-50) and (50-100) thousand represent one-half of this pattern, followed by the (10-25) category by 18%. Figures (00-22) and (00-23) show the population size of cities in Egypt.

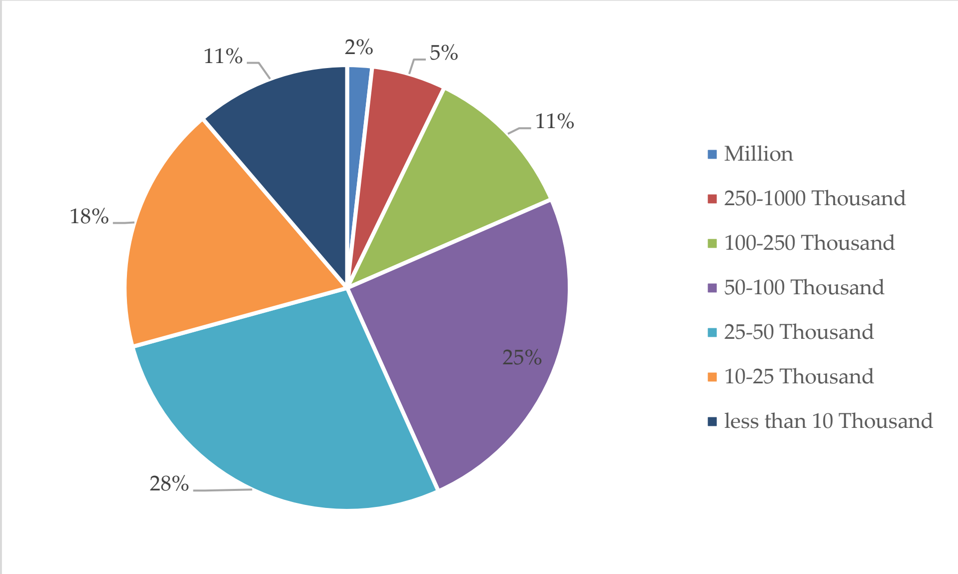


Figure (00-22) Cities population size distribution (%) (the author) based on the General Authority for Urban Planning (GOPP) reports.

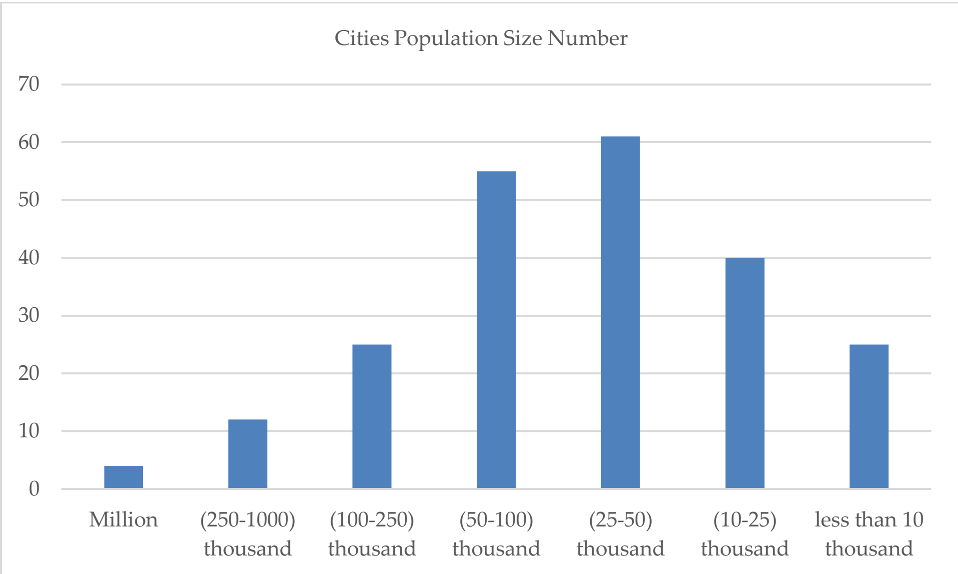


Figure (00-23) Cities population size by number in Egypt (the author) based on GOPP reports.

In terms of villages' population size, most villages (68%) are populated by less than 10 thousand inhabitants, followed by (10-15) and (15-25) thousands by 15% and 8%, respectively. Therefore, the largest population size is inversely proportional to the number of villages. Delta and MUE have the highest amount of villages (1404 and 1013), respectively, while SUE, Canal, and Alexandria have (677, 625, and 550). Figures (00-24) and (00-25) show the population size of villages in Egypt.

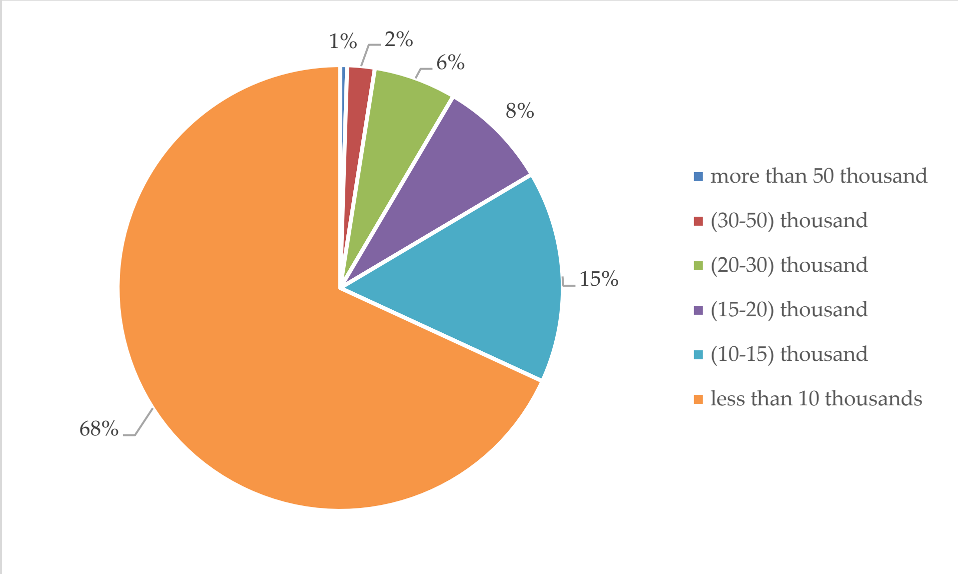


Figure (00-24) Villages Population Size Distribution (%) (the author) based on previous GOPP reports.

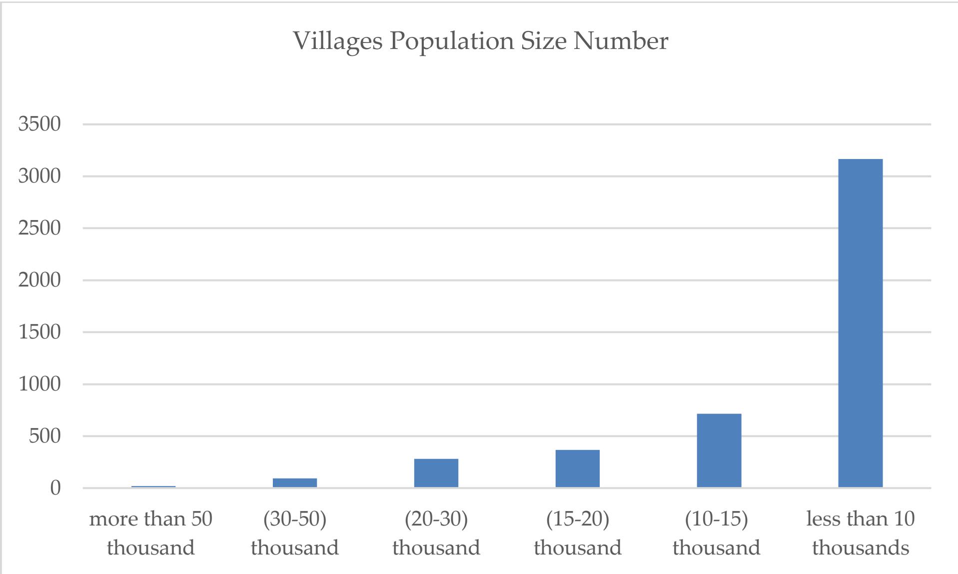


Figure (00-25) Villages Population Size by Number in Egypt (the author) based on GOPP reports.

0.6.2 Climate, Population, and Land Use in Egypt

Regarding Köppen's climate classification Egypt has a hot desert climate (BWh) that is hot, sunny, and dry year-round. The climate is generally arid except for on the northern Mediterranean coast, which gets winter rainfall. Vice versa, the extreme heat during the summer, although daytime temperatures are more moderated along the northern coast. Figure (00-26) shows the Köppen climatic classification of Egypt.

Figure (00-26) Köppen climate classification of Egypt (Wikipedia, 2021).

The current population of Egypt in January 2022 is 102.9 million inhabitants (CAPMAS, 2022), living on 5% of the total area of Egypt, belonging to the Nile Delta and Wadi. The lowermost areas are the Greater Cairo and the Delta regions (17366 and 123566) km² sequentially. Also, they have the uppermost population of 24.5 and 20 million inhabitants, with the highest population density of 1400/km². On the contrary, the MUE region has the lowest population of 4.5 million inhabitants, the highest area of 466024 km², and the lowest density of 10.4 /km². Regarding the rural population: the highest percentage is in Delta and NUE regions with (72 and 79) %, followed by the MUE and SUE regions with about 60%. Figure (00-27) shows the total area and population of the Egyptian regions, while Figure (00-28) depicts the population by (rural-urban) and population density.

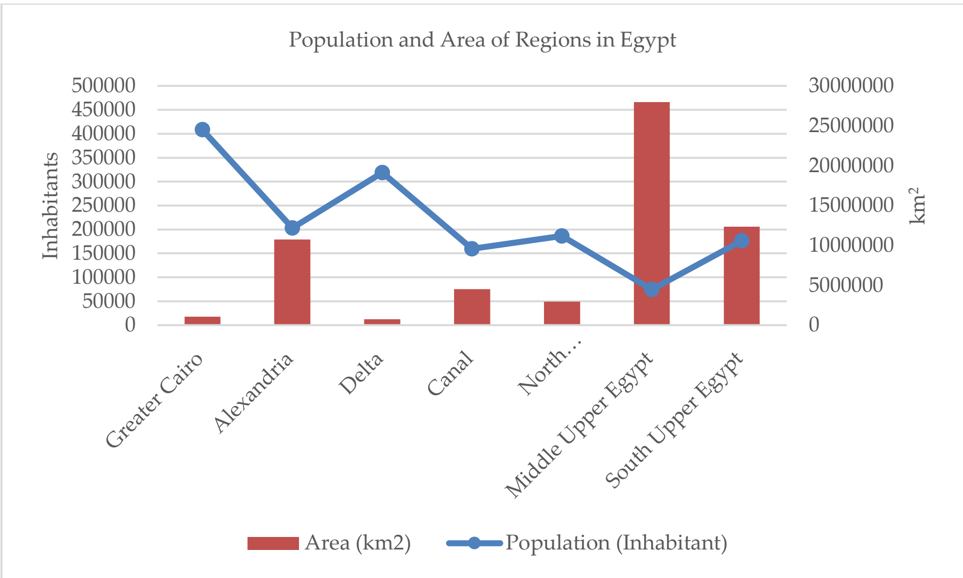


Figure (00-27) Population and Area of the Egyptian regions (CAPMAS, 2018)

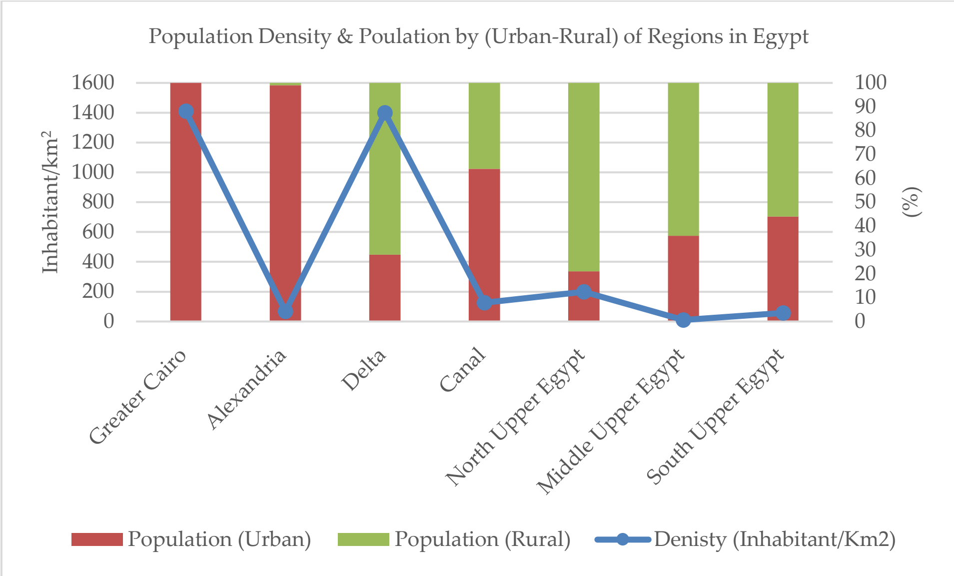


Figure (00-28) Population percentage (by rural-urban) in (%) and density in Egypt (the author) based on GOPP reports.

In terms of labors distribution by economic activities, Figure (00-29), the majority in all regions, except Greater Cairo, are working in the fishing and farming sector, with a significant concentration in Delta and NUE regions. Then, the transformative industries, retail trade, and construction sectors, respectively.

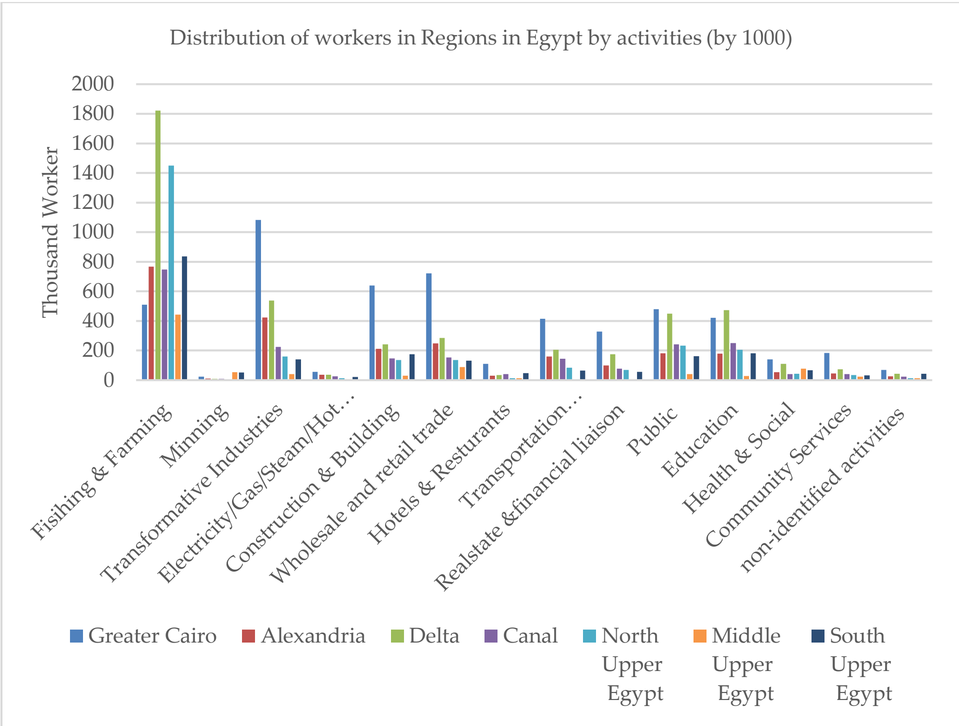


Figure (00-29) Workers distribution by Sector (the author) based on GOPP reports.

Moreover, finally, in terms of land use, Figure (00-30), the inhabited areas represent 60% of the total area of the mentioned regions, followed by the agricultural land inside reins, the so-called "*Al-Zimam.*"[4]

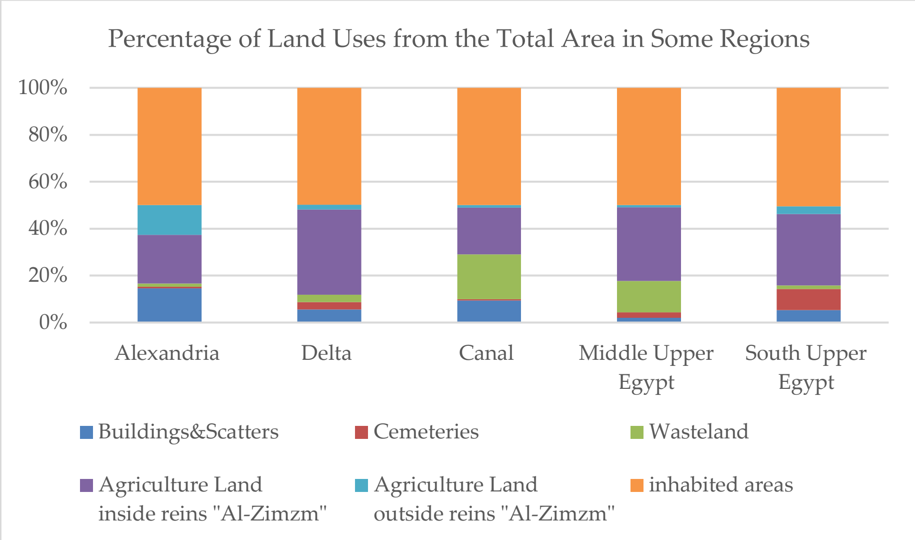


Figure (00-30) Land use distribution by sector in (%) (the author) based on GOPP reports.

0.6.3 Buildings Typology and Energy in Egypt

The total buildings number in Egypt is (16185063). They are divided into four main types, *regular buildings for housing purposes* (such as rural houses and villas), representing 82% of the total. Then *regular buildings for work purposes* (like shops, malls, and public buildings) by 5%. Then *makeshift buildings,* such as cemetery yards and fenced or unfenced used land, by 2%. Finally, the *nondescript buildings* by1 %. Delta region has 23% of entire buildings, followed by NUE, SUE, and Greater Cairo. The lowest amount is in the MUE region. Figure (00-31) shows the distribution of buildings by type in Egypt.

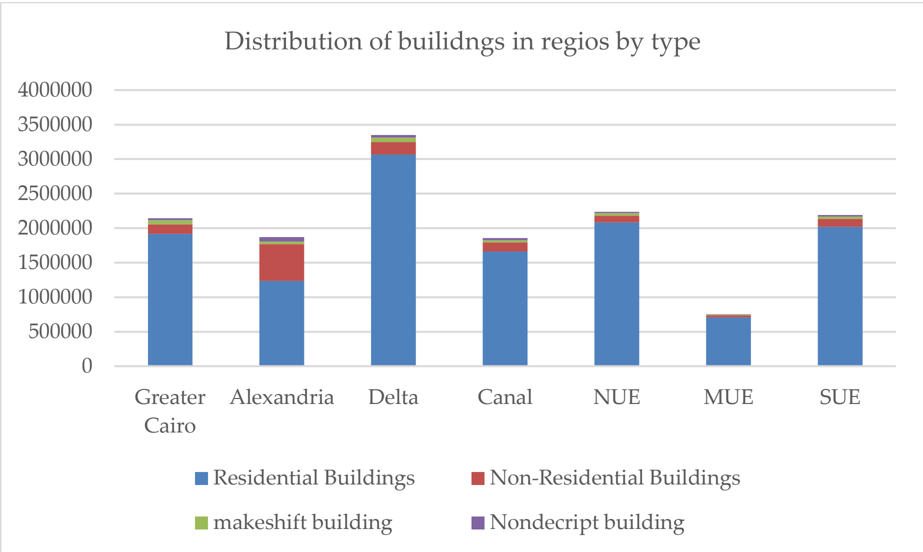


Figure (00-31) Distribution of buildings by types (the author) based on (CAPMAS, 2017b).

[4] Regarding CAPMAS Its area and detailed mapping were calculated by the General Survey Authority, and the books were prepared for calculating its budget in the tax records.

Generally, Egypt's average annual electricity consumption per inhabitant is 2020 kWh. Figure (00-32) shows the electrical energy distribution by the purpose of use. First, the residential lighting purpose recorded the heights by 47%. Second the industrial by 26%. Then the agriculture, governmental and commercial purposes by 5% for each. In terms of the annual residential lighting electricity consumption, the Greater Cairo region's inhabitants consume more than two million kWh of lighting. Second, Delta by 1.2 million kWh, followed by Suez, Canal, and Alexandria regions. Figure (00-33) depicts the annual residential lighting consumption by region.

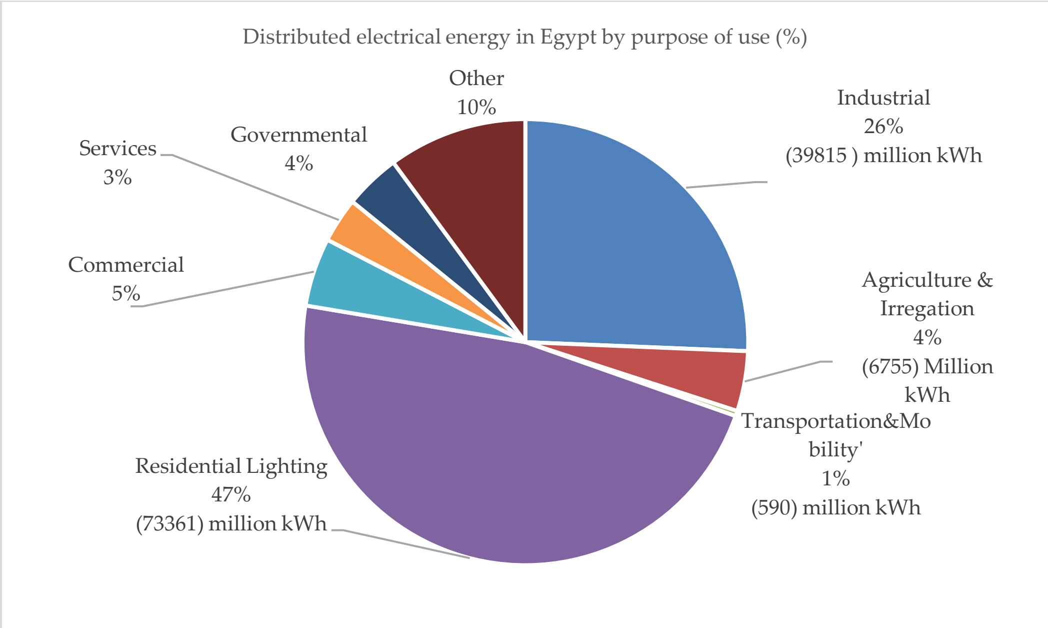


Figure (00-32) Energy distribution by use in Egypt (CAPMAS, 2017a).

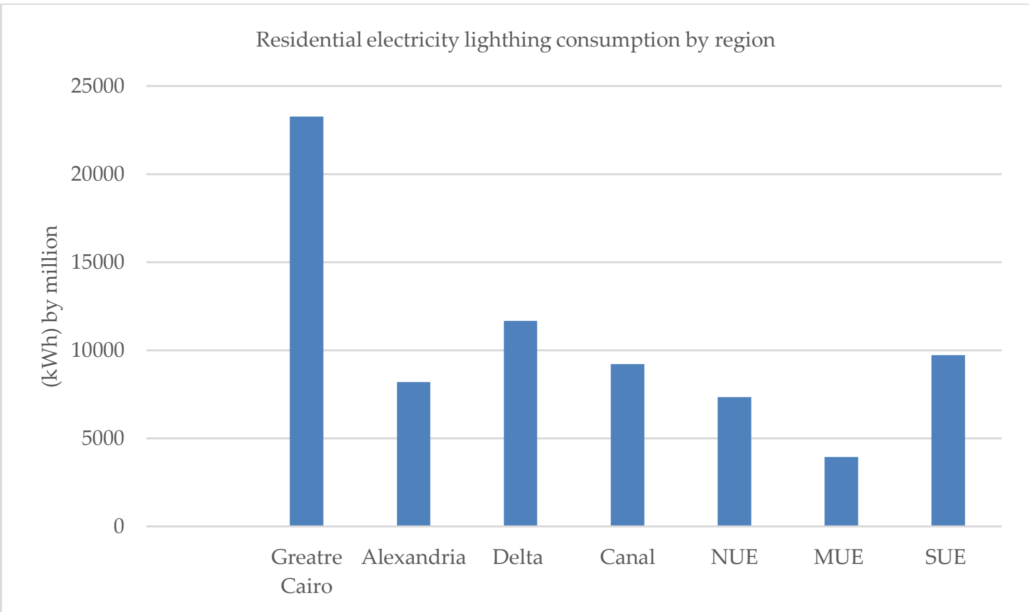


Figure (00-33) Annual consumption of residential electricity lighting (CAPMAS, 2017a).

0.6.4 Administrative Systems in Italy: Overview

Italy is subdivided into 20 regions -of which five enjoy a special autonomous status, 110 Provinces, and 8,101 Municipalities. The Nomenclature of Territorial Units for Statistics (NUTS) is a hierarchical method for dividing the economic territory of the EU and the UK to the socio-economic analysis of regions, framing the EU regional policies, and for statistical purposes (EUROSTAT, 2021a) that subdivide the territory into regions at three different levels (NUTS 1, 2, and 3) moving from larger to smaller territorial units (EUROSTAT, 2020c). Figure (00-34) shows the administrative hierarchy of the Italian regions.

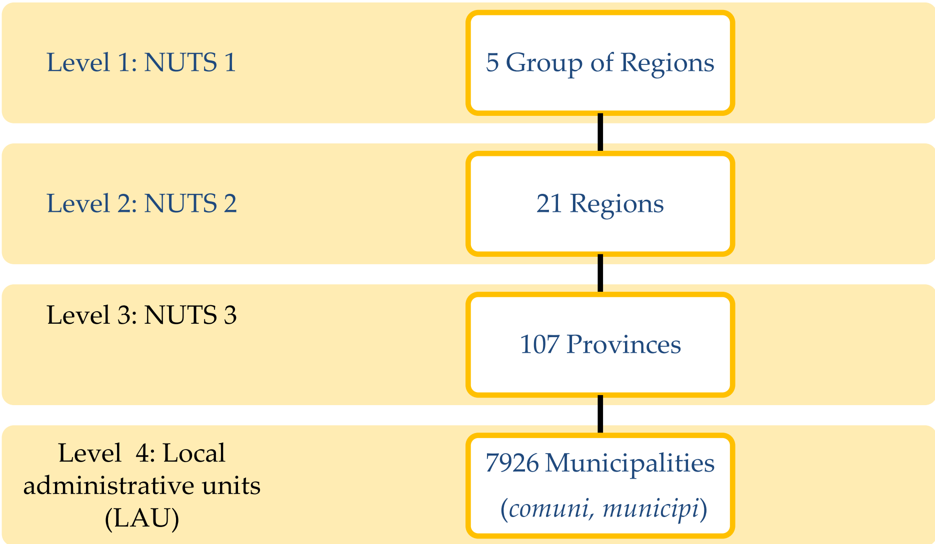


Figure (00-34) Administrative System Hierarchy in Italy (EUROSTAT, 2020a)

0.6.5 Climate, Population, and Land Use

The current population is about 59257566 (ISTAT, 2022), representing 13.3 % of the population of the EU-27 (EUROSTAT, 2020d). 29% of inhabitants live in rural areas. The total area is 301340 km² with an average density of 196.4/km². Figure (00-35) shows regions' population and area, and Figure (00-36) illustrates population density.

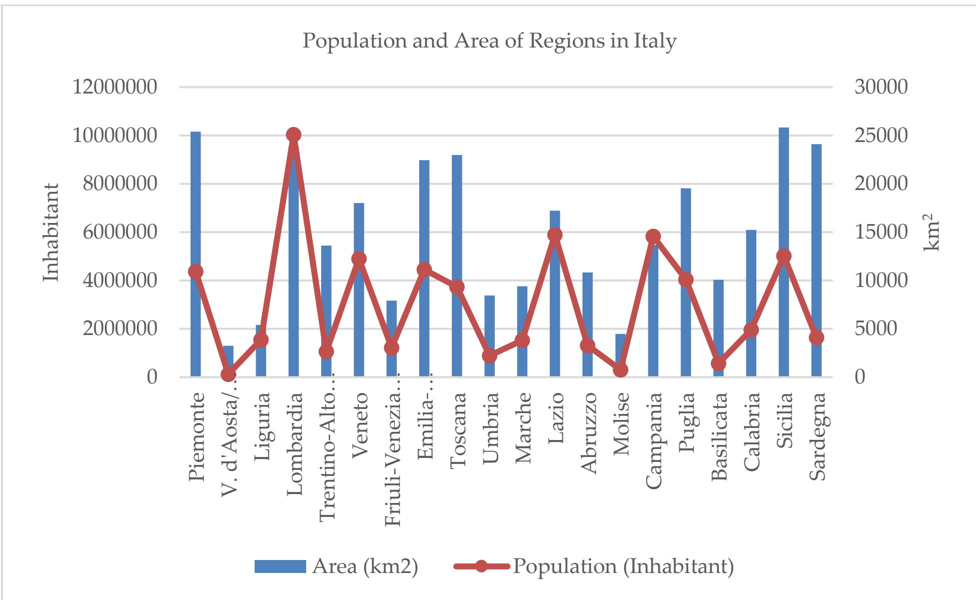


Figure (00-35) Population and Area of the Italian regions (the author) based on (ISTAT, 2021).

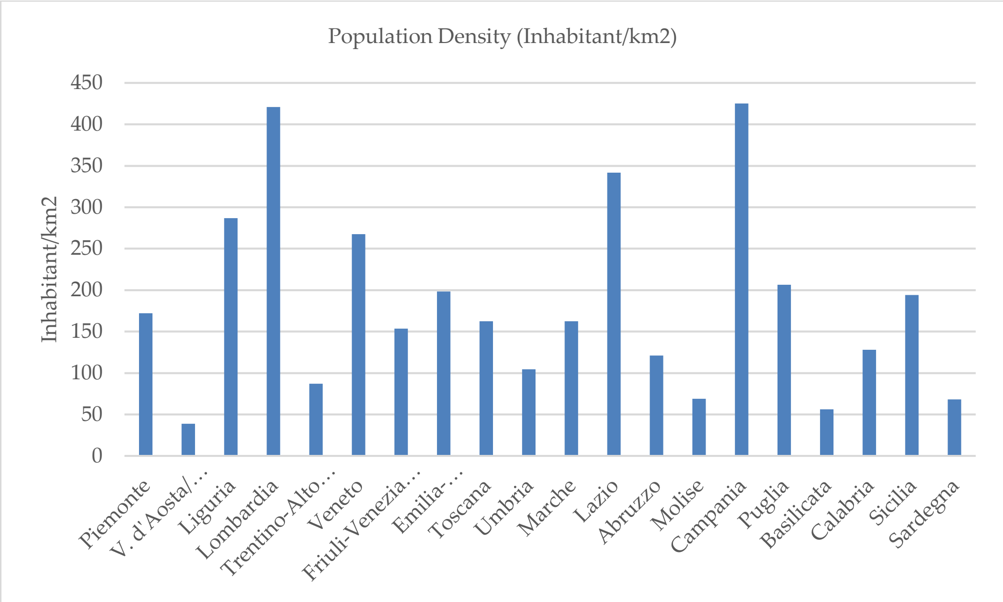


Figure (00-36) Population and population density in 2018 in Italian regions (the author) based on (ISTAT, 2021).

From the figures above, the regions of Campania and Lombardy have the highest population density at about 423/km², followed by Lazio, Liguria, Veneto, and Sicily regions by (342, 288, and 267) inhabitants/km², respectively, while the lowest is in Valle d'Aosta region by about 39/km².

Regarding Köppen's climate classification Italy has various climate systems, with a notable difference in temperature between the Tundra Climate (ET) in the northern parts and the Warm Mediterranean climate in the south (Csa). Figure (00-37) shows the Köppen Classification of climate in Italy.

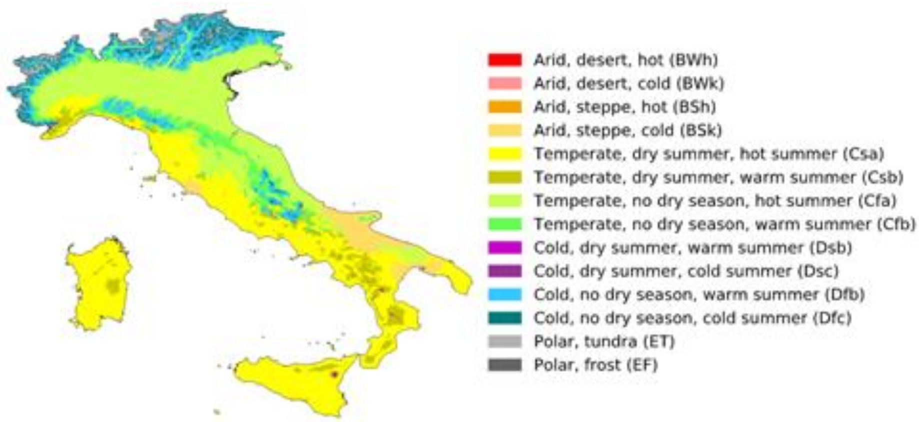


Figure (00-37) Köppen climate classification of Italy (Wikipedia, 2020).

In terms of land use, Figure (00-38), it is obvious that the agricultural lands represent the highest percentage in the majority of regions, led by Puglia with 80% and Molise and Sicily with 70%. Second, the forests predominate in Liguria by 45% and the lowest in Sicily by 1.9%

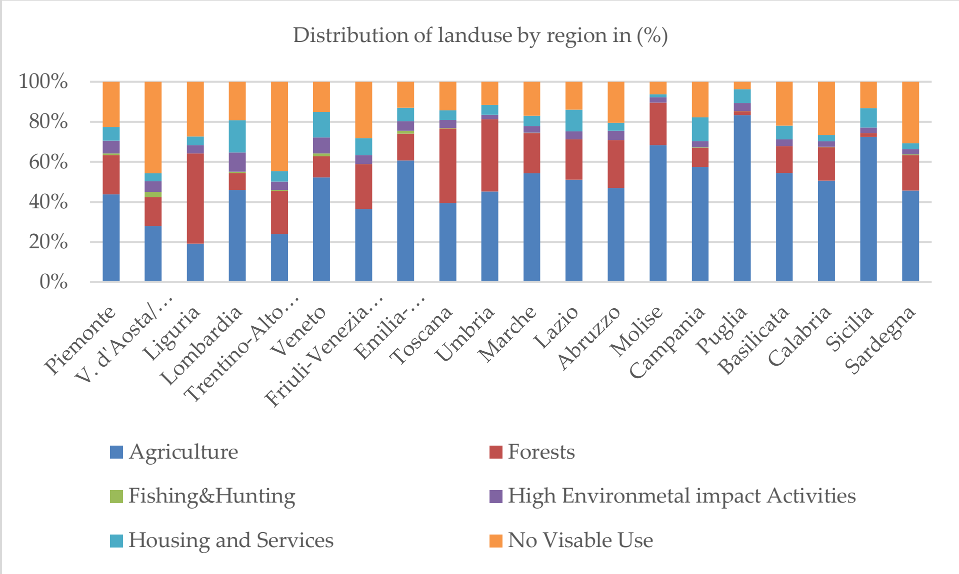


Figure (00-38) Land use distribution in the Italian regions (EUROSTAT, 2021b).

In terms of workers distribution, Figure (00-39), the minority are working in the agriculture sector despite their high agricultural land use. Puglia and Sicily come in the first place with 106 thousand workers, followed by Lombardy, Piemonte, and Campagna with an average of 70 thousand employees. While the services sector hires most employees in all regions, except Lazio and Campagna Industrial sector comes in the first place.

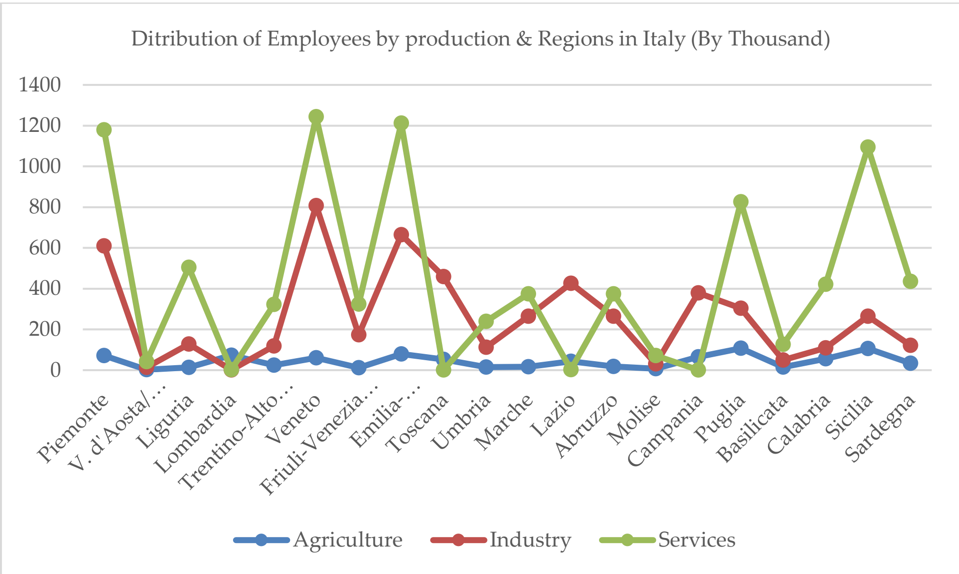


Figure (00-39) Employees distribution by production sector in the Italian Regions (by thousand) (ISTAT, 2011).

Eventually, In terms of regions' morphology, the territories consist of three typologies, mountains, hills, and plain areas. Each region has its morphology. For instance, the plain surface prevailed in Puglia, Veneto, Emilia-Romagna, and Lombardy. In contrast, hills (the prevailed surface in Italy) represent the major parts of Sicily, Sardinia, Umbria, and Marche, and the mountain surfaces cover the entire regions of Trentino-Alto Adige and Valle d'Aosta. Followed by Liguria and Abruzzo by 65%. Pizzoli & Gong (2007) stated that more than one geographical context, such as cities, agricultural lands, mountains, valleys, and costs, can be found in any municipality. Figure (00-40) illustrates the Italian Regions morphology.

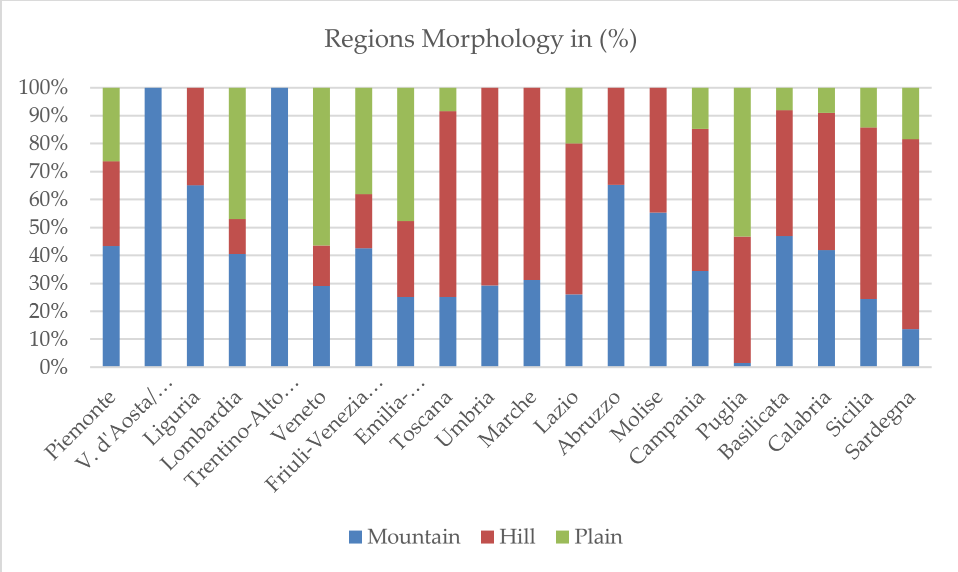
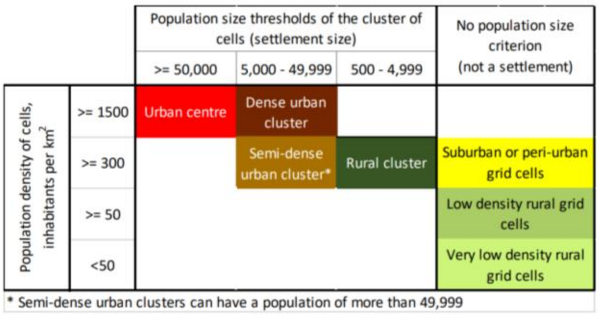


Figure (00-40) Italian Regions Morphology (Cavallaro, 2014) based on ISTAT

0.6.6 Settlements Patterns in Italy

UN Statistical Commission pointed out that the definition of settlement such as urban and rural in such a country varies notably between countries, limiting global comparability. For this reason, they avowed in March 2020 Degree of Urbanization (DEGURBA) as a tool for international comparison. That categorizes[5] the whole region based on population density, population size, and contiguity into 1 km² grid cells with similar size and shape. First, it classifies the grid cells into three parts (urban center, urban cluster, and rural). Rural areas are all areas outside urban clusters. "Urban clusters" are clusters of contiguous grid cells of 1 km² with a density of at least 300 inhabitants per km² and a minimum population of 5000. Secondly, it concerns overlaying these results in local units. Figures (00-41) summarize the Degree of Urbanization concept.



Level	Local Unit Classification Short terms	Technical terms
1	**City**	**Densely populated area**
2	City	Large settlement
1	**Town & semi-dense area**	**Intermediate density area**
2	Dense town	Dense, medium settlement
2	Semi-dense town	Semi-dense, medium settlement
2	Suburban or peri-urban area	Semi-dense area
1	**Rural area**	**Thinly populated area**
2	Village	Small settlement
2	Dispersed rural area	Low density area
2	Mostly uninhabited area	Very low density area

(1) (2)

Figure (00-41) Panel 1: DEGURBA level 2 grid Classification. Panel 2: shows short and technical terms for DEGURBA (UN Statistical Commission, 2020).

[5] The method was proposed by a consortium of international organizations (EU, OECD, World Bank, FAO, UN-Habitat, ILO) led by the EU. (https://ghsl.jrc.ec.europa.eu/degurba.php) (Accessed 1 October 2020).

The Organisation for Economic Co-operation and Development (OECD) has classified the regions by rural-urban and by population share in rural areas into three groups: predominantly rural areas, intermediate rural/urban areas, and predominantly urban areas, which can be coded by (3, 2, and 1) respectively (OECD, 2009). Table (00-01) shows these definitions, while figures (00-42) show the Italian provinces by rural-urban (NUTS 3) numbers, and Figure (00-43) shows the map.

Table (00-01) OECD Classification of rural regions (population share in rural areas based, in (%)

Aspect	Definition
Predominantly rural areas	Population's share living in rural areas > 50%
Intermediate rural areas	Population's share living in rural areas is between 20% and 50%
Predominantly urban areas	Population's share living in rural areas < 20%

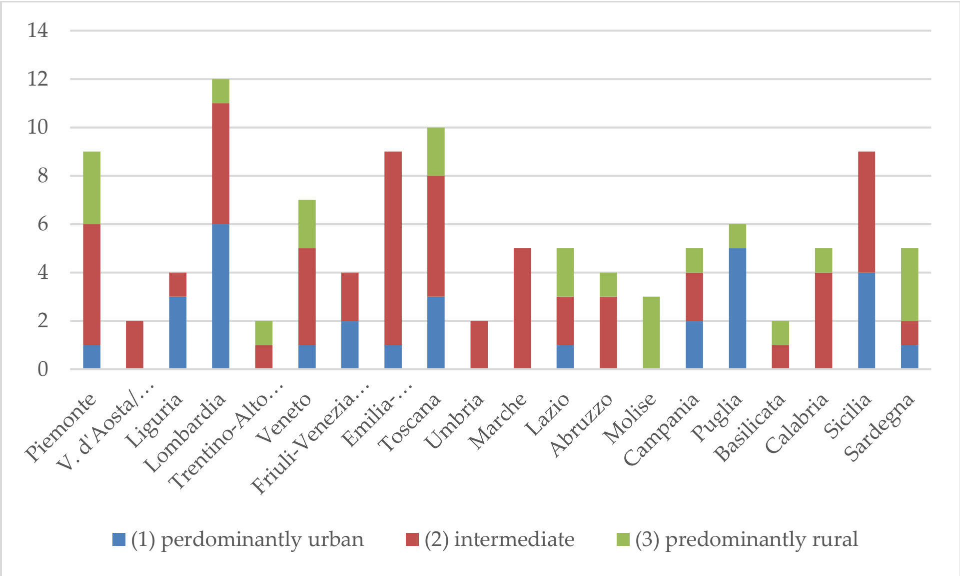


Figure (00-42) Italian provinces (NUTS3) in 2021 by (rural-urban) (the author) based on (EUROSTAT, 2020b).

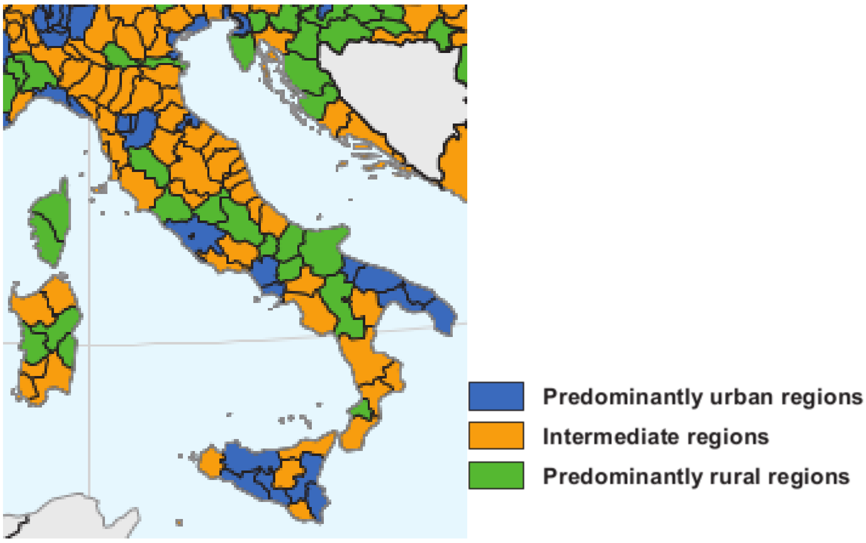


Figure (00-43) Classification of regions (NUTS 3) by rural-urban (OECD, 2009)

The OECD report highlighted the industrial district as one of the predominantly rural areas feature that relies on small-scale traditional manufacturing, such as musical instruments, jewelry, and clothing. The Ministry of Agriculture of Italy (MIPAAF) classified settlements into four categories, urban poles, rural areas with particular intensive agriculture (RR SIA), Intermediate rural regions (IRR), and Rural areas with development problems (OECD, 2009), which is a method of classification of administrative units by the degree of rurality. Table (00-02) shows their definitions and some characteristics.

Table (00-02) The MIPAAF classification of rural regions (based on their common characteristics), (the author) based on (OECD, 2009).

Aspect	Definition
Urban poles	It consists of provincial capitals with over 150 inhabitants/km2 and all heavily urbanized areas
Rural areas with specialized intensive agriculture (RR SIA)	• which include Urbanised Rural Plain Areas, Urbanised Rural Hill Areas, Predominantly Rural Plain Areas, and Significantly Rural Plain Areas • 22% of the national population; • Population densities are generally relatively high (253 inhabitants/ km^2) • These regions produce 38% of agriculture's value-added.
Intermediate rural regions	• Which include Predominantly Rural **Hill Areas** (North and Centre), Significantly Rural Hill Areas, and Significantly Rural **Mountain Areas** (North and Centre) • 24% of the national population, 32% of the national territory • a highly diversified economic base
Rural areas with development problems	It includes Predominantly Rural Mountain Areas, Predominantly Rural Hill Areas (South), and Significantly Rural Mountain Areas (South).

The MIPAAF developed a new methodology based on the OECD one, but by altitude area in each province (plain, hill, or mountain) (MIPAAF, 2014), as could be seen in Table (00-03). Figure (00-44) Illustrates the map of the MIPAAF classification.

Table (00-03) MIPAAF classification of rural areas (the author) based on (MIPAAF, 2014).

Aspect	Definition
predominantly urban municipalities (A)	• with rural population municipalities <15% of the total population).
Urbanized rural municipalities (B)	• population of rural municipalities> 15% and <50%; • the population of centers over 150 inhabitants /km^2 > 50% of the total population) due to the presence of densely populated centers (e.g., areas with strong agriculture - lowland areas in northern Italy).
Significantly rural municipalities (C)	• the population of rural municipalities> 15% and <50% of the total population; • the population of centers more than 150 inhabitants/km2 <50% of the total population) due to the absence of densely populated centers.
predominantly rural municipalities (D)	• population rural municipalities> 50% total population.

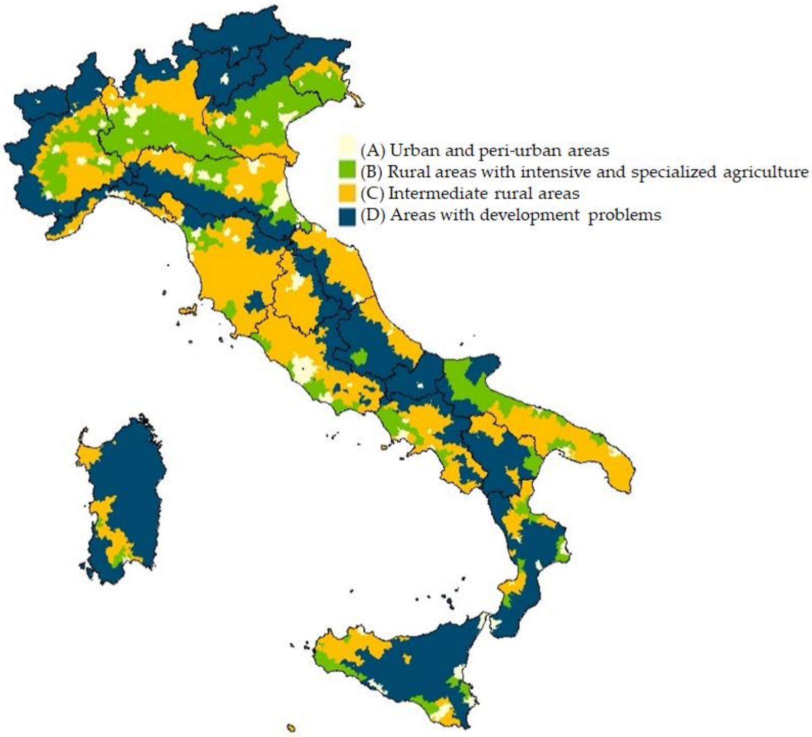


Figure (00-44) Ministry of Agriculture of Italy classification of rural regions (Reterurale, n.d.)

The Italian Ministry for Territorial Cohesion in 2012 has launched The National Strategy for Internal Areas, "*La Strategia Nazionale per le Aree Interne*" (SNAI). The inner areas are fragile territories, far from the main centers of supply of essential services (health, education, and mobility), and too often abandoned to themselves. Agriculture plays a vital character in terms of added value and employment. It covers a total of 60% of the entire surface of the national territory, 52% of the municipalities, and 22% of the population and is divided into over four thousand municipalities (ACT, 2019; Punziano & Urso, 2016; Pezzi, 2017).

The SNAI aims to invest in these areas by promoting and protecting the wealth of the territory and local communities. In addition to enhancing their natural and cultural resources, energy-saving, creating new employment circuits and new opportunities. In other words, to counteract the "*demographic hemorrhage*" (Barca et al., 2014). The SNAI selected 72 pilot projects that include a total of 1077 municipalities for about 2072718 inhabitants. Madonie area in the north center of Sicily could be taken as an example (Basile & Cavallo, 2020). Table (00-04) highlights the definition of inner areas. Figure (00-45) illustrates the inner areas in Italy and the SNAI's pilot project locations.

Table (00-04) Inner Areas definitions (based on accessibility to essential service in minutes) (SNAI).

Aspect	Description
Intermediate Inner Areas	Distance between 20-40 minutes from the nearest pole.
Peripheral Inner Areas	Distance between 40-75 minutes from the nearest pole.
UltraPeripheral Inner Areas	Distance more than 75 minutes from the nearest pole.

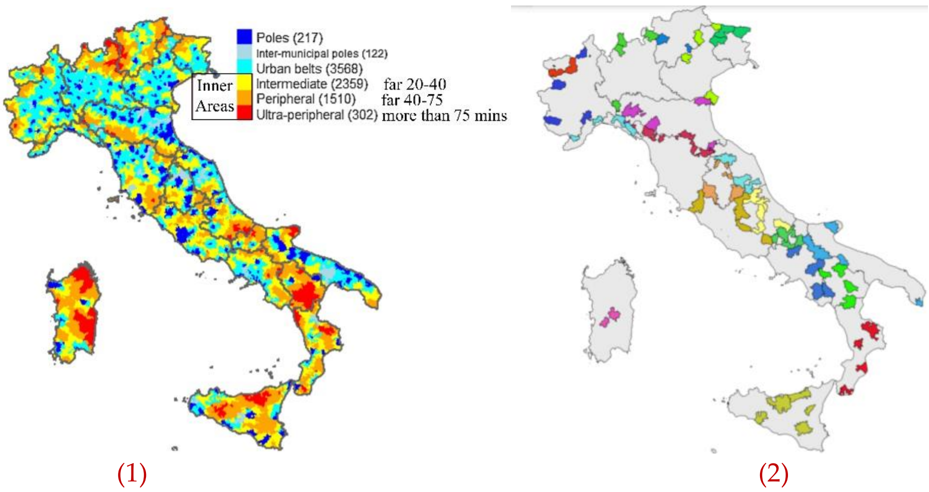


Figure (00-45) Panel 1: SNAI classification of Inners Areas (Romagnoli & Mastronardi, 2020); Panel 2: The distribution of the 72-pilot-project (ENRD, 2019).

0.6.7 Buildings and Energy in Italy

Regarding the ISTAT, the total number of buildings in 2011 in Italy accounted for (14515795) buildings. Lombardia and Sicilia have the high numbers, about 12% each, followed by Campania, Apulia, Veneto, Piemonte, and Lazio with an average of 7% for each, while Valle d'Aosta has the less amount by 4% (ISTAT, 2011). Figure (00-46) shows the Italian regions' total buildings and areas.

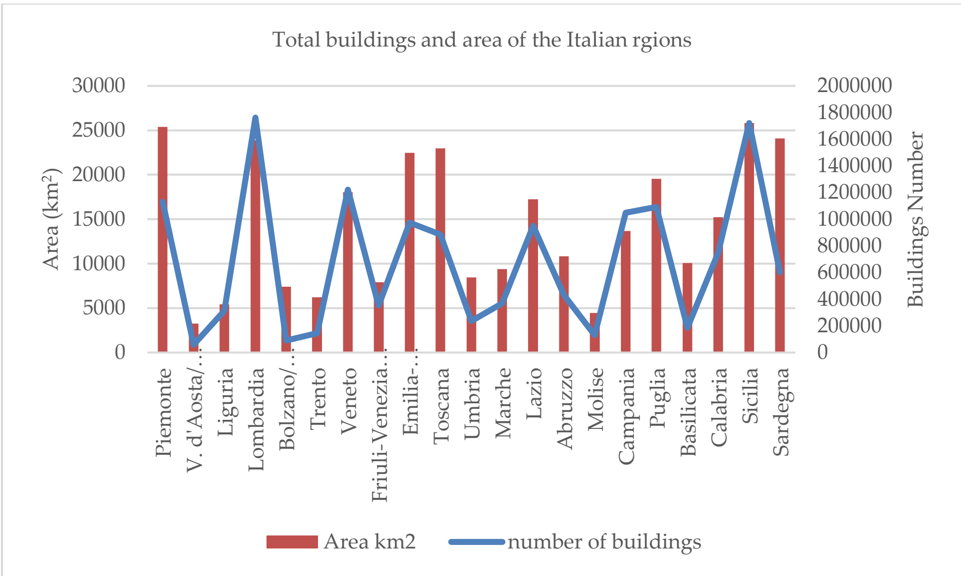


Figure (00-46) The total buildings amount by region and region's areas, (the author) based on (ISTAT, 2011).

The big share of buildings is for residential buildings accounted by (12398634) buildings it represents 86%, of the total number, followed by production and commercial buildings by about 2% of each, then services by 1%. Overall, one-half of the residential buildings have a good construction case, then 32% are in a very good case, 15% are in a medium case, and 2% (206092 buildings) are in a bad case. Figure (00-47) shows the distribution of buildings by type, and Figure (00-48) shows the construction case of the residential buildings.

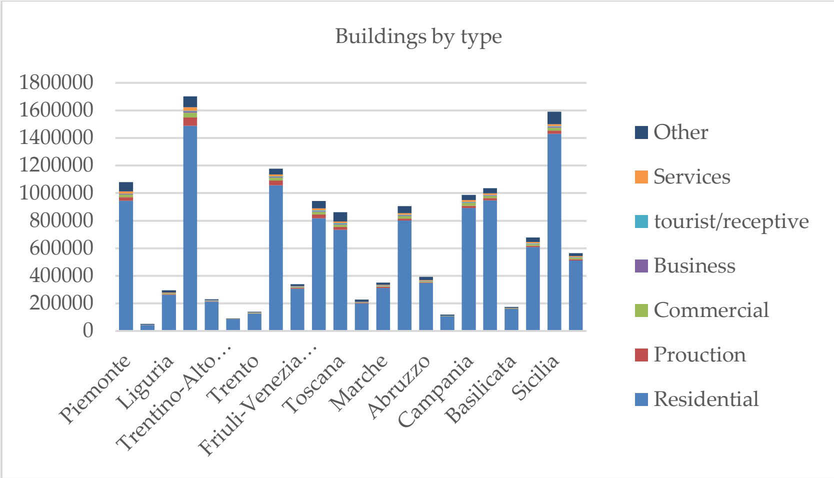


Figure (00-47) Buildings distribution by type (the author) based on (ISTAT, 2011).

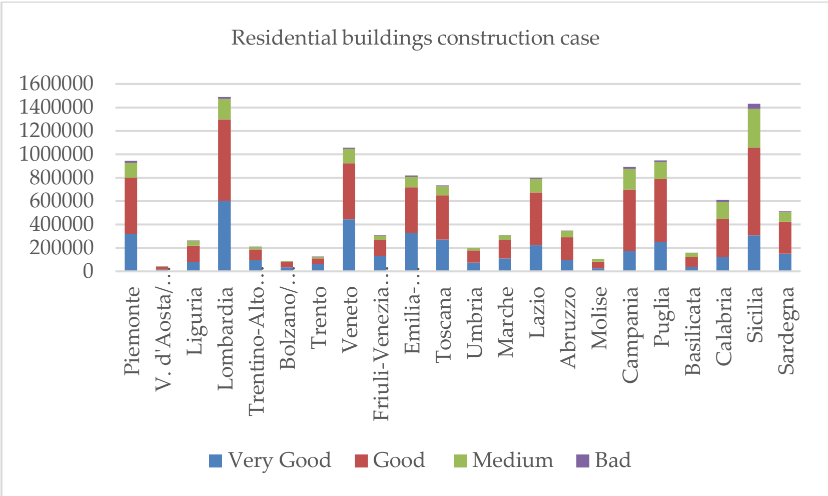


Figure (00-48) Buildings distribution by type (the author) based on (ISTAT, 2011).

The final energy consumption in 2016 amounted to 115.9 Mtoe (ENEA, 2015). The transportation sector consumed the highest share with 34%, followed by the residential and industrial sectors with 28% and 22% respectively, then services with 14%, as seen in Figure (00-49). As well as, the air conditioners consume 68% of total energy by types of end-use in households, as shown in Figure (00-50).

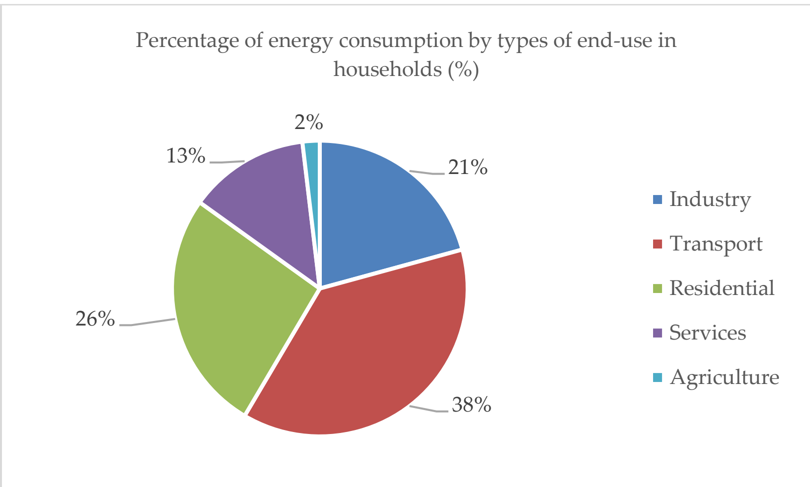


Figure (00-49) Shares of energy consumption by sector (ENEA, 2018).

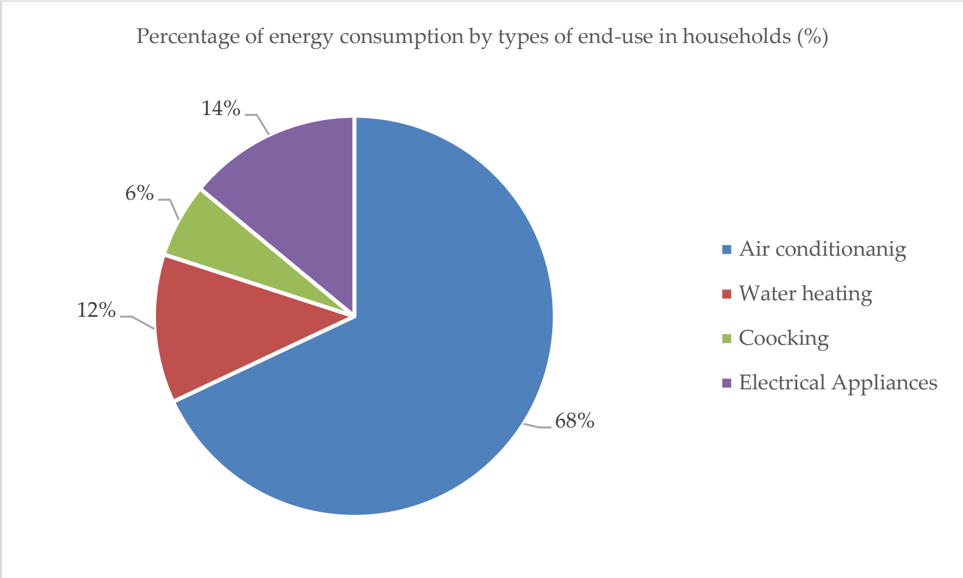


Figure (00-50) Percentage of energy consumption by types of end-use in households (ENEA, 2018).

The average electricity consumption per capita in Italy is 5022 kWh. Friuli-Venezia Giulia comes first by 8470 kW, followed by Valle d'Aosta by 7600 kWh. However, they have the lowest population and buildings density. On the contrary, inhabitants in Calabria and Campania consume around 2700 kWh annually. Figure (00-51) illustrates the annual electricity consumption in the regions by the inhabitant.

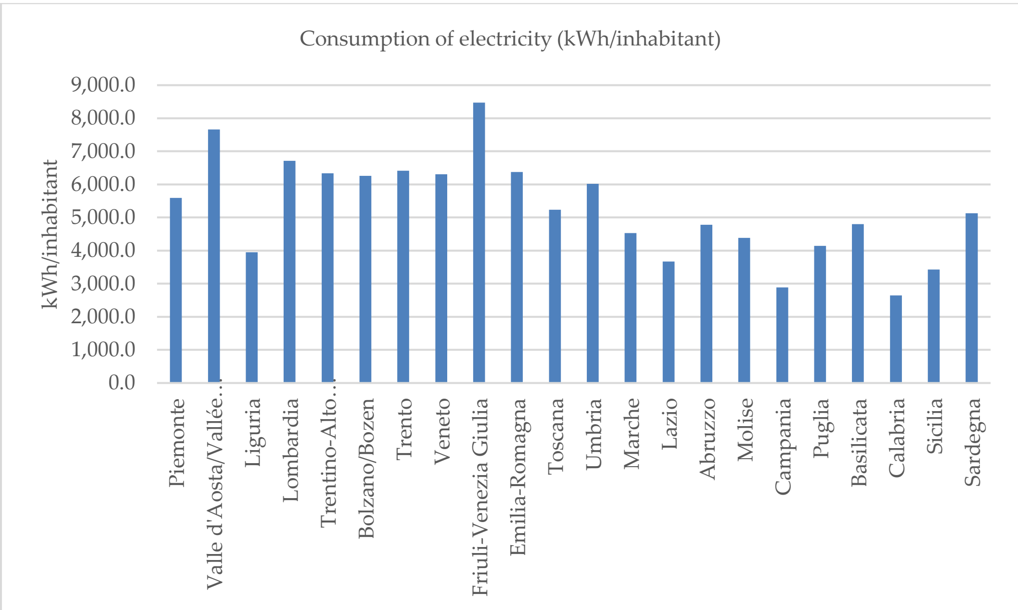


Figure (00-51) Annual consumption per person in the Italian regions (the author) based on (ISTAT, 2011).

0.6.8 Case Studies Selection in Egypt and Italy

Regarding the suggested selection criteria, the Delta region will represent the case study of the Egyptian context for many reasons. Firstly, it is adjacent to the Mediterranean Sea in terms of climate and coastal areas, it has the uppermost density population, and it hosts about one-fourth of the population in Egypt. 70% of them live in rural areas. Finally, it has a large number of villages.

Regarding land use, the agriculture area covers the entire region, the only agricultural region in Egypt, representing 63% of the Egyptian cultivated area (Elagouz et al., 2020). Moreover, most workers concentrated on the farming and fishing sector, and finally, the traditional building typology was transformed in the mid-1900s.

Likewise, the Lazio and Campania regions have similar characteristics regarding the same criteria. However, this study selected Lazio for an additional reason the author is studying at Sapienza University, which belongs to the region. Table (00-05) shows the relative weight of each region compared to traditional settlement criteria. All investigated aspects are summarized in a table. In each cell, two values, (1) means relevant, and value (0) means not relevant. The highest summation of these values represented the similarly qualified regions in both contexts.

Table (00-05) Selection criteria relative weight.

Regions	Mediterranean adjacent, have coastal areas	Climate-relevant	High Population Size due to country	Predominantly rural population > 50% in Egypt	Predominantly agriculture (land use)	Predominantly agriculture (worker)	Have a high percentage of villages (Egypt only)	Morphology; Plain Area	High density of buildings compared to the other regions	Total
EGYPT										
Greater Cairo	0	1	1	0	0	1	0	1	1	**5**
Alexandria	1	1	0	0	0	1	1	1	1	**6**
Canal	1	1	0	0	1	1	1	0	1	**6**
Delta	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**9**
NUE	0	0	0	1	1	1	1	0	0	**4**
MUE	0	0	0	1	1	1	1	1	1	**6**
SUE	0	0	0	1	1	1	1	0	1	**5**
ITALY										
Piemonte	1	0	0	1	1	1	N/A	1	1	6
Valle d'Aosta	1	0	0	1	1	0	N/A	0	0	3
Liguria	1	0	1	1	0	1	N/A	0	0	4
Lombardia	1	0	1	0	1	1	N/A	1	1	6
Abruzzo	1	1	0	1	1	0	N/A	0	0	4
Molise	1	1	0	1	1	0	N/A	0	0	4
Campania	**1**	**1**	**1**	**1**	**1**	**1**	N/A	**1**	**1**	8
Puglia	1	1	1	0	1	1	N/A	1	1	7
Basilicata	1	1	0	1	1	0	N/A	1	0	5
Calabria	**1**	**1**	**0**	**1**	**1**	**1**	N/A	**1**	**1**	7
Sicilia	**1**	**1**	**0**	**1**	**1**	**1**	N/A	**1**	**1**	7
Sardegna	1	1	0	1	1	1	N/A	1	0	6
Bolzano/Bozen	1	0	0	1	1	0	N/A	0	0	3
Trento	1	0	0	1	1	0	N/A	0	0	3
Veneto	1	0	1	1	1	1	N/A	1	1	7
Friuli-Venezia Giulia	1	0	0	1	1	1	N/A	1	0	5
Emilia-Romagna	1	0	1	1	1	1	N/A	1	1	7
Toscana	1	1	0	1	1	1	N/A	1	1	7
Umbria	1	1	0	1	1	0	N/A	0	0	4
Marche	1	1	0	1	1	0	N/A	0	0	4
Lazio	1	1	1	1	1	1	N/A	1	1	8

0.7 S.W.O.T Analysis

Strength	Opportuneness
S1. Energy Efficiency and retrofitting the built environment both are now global objectives. S2. Dealing with existing settlements and no need to demolish or modify. S3. Reserving the existing cultural fabric. S4. Academic Interest. S5. Distinguish contexts.	O1. People response. O2. National governmental goals. O3. Valorizing historical identity. O4. Boosting Economy. O5. Enhancing water efficiency. O6. The suggested interventions are in line with the national policies in both contexts. O7. Fostering a novel approach between the traditional architecture in Egypt and Italy.
Weakness	**Threats**
W1. The research case studies (Lasaifar Albalad and Pontinia) suffer from insufficient data. W2. Complicated relations with all these stakeholders.	T1. Bureaucratic laws. T2. Security approval. T3. The enclosed nature of the rural communities.

0.8 Research Structure and Methodology

The thesis comprises six chapters, using multiple methods and approaches to answer the research question and address the hypothesis. Firstly, in the Introductory Chapter, a **theoretical approach** identifies the definitions of the keywords, traditional settlement concept, addressing the problem background, and setting the criteria of selecting regional case studies in Egypt and Italy (**inductive method)** to represent the entire region that enabled to selecting the micro contexts in Chapter One.

Chapter One: aims to characterize the current built environment's physical and intangible characteristics (outdoor spaces, in-between spaces, buildings, and activities) in two traditional settlements in the Delta region in Egypt and the Lazio region in Italy, based on:

- First, the **analytical method** identifies the main characteristics of the macro contexts (the Regions);
- Second, the **field method,** namely **case study (on-site, GIS survey, questionnaires, face-to-face interviews),** to identify the micro contexts (the two villages), namely, the building typologies, urban fabric, and the buildings' electricity consumption;
- Thirdly, the **statistical analysis** to observe the correlation between the socio-economic factors and daily life with the domestic energy consumption;
- Fourthly, the **comparative analysis** method between the case studies in Egypt and Italy has been implemented.

The **outcome** of this chapter is the first input to the empirical study in Chapter Four.

Chapter Two aims to diagnose the retrofitting practices in traditional settlements in Mediterranean countries between 2011-2021, utilizing the **analytical method**, which was implemented in three stages:

- Phase I, a top-down perspective of national energy efficiency plans with particular reference to buildings in Egypt and Italy (as an inductive method to the Mediterranean region;
- Phase II is a systematic literature review (SLR) of the previous SLR to explore whether the associated (Phase III) study was conducted in the Mediterranean.
- Phase III, an SLR, was conducted based on the PRISMA checklist (preferred reporting items for systematic reviews and meta-analyses) to answer the following key question:
  What aspects were considered in the retrofitting strategies implemented in the region? Besides the sub-questions:

1) who are the stakeholders (role, influence, and interests);

2) what are the approaches, methods, tools, and results;

3) which kind of interventions (buildings, public spaces, mobility, and infrastructure).

The results identified the gaps and potentials in the retrofitting process in traditional settlements in the Mediterranean region.

This **outcome** is the second input to the empirical study in Chapter Four.

Chapter Three aims to enhance the collaboration between stakeholders using the agile methodology practices (scrum tool) during early-stage collaboration and project planning, utilizing **theoretical and analytical methods**. Based on the relevant theoretical concepts about the three domains (software engineering, project management, and energy retrofitting practices). To answer three questions:

- To what extent can the agile methodology (Scrum model) be adopted in transdisciplinary practices?
- Wah the restrictions and benefits of adjusting agile methods in collaborative work?
- What is the agreement level about the technical interventions?

The **outcome** provided a conceptual transdisciplinary framework.

In Chapter Four, based on the outcomes of the last three chapters, the framework will be evaluated, using utilizing the **qualitative method,** starting with **face-to-face interviews** and **on-site visits** to explore feedback and refine the procedure. Followed by **workshops and focus groups on validating the framework**. By answering the key questions:

- To what extent can the agile methodology (the scrum model) be adopted in transdisciplinary practices?
- Wah the restrictions and benefits of adjusting the scrum framework in collaborative work?
- What is the agreement level about the technical interventions?
- What is the perception of the participants of the subject?
- What are their concerns about the obstacles?
- To what extent can the study implement a pilot project?

The results showed that the framework proved effective in enhancing the participatory approach.

In Chapter 5, the significant research results have been presented and discussed, followed by recommendations and further studies. Figure (00-52) depicts the research structure and methods.

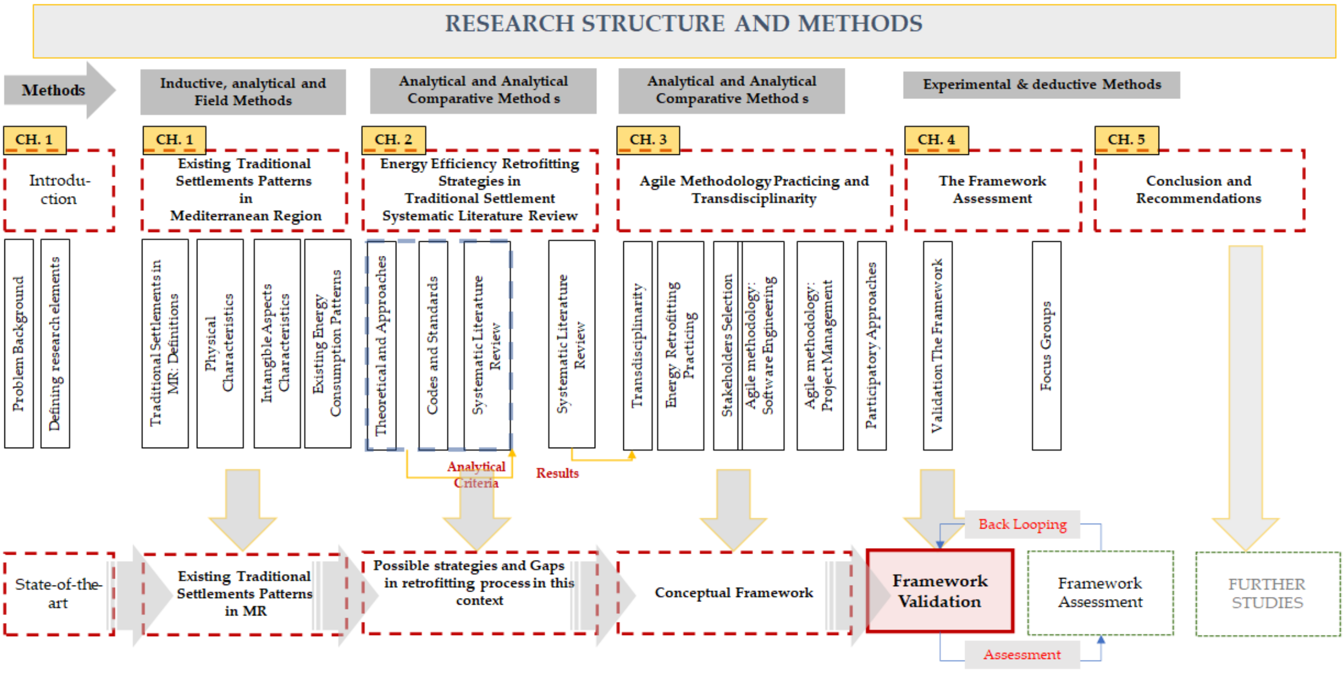


Figure (00-52) Research Structure and Methodology.

Introductory Chapter References

A., J. K. (1994). ENHANCING EFFECTIVENESS: AN INVESTIGATION OF ADVANTAGES AND DISADVANTAGES OF VALUE-BASED INTRAGROUP CONFLICT. *International Journal of Conflict Management*, *5*(3), 223–238. https://doi.org/10.1108/eb022744

Abdrabo, M. A., & Hassaan, M. A. (2015). An integrated framework for urban resilience to climate change – Case study: Sea level rise impacts on the Nile Delta coastal urban areas. *Urban Climate*, *14*, 554–565. https://doi.org/https://doi.org/10.1016/j.uclim.2015.09.005

Abouaiana, A. (2021). Retrofitting Rural Dwellings in Delta Region to Enhance Climate Change Mitigation in Egypt. *Environmental and Climate Technologies*, *25*(1), 136–150. https://doi.org/10.2478/rtuect-2021-0009

Abouaiana, A. A. A. (2016). *"Principles for Existing Rural House Sustainability in Delta Region (With Special Reference to Energy Efficiency)" (In Arabic)* [Cairo University, Giza]. https://doi.org/10.13140/RG.2.2.21412.71044

Abouaiana, A., & Mendonça, P. (2022). Retrofitting Dwellings in Traditional Coastal Settlements in Egypt and Portugal Using Nature-Based Solutions and Conventional Thermal Insulation Materials: Technical and Economic Assessment. *Journal of Architectural Engineering*, *28*(2), 05022005. https://doi.org/10.1061/(ASCE)AE.1943-5568.0000537

Aboulnaga, M. M., Elwan, A. F., & Elsharouny, M. R. (2019). Urban Climate Change Adaptation in Developing Countries. In *Urban Climate Change Adaptation in Developing Countries*. https://doi.org/10.1007/978-3-030-05405-2

ACT. (2019). *Territorial Cohesion Agency - Internal Areas National Strategy - Internal Areas National Strategy (In Italian)*. https://www.agenziacoesione.gov.it/strategia-nazionale-aree-interne/ (Accessed 11-2020))

Agile Manifesto. (2001). *Manifesto for Agile Software Development*.

Ahmad, G. E. (2002). Photovoltaic-powered rural zone family house in Egypt. *Renewable Energy*, *26*(3), 379–390. https://doi.org/https://doi.org/10.1016/S0960-1481(01)00131-8

Al-hagla, K. S., & El-sayad, Z. T. (2019). Using simulation methods to investigate the impact of urban form on human comfort. Case study: Coast of Baltim, North Coast, Egypt. *Alexandria Engineering Journal*, *58*(1), 273–282. https://doi.org/10.1016/j.aej.2019.02.002

Al, W., ORKING, G. R., & CLIMA, O. (2008). Climate change and food security: a framework document. *FAO Rome*.

Alatrokjy, A., & Fleyeh, M. K. (2014). Economic Factors in Study of Human Settlement. *Dananir Magazine*, *1*(6), 1–33. https://www.iasj.net/iasj/download/a3448fa6f4dc85ac

Alawadi, S., Mera, D., Fernández-Delgado, M., Alkhabbas, F., Olsson, C. M., & Davidsson, P. (2020). A comparison of machine learning algorithms for forecasting indoor temperature in smart buildings. *Energy Systems*, 1–17. https://doi.org/10.1007/s12667-020-00376-x

Allam, A. K., & Amer, I. A. (2001). *Rural housing in the Egyptian village, The Anglo Egyptian Bookshop. (In Arabic).* The Anglo Egyptian Bookshop. https://www.anglo-egyptian.com/ar/book.php?id=540

Almeida, M., Rodrigues, A., Cabral, I., Ferreira, M., Coelho, A., & Machado, G. (2014). *Deep energy retrofit of vernacular housing*. *November*, 32–36. https://repositorium.sdum.uminho.pt/handle/1822/43389

AlSayyad, N. (1995). From vernacularism to globalism: the temporal reality of traditional settlements. *Traditional Dwellings and Settlements Review*, 13–24.

Anagnostopoulos, G. L. (1977). Traditional settlements in the landscape. *Planning Outlook*, *20*(2), 3–5.

APM. (2021). *APM - the chartered body for the project profession*. https://www.apm.org.uk/ (Accessed 17-11-2021)

Aranha, J. L. (1991). ACOMPARISON OF TRADITIONAL SETTLEMENTS IN NEPAL AND BALI. *Traditional Dwellings and Settlements Review*, 35–47.

ARERA. (2021). *Energy: Government intervention reduces the impact of increases, + 29.8% for electricity and + 14.4% for gas. Zero impact on families in difficulty (Energia: intervento del Governo riduce impatto aumenti, +29,8% per elettricità e +14,4% per gas. Impatto z*. https://www.arera.it/it/com_stampa/21/210928agg.htm# (Accessed 10-10-2021)

Arouri, M. E. H., Ben Youssef, A., M'henni, H., & Rault, C. (2012). Energy consumption, economic growth and CO 2 emissions in Middle East and North African countries. *Energy Policy*, *45*, 342–349. https://doi.org/10.1016/j.enpol.2012.02.042

Bagshaw, D., Lepp, M., & Zorn, C. R. (2007). International research collaboration: Building teams and managing conflicts. *Conflict Resolution Quarterly*, *24*(4), 433–446.

Balaji, S., & Murugaiyan, M. S. (2012). Waterfall vs. V-Model vs. Agile: A comparative study on SDLC. *International Journal of Information Technology and Business Management*, *2*(1), 26–30.

Baldin, Giorgio Crosato, F. (2017). L'innalzamento del livello medio del mare a Venezia: eustatismo e subsidenza. *ISPRA, Quaderni - Ricerca Marina 10/2017, Roma. Autori*.

Barca, F., Casavola, P., & Lucatelli, S. (2014). *Strategia nazionale per le Aree interne: definizione, obiettivi, strumenti e governance*. Ministero dello Sviluppo Economico, Dipartimento per lo Sviluppo e la ….

Basile, G., & Cavallo, A. (2020). Rural Identity, Authenticity, and Sustainability in Italian Inner Areas. *Sustainability*, *12*(3), 1272. https://doi.org/10.3390/su12031272

Battisti, A. (2017). Revitalization and refurbishment of minor historical centers in the Mediterranean. In A. Sayigh (Ed.), *Mediterranean Green Buildings & Renewable Energy Selected Papers from the World Renewable Energy Network's Med Green Forum* (pp. 235–244). Springer. https://doi.org/10.1007/978-3-319-30746-6_17

Battisti, A. (2020). *Resilience of inner areas : Regeneration and enhancement strategies in small towns*. Technische Universität München Fakultät für Architektur. https://doi.org/10.14459/2020md1554213

Battisti, A., & Cimini, S. (2015). THE REGENERATION OF HISTORICAL SMALL TOWN CENTERS: A METHODOLOGY FOR PARTICIPATE ACTION. *BDC. Bollettino Del Centro Calza Bini*, *15*(2), 343–357.

Battisti, A., Persiani, S. G. L., & Crespi, M. (2019). Review and mapping of parameters for the early stage design of adaptive building technologies through life cycle assessment tools. *Energies*, *12*(9). https://doi.org/10.3390/en12091729

Beck, K., Beedle, M., Van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., Grenning, J., Highsmith, J., Hunt, A., & Jeffries, R. (2001). *Manifesto for agile software development*.

Benni, S., Carfagna, E., Torreggiani, D., Maino, E., Bovo, M., & Tassinari, P. (2019). Multidimensional Measurement of the Level of Consistency of Farm Buildings with Rural Heritage: A Methodology Tested on an Italian Case Study. *Sustainability*, *11*(15), 4242.

Bianco, V., & Marmori, C. (2022). Modelling the deployment of energy efficiency measures for the residential sector. The case of Italy. *Sustainable Energy Technologies and Assessments*, *49*, 101777.

Bouchair, A., & Dupagne, A. (2003). Building traditions of Mzab facing the challenges of re-shaping of its built form and society. *Building and Environment*, *38*(11), 1345–1364. https://doi.org/10.1016/S0360-1323(03)00065-9

Byrd, B. F., Dearmond, S., & Engbring, L. (2018). Re-visualizing Indigenous Persistence during Colonization from the Perspective of Traditional Settlements in the San Francisco Bay-Delta Area. *Journal of California and Great Basin Anthropology*, *38*(2), 163–190.

Calise, F., Cappiello, F. L., Vicidomini, M., Song, J., Pantaleo, A. M., Abdelhady, S., Shaban, A., & Markides, C. N. (2021). Energy and Economic Assessment of Energy Efficiency Options for Energy Districts: Case Studies in Italy and Egypt. *Energies*, *14*(4), 1012.

Caltabiano, I. (2006). The traditional architecture in Sicily: the rural area around the volcano Etna. *Proceedings of the PLEA2006—The 23rd Conference on Passive and Low Energy Architecture, Geneva, Switzerland*, 6–8.

CAPMAS. (2017a). *Annual Bulletin of Electricity and Energy Statistics 2015/2016*. Central Agency for Public Mobilization and Statistics.

CAPMAS. (2017b). *Egypt Population, Housing, and Establishments Census 2017.* http://www.capmas.gov.eg/Pages/ShowPDF.aspx?page_id=/Admin/Pages Files/201710914947book.pdf

CAPMAS. (2018). *Egypt in Figures*. Arab Republic of Egypt. Central Agency for Public Mobilization and Statistics (In Arabic). http://www.sis.gov.eg/UP/Egypt in Figures 2018/egypt-in-numbers2018.pdf

CAPMAS. (2022). *Central Agency for Public Mobilization and Statistics (In Arabic).* https://www.capmas.gov.eg/HomePage.aspx (Accessed 25-01-2022)

Cavallaro, C. (2014). Regional Geography. In S. Mangiameli (Ed.), *Italian Regionalism: Between Unitary Traditions and Federal Processes* (pp. 81–109). Springer.

Chan, L. H., & Chen, C. (2010). Conflict from teamwork in project-based collaborative learning. *Performance Improvement*, *49*(2), 23–28.

Cillis, G., Statuto, D., & Picuno, P. (2020). Vernacular Farm Buildings and Rural Landscape: A Geospatial Approach for Their Integrated Management. *Sustainability*, *12*(1), 4.

Conway, D., & Hulme, M. (1996). The impacts of climate variability and future climate change in the Nile Basin on water resources in Egypt. *International Journal of Water Resources Development*, *12*(3), 277–296. https://doi.org/10.1080/07900629650178

Cramer, W., Guiot, J., & Marini, K. (2018). Risks Associated to Climate and Environmental Changes in the Mediterranean Region. In *MedECC report*.

Dabaieh, M., Makhlouf, N. N., & Hosny, O. M. (2016). Roof top PV retrofitting: A rehabilitation assessment towards nearly zero energy buildings in remote off-grid vernacular settlements in Egypt. *Solar Energy*, *123*, 160–173.

Daglio, L., Boi, G., & Podda, R. (2020). Participated Strategies for Small Towns Regeneration. The Case of Oliena (Nu) Historic Centre. In *Regeneration of the Built Environment from a Circular Economy Perspective* (pp. 89–97). Springer, Cham.

Davico, A., & Mendonça, P. (2012). Memory of an ephemeral architecture. In Paola De Joanna, D. Francese,

& A. Passaro (Eds.), *Sustainable Mediterranean Construction. Sustainable environment in the mediterranean region: from Housing to urban and land scale construction* (Vol. 83, pp. 335–344). FrancoAngeli s.r.l., Milano, Italy. https://books.google.com.eg/books?hl=en&lr=&id=a5mFvlq8wi4C&oi=fnd&pg=PA129&ots=8B4p96PyFy&sig=D2JZn2adBRrBf54q0yQ6SKkfWig&redir_esc=y#v=onepage&q&f=false

De Dreu, C. K. W., & Weingart, L. R. (2003). Task versus relationship conflict, team performance, and team member satisfaction: A meta-analysis. *Journal of Applied Psychology*, *88*(4), 741–749. https://doi.org/10.1037/0021-9010.88.4.741

De Joanna, P, Dabija, A. M., Passaro, A., Vaccaro, G., & Sfinteș, R. (2020). THE REASONS OF THE VERNACULAR ARCHITECTURE FOR THE REGULATION OF CONTEMPORARY INTERVENTIONS. TWO EXAMPLES OF RURAL ARCHITECTURE ON DANUBE DELTA AND THE VESUVIUS. *International Archives of the Photogrammetry, Remote Sensing & Spatial Information Sciences*.

Di Figlia, L. (2016). Turnaround: abandoned villages, from discarded elements of modern Italian society to possible resources. *International Planning Studies*, *21*(3), 278–297.

Di Pilla, L., Desogus, G., Mura, S., Ricciu, R., & Di Francesco, M. (2016). Optimizing the distribution of Italian building energy retrofit incentives with Linear Programming. *Energy and Buildings*, *112*, 21–27.

Digital.ai. (2020). *15th State of Agile Report Agile adoption accelerates across the enterprise*. https://digital.ai/resource-center/analyst-reports/state-of-agile-report

DIJKSTRA, L., HAMILTON, E., LALL, S., & WAHBA, S. (2020). *How do we define cities, towns, and rural areas?* https://blogs.worldbank.org/sustainablecities/how-do-we-define-cities-towns-and-rural-areas (Accessed 12-08-2020)

Dybå, T., & Dingsøyr, T. (2008). Empirical studies of agile software development: A systematic review. *Information and Software Technology*, *50*(9–10), 833–859.

East, M. (2017). Integrated approaches and interventions for the regeneration of abandoned towns in southern Italy. *Interaction of Communities, Residents and Activists*, 87–102.

Eben Saleh, M. A. (1998). Transformation of the traditional settlements of southwest Saudi Arabia. *Planning Perspectives*, *13*(2), 195–215. https://doi.org/10.1080/026654398364527

Eisermann, M., Maurer, C., & Turner, I. (2019). *Boosting energy retrofits in condominiums Approaches for local authorities to facilitate change,*. Interreg Europe. https://energy-cities.eu/wp-content/uploads/2019/11/Guide_ACE_EN_web.pdf

El-Nahry, A. H., & Doluschitz, R. (2010). Climate change and its impacts on the coastal zone of the Nile Delta, Egypt. *Environmental Earth Sciences*, *59*(7), 1497–1506. https://doi.org/10.1007/s12665-009-0135-0

Elagouz, M. H., Abou-Shleel, S. M., Belal, A. A., & El-Mohandes, M. A. O. (2020). Detection of land use/cover change in Egyptian Nile Delta using remote sensing. *The Egyptian Journal of Remote Sensing and Space Science*, *23*(1), 57–62. https://doi.org/https://doi.org/10.1016/j.ejrs.2018.10.004

Elmenofi, G. A. G., El Bilali, H., & Berjan, S. (2014). Governance of rural development in Egypt. *Annals of Agricultural Sciences*, *59*(2), 285–296. https://doi.org/10.1016/j.aoas.2014.11.018

Elsaid, M. A. (2007). "Planning for sustainable rural development in Egypt." In *Ain Shams University, Faculty of Engineering, Cairo*. http://cpas-egypt.com/pdf/Marwa/English.pdf

Elsayed, O., & Eldeeb, S. (2013). *In pictures, Hurricane Gamasa disaster:400 lighting poles and 14 high-pressure* *towers were destroyed, electricity was cut off and two factories of linen and paints were destroyed. Dozens of acres of watermelon and tomatoes were destroyed in the villages o*. Youm 7. https://www.youm7.com/story/2013/5/12/-بالصور-كارثة-إعصار-جمصة-تدمير-400-عمود-إنارة-و14-برجًا/1061031#.U8q7uvmSzX4 (Accessed 19-06-2021)

Embabi, N. S. (2018). *Landscapes and landforms of Egypt*. Springer.

Embabi, N. S. (2020). Landscapes of Egypt. In *Environmental Remote Sensing in Egypt* (pp. 501–532). Springer.

ENEA. (2018). Energy Efficiency trends and policies in Italy. In *ENEA*. https://www.odyssee-mure.eu/publications/national-reports/energy-efficiency-italy.pdf

Engineering, M., Development, U., & National, B. (2018). *A PROPOSAL FOR DESERT HOUSE DESIGN IN EGYPT USING PASSIVE GROUND COOLING TECHNIQUES*. *4*(1), 21–41.

ENRD. (2019). *Strategy for Inner Areas Italy Working document*. https://enrd.ec.europa.eu/sites/enrd/files/tg_smart-villages_case-study_it.pdf

European Commission. (2018a). DIRECTIVE (EU) 2018/844 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency (Text with EEA relevance). *Official Journal of the European Union*, *61*, 17. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2018.156.01.0075.01.ENG

European Commission. (2018b). Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council,. *Official Journal of the European Union*, *61*(L 328). https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L:2018:328:FULL&from=EN

European Commission. (2020). *COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Stepping up Europe's 2030 climate ambition: Investing in a climate-neutral future for the benefit of our*. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0562&from=EN

EUROSTAT. (2020a). *European Commission Eurostat NUTS - Nomenclature of territorial units for statistics Correspondence tables National structures*. https://ec.europa.eu/eurostat/web/nuts/national-structures (Accessed 28-10-2020)

EUROSTAT. (2020b). *European Commission Eurostat NUTS - Nomenclature of territorial units for statistics History of NUTS*. https://ec.europa.eu/eurostat/web/nuts/history (Accessed 16-10-2020)

EUROSTAT. (2020c). *Glossary:Nomenclature of territorial units for statistics (NUTS)*. https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Nomenclature_of_territorial_units_for_statistics_%28NUTS%29#:~:text=The Nomenclature of territorial units,2 and 3 respectively%2C moving (Accessed 28-10-2020)

EUROSTAT. (2020d). *Population as a percentage of EU27 (from 2020) population*. https://ec.europa.eu/eurostat/databrowser/view/tps00005/default/table?lang=en (Accessed 15-10-2020)

EUROSTAT. (2021a). *European Commission- Eurostat- NUTS - Nomenclature of territorial units for statistics-Background*. https://ec.europa.eu/eurostat/web/nuts/background Accessed (16-09-2021)

EUROSTAT. (2021b). *Land use overview by NUTS 2 regions - Last update: 14-07-2021*. https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do (Accessed 16-10-2021)

FAO. (2018). *Guidelines on defining rural areas and compiling indicators for development policy*. http://www.fao.org/3/ca6392en/ca6392en.pdf

Fathy, H. (1989). *Architecture of The Poor: Experience in Rural Egypt. (In Arabic).* American University in Cairo.

Forleo, M. B., Giaccio, V., Giannelli, A., Mastronardi, L., & Palmieri, N. (2017). Socio-economic drivers, land cover changes and the dynamics of rural settlements: Mt. Matese area (Italy). *European Countryside*, *9*(3), 435.

Fulloni, A. (2019). ITALY IN CRISIS Bad weather, record high water in Venice: 1.87 meters. Two people died on the island of Pellestrina (ITALIA IN CRISI Maltempo, a Venezia acqua alta da record: 1,87 metri. Due persone morte sull'isola di Pellestrina). *Corriere Della Sera*. https://www.corriere.it/cronache/19_novembre_12/maltempo-sassi-matera-fango-detriti-venezia-allagata-san-marco-2bd9cec8-058b-11ea-a1df-d75c93ec44da.shtml (Accessed 15-08-2020)

Gao, Y. (2016). Top-down and bottom-up processes for rural development and the role of architects in Yunnan, China. *Buildings*, *6*(4), 47. https://doi.org/10.3390/buildings6040047

Ghonimi, I., & Zamly, H. (2017). Towards Sustainable New Settlements in Egypt: Lessons Learned from a Comparison between Traditional and Modern Settlements in Greater Cairo Region-Egypt. *Journal of Sustainable Development*, *10*(5).

Gobattoni, F., Pelorosso, R., Leone, A., & Ripa, M. N. (2015). Sustainable rural development: The role of traditional activities in Central Italy. *Land Use Policy*, *48*(2015), 412–427. https://doi.org/https://doi.org/10.1016/j.landusepol.2015.06.013

GOPP. (2008). *Development Strategy for the Governorates of the Republic: Delta Region (Dakahlia, Damietta, Kafr El-Shiekh, Monufia and Gharbia)*. Ministry of Housing, Utilities and Urban Communities represented by the General Organization for Physical Planning (In Arabic). http://gopp.gov.eg/wp-content/uploads/2013/03/2008-استراتيجية-التنمية-لمحافظات-الجمهورية-اقليم-الدلتا.pdf

GOPP. (2012). *Greater Cairo Urban Development Strategy*. Arab Republic of Egypt. Ministry of Housing, Utilities and Urban Communities represented by the General Organization for Physical Planning (In Arabic). http://gopp.gov.eg/wp-content/uploads/2015/07/1CFV-EN.pdf

GOPP. (2013). *Strategic Urban Plans for Northern Upper Egypt Region and Its Governorates*. Arab Republic of Egypt. Ministry of Housing, Utilities and Urban Communities represented by the General Organization for Physical Planning (In Arabic). http://gopp.gov.eg/wp-content/uploads/2012/09/المخططات-العمرانية-الإستراتيجية.pdf

GOPP. (2014a). *Tha National Urban Development Framework in the Arab Republic of Egypt*. Arab Republic of Egypt, Ministry of Housing, Utilities and Urban Communities, General Organization for Physical Planning. http://gopp.gov.eg/wp-content/uploads/2015/01/GOPP-PA_2014.pdf

GOPP. (2014b). *The Environmental Perspective of The Urban Development Strategy at The Republic Level : Canal Suez Region*. Ministry of Housing, Utilities and Urban Communities represented by the General Organization for Physical Planning, General Administration for Environmental and Natural Studies (In Arabic). http://gopp.gov.eg/wp-content/uploads/2010/11/المنظور-البيئى-لاقليم-قناة-السويس.pdf

Grano, M. C. (2014). Landscape, rural structures and popular architecture in the provinces of Potenza and Matera (In Italian). *Cultural Landscapes: Metodi, Strumenti e Analisi Del Paesaggio Fra Archeologia, Geologia* *e Storia in Contesti Di Studio Del Lazio e Della Basilicata (Italia). BAR International Series*, *2629*, 131–148. https://www.researchgate.net/publication/303932128_PAESAGGIO_STRUTTURE_RURALI_E_ARCHITETTURA_POPOLARE_NELLE_PROVINCE_DI_POTENZA_E_MATERA

Hall-arber, A. M., & Hall-arber, M. (2016). *Linked references are available on JSTOR for this article : HEAR ME SPEAK : ITALIAN AND PORTUGUESE WOMEN FACING FISHERIES MANAGEMENT*. *38*(2), 221–248.

Hall-Arber, M. (1996). Hear me speak: Italian and Portuguese women facing fisheries management. *Anthropologica*, 221–248.

HBRC. (2008). *Egyptian Code for Improving the Efficiency of Energy Use in Buildings, Part 1: Residential Buildings, ECP306-2005. (In Arabic).* Ministry of Housing, Arab Republic of Egypt.

He, Y. F., Chen, C. P., & Chou, R. J. (2019). The key factors influencing safety analysis for traditional settlement landscape. *Sustainability (Switzerland)*, *11*(12). https://doi.org/10.3390/su10023431

Hicks, M., & Foster, J. S. (2010). *Adapting Scrum to Managing a Research Group*.

Highsmith, J., & Cockburn, A. (2001). Agile software development: The business of innovation. *Computer*, *34*(9), 120–127.

Hinrichs, R. A., & Kleinbach, M. H. (2012). *Energy: Its use and the environment*. Nelson Education.

Ibrahim, A. M. (n.d.-a). *Characteristics of Rural Housing in Egypt (In Arabic)*. Retrieved February 27, 2021, from https://www.cpas-egypt.com/Articles/Baki/Study/14.html

Ibrahim, A. M. (n.d.-b). *Rural Housing Project Presented to the Rural Housing Committee of the Supreme Council for Research Support (In Arabic)*. Article. http://www.cpas-egypt.com/Articles/Baki/Study/27.html

ilgazzettino. (2020). *4859871_venezia5.jpg*. https://foto.ilgazzettino.it/photogallery_img/HIGH/98/71/4859871_venezia5.jpg (Accessed 15-08-2020)

Inayat, I., Salim, S. S., Marczak, S., Daneva, M., & Shamshirband, S. (2015). A systematic literature review on agile requirements engineering practices and challenges. *Computers in Human Behavior*, *51*, 915–929.

ISTAT. (2011). *15th Census of Population and housing 2011*. http://dati-censimentopopolazione.istat.it/Index.aspx (Accessed 01-09-2021)

ISTAT. (2021). *We Italy. 100 statistics to understand the country we live in (In Italian)*. National Institute of Statistics - Italy. https://noi-italia.istat.it/

ISTAT. (2022). *Welcome to I.Stat, the complete data warehouse for experts*. http://dati.istat.it/ (Accessed 25-01-2022)

Jackson, S. E. (1991). Team composition in organizational settings: Issues in managing an increasingly diverse work force. *Symposium on Group Productivity and Process, 1989, Texas A & MU, College Station, TX, US*.

Kearney, M. (2001). Peasants and Rural Societies in History (Agricultural History). In N. J. Smelser & P. . Baltes (Eds.), *International Encyclopedia of the Social & Behavioral Sciences* (pp. 11169–11171). Elsevier. https://www.elsevier.com/books/international-encyclopedia-of-social-and-behavioral-sciences/smelser/978-0-08-043076-8

Kruse, S., Stiffler, M., Baumgartner, D., & Pütz, M. (2013). Vulnerability and adaptation to climate change in the Alpine space: a case study on the adaptive capacity of the tourism sector. *European Climate*

Vulnerabilities and Adaptation: A Spatial Planning Perspective, 273–287.

Lacirignola, C. (2017). Rural Migration: Agriculture and Inclusive Development for a Resilient Mediterranean. *IEMed: Mediterranean Yearbook*, *2017*, 296–299.

Lawrence, D. L., & Low, S. M. (1990). The built environment and spatial form. *Annual Review of Anthropology*, *19*, 453–505. https://doi.org/10.1146/annurev.an.19.100190.002321

Ledda, A., Serra, V., & De Montis, A. (2019). The Effect of Rural Buildings on Landscape Fragmentation in Natura 2000 Sites: A Case Study in Sardinia. *Sustainability*, *11*(17), 4695.

Lejeune, J.-F., & Sabatino, M. (2009). *Modern architecture and the Mediterranean: vernacular dialogues and contested identities*. Routledge.

MacDonald, D., Crabtree, J. R., Wiesinger, G., Dax, T., Stamou, N., Fleury, P., Lazpita, J. G., & Gibon, A. (2000). Agricultural abandonment in mountain areas of Europe: environmental consequences and policy response. *Journal of Environmental Management*, *59*(1), 47–69.

Madalina, O. (2016). Conflict management, a new challenge. *Procedia Economics and Finance*, *39*, 807–814.

Mahgoub, Y. (2001). The Transformation of Traditional Rural Settlements in Egypt. *The Second International Symposium in the Built Environment,"Traditional Environments in a New Millennium: Defining Principles and Professional Practices. Amasya- TURKEY*. https://www.slideshare.net/ymahgoub/the-transformation-of-traditional-rural-settlements-in-egypt

Mahgoub, Y. (2016). *The Transformation of Rural Settlements and Dwellings in Egypt*. *January*. https://doi.org/10.13140/RG.2.1.4826.1204

Mardiana, A., & Riffat, S. B. (2015). Building energy consumption and carbon dioxide emissions: threat to climate change. *Journal of Earth Science & Climatic Change*, *S3*, 1.

Masria, A., Negm, A., Iskander, M., & Saavedra, O. (2014). Coastal zone issues: A case study (Egypt). *Procedia Engineering*, *70*, 1102–1111. https://doi.org/10.1016/j.proeng.2014.02.122

Mastrangelo, N., Francese, D., Mendonca, P., & Amorim, F. (2016). *Bioclimatic Performances of Traditional Straw Construction in Italy and in Portugal*. https://doi.org/10.30958/ajms.2-4-2

Mat Radzuan, I. S., Fukami, N., & Ahmad, Y. (2015). Incentives for the conservation of traditional settlements: residents' perception in Ainokura and Kawagoe, Japan. *Journal of Tourism and Cultural Change*, *13*(4), 301–329.

May, J., & Reid, A. (2010). *Architettura senza architetti [Architecture without architects. Guide to spontaneous constructions from around the world]*. Rizzoli. https://www.amazon.com/Architettura-senza-architetti-costruzioni-spontanee/dp/8817037850

Mehibel, M., Pitts, A., & Gao, Y. (2014). Sustainability and the Urban Planning Context: Housing Development in Algeria. *PLEA (Passive and Low Energy Architecture) Conference 2014, 16th-18th December 2014, Ahmedabad, India.* https://core.ac.uk/download/pdf/30731083.pdf

Miao, Y., & Chiou, S.-C. (2012). Traditional Settlements Boundary Visualization. *2012 16th International Conference on Information Visualisation*, 607–609.

Millhous, L. M. (1999). The experience of culture in multicultural groups: Case studies of Russian-American collaboration in business. *Small Group Research*, *30*(3), 280–308. https://doi.org/10.1177/104649649903000302

MIPAAF. (2014). *Rete Rurale Nazionale Nota sulla classificazione delle aree rurali per la programmazione 2014-20 [National Rural Network Note on the classification of rural areas for programming 2014-20]* (p. 4). https://www.reterurale.it/areerurali

MISE. (2019). *INTEGRATED NATIONAL ENERGY AND CLIMATE PLAN*. Ministry of Economic Development, Ministry of the Environment and Protection of Natural Resources and the Sea, and Ministry of Infrastructure and Transport. https://www.mise.gov.it/images/stories/documenti/it_final_necp_main_en.pdf

Moughtin, J. C. (1964). The traditional settlements of the Hausa people. *The Town Planning Review*, *35*(1), 21–34.

NEEAP Egypt. (2012). *Arab Guideline to Improve Electric Power Efficiency and Rational Use of Electricity of the End User Energy Efficiency Plan in the Electricity Sector*. National Energy Efficiency Action Plans (NEEAP) for Egypt, LAS-RCREEE-Med-EMIP, 2012. https://taqaway.net/documents/national-energy-efficiency-action-plans-neeap-egypt-las-rcreee-med-emip-2012

Nori, M. (2018). Rural Migrations and Mediterranean Agricultural Systems. *IEMed: Mediterranean Yearbook*, *2018*, 59.

Nori, M., & Farinella, D. (2020). *Migration, Agriculture and Rural Development: IMISCOE Short Reader*. Springer Nature.

Nunkoo, D. K., & Sungkur, R. K. (2021). Team conflict dynamics & conflict management: derivation of a model for software organisations to enhance team performance and software quality. *Global Transitions Proceedings*, *2*(2), 545–552. https://doi.org/10.1016/j.gltp.2021.08.007

OECD, O. (2009). *Rural Policy Reviews: Italy*. OECD, Publishing, Paris. https://doi.org/https://doi.org/10.1787/9789264056237-3-en

Okorafor, C., Chetty, R., & Haupt, T. (2021). A framework for Implementing Energy Retrofit Projects in Existing Building in South Africa. *IOP Conference Series: Materials Science and Engineering*, *1107*(1), 12001.

Ouda, K. (2010). *Atlas of risks of climate change on the Egyptian coasts and defensive policies. Publisher: Assiut University, Assiut 71516, Egypt, 2 volumes, 955 p., 734 pl.*

Pagano, G., & Daniel, G. (1936). Italian rural Architecture. In *Milano: U. Hoepli*. (In Italian). https://digit.biblio.polito.it/4236/15/Architettura_rurale_italiana_G.Pagano_e_G.Daniel_compressed.pdf

Pallini, C. (2006). Italian architects and modern Egypt. *Studies on Architecture, History & Culture*, 39–50.

Parrish, K. (2013). *A Path to Successful Energy Retrofits: Early Collaboration through Integrated Project Delivery Teams*.

Perpina Castillo, C., Kavalov, B., Ribeiro Barranco, R., Diogo, V., Jacobs-Crisioni, C., Batista e Silva, F., Baranzelli, C., & Lavalle, C. (2018). *Territorial Fact and Trends in the EU Rural Areas within 2015-2030*. Joint Research Centre (Seville site).

Pezzi, M. G. (2017). From peripheral hamlet to craft beer capital: Apecchio and the 'Alogastronomia.' *Italian Journal of Planning Practice*, *7*(1), 154–185.

Picuno, P. (2016). Use of traditional material in farm buildings for a sustainable rural environment. *International Journal of Sustainable Built Environment*, *5*(2), 451–460.

Pizzoli, E., & Gong, X. (2007). How to Best Classify Rural and Urban. *Ponencia Presentada En La Fourth International Conference on Agriculture Statistics*, 22-24. http://www.stats.gov.cn/english/ICAS/papers/P020071017557234385229.pdf

PMI. (2017). *A guide to the project management body of knowledge (PMBOK guide) / Project Management Institute* (Sixth Edit). Project Management Institute.

Pozoukidou, G., & Papageorgiou, M. (2013). *Protection of traditional settlements in Greece: Legislation and practice*. Aristotle University of Thessaloniki.

Punziano, G., & Urso, G. (2016). Local development strategies for inner areas in Italy. A comparative analysis based on plan documents. *Italian Journal of Planning Practice*, *6*(1), 76–109.

Queysanne, B. (1989). TRADITION AND MODERNITY IN THE FACE OF TIME. In *Source: Traditional Dwellings and Settlements Review* (Vol. 1, Issue 1).

Ragette, F. (2003). *Traditional domestic architecture of the Arab region*. Edition Axel Menges.

Ramadan, S. (2013, May). Aftershocks of “Dakahlia cyclone”: darkness in “Gamasa” and the collapse of houses and power towers (In Arabic). *Elwatannews*. https://www.elwatannews.com/news/details/179908 (Accessed January 2022

Ramadier, T. (2004). Transdisciplinarity and its challenges: The case of urban studies. *Futures*, *36*(4), 423–439. https://doi.org/10.1016/j.futures.2003.10.009

Ramakrishnan, P. S. (2001). Ethnobiology. In N. Smelser & P. Baltes (Eds.), *International Encyclopedia of the Social & Behavioral Sciences* (pp. 4846–4852). Elsevier. https://www.elsevier.com/books/international-encyclopedia-of-social-and-behavioral-sciences/smelser/978-0-08-043076-8

Rapoport, A. (1969). House form and Cultua. *London-University College: New Delhi: Prentice-Hall of India Private Ltd*, 73.

Rapoport, A. (1983). Environmental quality, metropolitan areas and traditional settlements. *Habitat International*, *7*(3–4), 37–63.

Reterurale. (n.d.). *Rural Areas - Zoning and Cartography Rural Areas 2014-2020 (Aree rurali - Zonizzazione e Cartografia AREE RURALI 2014-2020)*. Retrieved October 15, 2020, from https://www.reterurale.it/areerurali

Romagnoli, L., & Mastronardi, L. (2020). Can local policies reduce the gap between “centers” and “inner areas”? The case of italian municipalities’ expenditure. *Economies*, *8*(2), 33. https://doi.org/10.3390/ECONOMIES8020033

Rosenfield, P. L. (1992). The potential of transdisciplinary research for sustaining and extending linkages between the health and social sciences. *Social Science and Medicine*, *35*(11), 1343–1357. https://doi.org/10.1016/0277-9536(92)90038-R

Ruggeri, A. G., Gabrielli, L., & Scarpa, M. (2020). Energy Retrofit in European Building Portfolios: A Review of Five Key Aspects. *Sustainability*, *12*(18), 7465.

Saleem, A. A., Abel-Rahman, A. K., Ali, A. H. H., & Ookawara, S. (2016). An analysis of thermal comfort and energy consumption within public primary schools in Egypt. *IAFOR J. Sustain. Energy Environ.*, *3*.

Saleh, M. A. E. (1999). Development versus deterioration of traditional settlements of Southwest Saudi Arabia: Government policies and possible courses of action. *Habitat International*, *23*(1), 93–112.

Sangiorgi, F. (2008). The vernacular rural heritage: from the past to the future. *În: Futuropa*, 39. https://rm.coe.int/090000168093e668

Savvides, A., Michael, A., Malaktou, E., & Philokyprou, M. (2016). Examination and assessment of insolation conditions of streetscapes of traditional settlements in the Eastern Mediterranean area. *Habitat International*, *53*, 442–452.

Sbci, U. (2009). Buildings and climate change: summary for decision-makers. In *United Nations Environmental Programme, Sustainable Buildings and Climate Initiative, Paris*. https://wedocs.unep.org/bitstream/handle/20.500.11822/32152/BCC_SDM.pdf?sequence=1&isAllowed=y

Schiliro, D. (2015). Mediterranean, migrations and economic development. *Journal of Advanced Research in Economics and International Business*, *3*(4), 20–26.

Schmidt, S., & Weigt, H. (2015). Interdisciplinary energy research and energy consumption: What, why, and how? *Energy Research & Social Science*, *10*, 206–219.

SISGOV. (2009). *Home About Egypt Basic Information Landforms (In Arabic)*. https://www.sis.gov.eg/Story/4?lang=ar (Accessed 11-2020)

Smith, J. B., McCarl, B. A., Kirshen, P., Jones, R., Deck, L., Abdrabo, M. A., Borhan, M., El-Ganzori, A., El-Shamy, M., Hassan, M., El-Shinnawy, I., Abrabou, M., Hassanein, M. K., El-Agizy, M., Bayoumi, M., & Hynninen, R. (2014). Egypt's economic vulnerability to climate change. *Climate Research*, *62*(1), 59–70. https://doi.org/10.3354/cr01257

Sorrentino, F. (2013). Historic rural and urban settlements and new communities (In Italian). *Bloom: Bloom Trimestrale Di Architettura a Cura Del Dottorato Di Ricerca in Composizione Architettonica Della Facolta Di Architettura Di Napoli*, 58–62. https://www.academia.edu/48950439/Insediamenti_rurali_ed_urbani_storici_e_nuove_comunità

Sozer, H. (2010). Improving energy efficiency through the design of the building envelope. *Building and Environment*, *45*(12), 2581–2593. https://doi.org/10.1016/j.buildenv.2010.05.004

Statuto, D., Cillis, G., & Picuno, P. (2016). Analysis of the effects of agricultural land use change on rural environment and landscape through historical cartography and GIS tools. *Journal of Agricultural Engineering*, *47*(1), 28–39.

Stern, N., & Stern, N. H. (2007). *The economics of climate change: the Stern review*. cambridge University press.

Stoffle, R., & Minnis, J. (2007). Marine protected areas and the coral reefs of traditional settlements in the Exumas, Bahamas. *Coral Reefs*, *26*(4), 1023–1032. https://doi.org/10.1007/s00338-007-0264-4

Streule, T., Miserini, N., Bartlomé, O., Klippel, M., & de Soto, B. G. (2016). Implementation of Scrum in the Construction Industry. *Procedia Engineering*, *164*, 269–276. https://doi.org/10.1016/j.proeng.2016.11.619

Swetnam-Burland, M. (2015). *Egypt in Italy*. Cambridge University Press.

Tagliabue, L. C., Leonforte, F., & Compostella, J. (2012). Renovation of an UNESCO Heritage Settlement in Southern Italy: ASHP and BIPV for a "Spread Hotel" Project. *Energy Procedia*, *30*, 1060–1068. https://doi.org/https://doi.org/10.1016/j.egypro.2012.11.119

Tassinari, P., Carfagna, E., Benni, S., & Torreggiani, D. (2008). Wide-area spatial analysis: A first methodological contribution for the study of changes in the rural built environment. *Biosystems Engineering*, *100*(3), 435–447.

Teixeira, M. C. (1990). Portuguese traditional settlements, a result of cultural miscegenation. *Traditional Dwellings and Settlements Review*, 23–34.

Tempesta, T. (2010). The perception of agrarian historical landscapes: A study of the Veneto plain in Italy. *Landscape and Urban Planning*, *97*(4), 258–272.

Theocharis, G., Kuhrmann, M., Münch, J., & Diebold, P. (2015). *Is Water-Scrum-Fall Reality? On the Use of Agile and Traditional Development Practices BT - Product-Focused Software Process Improvement* (P. Abrahamsson, L. Corral, M. Oivo, & B. Russo (eds.); pp. 149–166). Springer International Publishing.

Thompson Klein, J. (2004). Prospects for transdisciplinarity. *Futures*, *36*(4), 515–526. https://doi.org/10.1016/j.futures.2003.10.007

Tian, C., Feng, G., Li, S., & Xu, F. (2019). Scenario analysis on energy consumption and CO2 emissions reduction potential in building heating sector at community level. *Sustainability (Switzerland)*, *11*(19). https://doi.org/10.3390/su11195392

Torreggiani, D., & Tassinari, P. (2012). Landscape quality of farm buildings: The evolution of the design approach in Italy. *Journal of Cultural Heritage*, *13*(1), 59–68. https://doi.org/https://doi.org/10.1016/j.culher.2011.06.002

Tosi, H. L. (1994). *Managing organizational behavior / Henry L. Tosi, John R. Rizzo, Stephen J. Carroll* (S. J. Carroll 1930- & J. R. Rizzo (eds.)). Blackwell.

Tsilimigkas, G., & Derdemezi, E.-T. (2020). Spatial Planning and the Traditional Settlements Management: Evidence from Visibility Analysis of Traditional Settlements in Cyclades, Greece. *Planning Practice & Research*, *35*(1), 86–106.

UN-Habitat. (2016). *ARAB REPUBLIC OF EGYPT NATIONAL REPORT*. https://uploads.habitat3.org/hb3/Egypt-Final-in-English.compressed-1.pdf

UN Statistical Commission. (2020). *A recommendation on the method to delineate cities, urban and rural areas for international statistical comparisons* (Statistical Commission Background Document Fifty-First Session 3 – 6 March 2020 Item 3(j) of the Provisional Agenda Items for Discussion and Decision: Demographic Statistics). https://unstats.un.org/unsd/statcom/51st-session/documents/BG-Item3j-Recommendation-E.pdf

United Nations. (2021). *#Envision2030: 17 goals to transform the world for persons with disabilities*. https://www.un.org/development/desa/disabilities/envision2030.html

Watts, D. J. (1981). Recurring patterns in traditional Afghan settlements. *Afghanistan Journal*, *8*(2), 66–72. https://krex.k-state.edu/dspace/handle/2097/1315

Wickson, F., Carew, A. L., & Russell, A. W. (2006). Transdisciplinary research: characteristics, quandaries and quality. *Futures*, *38*(9), 1046–1059. https://doi.org/10.1016/j.futures.2006.02.011

Wikipedia. (2020). *Koppen-Geiger_Map_ITA_present.svg*. https://upload.wikimedia.org/wikipedia/commons/f/ff/Koppen-Geiger_Map_ITA_present.svg (Accessed 09-11-2020)

Wikipedia. (2021). *Climate of Egypt*. https://en.wikipedia.org/wiki/Climate_of_Egypt (09-11-2020)

WYE, G. (2007). *Rural Households' Livelihood and Well-Being: Statistics on Rural Development and Agriculture Household Income*. UN ESCAP. http://www.fao.org/3/am085e/am085e00.htm

Xu, W., & Svetozar, Z. (2016). Planning structure of traditional settlements in mountainous regions in Guizhou province of China. *Architecture and Engineering*, *1*(2).

ZAMPERINI, E., & CINIERI, V. (2014). The ideological approach to the study of Italian rural architecture in first half of XX century. *Best Practices in Heritage Conservation and Management. From the World to Pompeii. Le Vie Dei Mercanti-XII Forum Internazionale Di Studi, Napoli, La Scuola Di Pitagora*, 1149–1158.

Zheng, H. C., Chen, C. Q., Tang, L., & He, Y. Q. (2013). Research on the Spatial Construction Strategy of Traditional Settlements for the Tujia Nationality. *Applied Mechanics and Materials*, *357*, 120–128.

I. Built Environment and Energy Consumption in Typical Mediterranean Traditional Settlements: *Cases of Egypt and Italy*

Abstract

The current pattern of the traditional settlements suffers from many environmental challenges, particularly the growing resource consumption and demand, such as energy, the core of development. This paper aims to diagnose the built environment operation energy consumption to apprehend energy efficiency requirements in the Mediterranean region in order to pave the way for retrofitting, in line with the other chapters' objectives.

An inductive method has been carried out by selecting two typical traditional settlements -in similar regions -in Egypt and Italy as representatives of the entire Mediterranean region. This study has been implemented into two hierarchal scales. First, identifies the characteristics of the current built environment pattern (physical and intangible) at national and regional levels relying on an analytical method of the official census and literature studies. Second, field studies on two similar case studies, Lasaifar Albalad, Delta Region in northern Egypt, and Pontinia, Lazio Region in central Italy, in order to characterize the existing built environment patterns and provide a comparative analysis between them.

Furthermore, a pilot experiment in Lasiafar Albalad has been implemented to investigate the correlation between the built environment and end-use energy consumption using statistical analysis, namely Pearson Correlation Coefficient) with the numeric data and using One-way analysis of variance (ANOVA) for the qualitative aspects.

In Lasaifar Albalad, a sample of 46 typical buildings representing all buildings types was examined. The current operating energy consumption of different building types quantified based on electricity bills and family visits social activity has been observed as much energy consumption rather than other social activities. A better understanding between energy consumption and the built environment was provided. In Pontinia, the statistical data was not significant, and a cultural barrier has been indicated. The influencer stakeholders were interviewed and identified. Finally, further studies to propose retrofitting these contexts, based on the outcomes, are presented.

Highlights

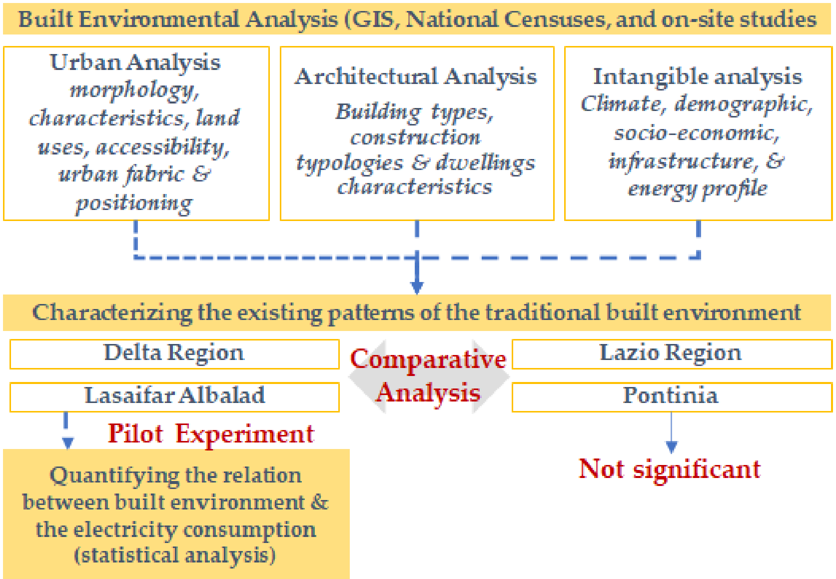
- The first study that diagnosed Lasaifar Albalad traditional settlement (representing the 339 main ones in Delta Region)
- The first study diagnosed the built environment in Pontinia traditional settlement (representing a typical rural pattern of the Lazio region, unique urban fabric, and architectural style of the 1930s in Italy and the World.
- Qualitative correlation and quantitative explanations were conducted between end-use energy consumption and spatial aspects, demographic factors, and economic activities in Lasaifar Albalad.
- A comparative analysis between Egyptian and Italian case studies has been provided.

Keywords

Building Typologies; Domestic Energy; Socio-economic Activities; Statistical Analysis

Nomenclature	
ISTAT	The National Institute of Statistics (the official body in Italy)
NUTS	Nomenclature of Territorial Units for Statistics
LAU	Local Administrative Unit (administrative division in EU)
DEGURBA	Degree of Urbanisation (LAU classifier in the territory of the EU)
EUROSTAT	The Statistical Office of the European Union
Mtoe	Million tonnes of oil equivalent (Unit of energy)
CAPMAS	Central Agency for Public Mobilization and Statistics (the official body in Egypt)
GOPP	General Authority for Urban Planning (Egypt)

Visual Summary



1.0 Introduction

Traditional Settlements are the societies and villages that emerged vernacularly, and they have distinguished architectural typology and urban fabric, achieving dwellers' satisfaction through transferring knowledge between generations. These patterns developed around the mid of 1900s due to significant milestones. They are rural in terms of high population density, relying on economic activities, such as fishing and farming, blending primitive -small-scale- and modern techniques. The prevailing buildings' typologies are contemporary that does not consider the environment.

Traditional Mediterranean settlements face many challenges, such as rural population decline on Euro-Mediterranean flanks or accessibility to the Mediterranean's southern regions' productive land resources. (Nori, 2018; Nori & Farinella, 2020). Nowadays, the built environment in the traditional Mediterranean settlements are being reformed rapidly, where a new pattern is taking the place of the vernacular due to many aspects, such as -but not limited to, industrialization in Italy (Torreggiani & Tassinari, 2012), the Modernist Movement in Cyprus (Al-Din, 2017), socioeconomic transformations in Egypt and Algeria (Zeghlache & Alıkhodja, 2017; Sebti et al., 2013; Mahgoub, 2001), and urbanization in Jordan (Baglioni, 2015).

These patterns developed considerably around the 1950s due to significant milestones- however, they originated in previous periods.

They are predominately rural in terms of high population density, relying on economic activities, such as fishing and farming, using the integration of primitive -small-scale- and modern techniques. The prevailing buildings' typologies are contemporary and do not consider the environment that consumes natural resources and increases the demand for energy and water resources. Therefore, this chapter aims to interpret the existing built environment pattern (physical and intangible) characteristics of (outdoor spaces, in-between spaces, buildings, and activities) deeply in traditional settlements in the Mediterranean region, with a particular reference to energy consumption. This chapter will focus on Egypt and Italy as an inductive method to generalize the whole region's results. Both represent two mainstreams in terms of geographic location, culture, religion, and economy, where Italy represents the European countries while Egypt represents the southern Mediterranean countries.

In order to foster a new approach, field studies have been carried out by selecting a similar traditional settlement pattern in both countries, based on several factors, such as population, the same small-dimension economy of farming activities, same building age, population size, and area. Each context has a historical past in this activity. Besides, a comparative analytical study between contexts has been provided. As concluded from the introductory chapter, the case studies belong to the Delta region in Egypt and the Lazio region in Italy.

1.1 Location

1.1.1 Delta Region

The Nile Delta is formed in Northern Egypt. It lies north of Cairo, then drains into the Mediterranean Sea. The vast triangle shape of the Delta is shaped by the discharge of the Nile Rosetta and Damietta branches. It is located between latitude 30 22, 31 50 and Longitude 30 10, 31 30. The Nile River spreads out and drains into the Mediterranean Sea. The Nile Delta is bounded from the East and Southeast by two main watershed areas escalating to more than 500 meters above mean sea level. To the west, the watershed is less developed morphologically, being only 100 meters above indicated sea level." (Zeidan, 2016). It covers about 220 km of coastline (Wiegel, 2009). Delta Region has several classifications based on different purposes.

In the Existing Physical Planning Regions scheme, the Delta is one of the seven physical planning regions of Egypt, which consists of (Greater Cairo, Alexandria, *Delta*, Suez Canal, North Upper Egypt, Asyut, South Upper Egypt) Regional Units as shown in Figure (01-01), with a total area of 12357.4 km2 (2.94 million *"feddans*[1]*")* representing about 1.22% of the total area of Egypt. Delta Region consists of Five Governorates (Dakahlia, Damietta, Kafr El-Shiekh, Monufia, and Gharbia), Figure (01-02). It has about 21.4 million inhabitants until January 2021, representing 22% of Egypt's total population.

Another classification, the Strategic National plan for urban development (2052), aims to accommodate the population increase until 2052 and achieve the population balance in line with the regions' capacity. It divided Egypt into ten instead of seven. Each area had particular activities. The core objectives are to achieve social justice and quality of life, reduce the unequal distribution of resources between regions, and provide job opportunities. That relies on a set of criteria such as direct accessibility for the region to a seafront as possible and economic resources diversity.

---

[1] It is an unit of area used in Egypt. It equals 4200 m^2, and equals 1.04 Acre approximately.

In this proposal, Delta Region consists of Eight Governorates that are in the previous classification, in addition to (Sharqia, Beheira, and Wadi El Natrun), as well. It is planned to be an agricultural and industrial region that strives on the local and regional levels. (GOPP, 2012; GOPP, 2013; GOPP, 2014).

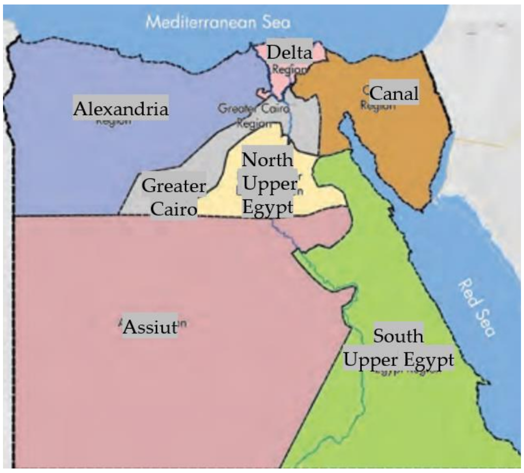


Figure (01-01) Existing Division of Egyptian Regions (GOPP, 2012)

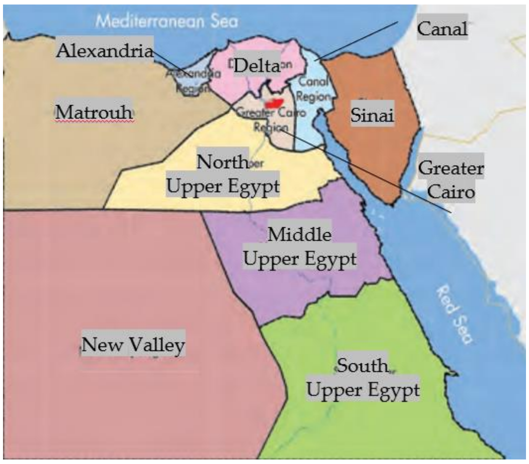


Figure (01-02) Proposed Division of Egypt into 10 Regions, Egypt 2052. (GOPP, 2012)

Geographically, Egypt is divided into six territories (Great Cairo, Upper Egypt, Middle Egypt, East Delta, West Delta, and *Middle Delta*). The context of this study (Middle Delta) consists of six governorates (Dakahlia, Damietta, Kafr El-Shiekh, Monufia, Gharbia, and Qualiobia) (Elmenofi et al., 2014).

1.1.1.1 Climatic Data – Delta Region

Egypt's climate zones are divided into eight local climatic zones (HBRC, 2008). Delta Region belongs to the Delta and Greater Cairo climatic region territory. Generally, the northern coastal area is warmer in winter than in the south and is less temperature and humid in the summer than the rest of the delta. Wind speed is higher in the coastal range and less as it goes south into the delta. Rainfall increases with moving north, ranging from (25 to 250) mm / year in the far south and the far northwest, respectively. (GOPP, 2008a). Figure (01-03) illustrates the local climatic map of Egypt. Figures (01-04) and (01-05) depict Cairo and Delta Climatic zone's climatic data and wind rise - elaborated by the author in a previous postgraduate study (Mamdouh et al., 2011).

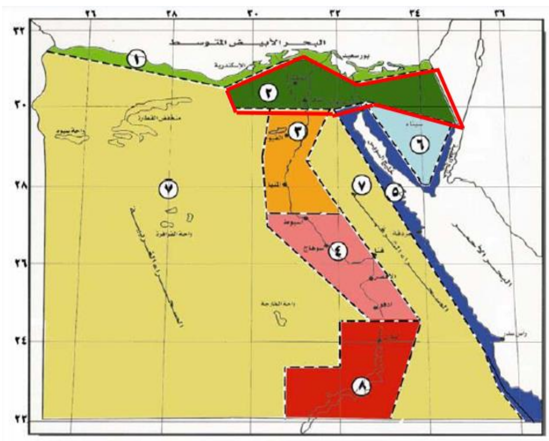


Figure (01-03) Egypt's Eight Climatic Zones. Delta and Greater Cairo Zone are framed with a red color.

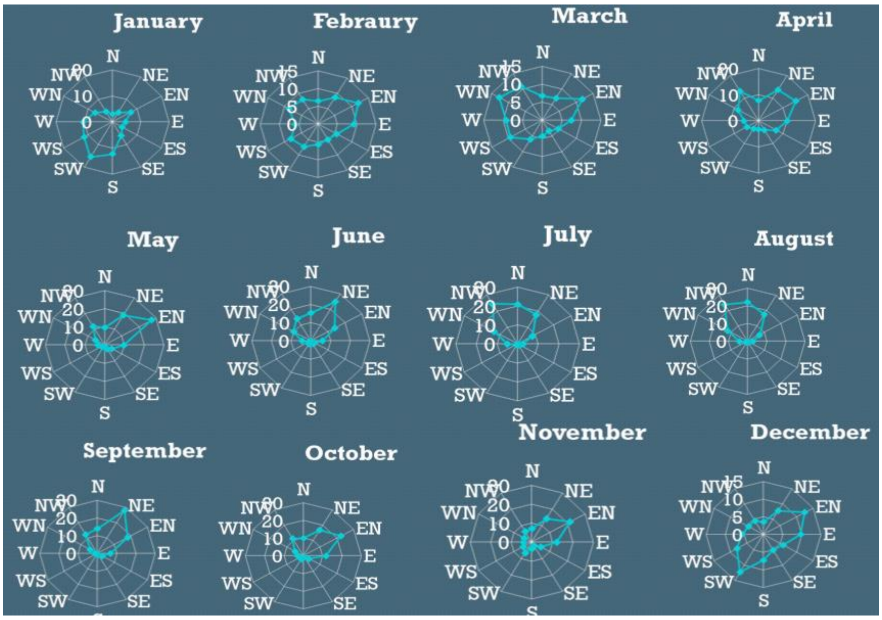
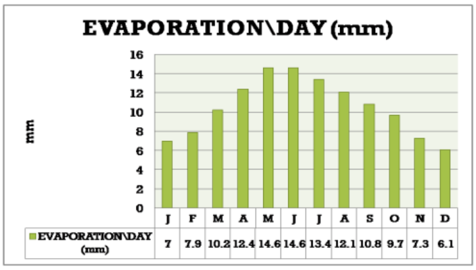
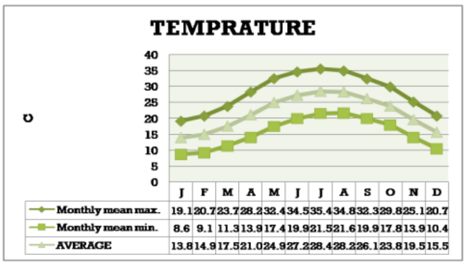


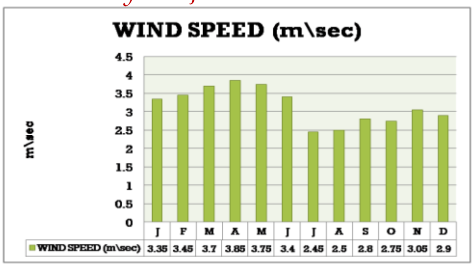
Figure (01-04) Monthly wind rose of Cairo and Delta local climatic zone.



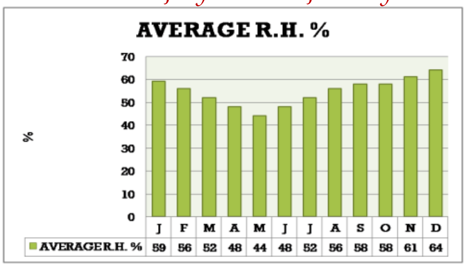
Max. May and June- Min. in December



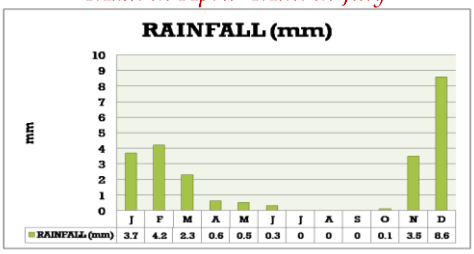
Max. in July-Min. in January



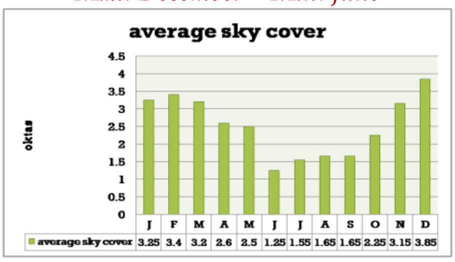
Max. in April- Min. in July



Max. December – Min. June



Max. December – Min. July, August, and September



Max. in December – Min. in June

Figure (01-05) Monthly climatic data of Cairo and Delta local climatic zone.

1.1.2 Lazio Region

Lazio Region is located on the Tyrrhenian coast in the central region group in Italy, divided into five provinces, namely Frosinone, Latina, Rieti, Viterbo, and Rome -the capital. It is located between latitude 30 22, 31 50 and

Longitude 30 10, 31 30 42. According to the National Institute of Statistics (ISTAT) (ISTAT, 2021d), the current population in 2021 is 5730399 inhabitants, the total area is 17232 km^2, representing 5.6% of total Italy, with a population density of 450 (Inhabitant/km^2) (ISTAT, 2021d). Lazio territory comprises three morphologies, hill areas by 53.9%, mountain ranges by 26.1%, and plains by 20%. In terms of population distribution per morphological area, most inhabitants live in the plain areas (59.7%), then 34.7% and 5.6% in hilly and mountain areas, respectively.

1.1.2.1 Climatic Data – Lazio Region

In general, the stretched peninsula of Italy makes the climatic conditions very variable. Regarding Köppen's climate classification, Lazio provinces fall into two zones. The first, for Rome, Latina, and Viterbo in the Mediterranean hot summer climates (Csa), characterized by drought and hot summer and mild, wet winters. The second, Riete and Frosinone in Humid subtropical climates (Cfa), are characterized by hot and humid summers and cool to mild winters. (CLIMATE-DATA, 2021). More descriptions of the climate of Italy can be found in reference (Fratianni & Acquaotta, 2017).

Locally, regarding the Presential Decree (D.P.R.) no.412 in 1993, Climate zones in Italy are divided into six local climatic zones as a function of Degrees Days[2], regardless of the geographical location from zones from (A) to (F) (Gazzetta Ufficiale, 2021). Lazio Region's municipalities belong to the four climatic zones, distributed by (10.1, 45.2, 42.1, and 2.4) % of zones (C, D, E, and F), respectively. Figure (01-06) depicts Italy's map by climate zone.

Figure (01-06) Local Climatic Zones Map in Italy. (the author) based on (Luce e Gas Italia, 2021).

[2] Degree Days is the sum, extended to all the days of a conventional annual heating period, of only daily positive differences between the temperature environment, conventionally set at 20 ° C, and the temperature daily external average; the unit of measurement used is the degree day (DD), for more see Article 1 D.P.R no. 412.

1.2 Administrative Systems

1.2.1 Administrative System – Delta Region

Table (01-01) summarizes the Delta Region's purpose-based classifications and specifies the context of the research study. The study will consider the Delta Region based on the existing physical planning for the following reasons. To be aligned with the current development situation and deal with these governorates bounded by the triangle shape (Rosetta branch in the West and Damietta branch in the east) as seen in Figure (01-01), which limits the horizontal extension into the desert back, which adds a challenge to work in this high-density area.

Table (01-01) Classification of Delta Region for Several Purposes.

	Physical Planning Regions	Egypt 2052 Urban Development Plan	Geographical	Climatic Region
Regions Numbers	7	10	6	8
Research Context	Delta	Delta	Middle Delta	Cairo and Delta
Governorates	(Dakahlia, Damietta, Kafr El-Shiekh, Monufia, and Gharbia)	(Dakahlia, Damietta, Kafr El-Shiekh, Monufia, Gharbia, Sharqia, Beheira and Wadi El Natrun)	Dakahlia, Damietta, Kafr El-Shiekh, Monufia, Gharbia and Qualiobia	Includes all mentioned governorates

Each governorate has a capital, followed by centers divided into administrative centers. Centers are divided into (local units) and divisions together. The administrative centers are located in the governorates with the countryside, and one center is divided into local units. The center's capital is the largest in the region, and it becomes a city, while the capital city of the local unit is a principal village or city. If the center is followed by more than one city, a set of dependencies villages follows the main village.

Suppose the capital of the center is a large city. In that case, it can be in two forms, a division or divided into several departments. Each of the several divisions has a head called the head of the neighborhood. In the case of one division, its ruler is the head of the city, and it is divided into several small districts, "*shyakha*," and the president of the city appoints the heads of these "*shyakha*." The Delta consists of five governorates, 106 districts and cities, and 1404 villages (GOPP, 2008a). Figure (01-07) shows the administrative structure of the Delta region governorates.

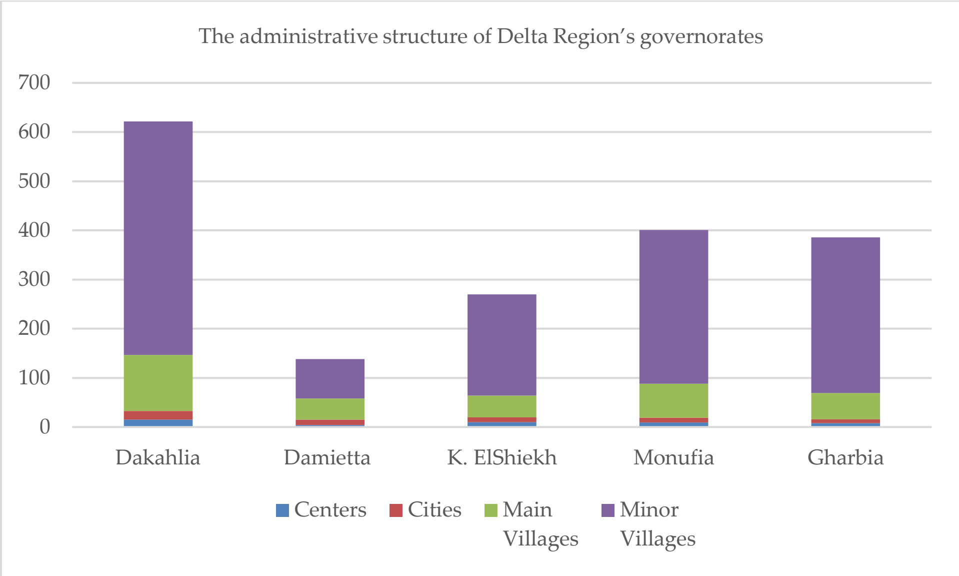


Figure (01-07) The administrative structure distribution by type of the Delta region (GOPP, 2008a)

1.2.2 Administrative System – Lazio Region

Regarding the statistical office of the European Union (EUROSTAT, 2021a), the Nomenclature of territorial units for statistics (NUTS) is a hierarchical system to divide the economic territory of the EU and the UK to the socio-economic analysis of regions, framing the EU regional policies, and for statistical purposes. It sub-divided the regions into four levels, hierarchies from larger to smaller territorial units. In Italy's case, it began with the five regional groups (NUTS1), then 21 regions (NUTS2), 107 Provinces (NUTS3), and finally 7926 Local Administrative Units (LAU) or so-called municipalities and town-halls. It is worth mentioning that, regarding the ISTAT, Italian regions are 20 regions, but regarding the Nomenclature of Territorial Units for Statistics, Trentino-Alto Adige/Südtirol is split into two regions.

Lazio Region has 378 LAU distributed in the five provinces. Regarding the Degree of Urbanisation classification (DEGURBA) provided by EUROSTAT, these LAU are classified into three categories based on a combination of population density, population size, and geographical contiguity, determined by minimum population thresholds applied to 1 km² population grid cells (European Commission, 2021a). The three classifications are cities (densely populated areas — code 1), towns and suburbs (intermediate density areas — code 2), and rural areas (thinly populated areas — code 3). Figure (01-08) shows the area and the administrative structure of the Lazio region. Figure (01-09) shows the area and the administrative structure of the Lazio region.

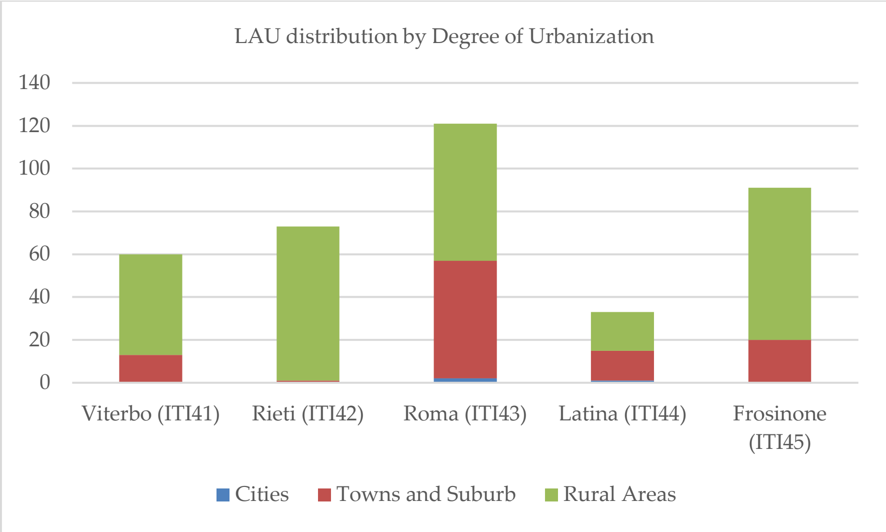


Figure (01-08) LAU administrative structure distribution of by the Degree of Urbanization of Lazio Region Provinces (the Author) based on EUROSTAT, the dataset is available on (European Commission, 2021b). The abbreviations after provinces' names are codes as per NUTS3, and each element, such as municipality, countries, and region, have their code among the EU countries.

The chart tells us that 272 municipalities are rural areas, representing 72% of the total municipalities. In the second place, 103 towns and suburb areas represent 27%, and only three cities, namely Rome and Anzio in Rome province and Latina in Latina province.

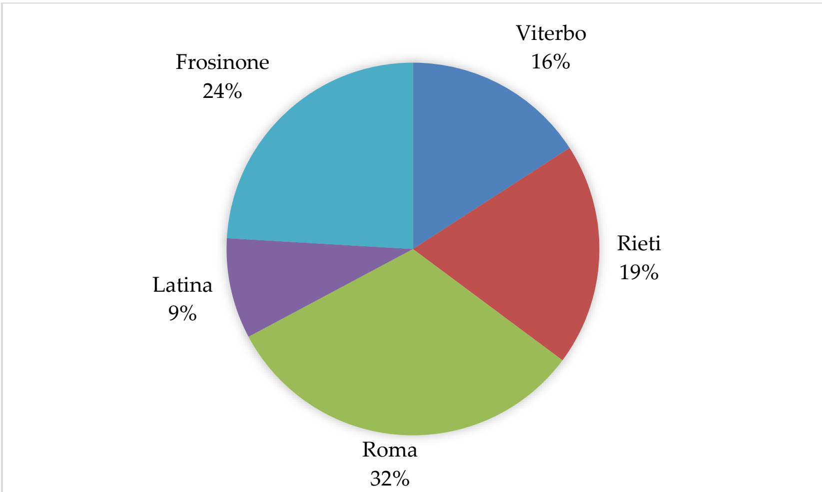


Figure (01-09) Lazio provinces by municipalities distribution. (the Author) based on ISTAT

1.3 Demographic and Socio-Economic Patterns

1.3.1 Demographical Characteristics – Delta Region

Several factors influencing the city's size, such as connecting to a strong road network and transport, strengthen relations between them and neighboring cities in the region and the functional and administrative role. The total population of the Delta region is 21912166 inhabitants. Dakahlia has the uppermost area of 3538.23 km^2 and a population number of 6862389 inhabitants. The lowest is in Damietta. The population is 1578983 inhabitants, and the area is 910.26 km^2.

The lowest population density in Kafr El-Shiekh is 1084/km², while the highest population density is in Gharbia at 2722/km², followed by Dakahlia and Monufia by 1940/km² and 1834/km² respectively, then Damietta by 1696 inhabitants/km². The ratio between males and females is almost likely 51% males to 49% females. The average household member is four persons. Figure (01-10) depicts the population and area of governorates. Table (01-02) summarises the demographic data and the administrative structure classification of the Delta's region provinces.

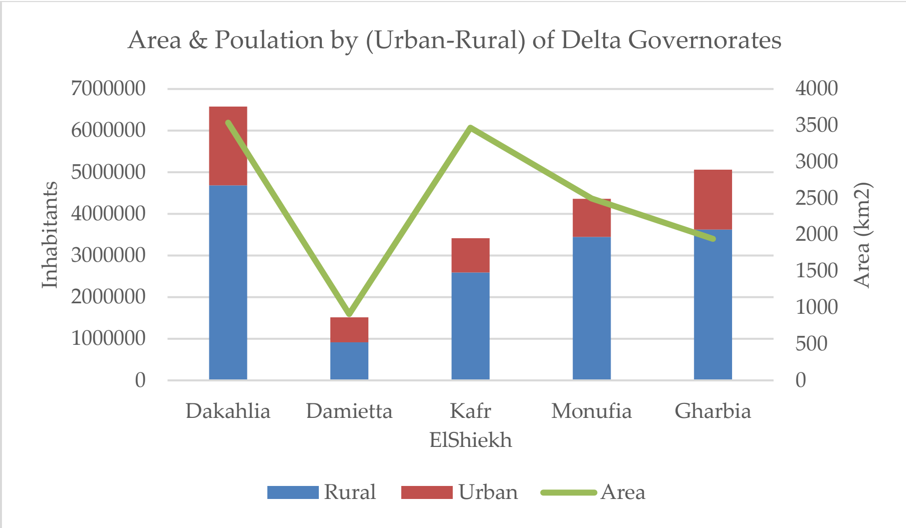


Figure (01-10) Population by (rural-urban) and area of region's governorates.

Table (01-02) The administrative structure of Delta Region's Governorates (GOPP, 2008a; CAPMAS, 2021)

Governorate	Area (km²)	Percentage of area (%)	Centers	Cities/ District	Main Villages	Minor Villages	Population in 2021	Population Density *(inhabitants/km²)*
Dakahlia	3538.23	28.6	15	18	114	485	6862389	1939.5
Damietta	910.26	7.4	4	11	43	80	1578983	1737.7
Kafr ElShiekh	3466.70	28.1	10	10	44	207	3600635	1083.6
Monufia	2499	20.2	9	10	69	315	4581813	1833.5
Gharbia	1943	15.7	8	8	53	317	5288346	2721.7
Total	**12357.4**	**100%**	**48**	**58**	**339**	**1404**	21912166	1773.2

1.3.2 Demographical Characteristics – Lazio Region

The total population of the Lazio region is 5720796 Inhabitants (females represent 51.7%). Rome province has the uppermost area and population number of 5363.28 km² and 4227588 inhabitants. On the contrary, Riete has the lowermost area by 3356.16 km2. The other provinces almost have similar areas ranging between (2750, 3247, and 3615) km² of Riete, Frosinone, and Viterbo, respectively. Figure (01-11) shows the population by sex and area in the Lazio provinces.

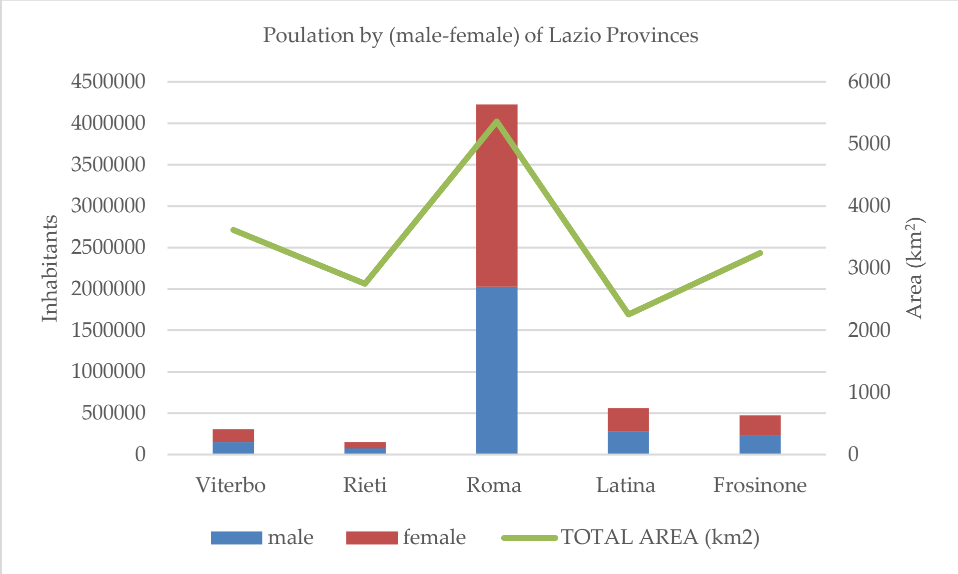


Figure (01-11) 2021 Population by (male/female) and area of region's provinces. (the Author) based on ISTAT

The highest population density was achieved in Rome province by 788.24 (inhabitants/km²), followed by Latina, Frosinone, and Viterbo, by (284.71, 145.81, and 84.90) (inhabitants/km²), respectively. The lowermost one was recorded in Riete at 55.15 (inhabitants/km²). Table (01-03) summarises the demographic data and the administrative structure classification of Lazio's region provinces.

Table (01-03) The administrative structure and demographic data of Lazio Region's Provinces (the Author) based on ISTAT

Province	Area (km2)	Percentage of area (%)	Cities	Towns/ Suburb	Rural Areas	Population in 2021 *(Inhabitants)*	Population Density *(inhabitants/km²)*
Viterbo	3615.24	21%	0	13	47	308830	85.42
Rieti	2750.52	16%	0	1	72	151335	55.02
Roma	5363.28	31%	2	55	64	4231451	788.97
Latina	2256.16	13%	1	14	18	566224	250.97
Frosinone	3247.08	19%	0	20	71	472559	145.53
Total	17232.29	100%	3	103	272	5730399	332.54

1.3.3 Socio-Economic Patterns and Infrastructure – Delta Region

The labor force is 33% of the total population of the region. Farming and fishing is the predominant sector that employs 41% of residents. Due to the abundance of fertile lands and multiple irrigation sources, it contributes to 22% of the national cultivated areas of Egypt. Comes in second place the transformative industries by 12% because of the distinguished industrial production, either the extractive industries such as (mineral resources, black sand), or the agriculture-based transformative industries, such as textile, sugar industry, and Compost plants. Then education and public service sectors by 10% of each, and finally the rest 27% distributed on the different sectors. Worth mentioning that the decreasing agricultural sector workers are in favor of services due to the rapid growth in transportation, communications, education, health services, and other social services. Figure (01-12) depicts the workers' distribution by sector in the Delta region.

.

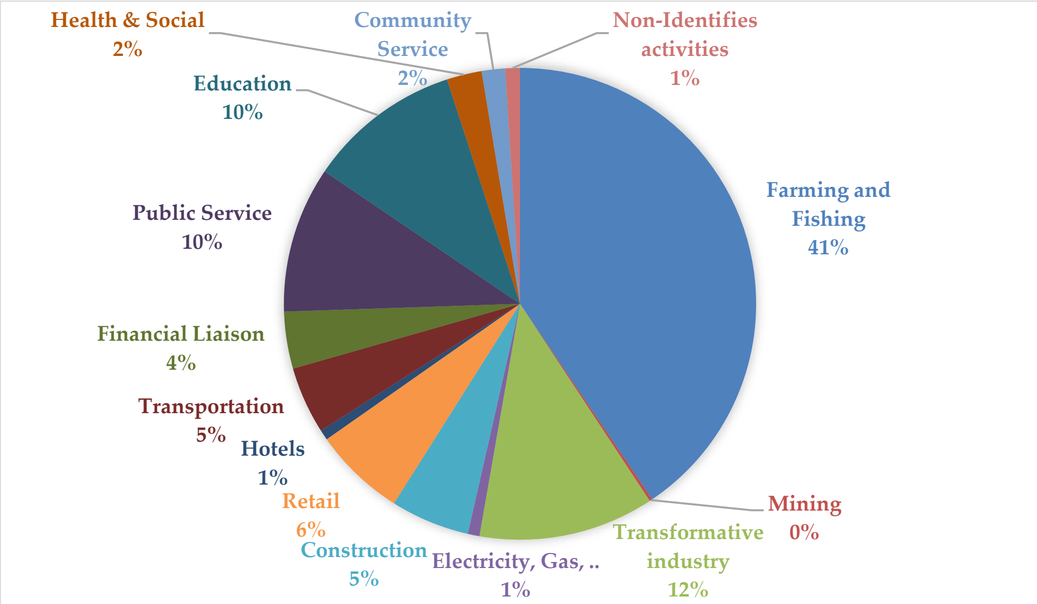


Figure (01-12) Workers distribution by sector in the Delta region.

The infrastructure networks include National and regional roads, railways, and roads Riverine and ports. In addition to communication networks, electricity, drinking water, and sanitation. The network of roads is distinguished. It has an international coastal road, the railway links it with Cairo and major cities in neighboring governorates, and the local network enables access to all villages (majors and dependencies). Many regional bus and taxi stops within the Delta region serve mobility. Figure (01-13) illustrates the national roads and railway networks in the Delta region and their relation with the surrounded areas.

It is noteworthy that Egypt is witnessing a notable improvement in the transport infrastructure quality, which the Egyptians can feel. The Organisation for Economic Co-operation and Development (OECD) has provided an assessment of the current development situation (OECD, 2020).

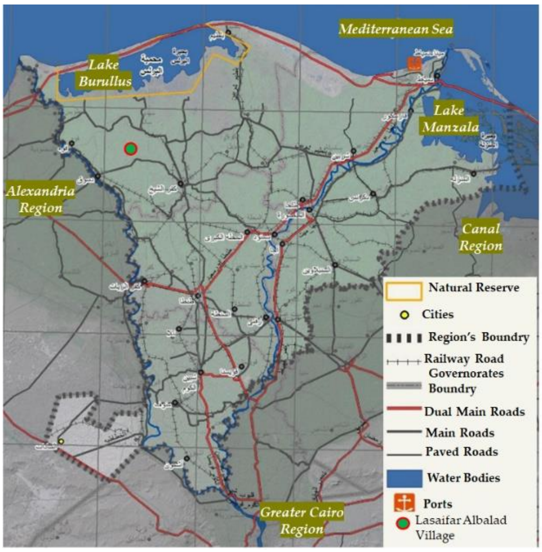


Figure (01-13) National roads and railway network in the Delta region. The map shows the capital cities of the region's governorates. the author based on (GOPP, 2015)

The average domestic water production is 0.9 million m³/day. It ranges between (0.45 to 1.36) million m³/day, the average daily accounts for 0.6 million m³. In contrast, the region faces a deficit in sanitation account of (150-275) thousand m³/day, except for Damietta. Regardless the water sanitation in Delta is not ideal (El-

Kowrany et al., 2016). Table (01-04) presents the sanitation situation in Delta provinces. Figure (01-14) shows an exposed sewage canal for solid and agricultural wastes. MWRI (2005) provided a holistic view of water resources management in Egypt.

Table (01-04) Sanitation needs for household consumption and various services in Delta Region, in (m^3) (GOPP, 2017b)

Governorate	Domestic Water Consumption	sanitation Household Consumption	Different services sanitation	Required sanitation amount	Available sanitation amount	Sanitation deficit (-) Surplus (+)
Dakahlia	788935	631150	63000	1009725	835500	-174225
Damietta	196921	158000	27000	264000	355900	+91900
K. ElShiekh	416785	334000	52000	553000	277414	-277414
Monufia	514879	412000	87200	705000	561000	-145000
Gharbia	632635	506000	185000	945000	852500	-92000

Figure (01-14) An exposed sewage canal for solid and agriculture wastes accumulates garbage on the canal banks. That has negative environmental and well-being impacts, and it promotes the spread of respiratory and epidemic diseases(taken by the author). The government is targeting the development of this canal.

In 2018, Egypt's primary energy production accounted for 186.3 TWh[3], while distributed energy accounted for 156.3 TW. The residential sector consumed 66.8 TWh (68% in urban and 32% in rural) (CAPMAS, 2021a). The Delta Region contributes to 11% of the primary energy production of Egypt (EEHC, 2019). Figure (01-15) summarizes Egypt's electricity production and distribution bodies hierarchy.

[3] One Terawatt (TW) = 1000 Gigawatt (GW). One Gigawatt = 1000 Megawatt (MW). One MW = 1000 Kilowatt (KW).

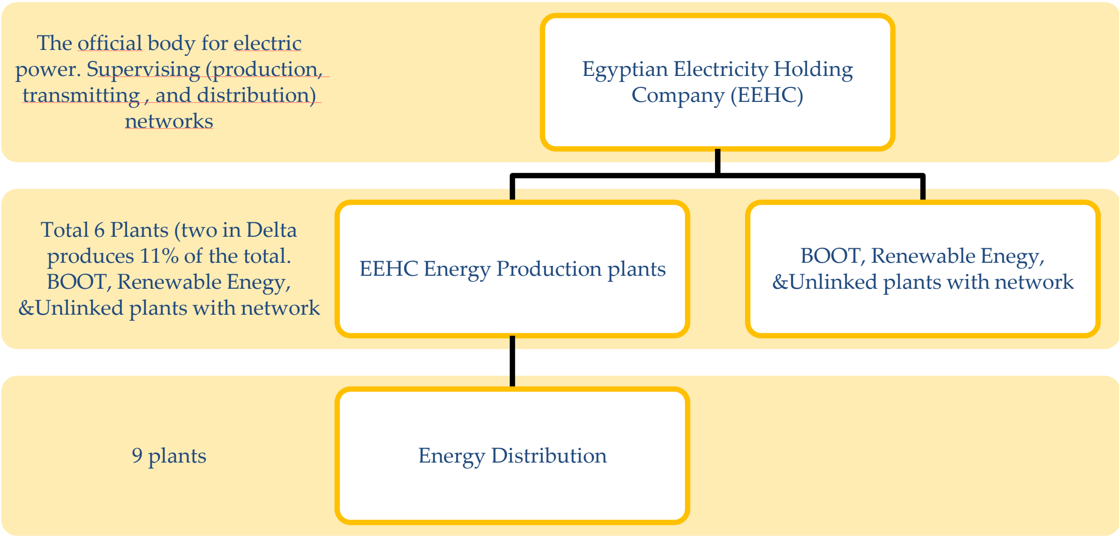


Figure (01-15) The official bodies of the electricity sector in Egypt.

Energy is essential in water treatment, and water is vital for electricity production and cooling power plants (Collins et al., 2009; WWAP, 2014). Despite this, the insufficiency of information available to evaluate this inter-relationship quantitatively (Larsen & Drews, 2019). "Water-Energy Nexus" is an emerging topic that is rising attention from the scientific and policy communities (Kurian, 2017; Magagna et al., 2019). Hence, achieving energy efficiency in Egypt reduces the stress on water resources, particularly in the light of the political situation because of the Grand Ethiopian renaissance dam that threatens the water share of the River. This was confirmed by (Diener & Meili, 2010) in their holistic study of rural settlements in the Assiut Region that such disruption of the water resources will significantly affect the conditions (social, economic, and political) and living patterns.

Delta has five public universities and many private higher education buildings in terms of educational services. The number of schools is about 1004, including all types (general - agricultural - industrial - commercial – "*Azhary*" [4]). Azhar schools come in the first place, followed by the general; while agriculture schools are the less amount, commercial and industrial schools numbers are exchanged in order over the five provinces. Figure (01-16) shows the distribution of the high schools in Delta's governorates. Figure (01-17) shows an example of the school buildings.

[4] They teache the curricula of the Egyptian Ministry of Education (as the general) in addition to Islamic religion sciences.

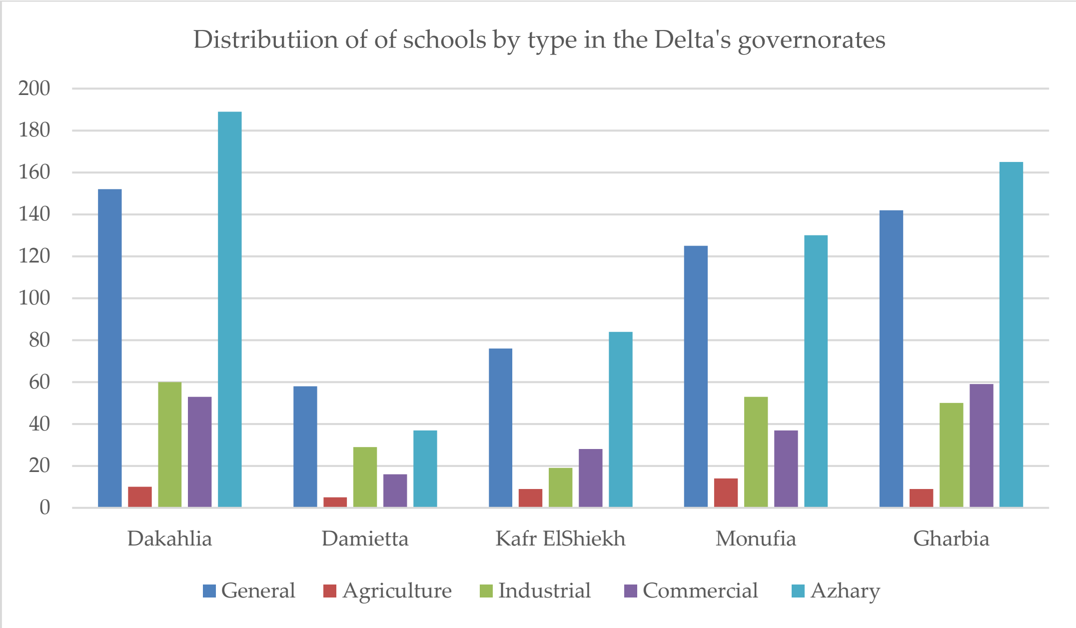


Figure (01-16) Distribution of schools (by type) in the Delta region (GOPP, 2017b).

Figure (01-17) A typical school in Awiera Village, Kafr Elshiekh. (taken by the author)

Delta Region has about 327 hospitals distributed between public and private, 506 cultural units (cultural houses, theaters, and public libraries). The social and sports activities include sports clubs, youth centers, stadiums, gymnasia halls, and post offices. The Delta region has many touristic features with historical and religious value. For instance, Kafr El-Sheikh is a nature reserve area (Lake Burullus) with a versatile ecosystem such as salt marshes around its coast. Figure (01-18) highlights the distribution of some services in Delta's governorates.

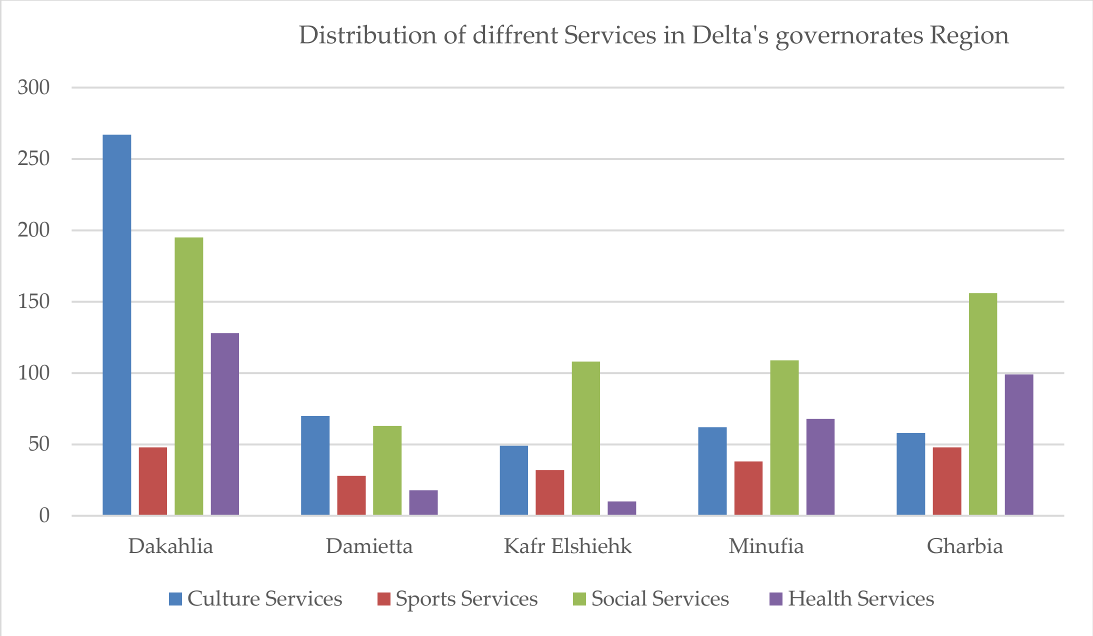


Figure (01-18) Distribution of different types of services in the Delta region. (the author) based on (GOPP, 2017b).

Eventually, in the socio-economic domain, in order to present a complete picture of the region in light of the national strategic plans, it can be highlighted as follows: fostering multiple sources to generate renewable energy, using agricultural wastes to generate for decentralize the energy generation. Besides providing a sustainable economic base in which farming, industrial, service, and tourism activities are integrated as a catalyst for regeneration, such as supporting innovation, science, and technology in the existing industrial zones, supporting training centers to encourage society for creativity and innovation. Moreover, to enhance the ecosystem, better management of the coastal areas and wetlands, and improve the logistical services (Airports, seaports, and land ports) and recreational tourism (GOPP, 2015; GOPP, 2017a; GOPP, 2018; GOPP, 2017b; GOPP, 2017c; GOPP, 2019; GOPP, n.d.).

1.3.4 Socio-Economic Patterns and Infrastructure – Lazio Region

Generally, the employment rate in Lazio Region is 65.3% of the total age group (24-64) years, higher than the Italian average by 2.3% (ISTAT, 2021a). At a provincial level, Regarding the 15th Census of Population and housing 2011 (ISTAT, 2011), the labor force in the Lazio region accounts for 2176961 employed people[5], representing about 41% of the total population in the region. Figure (01-19) shows labor force distribution in Lazio provinces by the inhabitant.

[5] The employed persons are, aged 15 years and over in a particular reference week, they characterized by many aspects such as -but not limited to, working upon payment or payment, are absent on work (because of holidays or sickness). More describtions are available on the glossary and remarks of ISTAT.

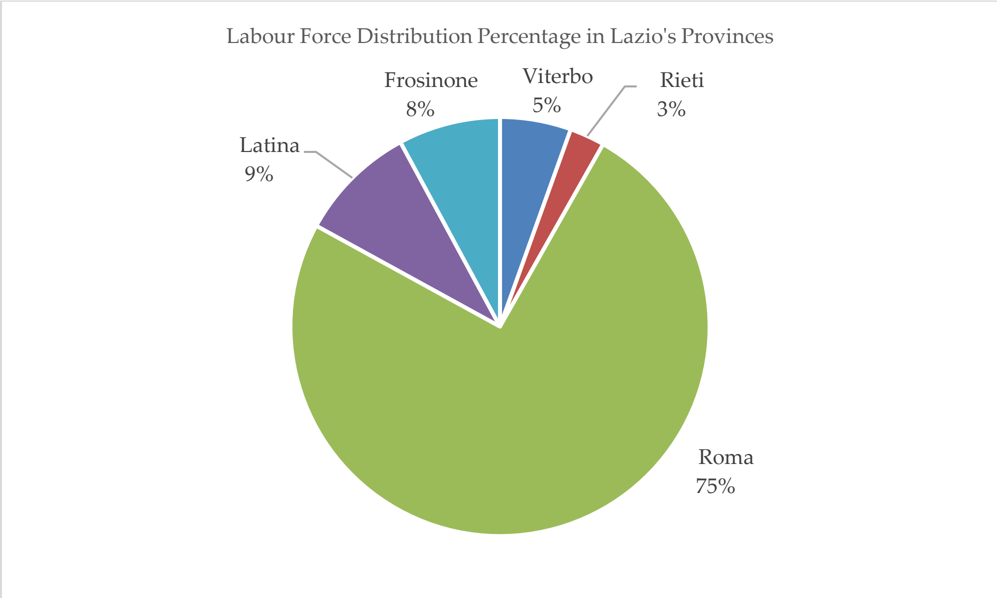


Table (01-19) Labour force distribution of Lazio provinces (by inhabitant) (ISTAT, 2011).

The figure depicted a strong positive correlation between provinces' population and employed persons. The highest in Rome is in terms of employees with 1628288 employees and the lowest in Viterbo with 119391 employees. It is distributed into six sectorial groups: *services* (financial and insurance activities, real estate activities, professional, scientific, technical, administrative, and support services), t*otal industry* (such as mining, manufacturing, electricity, and construction), *trade, hotels, and restaurants* (such as retail trade repair of motor vehicles, accommodation, and food service activities), o*ther activities* (Such as public administration, education, human health, and recreation) (ISTAT, 2021b). Figure (01-20) shows the percentage distribution of employed inhabitants by economic activity in Lazio provinces. Figure (01-21) summarizes the region's economic sector distribution in percentage.

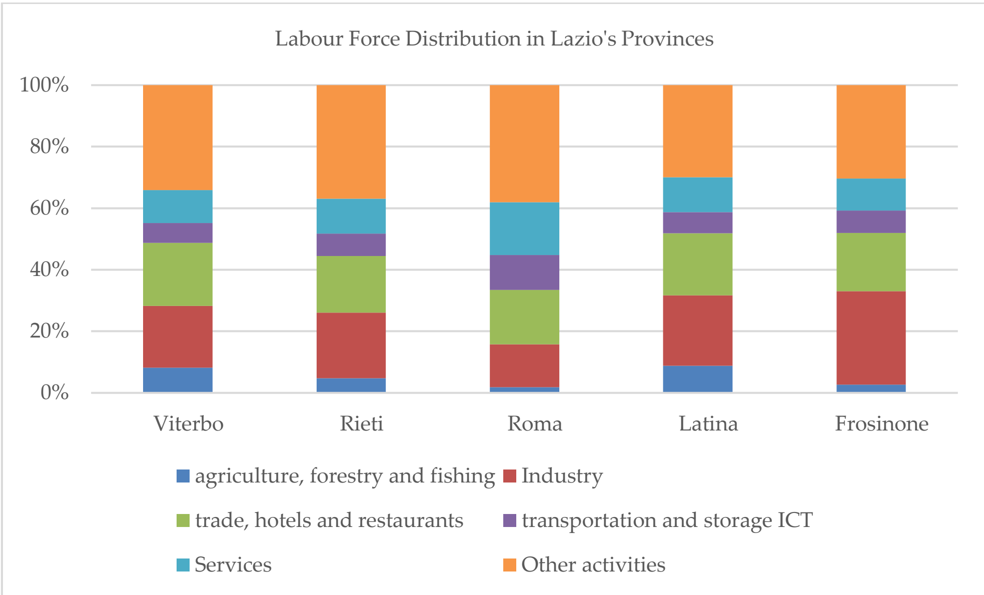


Table (01-20) The percentage of the labor force distribution by industry (branch of economic activity) of Lazio provinces (ISTAT, 2011)

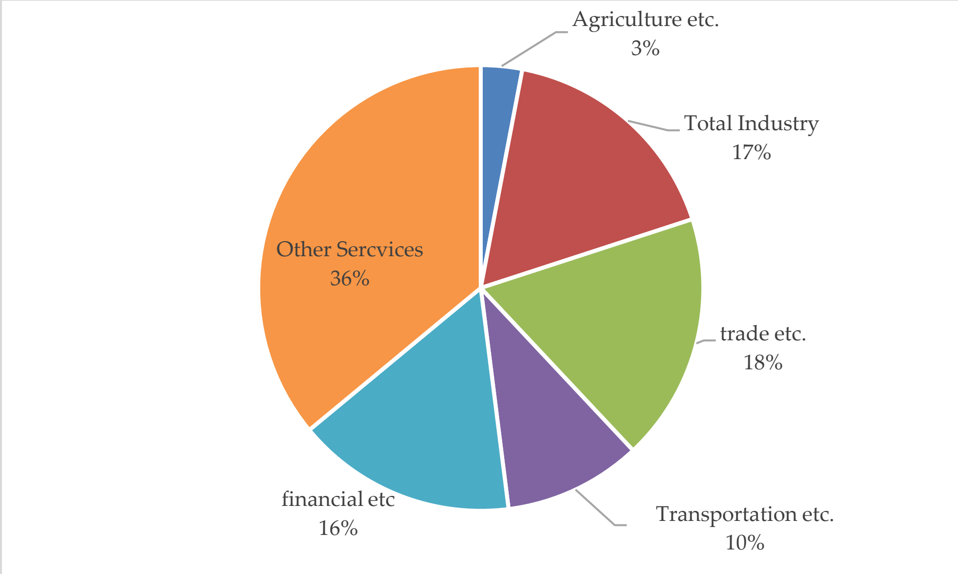


Figure (01-21) Employee distribution by economic sector in Lazio region (%)

The figures show that, in terms of the distribution by economic activity, the majority are working in the *"other activity"* sector, representing 36% of the total employees in Lazio by, 793376 employees. In the second place, three sectors have almost the same employees number in sectors *"trade and hotel,"* *"total industry,"* and *"financial and insurance"* by (18, 16, and 15) % respectively. Finally, 10% are employed in *the "Transportation*" sector, and only 3% in the "*Agriculture, forestry, and fishing*" sector.

The transport infrastructure in Italy is a versatile network, including railways, roads, waterways, ports, and airports. That is managed by the Ministry of Sustainable Infrastructure and Mobility (MIT) (MIT, 2021). The Italian railway system is the most flourishing sector managed by the Italian State Railways "*Ferrovie Dello Stato Italiane*" (FSI) (FSI, 2021).

The majority of the Italian employees (43%) -in 2020- rely on means of transport while going to their work, followed by 30% using their private cars, third the motorcycles[6] by 11%. Then the other ways, respectively, like buses, metro, bicycles and by foot. Almost the same indications for the kindergarten children and students aged under 34 years, 39% rely on means of transport, then 21% on private cars (predominate as passengers), third 15% by foot, finally the other means.

It is worth mentioning that the ISTAT provides some of the statistical data once for regions and ones for municipalities by type, such as metropolitan centers, suburb areas, settlements by population size. For example, in the case of Pontinia Settlement (Section 1.6), the settlement size is (10,001 - 50,000 inhabitants). Thus, a variation in the spent time in transportation has been observed. For instance, in this settlement pattern, 78% of the inhabitants spent less than 15 minutes in transportation going to work, compared to 45% at an average regional level in Lazio (the other group spent more than 31 minutes).

In general, among The persons aged 14 years and over, 5 million (87% of the total), 38% use trains frequently, which is higher than the national average (34%). The highest rate is in Bolzano/Bozen at 51%, and the lowest rate is in Sicilia at 10%. In coach transport, 13% are frequent users, less than the national average (16%). The highest in Bolzano/Bozen is 36 %, and the lowest in Umbria is 9%. Finally, 37% of the Lazio population are frequent bus users, higher than the national average (22%). The highest in Bolzano/Bozen by

[6] The author noticed that the Italians (with varies economic classes) use motorcycles (such as university students and professors and workers), which is totally different than Egypt that is limited to a particular economic class.

48%, and the lowest in Calabria by 11%. Figure (01-22) Highlights the connectivity between Lazio and the surrounded regions and the main ports.

Figure (01-22) The connectivity between Lazio and the other regions. The map retrieved from (Maps-Italy, 2021) is integrated with data from (ACPRail, 2021; AUTOMAP, 2021). The region has three highways, "*Autostrade*" that link the region with Milan in the north to Naples in the south, northern coastal areas in Genoa, and near the eastern coast in Abruzzo. Besides the railways and roads.

Italy ranks first in the EU for water abstraction for public water supply (ISTAT, 2019). The daily average is 419 liters per person, with a total abstracted amount of 9,2 million m^3. This amount is decreasing steadily due to leakage in the supply system (ISTAT, 2020). For instance, it was 9,5 million m^3 in 2015. In a regional context, Lazio withdrew drinking water at 1.17 million m^3 representing about 12% in 2015 of Italy's total resources from different water resources (wells, springs, rivers, natural lakes, artificial basins, and sea or brackish waters). In terms of the operated urban water system plants, Lazio has 635 plants with different types of treatment (ISTAT, 2021c).

In 2019, Italy's primary energy production[7] accounted for 42,95 Mtoe, the gross inland consumption[8] was 167,63 Mtoe, and the final energy consumption[9] was 124,30 Mtoe. Regarding ISTAT, this gap is because of energy sector losses. The highest consumer is the civil uses (household, commerce, service, and public

[7] The Energy Balance is the accounting tool used to quantify the flows of each primary energy source derived, in all phases, from production or importation of energy sources right up to the final uses in each economic sector.

[8] Is the total energy demand (the necessary energy to satisfy inland consumption.

[9] Is the total energy consumed by end users (excluding that which is used by the energy sector itself).

administration) with 38%, followed by transport and industry sectors with 31% and 22%, respectively. Then the bunkers and non-energy use by 7%. The lowest consumer is the agriculture sector at 2%. The annual electricity consumption per inhabitant in Lazio is 3673 kWh. Figure (01-23) shows the final use of the energy source.

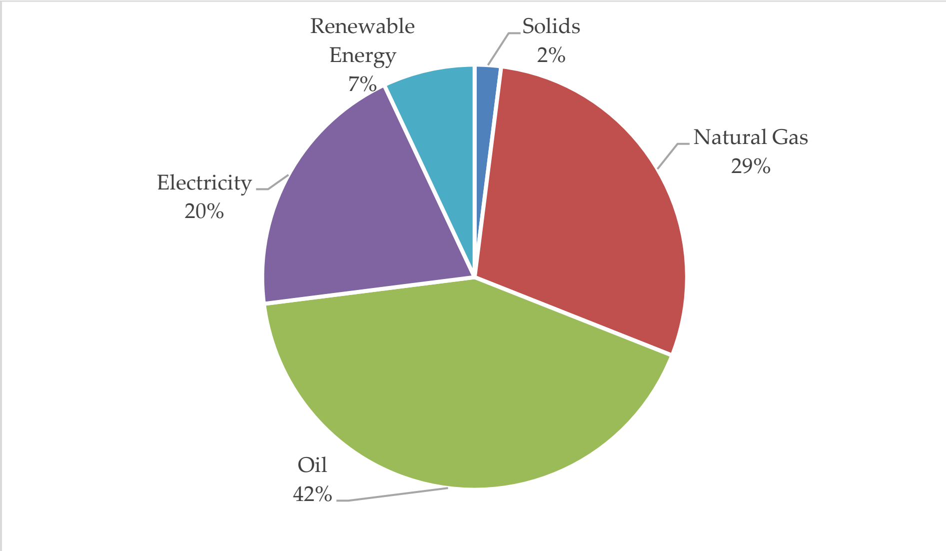


Figure (01-23) Final energy consumption by the source of energy (ARERA, 2019)

Regarding the ISTAT Consumption expenditure by item, The approximate household average consumption expenditure in 2020 in Italy is 2328 EUR divided by 18% for food and non-alcoholic beverages and 82% for non-food items (the highest is in Bolzano by 3040 EUR and the lowest in Calabria by 1854 EUR). In Lazio, the monthly average is 2642 EUR, which dropped by 9% compared to 2019 (the consumption was 2769 and 2780 EUR in 2018 and 2019). As a sequence of the lack of spending on many items due to the COVID-19 lockdown. However, at the same time, the expenditure on housing, water, electricity, gas, and other fuels represented 43% (1138 EUR), which represented 39% in 2019.

Lazio has six public universities, many institutes, and non-state telematic universities. The number of schools (pre-primary, primary, lower secondary, and upper secondary) is 4446, representing 8% of the total schools in Italy (54671). They are concentrated in Rome by 66%. Followed by Frosinone and Latina by (12 and 10)%, respectively, then Viterbo and Rieti by (7 and 6) %, respectively (ISTAT, 2022).

1.4 Urban Characteristics

1.4.1 Urban Fabric – Delta Region

Urban Fabric is the tangible factor of urbanism, emphasizing building types, thoroughfares, open space, frontages, and streetscapes but excluding environmental, functional, economic, and socio-cultural aspects. In other words, the set of features that characterize the built environment includes road networks, spaces, and buildings patterns (Abdelkader & Altouny, 1997). The Egyptian village urban fabric is characterized by three patterns organic, linear, and scattered, besides undefined tissues (Elsaid, 2007; Sweedan et al., 2007). Figure (01-24) shows an example of the urban fabric in the Delta region.

Figure (01-24) Aerial view of a typical urban fabric of Almahalla Alkobra District, Gharbia Governorate (taken by the author). It shows the physical characteristics of the administrative hierarchy from the city to districts, main villages, and dependents villages.

Firstly, *Traditional Organic* tissue represents the initial stage of the village's growth. It appears clearly in the old central area, characterized by randomness in the road network and narrow lanes with closed ends, and by increasing crowding and population density, and characterized by an old urban fabric that is predominantly residential, and the emergence of processes of replacing some old buildings with a mass of modern buildings. Figure (01-25) illustrates an example of the traditional road network.

Figure (01-25) A typical narrow close-end road (2m width) in Lasaifar Albalad settlement (taken by the author). As it can be seen, the road has a social function (e.g., funeral). One of the traditional tissue features rural settlements in the Delta region.

Secondly, *Linear* tissue, the second stage of the village's growth (the transitional phase surrounding the old center), is located on the periphery and extends over the axes of movement, canals, drains, and agricultural basins. The buildings contain structural typology with an average height of two or three floors' load-bearing walls and concrete or wooden roof. Figure (01-26) depicts an example of linear tissue.

Figure (01-26) A typical linear pattern in the traditional settlements, Lasaifar Albalad, Kafr Elshiekh governorate (taken by the author).

Thirdly, the *Scattered* tissue spreads in marginal areas outside the boundaries of the urban space, and its features include encroachment on agricultural lands (separate buildings in the middle of the fields) that appeared in the eighties period scattered over agrarian land on both sides of the primary and secondary entrances and regional roads between villages. In addition, new building types appeared, such as modern and residential villas. Figure (01-27) shows an example of scattered tissue.

Figure (01-27) A typical linear pattern in the traditional settlements, Menouf, Gharbia Governorate (taken by the Author).

1.4.2 Urban Fabric – Lazio Region

Traditional settlements in Italy have numerous patterns in terms of location (coastal and inner) and geography (hilly, plain, and mountain), accessibility and services (Territorial Cohesion Agency, 2021), population (European Commission, 2021a), and economic activities (agriculture, fishing, and forestry). Each pattern has its own built environment identity. The rural fabric is mainly characterized by small and medium-sized farms whose rural courts form a scattered settlement system that has different densities and structures concerning the size of the farm and the cultivation order (FORMICA, 2002; Picuno, 2012; Diti, 2013). Figures (01-28) and (01-29) show some examples of the traditional rural settlements in the Lazio regions.

Figure (01-28) Aerial view of a typical scattered distribution in the Lazio region's rural and suburban agricultural areas (taken by the author).

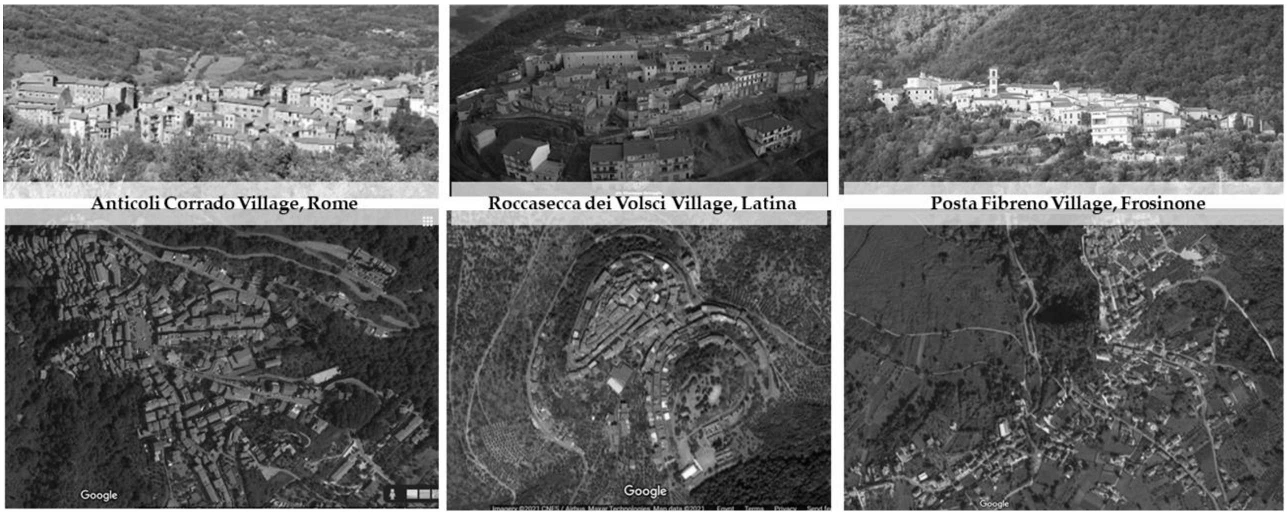


Figure (01-29) Aerial views of three traditional settlements in the Lazio region (Google Map). They have almost the same population size. Thus, the impact of topography on the urban fabric can be visualized.

Focusing on the agriculture-based traditional settlement pattern - the research realm, in the first 1900s, was a "*whole built complex*" or "*operation center*" to the farm. It was shaped by achieving families' needs, those who cultivated the farms. Its size correlates to the population in many forms: scattered dwellings, isolated or clustered farmhouses, and small villages. Each one has a different function: dwellings, stockbreeding, initial crops processing, and cooking and water supply structures (Torreggiani & Tassinari, 2012). In short, Maino et al. (Maino et al., 2016) characterized rural Italian buildings into four types (Dwellings, production buildings, mixed-function buildings, and temporary structures). That is the overall- characteristic. However, each region has identical buildings (Pagano & Daniel, 1936; Picuno, 2012).

For example, in the Basilicata Region, Grano (Grano, 2014), in her bibliographic analysis, stated that the early 1900s houses consisted of dwelling and annex -as storage- "*rustico,*" in three typologies, shared in one room in the same building, several juxtaposed or superimposed rooms in one building, and separate buildings. Besides, she grouped the farm types, namely, primitive forms (including the first two typologies), unitary forms (two floors), and particular forms (such as farms and holiday huts, with variable structural characters depending on the conformation of the ground and the availability of building materials).

Another example in the Lazio region, we can find the primitive circular-base hut "*La Caprareccia*," another developed one, the two-story houses with an elongated shape "*Casa Latina*," the massive farmhouse "*Il Casale*," and the tower house "*Casa a Torre*," Figure (01-30) depicts these typologies. Finally, Pagano & Daniel (1936) showed samples affected by the plain topography, representing the static mass and external stair, as seen in Figure (01-31).

Figure (01-30) Traditional rural buildings typologies in the Lazio region. Panel 1: shows A single-room dwelling built with mixed clay and straw (Pontiniaweb, 2021). The huts present in southern Lazio are called "*Caprareccia*." Panel 2: shows Two-story houses with elongated shapes and several rooms built in stone (Borghidilatina, 2021). The house developed with the increase of family members and agriculture intensity. The houses also incorporate the services, such as stables and barn. Panel 3: shows a massive farmhouse (two-story construction) "*Casale*." (DIGILAND, 2021). There was a large courtyard where part of the livestock was housed. Panel 4: shows a four-story tower house, "*Casa a Torre*," with massive fortification. (DIGILAND, 2021) Mixed-use building (residential, granaries, and stables).

Figure (00-31) Rural dwellings and farm building typologies of the early 1900s in the Lazio region (Pagano & Daniel, 1936).

The rural built environment patterns in Italy witnessed paradigm shifts due to many aspects. First, in the aftermath of World War 1, with the rise of fascist rule (Benito Mussolini) between (1922 - 1943), this political milestone led to significant rural built environment regeneration and change in the form of the traditional settlements in many regions. Secondly, at a glance, many legalizations were launched to restructure, such as Serpieri Law in 1924, the (Mussolini Act) integral land reclamation "*bonifica integrale*" in 1928, and others. That revolved around such as (Frost, 1934).

These initiatives aimed to recover the environmental deterioration such as malaria-ridden plains and wetlands, besides the hydraulic problems, modernizing agriculture technologies, and raising capacity. In other words, to restructure the rural landscape, exemplified in establishing new settlements and towns, improving the roads, irrigation, and drainage networks (Caprotti, 2007b; Margione, 2018) in many regions

(Lazio, Puglia, Emilia-Romagna, Piedmont, and Sardinia) (Monica & Bergamaschi, 2019). Figures (01-32) and (01-33) highlight the built environment in Agro Ponitina pre- and post-remediations, respectively.

Figure (01-32) Agro Pontine built environment pre-remediations in 1928. Right panel: typical traditional hut (MAP, 2021e). Middle panel: Cattle grazing in the malaria-ridden swamps. Left panel: Typical dwellings (so-called "*Lestra*") and daily activities used as a temporary shelter for shepherds during transhumance (BOTTONI, 2017).

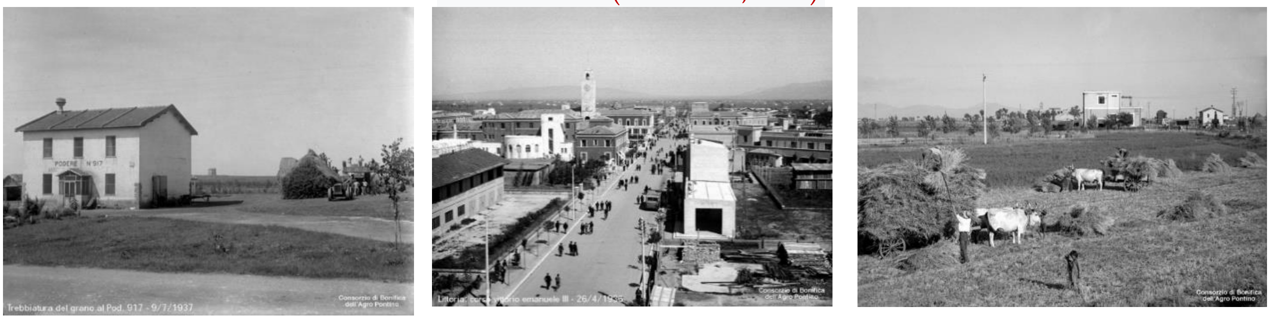


Figure (01-33) Agro Pontine built environment pre-remediations in (1936-1937). Left panel: Modern threshing building (MAP, 2021d). Middle panel: the main stree "*Corso*[10]" of Littoria town (MAP, 2021b). Right panel: Daily peasants' life on a typical farm (MAP, 2021a), the photo shows the scattered urban fabric.

"*Between pro- city and pro-village, I am pro-village*," Mussolini said (Weiner, 1976). These words reflected the exceptional attention of the rural village. In other words, the initial modern town grew from rural areas, namely Pontine Marshes or so-call "*Agro Pontina*," southern Lazio, that witnessed the emergence of five new towns Littoria (now Latina) (1932), Saupaudia (1934), Pontinia (1935), Aprilia (1937), and Pomezia (1939). The peasants have been resettled from northern Italy due to the high unemployment rate and overpopulation.

Latina town could be taken as an example. The planning was entrusted to the architect Oriolo Frezzotti. The public buildings represented the core of the new towns, which are the pivot of connections between different functions of the intimate contexts on one side and the ultimate urban contexts on the other. Figure (01-34) highlights the built environment characteristics of Latina town. The new towns have been discussed in detail from morphological and spatial perspectives and urban planning (Caprotti, 2007a) (Scricco, 2014) (Ippoliti et al., 2014) (Margione, 2018) (Bonfante, 2019).

[10] Corso is the main street of a city, begins and ends in a square, is often inserted in a pedestrian area and is usually flanked by elegant shops.

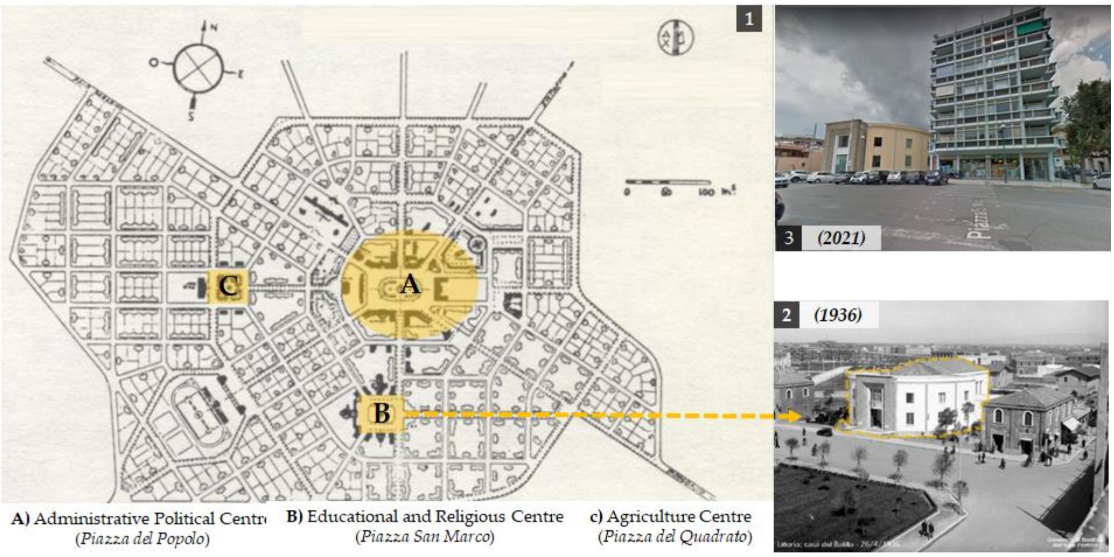


Figure (01-34) Panel 1: shows the master layout of Littoria (now Latina), the first established town in Agro Pontina. (the author) based on (Weiner, 1976). the planning was entrusted to the architect Oriolo Frezzotti; the public buildings are the core of these patterns denoted in the hierarchical squares (A, B, and C) -the symbol of the fascist power, then the linear buildings, maximum 3-story buildings (a typical feature of the rural settlements) the city connected from the central square by five axes towards surrounded urban contexts (sea, countrysides, and cities) (Margione, 2018). Panel 2: views the National Opera Building in 1936 "*Opera Nazionale Ballila*[11]" (MAP, 2021c). Panel 3: views the same zone in 2021 (Google Map). The figure shows the transformation of the architectural typology of the adjacent building, the road, and the public space; however, the Opera Building remains with minor changes in the roof.

The second world war in the 1940s was the second milestone that affected the Italian landscape negatively (Wendt, 1962). That is characterized in general by worsening living conditions. For instance, the flourished Agro Pontina project has been devastated, as described in (Mangullo, 2015): most farms were demolished, the land was swamped by water, and the pre-war livestock was lost.

Counter that, in short, the so-called post-war recovery (Tenzon, 2018) led to drastic transformations, to clarify; between the late 1940s and the 1950s, " 20% of the Italian landscape was intensely restructured (De Dominicis, 2019). The Italian government issued many initiatives started by the so-called "UNRRA Casas" to organize and plan the development interventions within many parts of Italy (Pontrandolfi, 2020). The Agrian Reform followed that to facilitate socio-economic development, funded by the well-known "*Cassa per il Mezzogiorno*," a public investment body to develop the southern regions (40% of population and area).

Regarding (Clark Carey & Carey, 1955; BOWE, 1961), the Agrian Reform issued to meet the dispersed families' demand, the constructed rural villages comprised dwellings and service buildings (school, nursery, church, post office, surgery, police station, recreation sports, and shops). Each village serves 4000 inhabitants in a 6000-hectare area. Another so-called Service Center (smaller than the village) aimed to serve 800 inhabitants in a 1000-hectare area, comprising a chapel, school, surgery, general store, and recreation center. Finally, the agricultural centers of offices and warehouses provide techno-economic support to the targeted population. They mentioned that these drastic changes led to significant sociological complications. This era was described in (Schachter, 1965) by the newly irrigated lands and opened schools, the adopted-modern farm techniques, and the numerous raising capacity initiatives.

[11] During the fascist regime, the name of *Balilla* given to boys between the ages of eight and fourteen, organized in paramilitary formations at the *Opera Nazionale Ballila*. (Treccani, 2021).

Thirdly, during recent decades, these traditional settlements and traditional buildings are being decreased – due to many causes- steadily (Caltabiano, 2006; Grano, 2014; East, 2017; Picuno, 2016; Ledda et al., 2019; Daglio et al., 2020). As discussed in many studies at a regional level in Italy, such as Campania (Sorrentino, 2013; De Joanna et al., 2020), Emilia-Romagna (Tassinari et al., 2008), Veneto (Tempesta, 2010), Basilicata (Forleo et al., 2017; Cillis et al., 2020), Abruzzo (MacDonald et al., 2000), and Sardinia (Perpina Castillo et al., 2018). Di Figlia (2016) investigated the abandoned traditional rural villages deeply in the twentieth and twenty-first centuries. He characterized them in terms of the urban fabric, abandonment causes, existing conditions, and accessibility. Figure (01-35) shows Di Figlia's classification of the abandoned Italian settlements. Figure (01-36) shows abandoned rural building in the Lazio region.

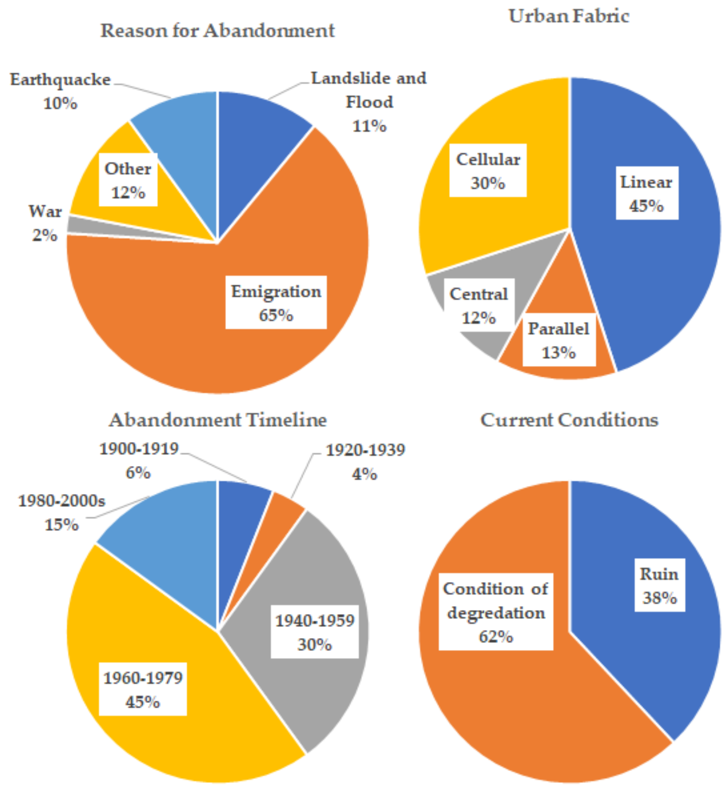


Figure (01-35) Some of the characteristics of the abandoned settlements in Italy. Re-produced by the Author based on (Di Figlia, 2016). First, the pie charts indicate the urban fabric classification. They emphasized the scattered urban tissue of rural settlements in Italy. Second, the reasons for the abandonment have been discussed in several studies, for instance, emigration (Schachter, 1965), natural disasters (earthquakes) (East, 2017), wars (Grano, 2014), and the other reasons referred to the declaration of unfitness or public work constructions. Third, the timeline supported the significant shift of traditional settlements pattern in the aftermath of the second world war, particularly between the 1940s and 1980s. Fourth, the majority of the existing settlements face a certain level of degradation.

Figure (01-36) Abandoned rural dwellings from the mid-1900s (taken by the author). Left panel: inside the inhabited center in Pontinia. Right panel: a building located in the marginal area of Aprilia.

1.4.3 Land Use – Delta Region

The agricultural lands represented the uppermost area in all governorates out of 12123.1 km². This behavior changed in Monufia as well buildings area is almost one half the total area. The highest in Gharbia by 86% the lowest in Monufia is 68%. The Kafr El-Shiekh has a different behavior, with a 16% of the Non-cultivated areas and 11% cemeteries. Figure (01-37) Land Uses of Delta Region Governorates.

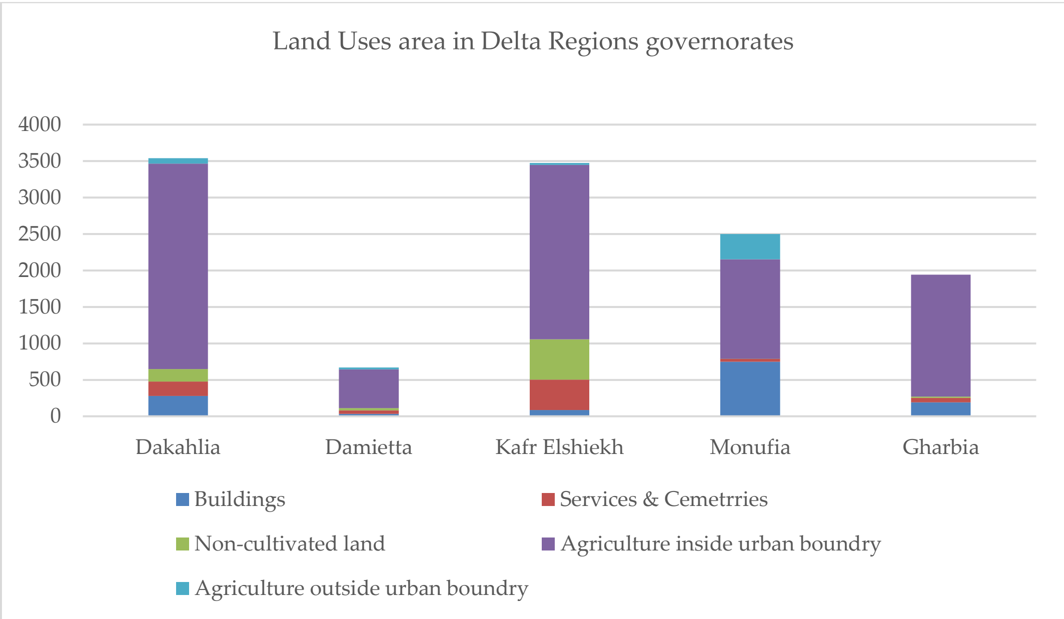


Table (01-37) Land Uses of Delta Region Governorates (GOPP, 2008a).

1.4.4 Land Use – Lazio Region

The land uses functional dimension corresponds to the description of areas regarding their socio-economic purpose (European Commission, 2001). In this domain, the agricultural lands exemplified the uppermost area in the Lazio region by 7349 km² (43%), followed by 30% of the forestries. Third, the unused and abandoned areas embody 14% of the entire area by 2488 km². Fourth, the heavy environmental impact activities, such as (mining, energy production, industry, and construction) and residential areas, exemplify nearly 6% for each, while services such as (recreational and commercial) exemplify 1.5%. Finally, fishing and aquaculture represent less than 1%. Figure (01-38) shows the land use distribution in Lazio Region.

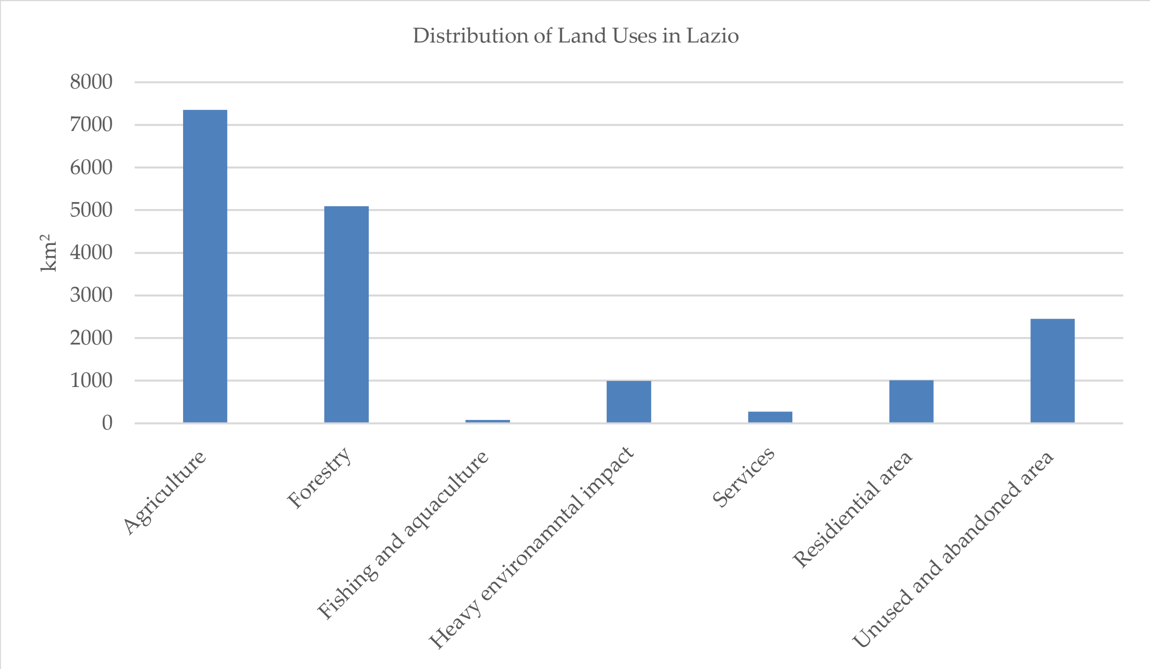


Figure (01-38) Land uses of Lazio Region (EUROSTAT, 2021b).

1.5 Built Environment and Energy

1.5.1 Buildings and Dwellings Characteristics - Delta Region

Egypt has (16185063) buildings divided into four main types, regular buildings for housing purposes, regular buildings for work purposes, makeshift buildings, and nondescript buildings. Delta region has 3716088 buildings representing 23% of total buildings in Egypt. Figure (01-39) shows the relation between buildings' numbers and the area of the Delta region governorates.

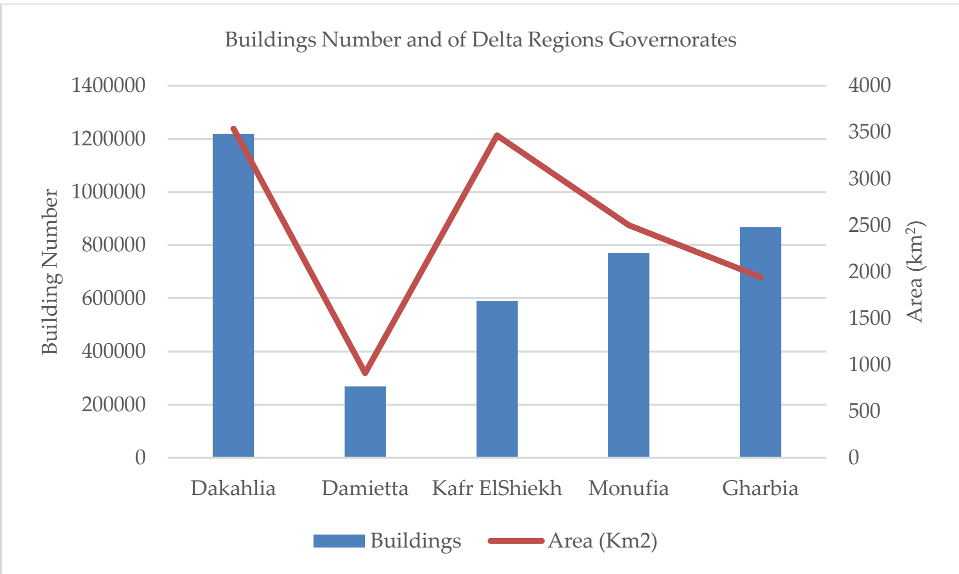


Fig (01-39) Distribution of buildings by types. (the author) based on (CAPMAS, 2017b; GOPP, 2008b)

The figures tell us that the Dakahlia governorate has the largest area and the highest buildings number. On the contrary, Damietta has the lowest area and building numbers. Kafr Elshiekh has almost the same area as Dakahlia, with half the building's number. Housing buildings represent the majority of buildings' residential energy consumption due to lighting recorded the heights values in regions governorates. Table (01-05) defines different building types in Egypt. Figure (01-40) shows the distribution of residential buildings in rural and urban contexts.

Table (01-05) The definition of buildings for housing and work purposes (GOPP, 2017b)

House/ Apartment Building	It consists of a floor and up to 14 floors, whether the floor contains an apartment or more
Skyrise Apartment Buildings	It consists of 15 floors or more.
Villa with one or more unit	A building consists of one or more units and not more than four floors. It may have a garden and a fence from the outside and a garage for the car.
Chalet	It is a building that is mainly built for housing and consists of one or more floors and not more than four floors, usually located near the coastal areas
Country house (one/more) unit	A building contains one or more units and consists of one or two floors at most. It is built of mud bricks. It does not contain apartments but rather rooms.
Public building	A place designated for the residence of many individuals for various reasons and occupies one or more buildings or more housing units within one or several buildings.
Work Building	They are the buildings established mainly for work and in which an activity of economic activities is carried out, such as governmental buildings, mosques, and factories.
Mall	It consists of one or more floors and is used for commercial, entertainment, and service purposes. Or a mixed-use building (residential, commercial, and administrative)
Shops	One or more shops and a group of adjacent stores, not topped by residential units.
Boathouse	Not a countable building, it is used for residential or work or both purposes.
Makeshift Buildings	Like cemeteries, tints, stilt house

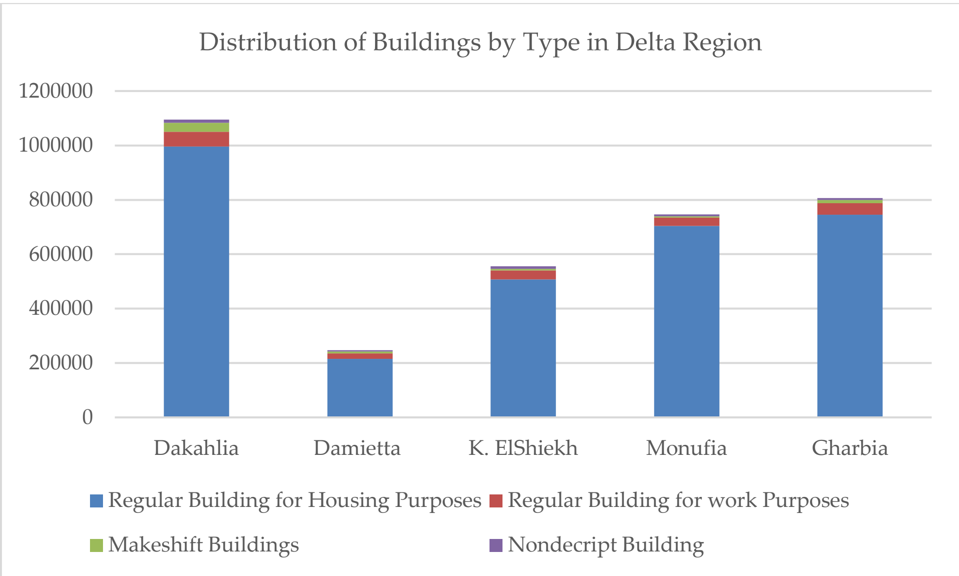


Fig (01-40) Distribution of buildings by types (the author) based on (CAPMAS, 2017b)

The figure tells us that residential buildings predominate in urban contexts by 94% approximately. In rural contexts, residential buildings came first with 99% in Damietta, 94% in Gharbia, Kafr Elshiekh, and Dakahlia, while the lowest amount of this prevailing type is located in Monufia at 80%. Figure (01-41) illustrates two examples of the skyrise and villa. Figures from (01-42) to (01-45) depict examples of makeshift and undefined buildings.

(1) (2)

Figure (01-41) Panel 1: An example of a typical country house located in the Delta region. The wall construction is made from mud-brick and wood and rice straw roof. It represents 5% of total residential buildings (212085 buildings in rural and 15279 buildings in urban); Panel 2: Typical modern dwellings pattern in rural areas. The construction typology is reinforced concrete skeleton and red brick. This typology represents about 94% of total residential buildings (2270302 buildings in rural and 655734 buildings in urban) (taken by the author).

(1) (2)

Figures (01-42) Panel 1: A typical skyrise apartment building pattern is usually located on the Nile Riverfront and at the city/district entrance. It represents less than 1% of residential buildings. Panel 2: An example of a typical fenced villa located in the Delta region. The construction typology is a reinforced concrete skeleton and red brick. This typology represents about 0.5% of total residential buildings (5228 buildings in rural and 2910 buildings in urban) (taken by the author).

(1) (2)

Figures (01-43) Panel 1: A typical makeshift building (coffee shop) in rural areas, usually located along with the local road networks. Monufia Governorate. Panel 2: A typical makeshift building (cemeteries), usually located on the outskirts of the village (taken by the author).

(1) (2)

Figures (01-44) Panel 1: A typical undefined abandoned building. Monufia Governorate. Panel 2: Typical shops, Gharbia Governorate (taken by the author).

(1) (2)

Figure (01-45) Panel 1: Typical work building. A mosque, Kafr El-Sheikh. Panel 2: Typical work building. An agriculture society, Kafr Elshiekh (taken by the author).

Apartment buildings are predominant in all the governorates. Figure (01-46) shows the distribution In the regular building for house purposes.

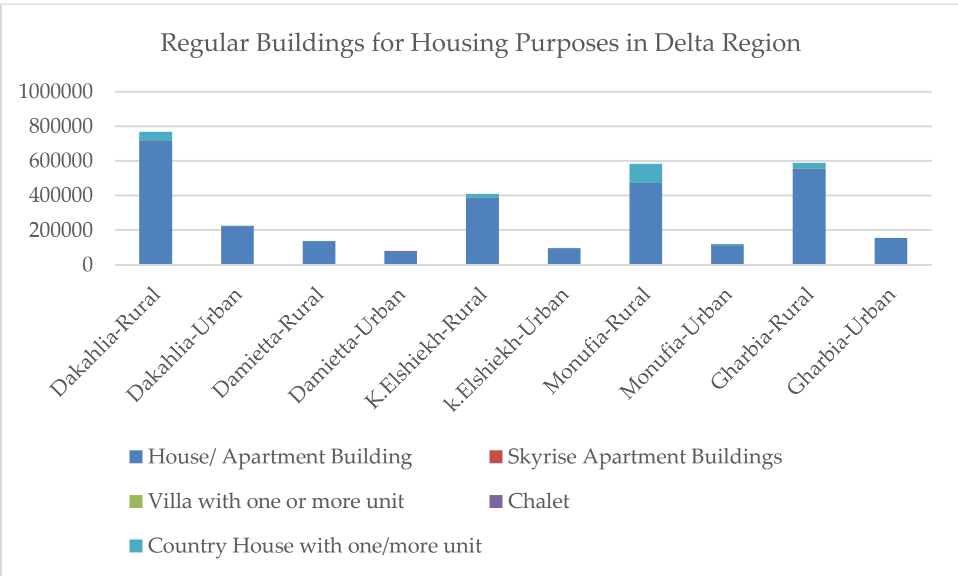


Fig (01-46) Distribution of the regular buildings for housing purposes in the Delta governorates by (urban-rural) (the author) based on (CAPMAS, 2017b).

Rural areas have 2462216 buildings, representing 78% of the total buildings in the Delta region. The house apartment buildings are the majority. By floor number term, the average prevailed typologies are that the 1-story and 2-story buildings represented the highest number by 70% (915788 and 918040). Next, the 3-story by 21%, then by the four and five floors by 7% and 2%, respectively. Fig (01-47) illustrates the distribution of the residential buildings in rural areas by floor.

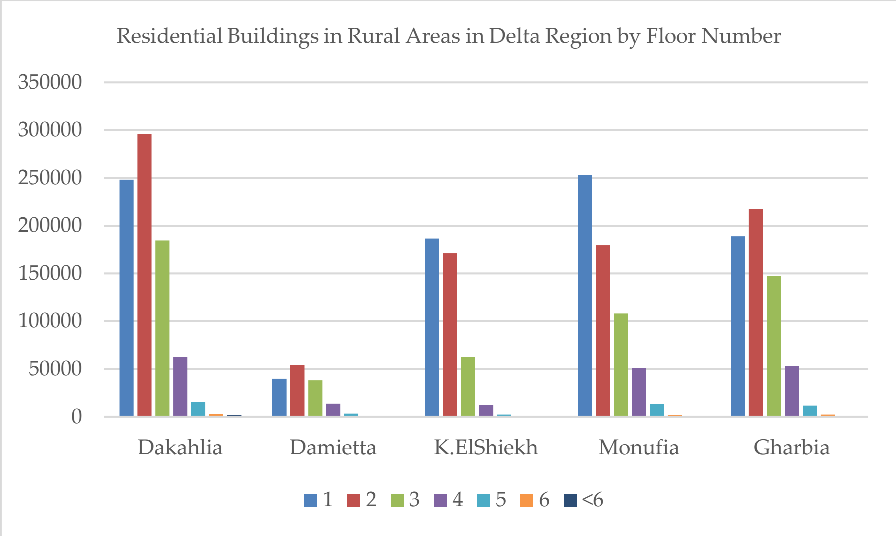


Fig (01-47) Distribution of dwellings in rural areas in Delta Region governorates by floor number (the author) based on (CAPMAS, 2017b).

Abouaiana (2016), in a field study of rural settlements in the Delta Region, characterized the typical modern rural dwelling in terms of construction, location, and morphology. As shown in Table (01-06)

Table (01-06) The current modern dwelling pattern in Delta Region (Abouaiana, 2016).

Construction Date and Location	In the 1980s. It locates inside an agricultural area or urban mass
Floors no./ height (m) / Foot print (m^2)	2 floors with a 2,90 m highet. The area ranges between (80-160) m^2
Morphology / Average Room Areas	include a hall, three rooms, bathroom, kitchen, staircase, terrace, and sometimes farmyard. The average room area is 14 m2.
Construction typology & finishing	the roof is constructed of a reinforced concrete slab. The walls are constructed of red brick (12 and 25) cm. Elevation finished with cement plaster.
Window to wall ratio / Type	The average window to wall ratio (WWR) is 12%. Windows are made of single clear glass 3mm with a wooden frame and local shading screen “sheesh.”

The majority of the buildings are in good construction status, about 71% in Kafr Elshiekh and 78% in the other. Simultaneously, an average of 17% needs minor renovation in Damietta and Kafr Elshiek, then 12% of others. Only 8% of buildings require medium renovation, and 3% have deteriorated, as shown in Figure (01-48). Figure (01-49) depicts the distribution of residential buildings by construction status.

Fig (01-48) A dwelling in a rural settlement in a bad construction condition and requires significant rehabilitation (taken by the author).

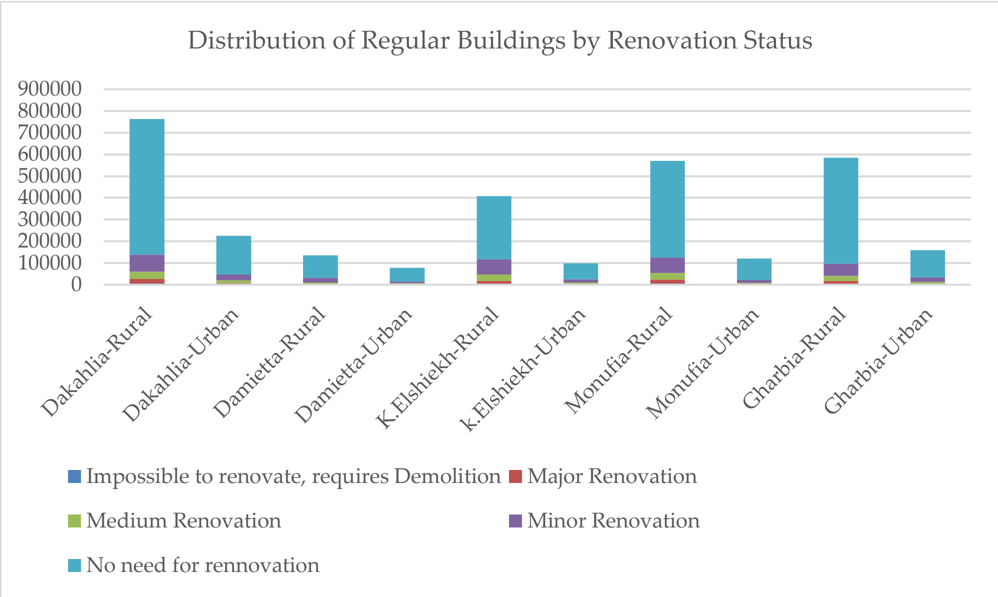


Fig (01-49) Construction status of regular buildings for (housing and work) purposes (the author) based on (CAPMAS, 2017b).

1.5.2 Buildings and Dwellings Characteristics – Lazio Region

Italy has a total of (14515795) buildings. 4% of them are building complexes, which are, regarding the ISTAT glossary, "*set of non-residential constructions, buildings, and infrastructures, that is usually located in a limited area (often closed and well-delimited). They are aimed exclusively (or mainly) at the activity of a unique association, institution, company or institutional household*." Lazio region has 954679 buildings, accounting for 6.6% of Italy's buildings, divided into seven types. Table (01-07) defines some of these types by function. Figure (01-50) shows the distribution of entire buildings by number in Lazio provinces.

Table (01-07) The definition of building complexes and buildings by function (ISTAT, 2021b).

Aspect	Description
Production Building	Industry, handicraft, agriculture, and general production.
Business district/ tertiary.	Public and private administrative offices, financial districts, insurance companies, and representative offices.
'turist/receptive.'	Tourist residences, hotels, convention centers, health spas, and camping areas.
Services	• Services to person: cultural, social, health, welfare, and hospital services, sports facilities, education, technological systems, public parking lots, fairs/exhibitions, park areas/gardens; • Services to the community, such as barracks and prisons.
Other	Religious institutions and churches.
Building Complex	Used (totally or partially) for residential (and/or) goods and services production purposes.

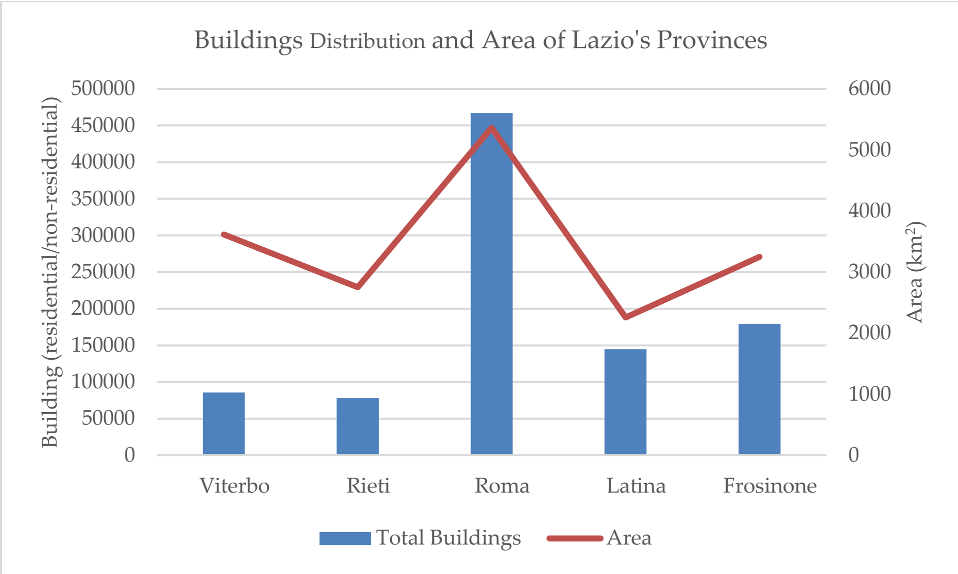


Table (01-50) The distribution of entire buildings, by number, in Lazio provinces and the area.

Rome has the highest buildings numbers in the region with 4.7 million (49%), in the second place Frosinone and Latian by (19 and 15) % respectively, then Viterbo and Riete by (9 and 8%). The significant share of buildings in all provinces is for residential buildings, which accounted for (801210) buildings, which signifies 88% of the total number. For the non-residential buildings, the "other buildings" came first (53898), indicating 6% of the total buildings, followed by commercial, production, and service buildings by 5%, finally, tourists and services by 1%. Figure (01-51) summarizes the building distribution. Figure (01-52) depicts the distribution percentage of regular buildings by type in Lazio provinces.

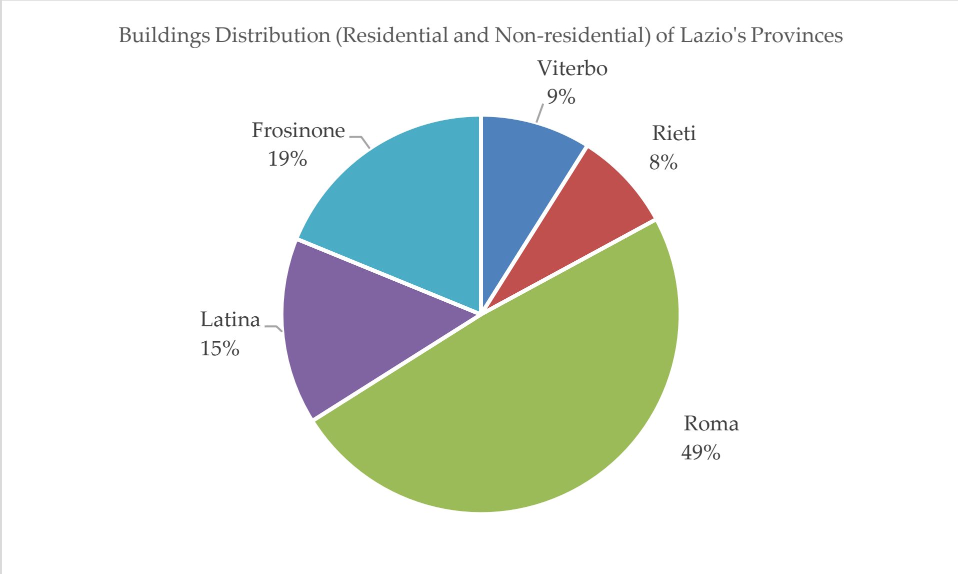


Table (01-51) The percentage of the buildings distribution (residential and non-residential) of Lazio's Provinces (ISTAT, 2011).

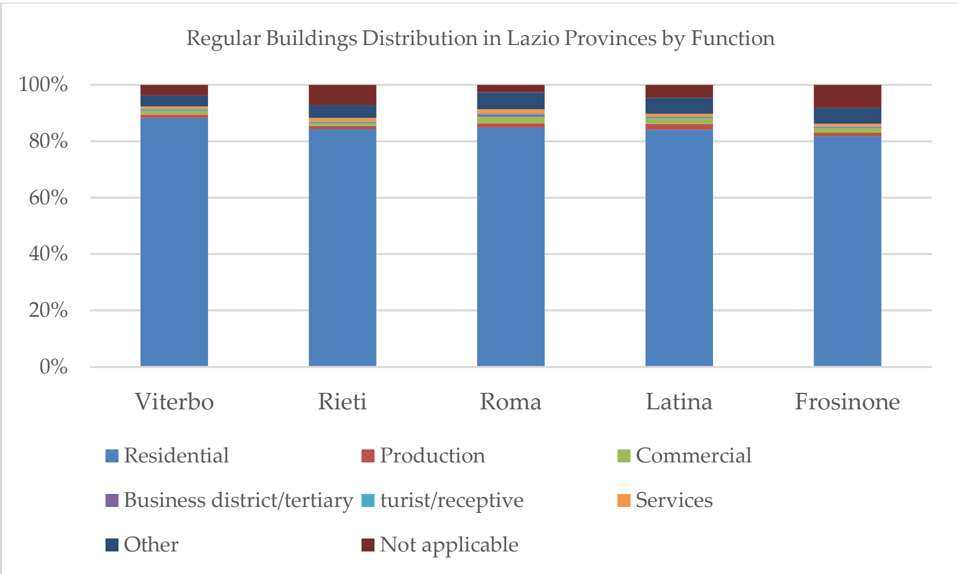


Figure (01-52) The distribution percentage of regular buildings by type in Lazio provinces (ISTAT, 2011).

In terms of the construction period, between 1945 and 2011, the average number of residential buildings number increased by 16% each decade. The 1980s witnessed the highest growth of 21%, followed by the 1960s and 1990s by (17 and 14) %, respectively. Regarding building construction conditions, one-half of the residential buildings have a good construction case, then 32% are very good, 15% are in a medium case, and 2% (206092 buildings) are in a bad case. Figure (01-53) shows the construction case of the residential buildings. Figure (01-54) shows a poor condition building example.

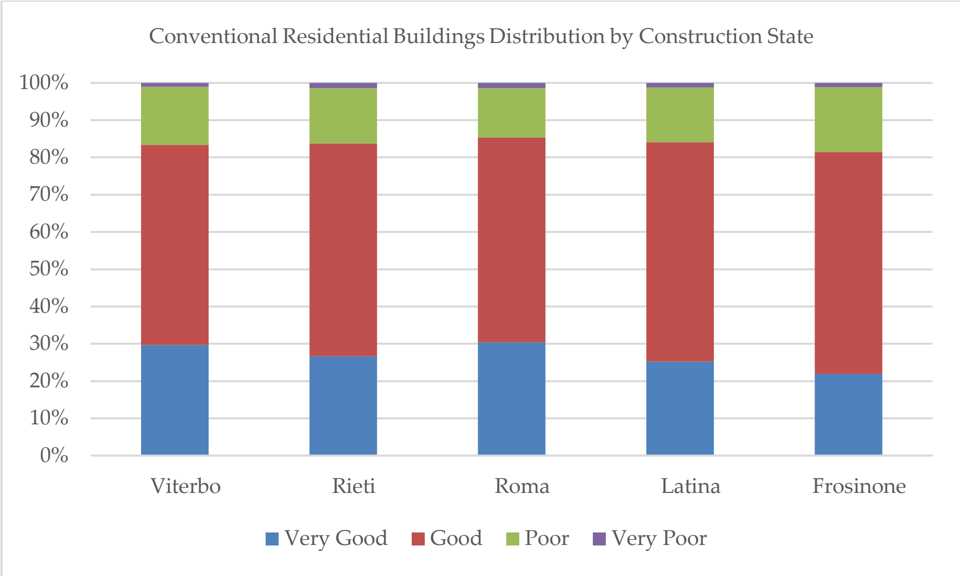


Figure (01-53) Distribution percentage of the regular residential buildings in Lazio provinces by the construction state (ISTAT, 2011).

Figure (01-54) An example of a rural building by construction condition Pontinia, Lazio Region (taken by the author).

In terms of dwelling numbers in the residential buildings, Figure (01-55), all provinces have almost the same distribution percentage behavior. The majority of the buildings have more than nine dwellings. However, apart from Frosinone, the data indicated different behavior, where 84% of the buildings have (1-2) dwellings. In terms of floor number, Figure (01-56), the data indicated that all provinces have the same distribution percentage behavior. The highest are two-story buildings by one-half, and the lowest is four or more ones by 10%. Other than Rome case recorded (40 and 10) % respectively.

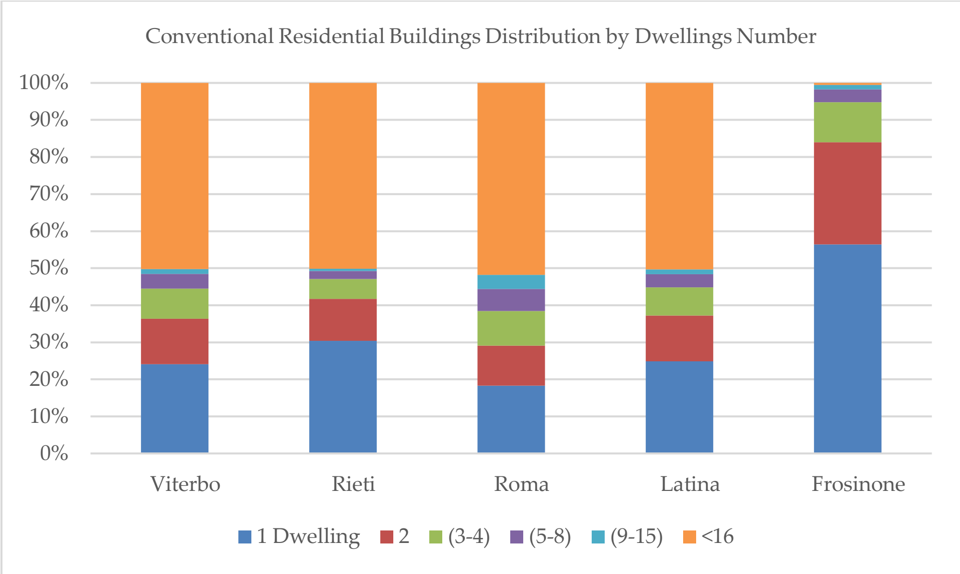


Figure (01-55) Distribution percentage of the regular residential buildings in Lazio provinces by dwellings number (ISTAT, 2011).

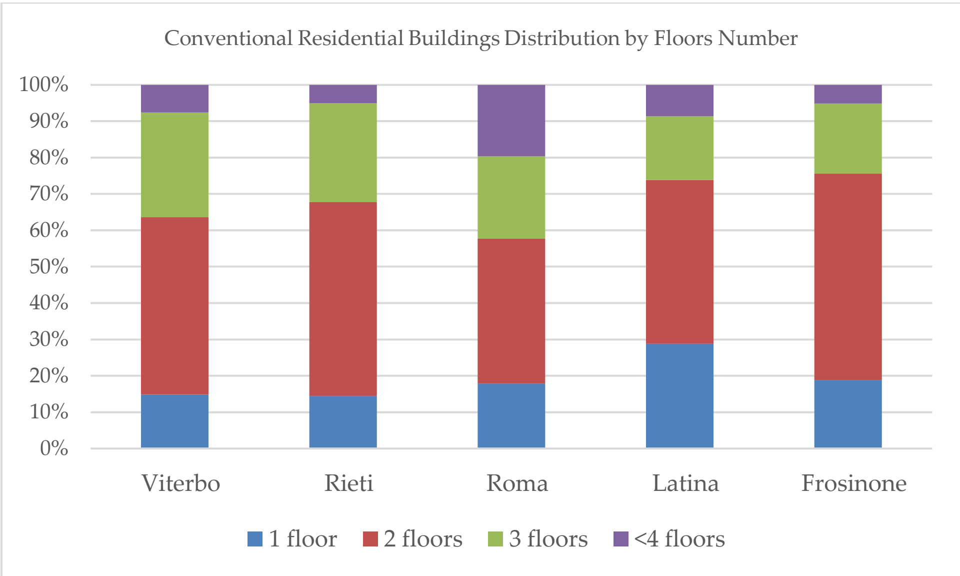


Figure (01-56) Distribution percentage of the regular residential buildings in Lazio provinces by the number of floors (ISTAT, 2011).

The average room number of the dwellings is 4.08 rooms/dwelling, 32% consists of four rooms, then (24 and 19) % have three and five rooms respectively. Almost 11% for each (two and six or more), finally 2% have only one room. 73% have one kitchen, 26% have a kitchen corner, and 1% have two or more kitchens. Most have a staircase by 60%. 29% of the dwellings have four rooms, and 11% have two or more. Figures (01-57) and (01-58) illustrate some examples of modern buildings (residential and non-residential) in the Lazio region.

Figure (01-57) Some examples of residential buildings in traditional settlements in the Lazio region (Google Maps, 2021). Panel 1: shows typical three-story buildings in Roccagorga, Latina. Panel 2: shows a four-story building in Carpineto Romano, Rome. Both indicate 9% of the residential building by floor number. Panels 3 and 4: show two-story residential buildings with shops/services on the ground floor in Amaseno, Frosinone, and Poggio Mirteto, Reiti, respectively.

Figure (01-58) Some examples of service and commercial buildings in traditional settlements in the Lazio region(Google Maps, 2021). Panel 1: shows a contemporary police station in Torrice, Frosinone. Panel 2: shows a private medical center in Acquapendente, Viterbo. Panels 3: depicts an elementary school in Roccagorga, Latina; the elementary schools in Lazio have the highest share by 40%. Panel 4: shows a modern shopping store in Sant'Elia Fiumerapido. Services and commercial buildings are (11803 and 18979), demonstrating (8 and 13) % of the total non-residential buildings in Lazio.

1.5.3 Economic Activity, Built Environment, and Energy – Delta Region

As introduced, farming and fishing are the major activities in the Delta region to investigate the relation of activities and the built environment. the Author implemented a field trip in a typical traditional settlement (Al-Bannaien) in Kafr Elshikh Governorates where the small-dimension fisheries economy is prevailing (Abouaiana & Mendonça, 2022). A set of personal meetings with fishers took place. They described the dominant local fishing cycles as follows: a group consists almost of some (3-4) fishermen, collect fish yield from individual local fishermen, then move to fish big market "*Al-Bursa*" near to the border of the settlement, to sell the yield per box or "*Wazna*" -which equals 2 kilograms, which is managed by the "*Al-Bursa*" owner for 10% of total sales. Then it is distributed to other cities.

Other patterns of the fishing process, namely, selling the yield in a fish stock "*Al-Halaqa*" to the locals. The second one is to collect the small fish by children and a few fishers to sell them at too low prices to feed poultry and birds. Figures (01-59) show one of the traditional boats and the illegal fishing process of small fish to feed poultry and birds.

(1) (2)

Figures (01-59) Fishing activities in Al Bannaien traditional coastal settlements in the Delta region (taken by the author, 2019). Left panel: One of the legal fishing processes. Right panel: primitive (illegal) fishing process.

The relation of fishing activities with dwellings is a weak direct correlation, as the local fishers described. On the contrary, the fishing culture's impact affects the built environment, notably visually, represented in landmarks, the distinguish boat industry that integrated with the landscape as shown in Figure (01-60).

(1) (2)

Figures (01-60) Visual impact of the small-dimension fishing economic activities on the built environment in Al Bannaien traditional coastal settlements in the Delta regions (taken by the Author, 2019). Panel 1: Integration of the boating industry with the landscape. Panel 2: A symbolic landmark shows a soldier and a fisherman.

The distributed energy in Delta region in 2017 accounts for 20272 million kWh. The residential lighting purpose consumed the highest amount of energy, with 70% in Dakahlia and Gharbia and an average of 45% for the other three. Conversely, the electricity transmission company does not distribute electricity for the transportation sector in the Delta region (the less amount distributed energy in Egypt by 590 million kWh yearly). Each governorate has a different behavior of energy consumption. Table (01-08) summarises the energy distribution percentage among the sectors. Figure (01-61) shows the electrical energy distribution by purpose. Conspicuously in the era of pandemia -if prolonged, the daily residential electricity consumption is anticipated to rise daily by 7% to 23% because of working from home (IEA, 2020).

Table (01-08) The percentage of the distributed electrical energy according to the uses by (%)

Governorate	Industry	Agriculture & rrigation	Lighting	Commercial	Services	Governmental Bodies	Public purposes
Dakahlia	6	1	70	3	4	3	13
Damietta	11	3	43	8	5	8	22
K. ElShiekh	5	3	47	3	4	3	35
Monufia	9	10	53	2	2	2	22
Gharbia	12	1	69	7	2	6	3

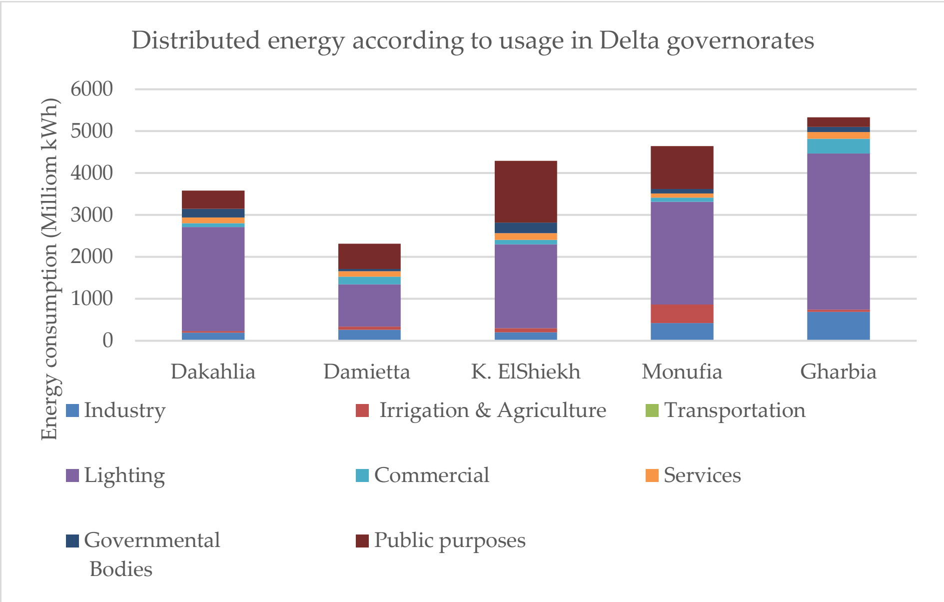


Figure (01-61) Annual distributed energy by the purpose of use in Delta governorates (the author) based on (CAPMAS, 2017a).

Regarding electrical appliances, 89% of the Egyptian families in rural contexts have refrigerators, 33% have electrical water heaters (besides 15% use gas water heaters), 19% have automatic washing machines, and 4% rely on airconditioning, 5% microwaves, and ovens. Figure (01-62) shows some of the electrical appliances and typical cooking.

(1) (2) (3)

Figure (01-62) Panel 1: shows a typical gas oven for cooking purposes. Usually, it is located outside the kitchen. Panels 2 and 3: show some electrical appliances (Abouaiana, 2016).

1.5.4 Economic Activity, Built Environment, and Energy – Lazio Region

In the Mediterranean Sea, Lazio Region produced fishery in 2019 by 5679 tons (3.3%) of the total production in Italy (173961 tons). It is located in the ninth place of the coastal provinces. Sicilia has the highest share by 19%, and the lowermost in Molise at 1%. By the fishing method, the small-scale fisheries exemplify 20% of the total in Lazio, higher than the Italian national average (12%). However, Raicevich et al. (Raicevich et al., 2020) mentioned that small-scale fisheries play a limited role in the Italian Gross domestic product (GDP).

The total farms in Italy in 2016 accounted for 1145705 farms, distributed over an area of 16525472 hectares. In Lazio, the total number of farms is 68295 farms, distributed on 827588 hectares. They exemplify 5% of the national farm areas. In terms of area, Lazio came in ninth place among regions. The highest is in Sicilia at 10%, and the lowest is in Liguria at 0.5%. The farmer manages 94% of these farms and 6% by other management forms. 72% of farms rely on mechanical means. Such as hoeing and tractors. Figure (01-63) shows examples of agricultural activities

Figure (01-63) Two examples of the small-dimension economies (farming) visual impact on the built environment Pontinia settlement, Latina (taken by the author).

Noteworthy, the number of Italian farms is decreasing annually. For instance, between 2015 and 2016, it has fallen by 36% (34% in Lazio). A recent study discussed this phenomenon in Italy (Zavalloni et al., 2021). Regarding the farms' distribution at a provincial level, Rieti has the lowest share by 9%, and Frosinone is the highest at 27%, then around 21% of the other provinces[12]. Figure (01-64) shows the distribution percentage of the farmlands in Lazio provinces in 2016

[12] Pontinia (the selected case study) has 1212 farms representing 6% of the total farms in Latina province (ISTAT, 2010).

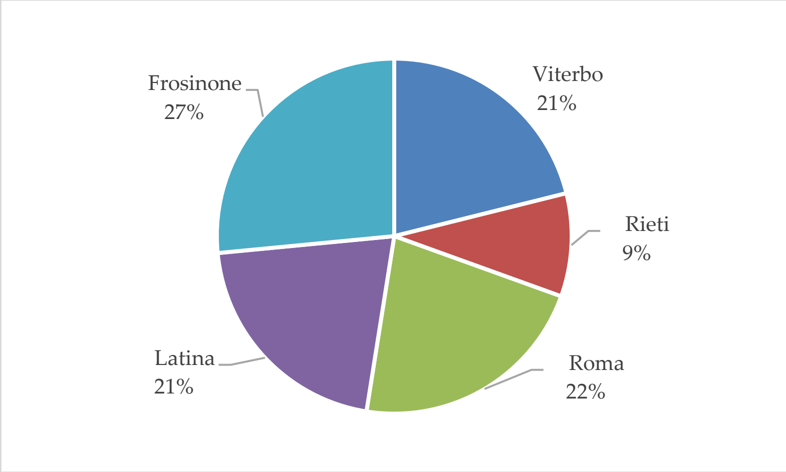


Figure (01-64) Distribution percentage of the farmlands in Lazio provinces in 2016 (ISTAT, 2022).

The ISTAT does not separate between small-dimension and large-scale economies for forestry economies. However, the felling -trees cut down- areas in Lazio in 2015 were 4222 hectares[13] (8%) of the total area of Italy is 54218 hectares, coming in sixth place in the national production. Bolzano/Bozen has the uppermost share by 27%, and the lowest in Abruzzo by 3%.

Regarding electricity consumption by sector, the services sector has the highest share with 8.798 Gwh (44%), followed by the residential and industrial sectors with 33% and 22%. The agriculture sector is less than 2%. At a provincial level, the highest electricity consumption in Rome by 69%, followed by 12% for each Frosinone and Latina, then 5% and 2% in Viterbo and Rieti, respectively. In per capita terms, Frosinone came in the first place with 5062 kWh/inhabitant, the second Latina with 4120 kWh/inhabitant, third 3316 kWh/inhabitant in Rome and Viterbo, then 3143 kWh/inhabitant. Figure (01-65) depicts the electricity consumption by sector in Lazio provinces.

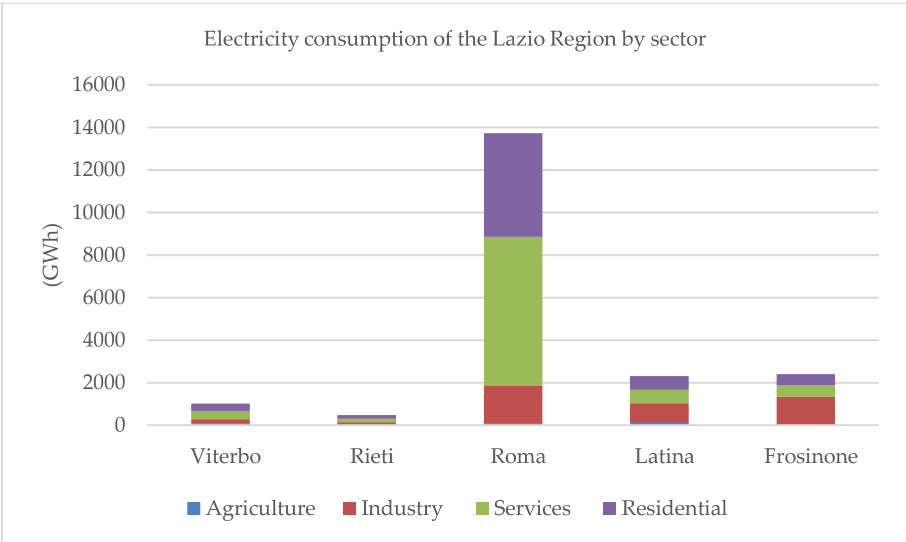


Figure (01-65) Electricity consumption of the Lazio Region by sector (Terna, 2020).

Regarding the electrical appliances, the majority of the families in Lazio have "White Goods," specifically, refrigerators and washing machines (99 and 95)%, then dishwashers by 35%, freezers by 20%, and 1% rely on clothes dryers. On the other hand, only 28% of households have air conditioning (electricity-

[13] The hectare equals 2.4 feddan (the equevelant measurement unit in Egypt) that equals 10000 m^2

driven). Instead, most families (68%) rely on heating pumps, fixed or portable systems by 28%, and 4% on centralized or autonomous systems.

On the contrary, 99% of the households have water heaters. The autonomous systems prevailed with 68%, followed by the electrical ones with 23%, then the methane (the leading component of the natural gas), and centralized systems with 4% each. In terms of heating systems, they exist in 99.6% of the Italian dwellings, the autonomous one led by 63%, followed by the centralized and autonomous systems by 22% and 15%, respectively. The energy source It is worth mentioning that the domestic water heaters and inner spaces rely on the combustion systems because of related aspects to the availability and primary energy sources purchasing in economic terms (De Santoli et al., 2019). Figure (01-66) shows the percentage of households with water heaters, air conditioning, and heating systems.

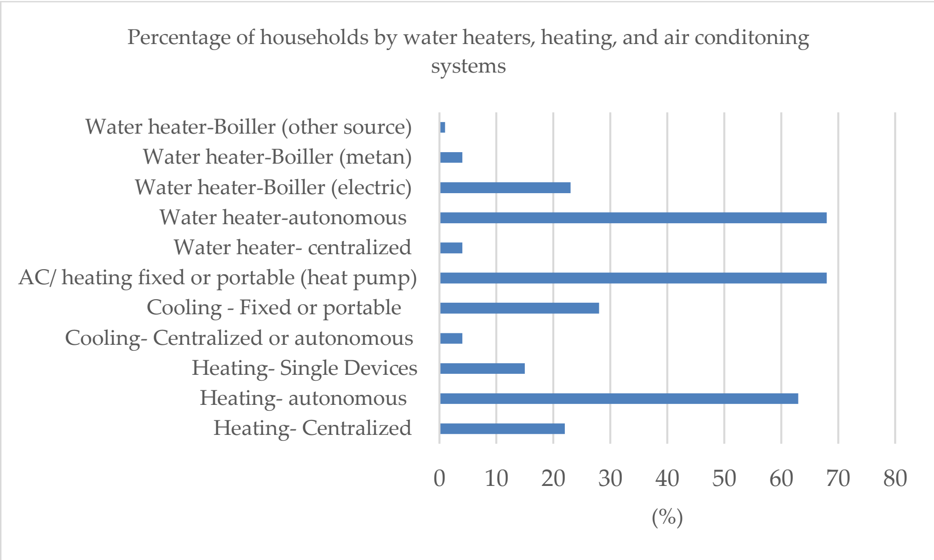


Figure (01-66) Percentage of households by heating[14], air conditioning, and water heaters systems in 2013 in Lazio (ISTAT, 2022).

1.6 Case Studies

1.6.1 Lasaifar Albalad Traditional Settlement

1.6.1.1 Spatial Analysis

Lasaifr Albalad comes in Egypt's fourth administrative system level (submunicipal division). It represents one of the 339 typical main villages in the Delta region. It follows Konaieset Alsaradoosy Local Unit that follows Desouq District in the Kafr El-Shiekh governorate. The population is estimated at 14000 inhabitants[15]m in

[14] Regarding the ISTAT Glossary; "*the central system designed to heat all of the living quarters in the same building, and housed in a dedicated utility room. The independent is designed to heat a single living quarter and usually located inside it or nearby and that is controlled independently. Lazio Region is one of the main producing engines of Italy, with a GDP of about 170 billion euro in 2011, the Lazio economy represents 10.7% of the national GDP and it is comparable to that of entire European countries (Portugal, Hungary, Ireland, and Greece). The single device is and ot connected to a centralised or permanent independent system*

[15] The population of the village in 1997 accounde for 5311 inhabitant, as mentioned in the official urban boundary map released in 2000. In 2006 the population accounted for 8589 as per Wekipedia based on 2006 census. The Author used an Excel logic to generate the estimation of current year, as well the locals supports this estimation.

2021. The inhabited area (inside the urban boundary) is between (0.3-0.4) km². Figure (01-67) depicts the ultimate and intimate contexts of the case study.

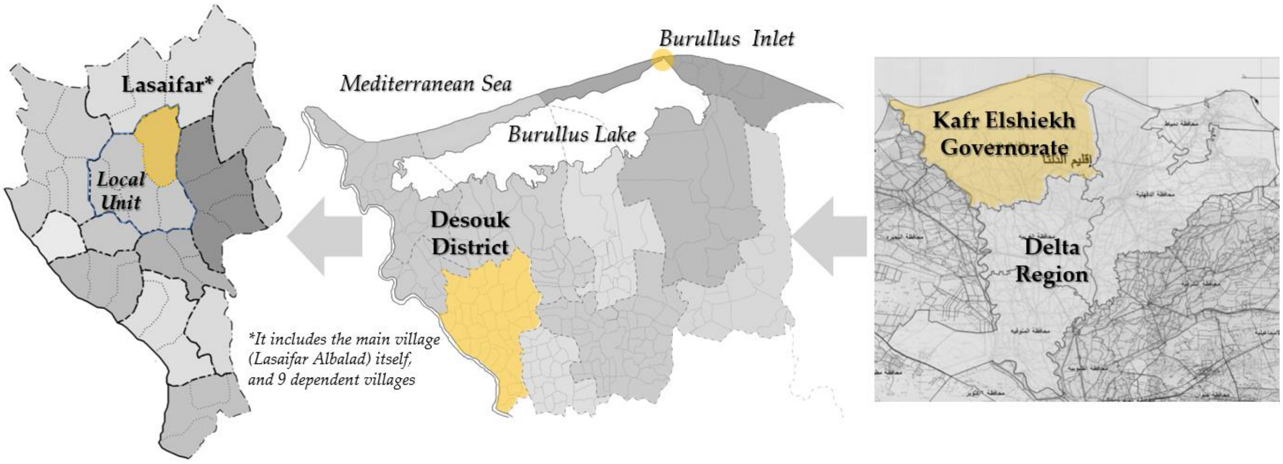


Figure (01-67) The ultimate and intimate contexts of the Lasiafr Albalad village. (the author) based on the GOPP official maps.

The settlement contains the urban fabric typical of villages in the Delta region. The local road network includes four width gradients from (8,6,4, and 2) m. It has a central public space and some private spaces (between dwellings and private gardens attached to houses) in terms of outdoor voids. In terms of water bodies, the settlement is bounded by two canals from the east (along the main road) and west and a sewage canal (from west to east) on the southern edge. Figure (01-68) shows the settlement's urban tissue and land use distribution.

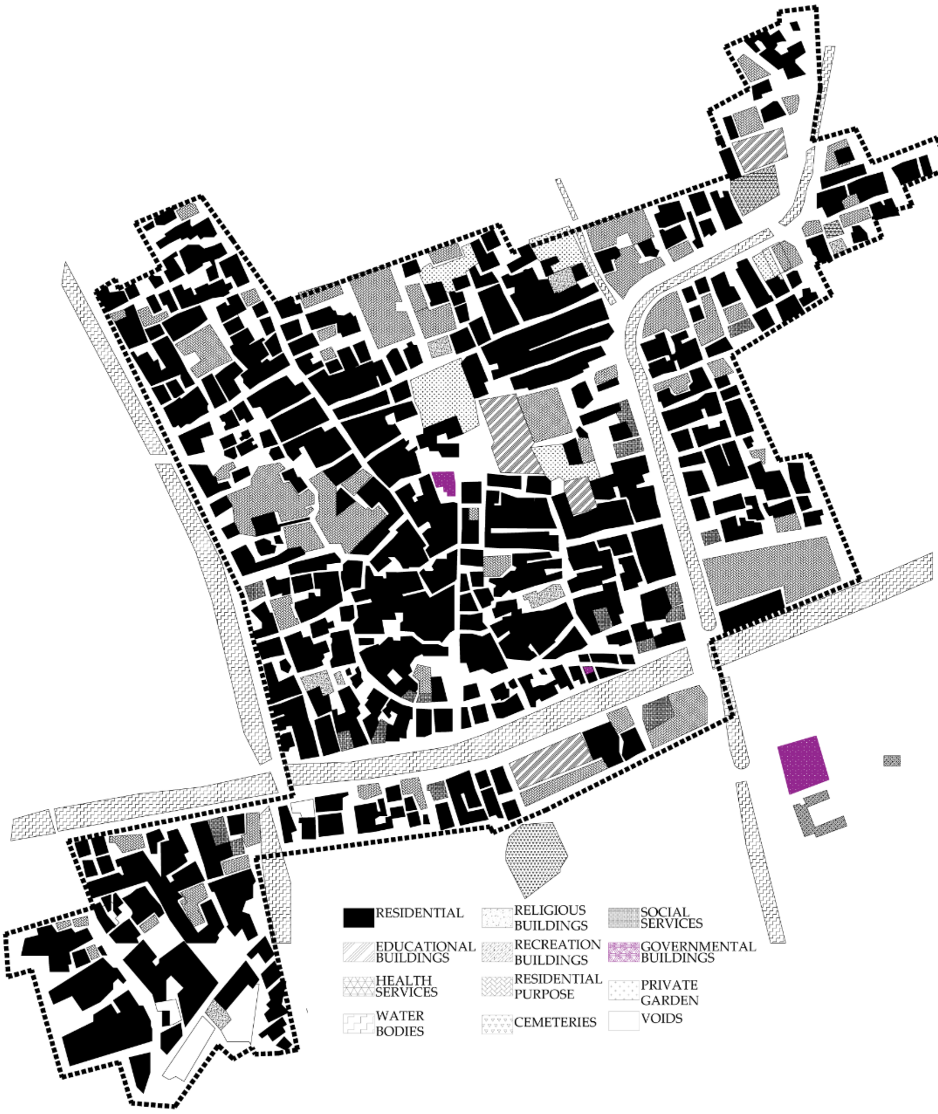


Figure (01-68) Urban fabric and land use of Lasaifar Albalad (the author). The map is available in AutoCAD (.dwg format) (Abouaiana, 2022b).

The total number of buildings in the settlement is about 700 buildings can be categorized into two groups. Firstly, the residential buildings are distributed as 670 residential buildings and 30 non-residential buildings[16]. Some residential buildings include different economic activities "shops" on the ground floor distributed randomly. Few residential buildings are vacant, and the bulk has two and three floors. Almost all the buildings have one unit per floor only. All residents live in their ownership, whether extended family (grandfather, father, and son) or a house with relatives of the same family.

The non-residential buildings have different types, in the first place, the religious buildings -mosques- by six buildings, then four primary and preparatory schools (general and Azhar), thirdly the governmental ones (Mayor's House and the agriculture association), fourthly public service buildings (post office, health unit, and temporarily closed events center because of the pandemic), then the recreational youth sports center. Finally, some commercial and storage buildings are distributed along the penetrating water body. Figure (01-69) shows different building types.

[16] The number of plots has been counted from the official urban boundary map received from the agriculture association.

Figure (01-69) Examples of the non-residential buildings in Lasaifar Albalad (taken by the author) Panel 1: The Mayor's "*Omda*" building is located in the core of the settlement. In front of the public urban void. Panel 2: The classes of the preparatory school are southwest oriented (the preferable is north-east or northwest). Frosted stickers covered the windows to protect them from the sun. Panel 3: The youth center. Panel 4: The agricultural guidance building.

The inhabitants' lifestyles can be grouped into three parts. Firstly, the youth meet together in the youth center to play football or another private playground, coffee shops, or walk, similarly the adults and elderly, with fewer sports activities and more home meetings. Finally, women have a more enclosed life, predominated by the home meetings, shopping in the temporally public market (on Tuesday morning). In comparison, playing outside is one of the preferable activities for children. Figure (01-70) depicts a typical recreational pattern in the settlement.

Figure (01-70) Canal bank functions as an outdoor public space. It has an economic function (coffee shop) (taken by the author).

The settlement is considered a focal point to the surrounded ones (dependents and other main villages) in the basic-education schools. Vice versa, the older students moved to the Desouk district for the secondary schools and the other centers for higher education, like Kafr Elshiekh university. The main transportation is small buses which lead to the cities. Recently the local community bought a bus to deliver the students to the university directly. Otherwise, the small 3-wheel-car "Tuk-tuk" is the leading transportation means, particularly at the micro-scale.

1.7 Pontinia Traditional Settlement

1.7.1 Spatial Analysis

Pontinia comes in the level four – a local administrative unit- of the administrative system of Italy, representing one of the 33 municipalities. It is located in Latina Province in the Lazio region. The population in 2020 accounted for 14945 inhabitants (Eurostat, 2021a). The inhabitant center's area (inside the urban boundary) is 1 km^2. The elevation map varied between (0-21) m. Figure (01-71) depicts the ultimate and intimate contexts of the case study.

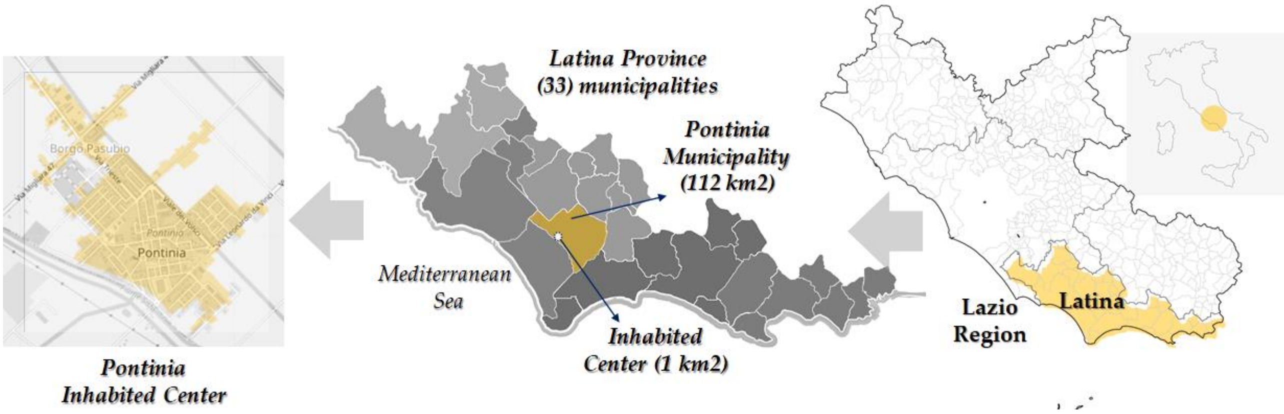


Figure (01-71) The ultimate and intimate contexts of the Pontinia village (the author).

The settlement contains the urban fabric typical of the fascist-era villages in the Lazio region. Two parallel main roads and two water bodies bound the settlement on the north-west and south-east axis, Appia Street "*Via Appia*"[17] from the east and Via Pontina from the west, which links Mussolini towns with Rome and Campania. Perpendicularly, parallel roads link the main roads, those so-called Miliara (*Migliara*) with a serial number, the main in Northern Pontina is Via Migliara 47. Figure (01-72) shows the road network in Pontinia.

[17] Via Appia was the major route of communication in the surrounded context, so and it was essential to be linked wth the roads came from the new towns. (Scricco, 2014).


Figure (01-72) The local road network surrounded Pontinia (taken by the author). Left Panel: shows the "*Via Migliara 47*" (6m width) that led to a smaller one, the so-called "*Strada.*"Right panel:("*Strada Portosello*") (4m width).

It has a central public space (political and administrative core) that leads to the religious and educational core then to smaller services centers, almost a typical pattern like this shown in the Littoria masterplan see Figure (01-34). Figure (01-73) shows the original scheme of Pontinia.

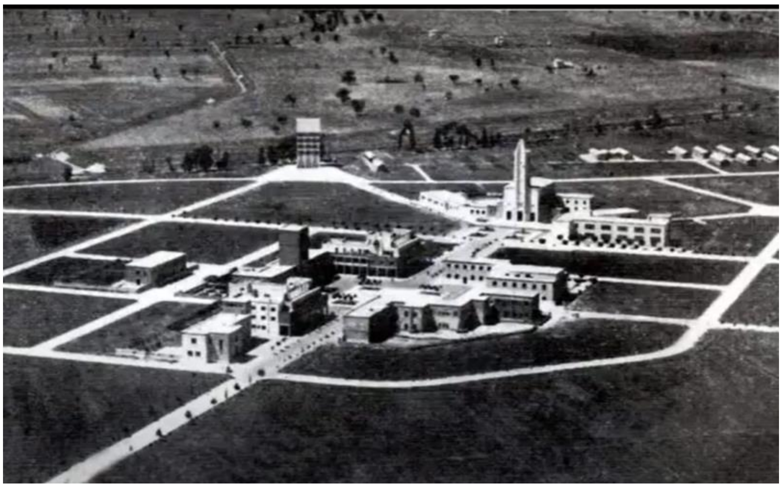


Figure (01-73) The original built environment of Pontinia (BOTTONI, 2017).

The initial stage of the village (the core) consisted of the public buildings, as seen clearly—besides houses for the laborers. The village was inaugurated on 18 December 1934. Its design was supervised by Italian architect Oriolo Frezzotti (Margione, 2018). Figure (01-74) shows the current urban tissue and land use distribution.

Figure (01-74) Urban fabric and land use of Pontinia village. The author edited the majority of buildings on the Open Street Map in October 2021 (OpenStreetMap, 2021). The map is available in AutoCAD (.dwg format) (Abouaiana, 2022d). It is evident that the buildings have two orientations: first to the north in the center (original scheme) along the north-northwest and south-southeast axis. Second, in parallel to the road network, to the north-west along the north-east and south-west axis.

Pontinia has two waterbodies Sisto River on the western side and Canal La Botte on the east. Figure (01-75) illustrates the waterbodies in Pontinia.

(1)

(2)

Figure (01-75) The waterbodies surrounded the inhabited center of Pontinia (taken by the author). Panel 1: River Sisto. Panel 2: Canal La Botte.

The total number of buildings in the settlement is about 1349, as counted from Google Maps and Open Street Maps (ISTAT census indicated 2366 buildings in the entire Pontinia). They can be grouped into two classes. The residential buildings are 1199 (88%), including many small attached structures such as sheds, small stores, and garages, besides 150 non-residential buildings, including a few attached buildings too. Figure (01-76) depicts structures examples of the attached residential buildings.

Figure (01-76) Examples of the attached structures to the residential buildings provide different functions (here, car parking), shed from steel (the building on the right), and wood (on the left one).

The residential buildings can be categorized into three groups. First, the *detached houses,* with pitched roofs, have almost a rectangular or square shape of one to three-floor, are usually located in marginal areas, as shown clearly on the urban fabric map Figure (01-74) (extended strips from the inhabited center) with one or two floors including one or two families. Second, the *residential buildings* vary between (3-5) floors with an average of 3 floors in the center, either for residential purposes or mixed-use with commercial and service purposes on the ground floor. The third is the southern margin's residential complex (four or more floors). Scricco (2014) emphasized the observed positive correlation between buildings' height and roads width. Figure (01-77) shows examples of residential building typology.

(1)

(2)

(3)

Figure (01-77) shows examples of residential buildings typologies. (taken by the author) Panel 1: shows a single-family detached villa in the scattered urban fabric. In terms of floor number, it represents 20% of the total building. Panel 2: shows a seven-story building (with a roof floor). The ground floor is used as car parking. This typology (4 or more floors) represents 4%. Panel 3: shows a four-story residential building (under construction, January 2022). As is seen, the building is implemented in line with the economic incentive, Ecobonus 110%. (Chapter Two) has discussed the energy efficiency measurements in Italy and Egypt.

The non-residential buildings have different functions. First, the religious buildings, a church in the center, second, the public service buildings (municipality, agricultural consortium, culture palace, police station, hospital, municipal pharmacy, local health unit "*A.S.L*," and banks), third, school buildings, fourth, recreational buildings (3-star hotel, day-use house, bars, sports hall, elderlies care), then commercial buildings (big stores, supermarkets, tractors/agriculture machines vendors) vendors and finally monumental buildings (water tower). Figure (01-78) shows some examples of public and services buildings.

Figure (01-78) Examples of public buildings (taken by the author). Panel 1: shows the historic theater. Panel 2: show the municipality building. Panel 3: shows "*Giovanni Verga*" secondary school. Panel 4: show the rural bank (a contemporary architectural typology inspired by the original scheme).

To diagnose the Italians' lifestyle. The ISTAT daily life indicators grouped the settlements by size. In the case of Pontinia (10-50 thousand inhabitants), the residents spend their daily life between different activities, namely personal care, employment, study, household work, meetings, leisure, and finally, travel. These activities are based on age groups, weekends, and weekdays.

To clarify in short, first, the age group 15 years or more (84% of Pontinia's inhabitants) is spending 53-61% of their day in personal care. Second. a range of 20-27% of their free time, in descending order, watching TV and reading, social life, sports and outdoor activities, and computing and hobbies. Third, 12-15% in the household works, Fourth, in employment by 2-6% on weekends, and 12% on weekdays. Then they spend 5% of their time-traveling, and finally an average of 2% of each studying and doing voluntary work. Figure (01-79) shows the hours percentage of the inhabitants aged 15 years or more daily activities.

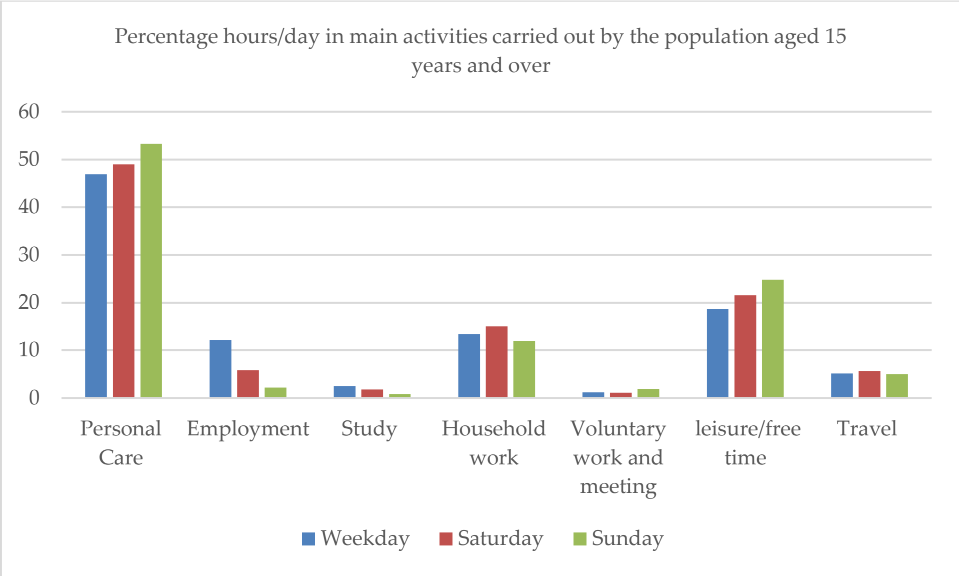


Figure (01-79) Percentage hours/day in main activities carried out by the population aged 15 years and over (ISTAT, 2022)

The aged group between 3-14 years have the same activities, excluding employment, precisely the same as the other group's first two activities. Third, the studying activities by 6% on weekends and 21% on weekdays. Then traveling (the same as the other group), 2% in household works, and finally the voluntary work on Sunday only by 2%. Figure (01-80) summarizes the percentage of hours/day in main activities carried out by the population aged between 3-14 years.

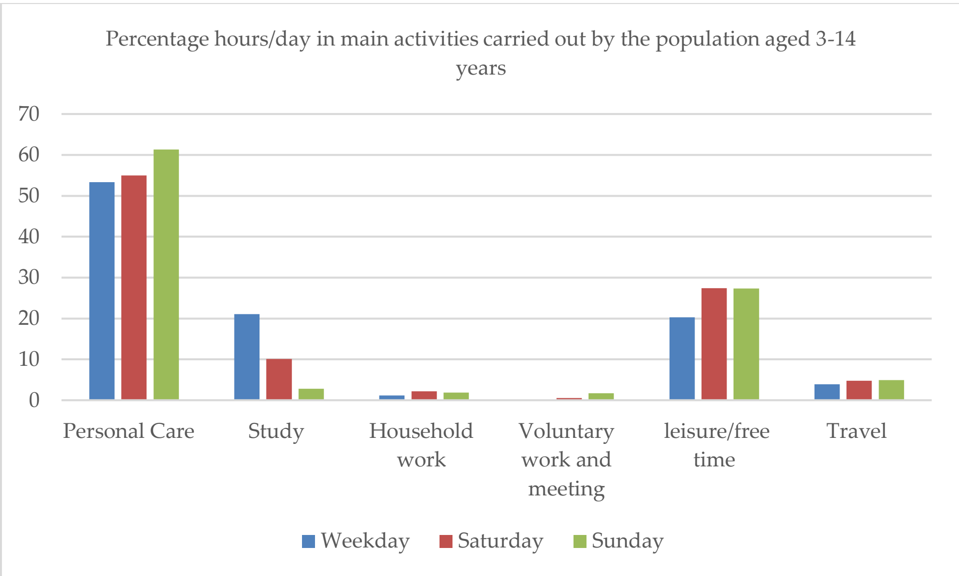


Figure (01-80) Percentage hours/day in main activities carried out by the population aged between 3-14 years (ISTAT, 2022).

1.8 Built Environment and Electricity Consumption Correlation

1.8.1 Introduction and Limitations

Many studies have investigated the energy consumption with residential building forms such as floor area ratio (Dawodu & Cheshmehzangi, 2017), buildings typologies (Torabi Moghadam et al., 2018), integrated with economic aspects such as economic growth (Jobert & Karanfil, 2007) and income (Wyatt, 2013), in addition to demographic, occupant behavior and, social aspects (Wright, 2008; Antonopoulos et al., 2019; Sena et al., 2021), and using of appliances (Huebner et al., 2016).

Other studies investigated these factors besides the occupancy rate in school buildings (Almeida et al., 2013) or mixed-use buildings (Woo & Cho, 2018). Other studies mapped the numerous approaches and methods between energy use and the built environment at an urban scale based on literature reviews (Anderson et al., 2015; Sharifi & Yamagata, 2016). Although all of these studies are implemented in international urban contexts at macro and mesoscale, they paved the way for these types of assignments in microscales.

There is a lack of research investigating the correlation at Egypt's microscale (Egyptian villages). Almost in Italy, some recent studies showed the topic is still growing, which reflects the importance of this issue, despite being carried out in the urban context, such as in historical areas in Campania (Ascione et al., 2013) and Sicily (Cellura et al., 2017), the middle-size cities in Lombardy (Caputo & Pasetti, 2017) and Piedmont (Torabi Moghadam et al., 2018), and finally the metropolitan areas in Turin (Delmastro et al., 2015; Carozza et al., 2017).

Therefore, the seminality of this study is characterizing the existing built environment patterns, namely, buildings typologies, economic activities of dwellers, such as work type, and location, besides social aspects such as education level and type of lifestyle, in both microscale contexts in traditional settlements in Egypt and Italy, that found significant points of contact and differences between both contexts.

Then the study provided a pilot experiment to explore the correlation of diagnosed built environment with the domestic electricity consumption (in Egypt only), which will pave the way for similar experiments in different contexts. Figure (01-81) portrays the investigated elements in the on-site survey.

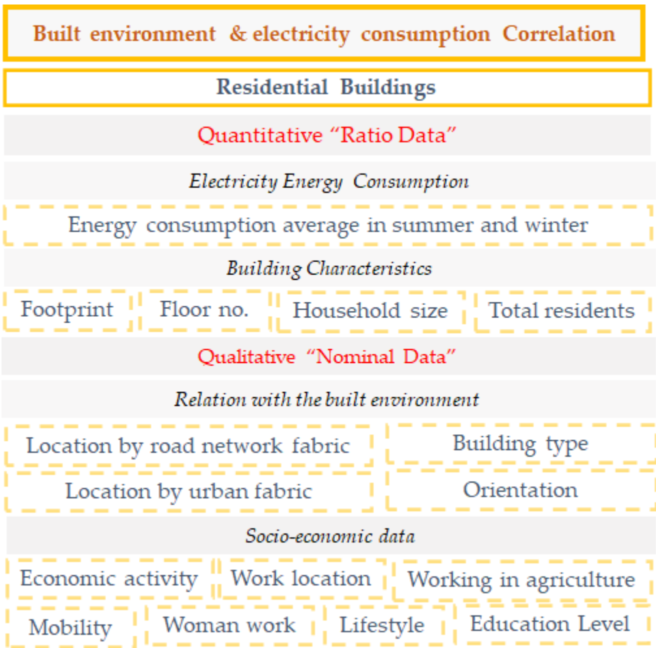


Figure (01-81) The investigated factors in the field study in the Lasaifar Albalad settlement.

The experiment was implemented successfully in Lasaifar Albalad, Egypt. While in the Pontinia case, the experiment was limited to the pre-test stage. Despite that, the preliminary stage's results (the uncompleted experiment) have been discussed to enhance future practices in Pontinia.

1.9 Data Collection Method – Lasaifar Albalad

Generally, it is noteworthy that the non-residential buildings are few compared to the residential ones. Hence, identifying the correlation with energy will be different because of the variation in function, occupation ratio, users, and operation hours.

Contrariwise, the residential buildings, and for many reasons. They represent most of the buildings with different characteristics in terms of type (full residential or mixed-use activity on the ground floor) and the dweller's socio-economic factors. A typical mixed-use building that includes a milk manufacturer lab can be taken as an example. In this type, despite having only four buildings in the settlement, the monthly consumption of this activity is about 1000 kWh, while in the others, the consumption is less than the equivalent for residential purposes.

The field study occurred in April 2021 to investigate the mentioned factors in figure (01-xx). The first layer was personal meetings with the representatives of governmental bodies and locals to describe the purpose of the study and the anticipated results. The second layer analyzes the urban characteristics, building types typology, demographic data, and the average electrical energy consumption in summer and winter. This step relied on the Open Street Map satellite image[18].

The responses were collected based on direct contacts, integrated with an electronic (Googe Form) closed-end structure questionnaire (the questionnaire is available on (Abouaiana, 2022). It was distributed among three public accounts of the village on social media (Facebook). It aims to build and enhance the locals' awareness of this intervention. Although the Author believes this sample is homogeneous, on-site meetings took place to avoid bias against those who use information and communication technology. Samples' selection

[18] The author's contribution to the Open Street Map is available at https://www.openstreetmap.org/edit#map=17/31.18297/30.71843 (Accessed 03-05-2021)

in-situ considered that the buildings have different floors, types, and locations. Besides, it is known that some of their dwellers have no access to the internet.

A sample of 46 buildings was selected. Firstly, 14 non-residential almost represented them apart from some shops. Secondly, 32 residential buildings located in different areas in the village (varies urban fabric) related to the road network, the paterfamilias have various economic activities.

Likewise, in the online questionnaire that simplified the scientific terms, for instance, to determine the location in which urban tissue, the respondents were asked to describe dwellings' location that is surrounded by many buildings like beside grand mosque (organic), along with the main road (linear), and near to village's outskirts like being beside of the health unit or cemeteries (scattered). Another multiple-choice question to calibrate the answers is to describe the road width in front of their homes (2, 4, and 6 m).

In the question of the average energy consumption in summer and winter, the respondents were asked to report the other units in the building because almost every building has extended family or relevant residents. The household size and number were investigated, in addition to floor numbers and whether the ground floor has a shop.

To determine the economic activities, a set of questions was provided, such as working in the agriculture sector (to diagnose this small-dimension activity), work type, work location (in the village, in the city, in Delta Region, and outside), the used transportation to work, lifestyle, and education levels. This socio-economic information is not only examined in energy consumption terms but also calibrates the answers. Figure (01-82) is synopsizing buildings' numbers and sources of data collection. The dataset (EXCEL and SPSS files) are available on the following Google Drive link:

https://drive.google.com/drive/folders/1w62dU9by4CyZXuIj0G6o9QsVocFVSIVR?usp=sharing

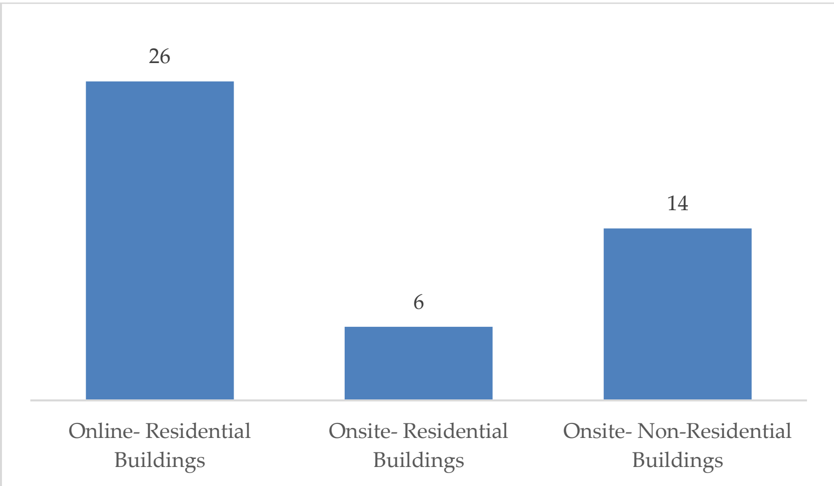


Figure (01-82) The examined buildings' distribution by type and source of data collection.

1.9.1 Sample Characteristics - Non-Residential Buildings

Mosques come in the first place by distribution. The footprint of the grand mosque is about 300 m^2 (the maximum capacity is about 250 prayers). It consumes monthly 180 and 220 kWh in the winter and summer months. The average annual consumption is 2400 kWh. It has a 10 kW diesel generator for an emergency.

The school buildings (Azhary and General), first the general education, the footprint of the preparatory one is 220 m^2. It comprises three floors, with a total built-up area of 660 m^2 approximately. The first and the second floors have eight classes (each class has a "smart display" and a computer). It includes two computer labs, a library, a science lab, and executive rooms. The monthly consumption is about 500 kWh monthly (commercial tariff), with an annual consumption of 6000 kWh. While the primary school consists of three floors and ten small classes, the footprint area is 210 m^2. The total built-up area is 630 m^2. The average monthly consumption is 250 kWh (3000 kWh annually).

The health unit building has a footprint area of 65 m^2. The building consists of two floors, and the total built area is 130 m^2. The center provides essential medical services, vaccination, and related-health activities during particular working hours. The average monthly consumption is around 1000 kWh, annually 12000 kWh, which is high compared to the average energy consumption in the settlement due to mandatory equipment such as medicines, refrigerators, and sterilization devices.

The governmental buildings: the agriculture association supports the peasants, provides them with production inputs, financing, and marketing processes, and reduces production costs. The area of the one-floor building is 75 m^2 approximately. The monthly average consumption is about 110 kWh (the annual is 1320 kWh nearly).

The same for the social buildings; the social development building, has two floors with a footprint area of 120m^2. It consists of two floors, including an official social affairs unit and a kindergarten. The monthly consumption is about 120 kWh. The official operation hours are 35 hours weekly. It plays a vital role in the community development process. For instance, it provided a private bus to transfer university students to Kafr Elshiekh University and established a post office that offers many financial services. The events house area is 130 m^2 -it has been temporally closed since the pandemia. It was used for social events, mainly funerals.

In terms of commercial purposes, the independent shops' buildings like restaurants, vehicles, mechanics workshops, bakeries, and gas providers are distributed mainly along the main road. The average area is between 16-25 m^2, with monthly consumption ranges of 80-120 kWh. In other words, 1200 kWh average annual consumption. The operation hours are nearly 10 hours daily. Figure (01-83) summarizes the yearly energy consumption of the non-residential buildings by meter square to enable a comparison.

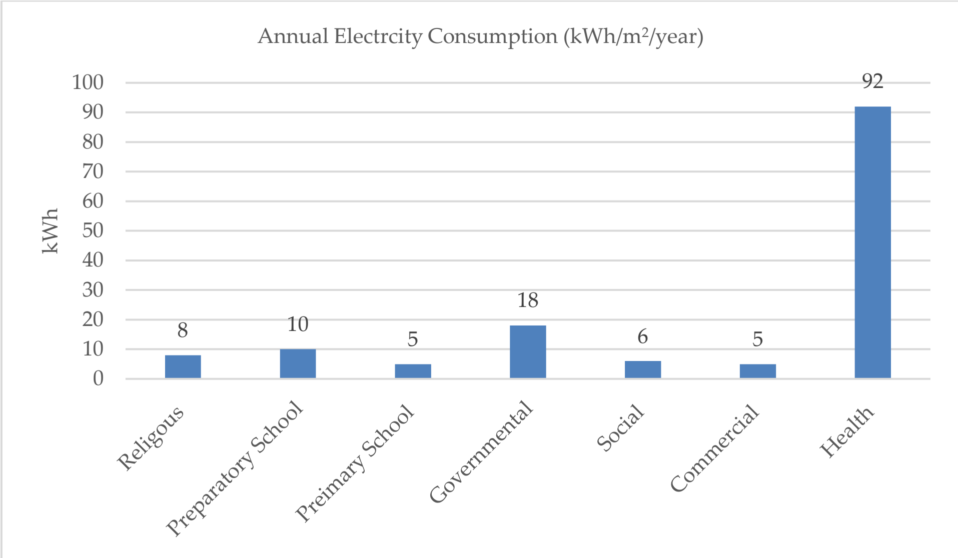


Figure (01-83) The average square meter annual energy consumption of the non-residential buildings in traditional settlements in the Delta region.

1.9.2 Residential Buildings Characteristics – Continuous Data

The selected sample have represented 83 households and 458 inhabitants. In terms of footprint area, the mean is 100 m². The amount is the dwellings between (90-100 m²) by 15 frequents, followed by six (70-80m²)-buildings, then four residences in between (110-120 m²), the others are distributed equally, as seen in Figure (01-84).

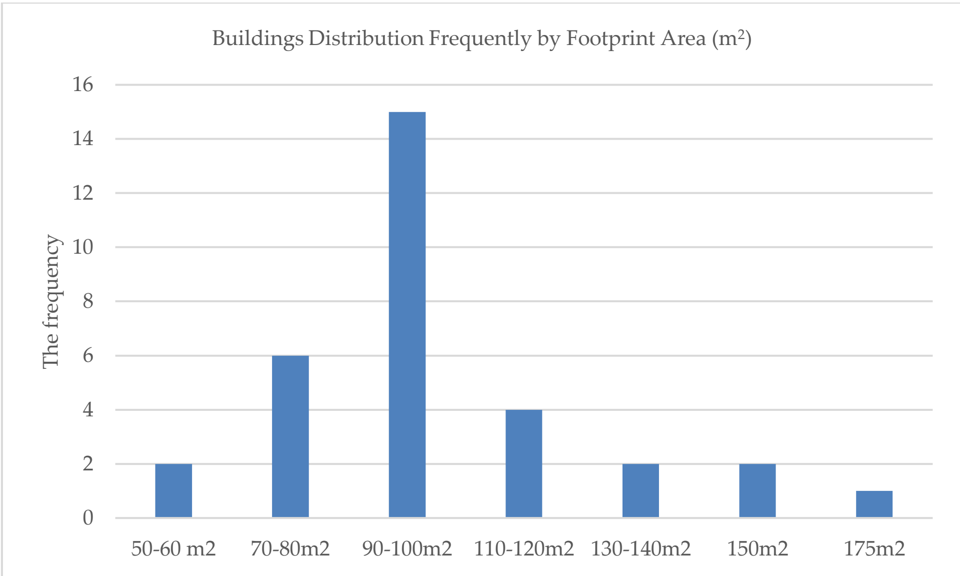


Figure (01-84) Residential buildings distribution by footprint area.

By floor number, 14 buildings have two floors by 44%, then the three-floor by 8 (25%), came behind one-floor by four buildings, and four-floor and five-floor buildings by 3 for each Figure (01-85) depicts the sample distribution by floor number.

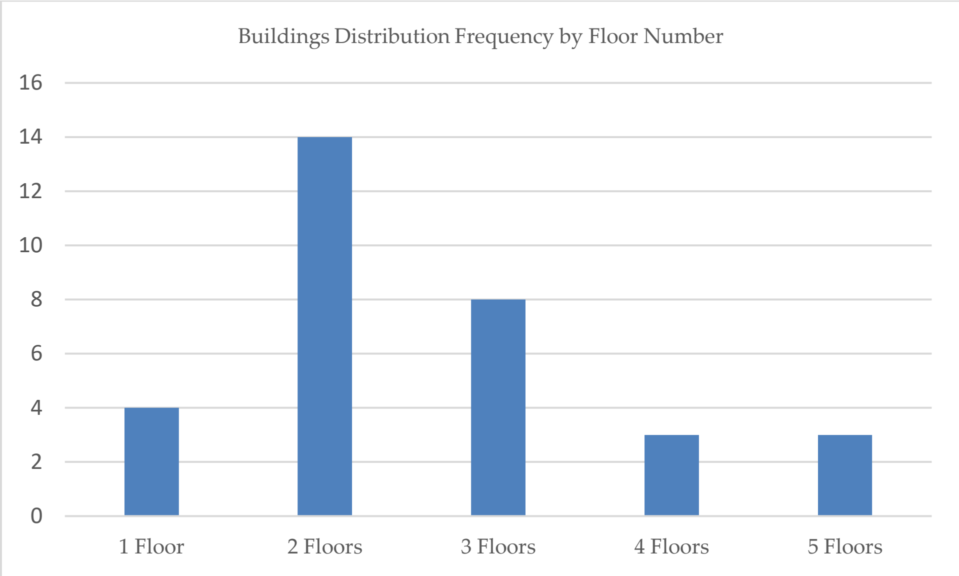


Figure (01-85) Residential buildings sample distribution by floor number.

The mean of the total built-up area is 269 m^2. Nine buildings have (140-180 m^2) by 28 %. Secondly, 15 buildings are distributed equally for the areas between (90-120 m^2), (200-240 m^2), and (270-300 m^2), in third place the largest areas (450-520 m^2) and (560-650 m^2) repeated three times for each, and only two buildings between (360-400 m^2) Figure (01-86) depicts the sample distribution by built-up area.

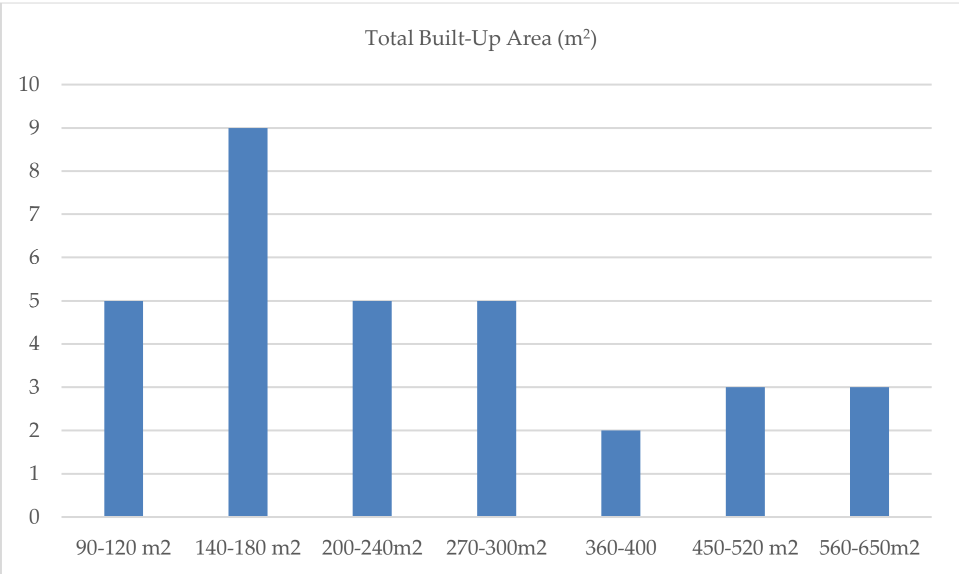


Figure (01-87) Residential buildings sample distribution by built-up area.

In terms of monthly energy consumption, the household's consumption ranges between (50-495 kWh) in summer and between (50-560 kWh) in the winter. The mean is 200 kWh approximately. Figure (01-88) interprets the monthly average consumption of households. By building, the average annual consumption ranges between (1140- 14964 kWh) with a mean of 5678.25 kWh. Consumption between (3001-4000 kWh) frequented by 19% followed by (1000-2000 kWh) categories by 16%The less frequent is (8001-9000 kWh) group by one building, almost the other categories distributed equally. Figure (01-89) expounds on the annual consumption frequency of the sample.

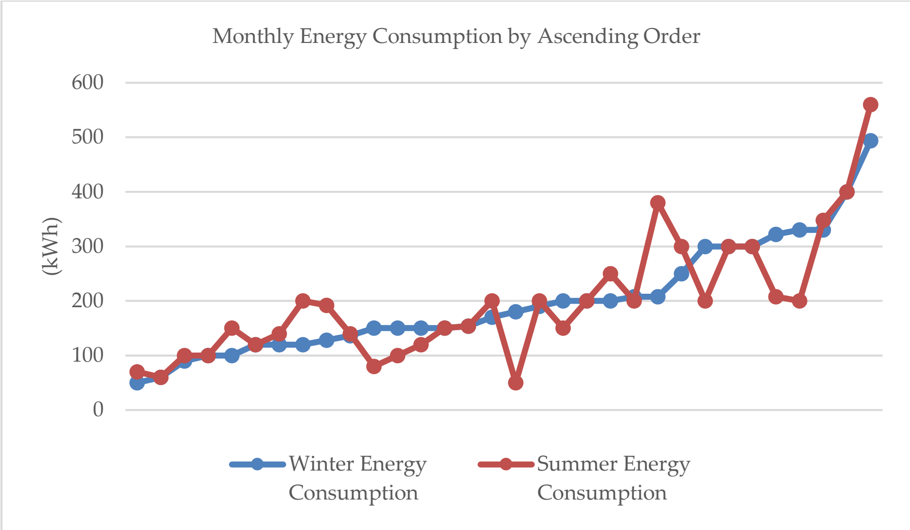


Figure (01-88) Households samples average monthly consumption in winter and summer.

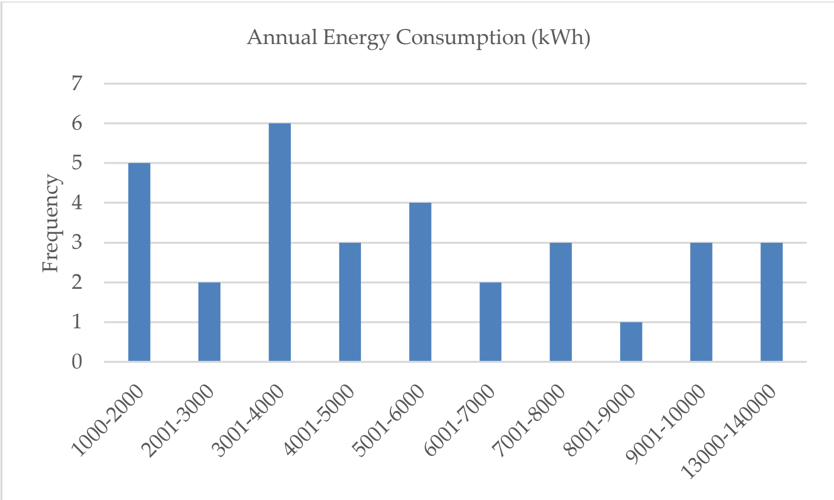


Figure (01-89) Distribution of the residential buildings by annual energy consumption.

1.9.3 Residential Buildings Characteristics – Nominal Data

Figure (01-90) summarizes the economic activity characteristics of the paterfamilias and the social activities of households. In terms of work type, 41% are employees, seven respondents (22%) are work as freelance (by task) such as in the construction industry, then 13% are not working (unemployed and retired), 9% are self-employees or business owners. In terms of work location, 37% work in the settlement, secondly those who work inside and outside the region, 22% for each. 16% stated they currently work in the Gulf Countries.

Regarding mobility to work, the majority, one-half rely on public transportation (so-called microbus), 23% walk to work, then 13% use their cars. The data indicates that those, who work in Lasifar, go to work on foot and by public transportation.

Two-thirds of wives are not working. The prevailing pattern of the respondents' recreational activities is family visits by 53%, which came behind other activities, including spending time in coffee shops and the youth center. These activities are implemented by small size families, in third place walking and going to Disouk City by 12% for each.

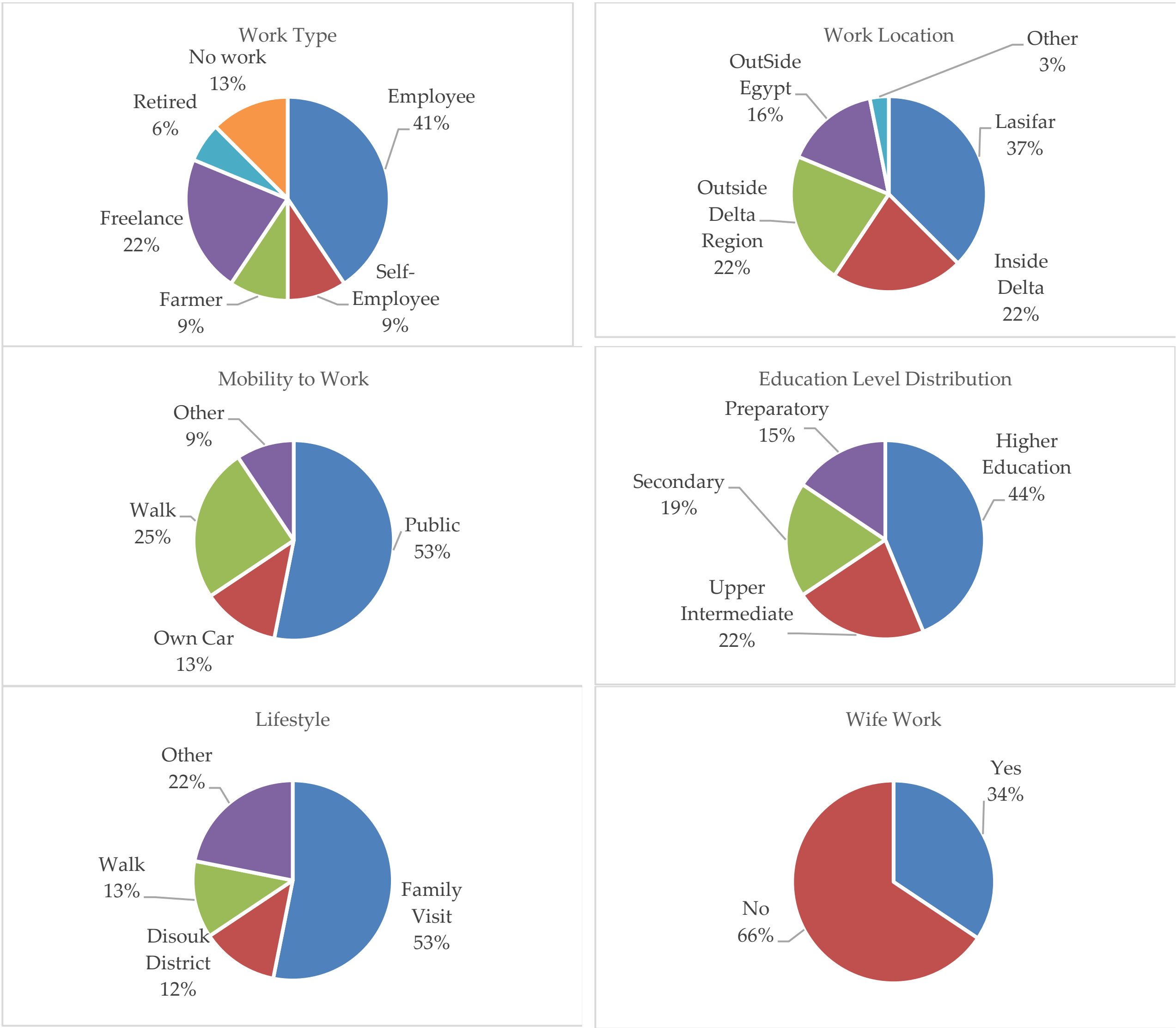


Figure (01-90) The economic related-activity characteristics of respondents.

In order to identify the buildings positioning in the village -as described in (section 1.5.3), Figure (01-91) illustrates the matrix between urban tissue and local road network width. 12 buildings (38% of the total) located on the organic fabric. They are distributed equally on the different road widths. Secondly, the linear fabric includes 13 buildings (41% of the total), the majority overlooks the 6-m road; finally, the scattered fabric (surrounded by the agriculture area) has seven buildings distributed on the 4m and 6-m roads. The absence of the 2-m road supports the aim of the question to ensure the best description of the urban tissue.

The respondents were asked to describe their feeling toward thermal comfort, represented in describing the orientation, where "*Bahary*" (towards north- seaside) means a good condition, while "*Qibli*" (towards south) means non-comfortability. 19:13 responses reported good thermal comfort. A positive relation between locating on linear and scattered fabric with good thermal comfort indicated, vice-versa the traditional one.

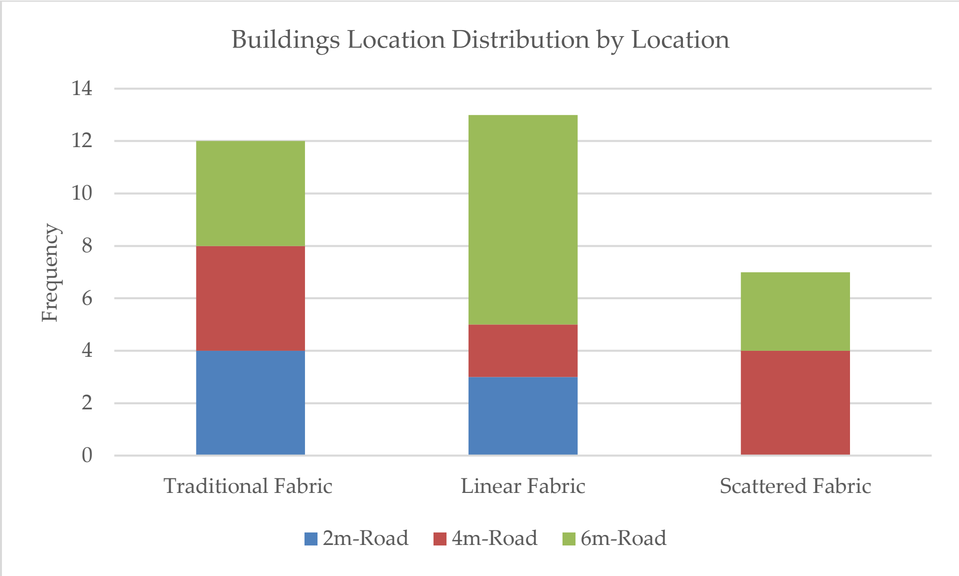


Figure (01-91) Distribution of the sample buildings by urban tissue and local road network width.

In order to investigate the relation between dwellers' small-dimension agricultural activities, the interviewed peasants described the predominant local farming cycles as follows: "*wheat and rice crops production, after harvesting, the crops prepared in the relative industry, namely, wheat grinding and rice bleaching in a factory in the village or nearby village/district for domestic use and to sell them.*" The sugar beet crop is connected to the leading (governmental) sugar production factories in a particular city/district. Almost all the workers in this are from the village. Figure (01-92) shows a grain storage building.

Figure (01-92) A grain storage building in the district. To receive the peasants' production, then to sell and distribute it (taken by the author).

Another economic pattern, poultry farms, significantly impact electricity consumption. At the macro scale, poultry farming demands energy due to needed lighting (for 24 hours) that increases productivity and air conditioning in summer (no large-scale farms are indicated in the settlements). In the same vein, a local explained the process: "*the monthly electricity bills doubled during farming birds months from October to June due to needed lighting,*" He also used the upper roof for this purpose. Figure (01-93) shows two local economic activity examples in two dwellings. Figure (01-94) demonstrates private open spaces attached to the dwellings (private), including small-dimension economic activities.

(1) (2)

Figure (01-93) Small-dimension economic activity examples in the same dwelling (taken by the author). Panel 1: shows a poultry farm inside a vacant apartment (third floor and the last) in a family-extended building. As seen, an electrical wire used in lighting came from the dweller's below-floor. Panel 2: shows a bird farm on the roof floor (taken by the author).

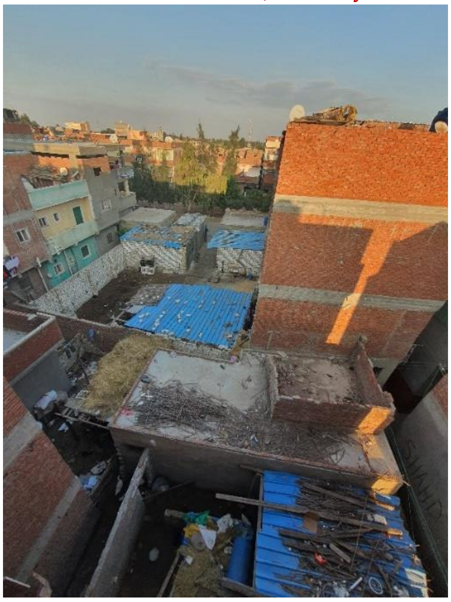


Figure (01-94) Typical in-between space configurations, used as poultry and bird farms and stores. The light structure consists of red brick walls and corrugated galvanized steel sheets (taken by the author).

In order to describe the whole scene, rice irrigation could be taken as an example of indirect relation with energy. In its agricultural cycle (3-4 months) annually, the *feddan* (4200 m^2) requires a significant amount of water (nearly ten times of surface irrigation times), besides 20 liters of fuel for the irrigation pump. What explains the low percentage (4%) of the total distributed electricity for the agriculture sector (as introduced in the past chapter). No detected relation with electrical energy consumption.

All interviewed peasants described the relation of the economic activity with their dwelling, and they stated there to store some crops production for domestic uses only. They might keep a few elements inside their residences for work purposes, which is different, absolutely, from many years ago when they were storing fuel and farming pieces of equipment. Thus, the dwellings typology does not influence economic activities, either visually or in terms of energy efficiency.

1.9.4 Quantifying The Correlation -Statistical Analysis

Statistical analysis plays a significant role in organizing and processing data scientifically and mathematically (DePoy & Gitlin, 2019), which explains the relations between variables that have four main measurements scale, as shown in Table (01-09).

Table (01-09) Types of data, based on (Boslaugh, 2012)

Data Type	Scale Measurements	Describtion
Qualitative	Ordinal	It refers to data that has some significant order.
	Nominal	Names of labels that do not have numeric values
Quantitative	Interval	The data is measured on a scale that has a distance from one another
	Ratio	*"It has all the qualities of interval data (natural order, equal intervals) plus a natural zero point."*

Numerous statistical models were used to diagnose the relatedness between dependents and independents variables, Pearson correlation coefficient (r) is one of the most commonly used techniques that measure the strength and direction between two ratios (continuous) variables. It is determined by (*r*) value that lies between (-1 and +1), where the (+1) indicates a strong linear correlation between variables and (-1) represents a perfect weak correlation, and (0) no relation exists. (Khamis, 2008; Hauke & Kossowski, 2011) (Boslaugh, 2012).

In this research context, many previous studies investigated different aspects of energy consumption in different contexts, in residential buildings such as (Chen et al., 2008; Santin, 2011; Dedinec & Dedinec, 2016; Rahman et al., 2017; Nasaruddin et al., 2021; Tran et al., 2021).

The analysis took place using IBM SPSS Statistics software that is used to analyze data, predict and plan to prove assumptions and accurate conclusions to resolve problems in research and business (IBM, 2021). In addition, many websites provide open resources -calculators- working with statistics and formulas such as (Statistics, 2021). Table (01-10) shows the correlation with energy consumption.

Table (01-10) Correlation coefficient between numeric data and annual building energy consumption

Aspect	R	P Value
Footprint	+0.342	0.055
Built-Up Area	+0.836	0.000
Total Members	+0.604	0.000
Floor Number	+0.887	0.000

The table shows Pearson Correlation Coefficient between building and demographic characteristics and annual energy consumption. A very strong positive correlation was found between floor number and built-up area (0.887 and 0.836). In contrast, the total residents in the building do not correlate (weak) between the footprint and the annual energy consumption.

In the second variables group, the nominal, One-way analysis of variance (ANOVA) is one of the most broadly used statistical methods for assumption examination (St & Wold, 1989), which enables interpret a numerical variable by a qualitative variable's means. In this sense, it grants the descriptors analysis that presents significant differences between a set of groups of a variable (David, 2017), three or more. For more about statistical analysis (Boslaugh, 2012).

In the research context, many studies analyzed the effect between the qualitative aspects and energy consumption and demand in residential buildings, such as the building geometry in the Mediterranean climate (Pacheco-Torres et al., 2015), building operation (Lu et al., 2016), building systems (Hsu, 2014) and typology (Martinez & Choi, 2017). In addition to different design variables in office buildings (Mechri et al., 2010; Lam et al., 2015; Bramiana et al., 2016).

The first independent variable is the work type. As shown in Table (01-11), the probability value (p-value) equals 0.235 (more than 0.05), which means no statistically significant between work type and energy consumption variables. In other words, no observed effect. Furthermore, no multiple comparisons are required.

Table (01-11) ANOVA Work type with annual energy consumption, data extracted from SPSS results

Group Code	Group Description	Mean	Standard Deviation	F Value	Sig.
1	Employee	5592.92	2533.883	1.465	0.235
2	Self-Employee	6800	1705.872		
3	Farmer	100084	7706.227		
4	Freelance	5412	4318.061		
5	Retired	4170	466.690		
6	No Work	3030	2833.161		

Secondly, Table (01-12) illustrates the variation analysis between mobility group variables with annual buildings energy. P-value equals 0.911, which means there is no statistically significant relationship between mobility to work and the energy consumption variable.

Table (01-12) ANOVA test Mobility variable and annual energy consumption variable

Group Code	Group Description	Mean	Standard Deviation	F	Sig.
1	Public Transportation	5214.35	3101.115	0.177	0.911
2	Private Car	6132	3639.398		
3	Walk	6316.50	5490.798		
4	Other	6000	3186.785		

Table (01-13) shows the variation analysis between work location group means with annual buildings energy. P-value equals 0.087, which means no observed effect between mobility to work location and energy consumption variable.

Table (01-13) Variation analysis of work location variable and annual energy consumption variable

Group Code	Group Description	Mean	Standard Deviation	F	Sig.
1	Lasaifar Albalad	7230	4827.620	2.277	0.087
2	Kafr Elshiekh Gov.	7145.14	2480.721		
3	Outside Delta Region	3658.29	1808.054		
4	Outside Egypt	3096	1648.417		
5	No Work	3840	0		

Table (01-14) shows the variation analysis between education level group means with annual buildings energy. P-value equals 0.783, which means no observed effect between education level and energy consumption variable.

Table (01-14) Variation analysis of education variable and annual energy consumption variable

Group Code	Group Description	Mean	Standard Deviation	F	Sig.
1	University Education	5030.57	2448.254	0.358	0.783
2	Above-Intermediate	6516	3734.526		
3	Secondary	6540	5021.819		
4	Preparatory	5284	5685.529		

Table (01-15) shows the variation analysis between lifestyle group means and annual energy consumption. The results indicated that there are statistically significant differences between variables, where the F value is (4.432) with a significance value of (0.011). Therefore, it is presumed that at least one of the group means is significantly dissimilar from the other. In order to determine which of the differed particular groups, it is acceptable to continue with post hoc testing (Brown, 2005), so-called multiple comparisons, as seen in Table (01-16).

Table (01-15) Variation analysis of lifestyle and annual energy consumption variable

Group Code	Group Description	Mean	Standard Deviation	F	Sig.
1	Family Visits	6654.35	3577.10	4.432	0.011
2	Going to Disouk district	8397	4390.266		
3	Walking	5178	2834.736		
4	Other	2040	1074.430		

Table (01-16) Multiple comparisons between lifestyle group means with energy consumption

Life Style with Energy Consumption	Mean diffrences	Significance
1:4	4614.353	0.018
(*) it means at a significance level of (0.05) (**) it means at a significance level of (0.01)		

The result showed that the mean consumption of buildings whose residents predominantly perform family visits as a fundamentally social activity is higher than buildings' mean consumption of those who tend to carry out other social activities (spending time in the youth center and coffeeshops) by a variance (4614.353 kWh) at a significant level 0.018. No statistically significant level between other group means.

Table (01-16) shows the variation analysis of wives' work status with energy consumption. The results indicated no observed effect between wife work and energy consumption.

Table (01-17) Variation analysis of lifesWife Work Status and annual energy consumption variable

Group Code	Group Description	Mean	Standard Deviation	F	Sig.
1	Working Wife	6133.09	3074.036	0.242	0.626
2	Housewife	5440	4092.959		

In order to explain the effect of location, Tables (01-18) and (01-19) tell us that there is no statistical significance between building location group means (by fabric and by road) and energy consumption.

Table (01-18) Variation analysis of location by urban fabric group means and annual energy consumption

Group Code	Group Description	Mean	Standard Deviation	F	Sig.
1	Traditional Fabric	5492	3659.470	0.149	0.862
2	Linear Fabric	4572.92	3823.805		
3	Scattered Fabric	6378.86	4200.079		

Table (01-19) Variation analysis of location by road network group means and annual energy consumption

Group Code	Group Description	Mean	Standard Deviation	F	Sig.
1	Road 2 m	3420	1535.187	2.218	0.127
2	Road 4 m	5470.80	3089.142		
3	Road 6 m	6870.40	4436.363		

1.9.5 The Stakeholders

In Egypt, engaging stakeholders in such a development process is too important. One of the pilot experiments in traditional settlements in the 1960s implemented by Architect Hassan Fathy pointed out the importance, although he provided profound environmental, social, and economic benefits, the locals left the village, as he described, basically because of missing an economic activity (Fathy, 1989).

In Italy, in the current era, engaging local peasants in the decision-making in farming settlements significantly impacts the environmental aspects of the rural landscape (Gullino et al., 2018), like energy. On another level, in the building sector, locals are the main obstacle to adopting energy-saving strategies in dwellings in the south of Italy (Berardi, 2013), besides the low readiness of EU locals (Interreg EU, 2019). For these reasons Italian government pays notable efforts towards engaging the local community in the National Energy and Climate Plan (Candelise & Ruggieri, 2020), as they summarized some of these efforts.

Along with the different contexts in the domain of environmental and energy development, stakeholders are the first layer to ensure the success of any project (Smith, 2000) through a better understanding of many factors, such as the cultural and social aspects (Elmustapha et al., 2018), and locals' attitude (Jacobs & Buijs, 2011). Many definitions of stakeholders are summarized by (Sharp et al., 1999).

Back to the field study context, numerous talks with dwellers have been implemented about the research's expected findings and the current environmental situation of the settlements. The discussions were totally varied between those who showed uncertainty about the issue and those who showed the ability to collaborate to improve their place. This step is rudimental to ensure the effectiveness of the intervention for better understanding the stakeholders' needs, include them in decision-making, and identify the actors and influencers, as introduced.

To conclude, after examining the population sample, the stakeholders who offered collaboration can be grouped into four groups. First, some of the influencers are locals (youth and elderlies), the managers of the Agriculture Association (they are the representatives of the Egyptian government in implementing the rural development initiatives), employees from the local unit to which the village belongs, that the case study, program presenter working in the local television for the Delta region (Channel 6). It is worth mentioning that (Chapter Three) has described the stakeholder analysis and participatory approaches in detail.

1.9.6 The Conclusion of the Egyptian Case Study

The Delta region is one of the seven planning regions of Egypt, whose volumetric size classes range from cities and centers in the urban areas, which are linked by a diverse network of distinctive roads, and even the villages in the rural areas, which are characterized by a typical urban fabric od Delta's village, the organic, linear and scattered fabric.

The region is the only agricultural region in Egypt, where less than half of the labor force works in the agricultural and fishing sector. The agricultural areas constitute 75% of the region's area. While the average building area is 11%, the governorates' percentage varies between 30% in Menoufia and 3% in Kafr El Sheikh.

The region's governorates are similar in the land use distribution and density except for Kafr El-Sheikh, which has slightly different behavior in terms of low population density, the percentage of uncultivated lands, services, and cemeteries, that represent 30% of the total area.

Buildings are concentrated in the rural areas at 75% (due to the population distribution), and residential buildings represent 90%. The heights of residential buildings differ from urban ones, despite the similarity of the structural system (reinforced concrete and red brick), as buildings with one and two floors constitute 70% of the total residential building, while the three floors are less than a quarter—the majority of the buildings in a good construction condition. At the same time, 20% need renovation to varying degrees.

In terms of electricity consumption, lighting accounts for more than half of the total distributed electrical energy in the region. Residents use conventional electrical appliances such as refrigerators and washing machines. The residents who own electric water heaters (one-third) and rely on air-conditioners for cooling in the summer (4%) consume more monthly energy consumption at a remarkable rate of 50% (Abouaiana, 2021).

In the same context, small-dimension economic activity greatly affects the electricity consumption to rely on lighting to provide a suitable environment for raising birds and poultry. The built environment is not affected by this kind of activity. Other than the coastal settlements, the fisheries culture has an apparent visual impact on the landscape. The economic activities do not influence dwellings typologies.

The study selected a typical case study representing traditional settlements in Egypt using a field method. A set of interviewees with the locals took place to explore the socio-economic activities and explain the possible benefits of the research. The urban characteristics and the architectural typologies were diagnosed by integration of the on-site study and questionnaire.

The buildings sector -one of the primary elements of the built environment- was categorized into two groups: the non-residential. A positive correlation between the number of electrical appliances and energy consumption was determined—the higher number of them, the higher consumption. The square meter consumes (5-18 kWh) annually, apart from the health center buildings, which consume about 90 kWh yearly. The lighting demand does not affect due to daytime operating hours, unlike dwellings, in which the lighting represents 40% of total consumption.

The current average consumption of the dwelling's square meter is 21 kWh annually. There are two types of meters, prepaid (the majority) and conventional ones. The majority of locals reported that the consumption of the prepaid meters led to higher consumption. The author believes it is a myth because it is a new technology, and they have not been used to doing it like many years ago. The Egyptian government implemented this step toward the digital transformation plan. The kWh prices for different purposes and other data are available in this official report (MOEE, 2020).

The statistical analysis supports that the collected data are homogeneous and are distributed normally. A robust correlation was found between energy consumption, occupancy rate, and the total built-up area. At the same time, a significant observed effect of the family visiting social activity on energy consumption.

These results led to a better understanding of the domestic energy consumption situation as a readiness step to improve energy efficiency. Rodrigues et al. (2014) emphasized this meaning in a similar meadow. The technical efficiency of buildings and related activities is vital in fulfilling global sustainability goals (IEA, 2020).

The study engaged the stakeholders representing two perspectives (bottom-up and top-down) in the scene. The bright side is that they were enthused to collaborate towards improving their built environment. However, it requires the deepen the technical study, which will be examined in the next chapter by mapping the relevant previous studies that were conducted in the Mediterranean region to explore the methods, approaches, tools, and best practices that can be applied in our micro contexts.

1.10 Data Collection Method – Pontinia

In Pontinia, The field study occurred between December 2021 and January 2022. The procedure was different from the method implemented in Lasaifar Albalad. The first layer was analyzes the urban characteristics, building types typology, demographic data, and the average electrical energy consumption in summer and winter. Thus, a questionnaire has been developed for this purpose to analyze the urban characteristics, building types typology, demographic data, dwelling characteristics, and the average electrical energy consumption in summer and winter. The questionnaire is available at (Abouaiana, 2022b).

Noteworthy, the questions have been modified (than the Egyptian case study) in order to be suitable to the Italian context, based on two sources. First, the ISTAT aspects, such as social activities, for instance, the educational level (e.g., 2-3 year diploma "professional qualification" and diploma 4-5 years "maturity"). The daily life aspects. Second, the domestic energy consumption data and building thermal performance are based on the RECON tool developed by ENEA (RECON, 2021).

It was distributed among many accounts (official and non-official) of Pontinia's social media platforms (Facebook). The questionnaire has been published on the official groups. However, another group felt non-comfort with publishing the questionnaire. Within six weeks, only 11 valid responses (the total is 13) have been collected. The interpretation of this weak interaction can be one of the following, some technical terms, unclear questions, or aim. The local community does not know the expected benefits of the project aim. The enclosed nature of traditional societies as (Introductory Chapter). Noteworthy that similar feedback was indicated from the experiment in Lasaifar Albald (where the author origins).

The majority of the respondents did not answer the question about the building location and building form (either wrote "I do not know" or skipped the questions).

The potential is that the majority of the respondents showed a good awareness of climate change topic 91%, such as, *"Over time the average temperature of the earth rises, this is also due to the emissions and pollution of the more industrialized states. This rise in temperature causes climate change," "The temperature is therefore increasing, climatic imbalance and melting of the iceboxes," "it creates massive damage," "it has gotten much worse,"* and finally tho, others answered which means yes, I know.

In the optional question about their opinion on improving energy efficiency, improving the environment, or improving buildings, 18% recommended two different strategies, namely, "*activate separate waste collection and use all lights with sensors,*"[19] "*insulate buildings, recycle the water used in the home.*" While 18% answered in general by "*Eliminate wasted power*" and "*economic incentives*." Annex (01-01) summarizes the sample characteristics.

1.11 Comparative Analysis

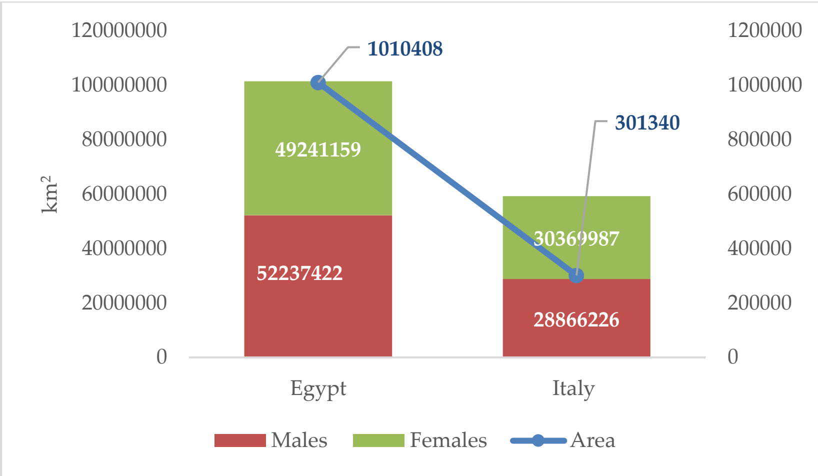
This chapter aimed to characterize the existing built environment patterns in the traditional (agriculture-based) Mediterranean settlements and highlight and explore the domestic electricity consumption patterns towards a better understanding of the relationship between them, as an initial step in line with the chapters' outcomes (Chapters 2 and 3) and the main objective.

[19] The author argues that the participant is willing to retrofit her building because she showed interest in receiving the study's results. Therefore, she might be contacted in future research.

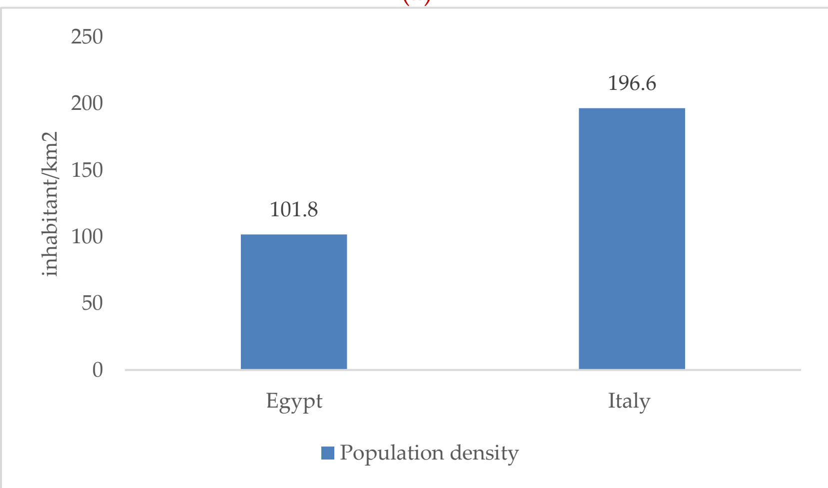
Egypt (representing the southern Mediterranean sea countries) and Italy (representing the European Mediterranean ones) have been selected. Table (01-20) shows the administrative systems in the case studies. Figure (01-95) shows the area, population, and density.

Table (01-20) Egypt and Italy in numbers: administrative system hierarchy

Administrative System	Egypt	Italy
Level 1	7 Group of regions	5 Group of regions
Level 2	27 Governorates	21 Regions
Level 3	185 District	107 Provinces
Level 4	4741 villages and 30888 satellites	7926 Municipalities



(1)



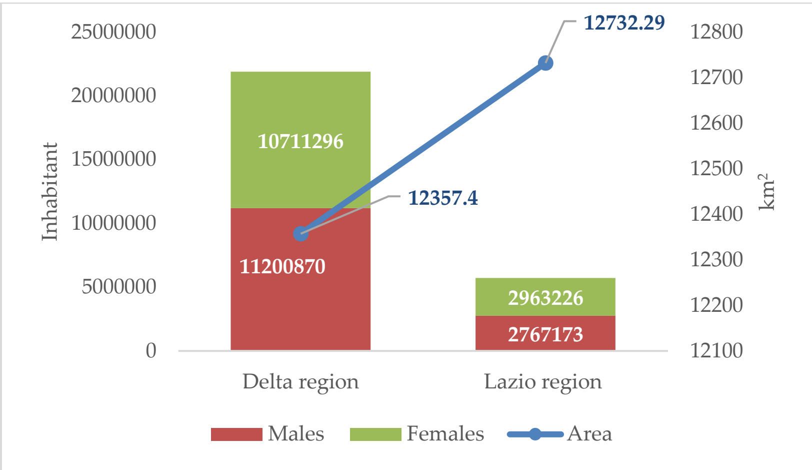
(2)

Figure (01-95) Egypt and Italy in numbers. Panel 1: area and population by sex, the reference year 2021. Males represent 51.5% of the total population in Egypt and 48.7% of the Italian total. Panel 2: population density.

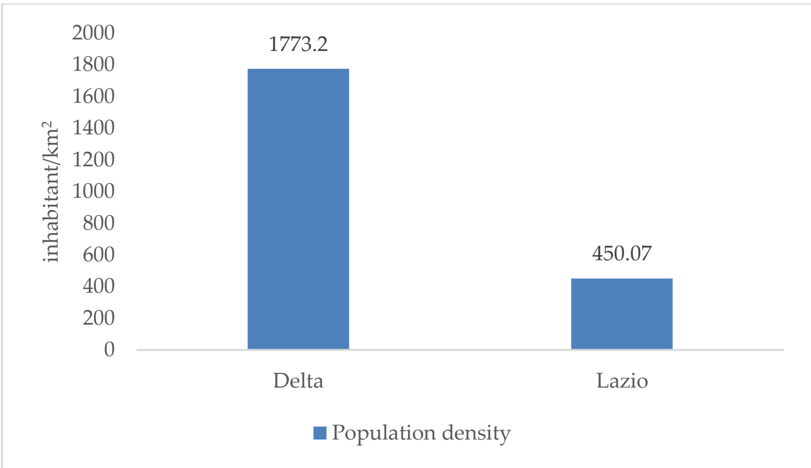
Two traditional settlements in Lasaifar Albalad, in Kafr El-Shiekh Governorate, Delta Region, Egypt, and Pontinia, Latina Province, Lazio Region, Italy. Both have the same characteristics: population (15000 inhabitants), predominantly rural, Mediterranean climate, building age (first mid-1900s), the similarity of the inhabited area (0.4 – 1 km²), the agricultural economic activities, vast farm areas, similarity in land uses and the plain topography. The reference year is 2021 unless otherwise noted. Table (01-21) shows the main features of the Delta and Lazio regions. Figure (01-96) shows the regional area and population by sex and population density.

Table (01-21) Delta and Lazio regions in numbers: population, area, and density.

Factor	Delta	Lazio
Population	21912166 inhabitants	5730399 inhabitants
Population percentage from the total country population	21.6%	9.7%
Area	12357.4 km2	12732.29 km2
Area percentage from the total country area	1.2%	4.2%
Population Density (inhabitants/km²)	1773.2	450.07



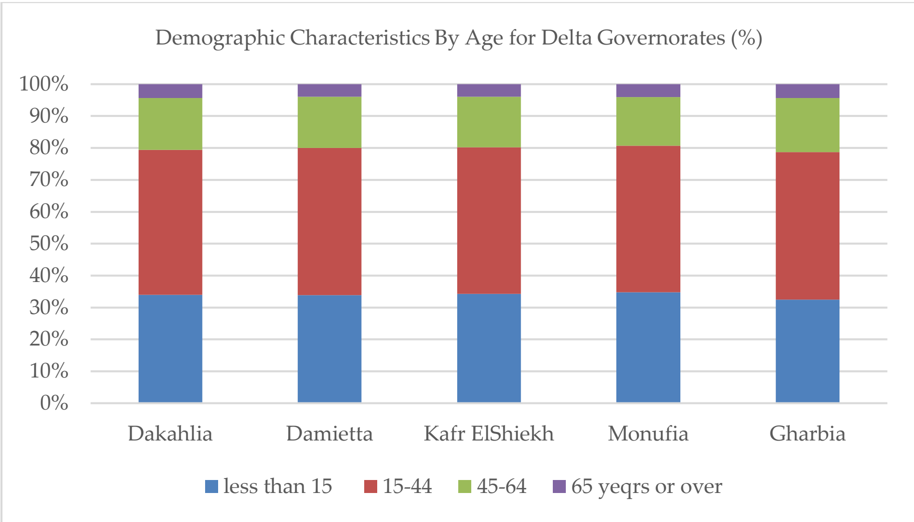
(1)



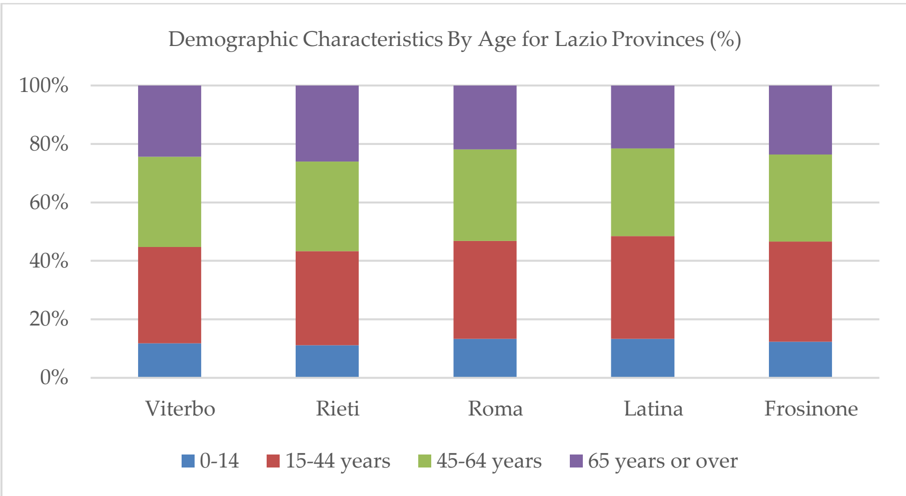
(2)

Figure (01-96) Delta and Lazio regions in numbers. Panel 1: Area and population by sex, the reference year 2021. Males represent 51.1% of the total population in Delta and 48.3% of the Italian total, almost the same as the national percentage. Panel 2: population density. Both population density is high compared to the national average.

Regarding the population distribution by age groups, it is evident that the age group (0-14) years represent 35% of the total, the (15-44) age group is 45%, the age group (45-64) represent 15%, and only 5% more than 65 years. On the contrary, the age group (0-14) year represents 13%, the age group (15-44) year is 33%, the age group (45-64) represent 33%, and finally 21% more than 65 years. Figures (01-97) show the age group's population distribution in both contexts.



(1)



(2)

Table (01-97) Delta and Lazio in numbers: the percentage of population distribution by age. Panel 1: The Delta region governorates. Panel 2: The Lazio region provinces.

At the next administrative level, the case studies belong to Kafr El-Shiekh Governorate, Delta Region, and Latina Province, Lazio Region. Kafr El-Shiekh has 16.4% of the total inhabitants in the Delta region, living on 28% of the total region's area. The population density is lower than the regional average by 41%. While Latina has 9.9% of the total inhabitants in the Lazio region (the same percentage compared to the region of Italy), living on 16.4% of the total region's area. The population density is 251 inhabitants/km^2. Table (01-22) shows the main features of the provinces.

Table (01-22) Kafr El-Shiekh and Latina regions in numbers: population, area, and density, compared to the regional levels.

Factor	Kafr El-Shiekh	Latina
Population	3600635 inhabitants	566224 inhabitants
Population percentage from the total region population	16.4%	9.9%
Percentage of the rural population to the total number in the same governorate or province	76%	13.2%
Area	3466.70 km2	2256.16 km2
Area percentage from the total region area	28%	17.7%
Population Density (inhabitants/km2)	1038.6	250.97

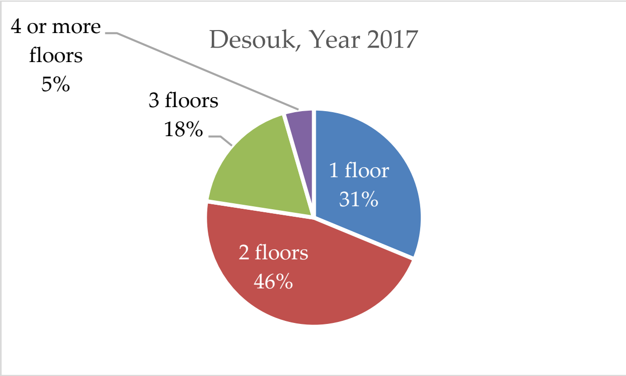
In terms of the administrative hierarchy, Kafr El-Shiekh has ten centers (21% of the region's total), ten districts/cities (17% of the region's total), 44 main villages (13% of the region's total), and finally 207 satellite villages (15% of the region's total). Latina has one city out of three in the Lazio region, 14 towns (14% of the region's total), 18 rural municipalities (7% of the region's total). In this line, the rural population in Kafr El-Shiekh is 76%. On the other hand, Desouk rural district, to which the case study belongs, has 110176 inhabitants (15 years or more)[20]. The area of the rural municipalities in Latina is 676.8 km2, and the population is 74488 inhabitants (13%) (Eurostat, 2021a).

It is noteworthy that the official statistical data (demographic and housing characteristics) are available at the governorates and districts level divided by urban and rural (the case study belongs to the Desouk rural district Kafr El-Shiekh) available at (CAPMAS, 2019). The 14th General Population, Housing, and Establishments Census of 2017 is the first electronic census. The difference from Italy is that the statistical data are available on the ISTAT for the municipalities level in Italy. However, it was available for building on the 15th Population and housing census in 2011.

Therefore, in this part, the comparison will be between Desouk rural district[21] and Pontinia, taking into account the two different release times (2017 and 2011). Figure (01-98) shows the comparison between residential building distribution by floor number.

[20] Representing 66.2% of the total population.

[21] Including 11 local administrative units.



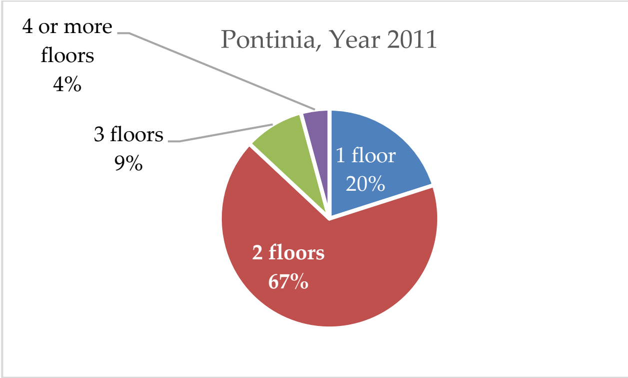
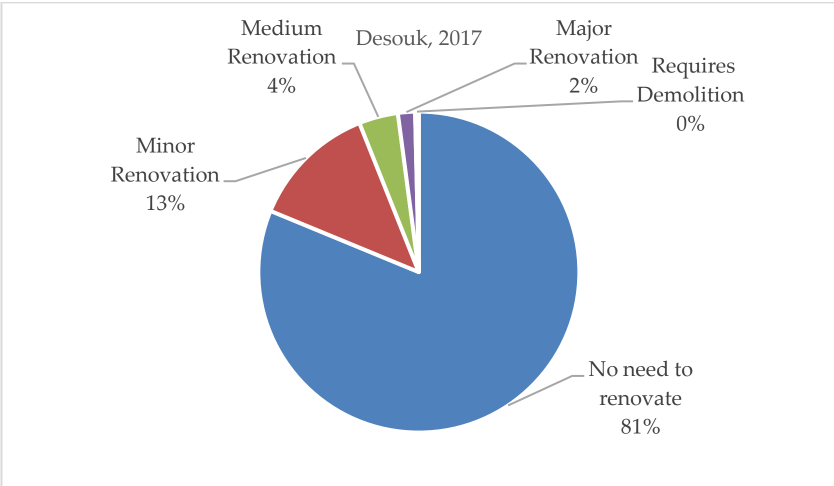


Figure (01-98) Desouk and Pontinia in numbers: distribution of the residential buildings by floor number. Almost the same behavior between the two contexts. In both contexts, one and two floors prevailed by 77% in Desouk and 87% in Pontinia, which finds a typical characteristic (low rise buildings) of the traditional settlements.

In Egypt, the census classified the buildings, by construction status, into five groups by the need for renovation. However, only 19% of the buildings require renovation. While in Italy, the census has classified the buildings into four groups, only 16% of the residential buildings are in poor and very poor status. Figure (01-99) shows the residential building distribution by building status in Desouk and Latina.



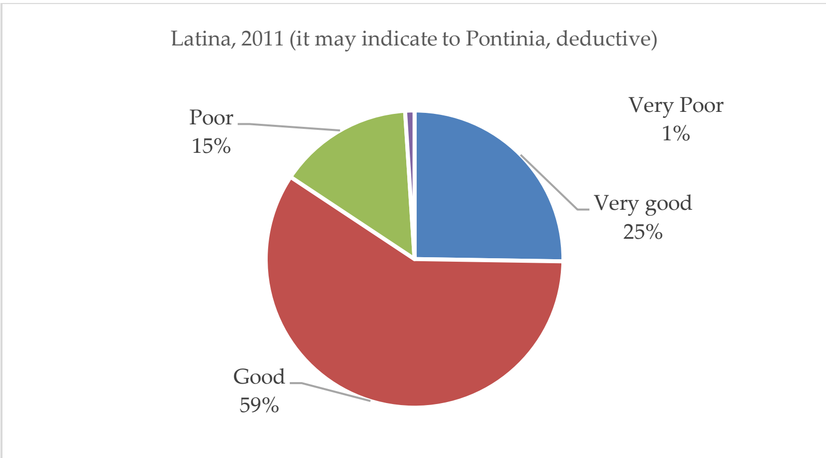


Figure (01-99) Desouk and Pontinia in numbers: distribution of the residential buildings by renovation and construction status, compared to the regional level.

By construction period, Table (01-23) shows the number of residential buildings in Desouk and Pontinia.

Table (01-23) Number of the residential buildings (absolute values) by the construction period

Factor	Desouk	Pontinia
Until 1944	190	185
1945-1960	474	376
1961-1970	2164	767
1971-1980	3575	528
1981-1990	13335	254
1991-2000	19327	155
2001-2010	12469	101

It is evident that the number of buildings in both contexts (Desouk rural district and Pontinia) before 1944 were almost the same (185 and 190 buildings), which added another similarity to the selected criteria. The Egyptian census referred to "*Building the Oldest Part*" because of the phenomenon of the extended house family. Figure (01-100) shows the growth rate percentage in the number of residential buildings by construction date compared to the total building number.

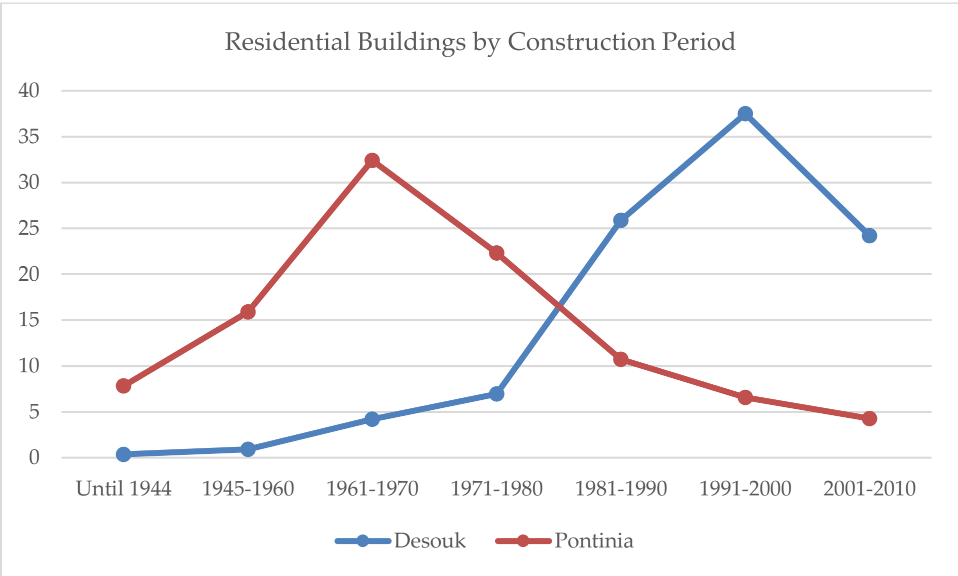


Figure (01-100) Desouk and Pontinia in numbers: growth rate percentage in the number of residential buildings by construction date compared to the total building number.

It is evident that the boom in Desouk occurred between 1980 and 2000, which is supported by the argument of this research that the increasing amount of modern construction buildings, in the aftermath of the well-known events, respectively, the Egyptian-Israeli war, the economic openness policy, and migration to the gulf countries. On the other hand, in Pontinia, the boom occurred in the late 1950s and 1960s in the post-war recovery era.

1.12 Lasaifr Albald and Pontinia: Field Study Conclusion

Integrated field trips have been implemented to explore the intimate contexts (Lasaifar Albalad and Pontinia). Although the similarity between the two contexts in general, it is patently clear that there are some significant variances. First, Lasaifar Albalad was a vernacular settlement grown by locals to achieve their socio-economic needs and developed by the time mainly by the government. On the contrary, the planners and architects of the fascist era have planned Pontinia in order to improve the quality of life and treat the environmental deterioration, inspired by the rural Italian architecture and rational architecture which produced the fascist architecture. Figure (01-101) shows the urban tissue in both contexts.

(1) (2)

Figure (01-101) The urban tissue in Lasaifar (Panel 1) and Pontinia (Panel 2).

It is clear that both contexts' urban fabric has grown from the core to outside, the compacted vernacular fabric in Lasaifar Albalad and the regular fabric by the architects' interventions in Pontinia. However, the scattered building and linear fabric on the settlements' boundaries as common characteristics of rural Mediterranean settlements.

Pontinia has a unique rural character and fabric, belonging to a particular era in contemporary history in Italy and the world. In the same vein, the author has been implemented another field study trip in another two municipalities Aprilia (suburb) and Latina (City), to support his understanding of the fascist era's cities. It was easy to recognize the similarity between the two municipalities. The perception of the road network was: easily connected and wide (in terms of buildings, and roads network, it is recognized as an urban compared to the Egyptian rural context). These regular road networks wanted to connect the cities with the sea on the west, and the main roads delivered to Rome. "*Omnes viae Romam ducunt*." Vice versa, in Lasaifar, the road network is compacted and has small widths from the major road to the smallest, which is usually close-ended.

For public and green spaces (apart from the vast agricultural lands), a significant variation has been indicated in terms of the lack of them in Lasaifar inside the urban mass areas. The majority of the voids are in-between spaces, exclusively for dwellings. Vice versa, in Pontinia, there is an abundance of parks, open spaces, plazas, and vast road networks. Another variation is the floor area ratio. The majority of the buildings inside the urban mass in Lasaifar have 100% FAR. Vice versa, in Pontinia, it could be recognized the small FAR.

In terms of population, both settlements have almost the same population. Considering the ISTAT indicated the population in Pontinia included the inhabited center and the scattered building outside the center. Also, in Lasaiafr, the author has estimated the population using statistical Excel logic based on the available previous data.

In the environmental scene, it was evident that in Pontinia, environmental community activity based on plastic recycling has been spotted, besides the existence of and the green infrastructure represented in the vehicle electrical points, and the small photovoltaic panels on some dwellings and the municipality buildings. Figure (01-102) shows some energy efficiency practices. Figure (01-103) shows some environmental interventions. Furthermore, a similarity between water bodies has been observed in terms of the wetlands distributions.

(1) (2)

Figure (01-102) shows some energy efficiency practices (taken by the author). Panel 1: Photovoltaic cells on a residential building. Panel 2: Installed photovoltaic panels on the municipality buildings.

(1) (2)

Figure (01-103) Panel 1: A Christmas tree has been made from recycling, which may indicate an awareness level. Panel 2: green infrastructure practices represented in the electrical vehicle charging (taken by the author).

In the same vein, in Lasiafar, no green infrastructure or photovoltaic cells were indicated. The most noticed intervention is the canal linen to mitigate climate change and improve water resources efficiency, in line with the national presidential initiative Decent Life, which aims to regenerate the rural built environment in all rural areas in Egypt. Moreover, in (Chapter Four) the research has contributed to the first off-grid solar plant in Lasaifar Albalad).

From an economic perspective, few dwellings have a small-scale dimension of economic activity inside dwellings in Lasiafar Albalad. In Pontinia, this pattern is not existing. Another observation is the significant number of private cars in Pontinia and the numerous parking lots, which are different from Lasaifar entirely.

From a cultural perspective, both societies are enclosed, as observed from two situations. First, the author was asked by people (with some caution), "*why are you taking photos, and who are you.*" (however, the author's origin from this context). In Pontinia, the same behavior was observed: "*why did you select Pontinia?*" No observed interaction on the Facebook Group (local community). Second, during the distribution of the questionnaire and on-site meetings. It makes sense in Pontinia much more Egypt, represented in the interaction to the questionnaire was too weak. The collected responses were 11 from Pontinia (insignificant) and 26 from the other side. It was easy to contact the locals in Lasaifar vice versa in Pontinia because of the covid-19 precautionary measures (this is also a clear point of contention).

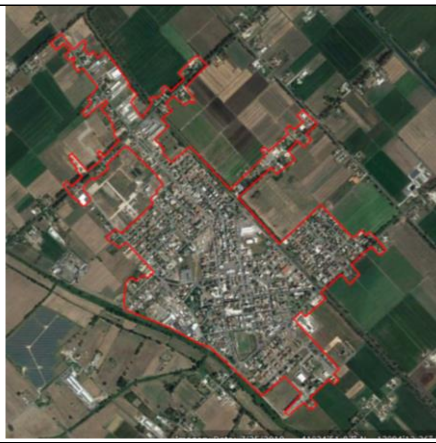
Although the insufficient participation by the local Italians has been proved in the study of Grifoni et al. (Grifoni et al., 2014) as a set of Italian experts concluded, the issue may be interpreted from a different perspective, such as related to the questionnaire itself, or maybe the locals' priorities. Finally, maybe because the lead researcher is a foreigner. Nonetheless, the bright side was the high support level and encouragement from the Municipality of Pontinia (which was not expected at the beginning of this research), such as sharing the questionnaire on the official Facebook page and providing feedback to the questionnaire, in addition to other factors described in detail in (Chapter Four), which could be a strong foundation for further studies.

In conclusion, the study provided the first intervention that focused on investigating the built environment in Lasaifar Albalad and Pontinia traditional settlements. Moreover, it has been succeeded in quantifying the domestic electricity consumption and finding novel statistical observations between the built environment in Lasiafar Alabald that can be replicated in the other rural settlements in the Delta region. On the other hand, in Pontinia, the study failed to quantify the domestic electricity consumption and find the relationship with the built environment as a sequence. Therefore, the main finding is that the used method should be excluded, and another approach should be obtained.

In this scene, the electrification systems in both contexts are totally different. The electricity sector is centralized and government-owned in Egypt, so all clients are subject to one system. On the contrary, Italy's electricity market is decentralized and subject to free-market mechanisms, which means wide variance such as in tariff prices due to the competitive market.

To clarify, the average price of electricity is 0.2259 EUR/kWh (Eurostat, 2021b). However, the prices vary depending on four aspects. First, the varied factors: the selling prices depending on the market (the cost determined by the suppliers), consumption time during the day, and the consumption amount. The other three are fixed aspects, network service related to infrastructure (bringing the energy from production plants to the end-user), taxes, and electric system rates (e.g., reserved funds to support renewable energy) (De Santoli et al., 2019). Therefore, these factors can also be considered obstacles were preventing the utilized method to quantify electricity consumption. In other words, this issue should be re-investigated, and a new method should be obtained. Table (01-24) summarizes some characteristics of the two case studies.

Table (01-24) Selected case studies in Egypt and Italy.

	Lasaifar Albalad	Pontinia
Location	31.18°N 30.72°E	41.41°N 13.04°E
Administrative System Hierarchy	Fourth Level Submunicipal divisions	Fourth Level Local Administrative Unit (LAU)
Population Size	14000 inhabitants	14945 inhabitants
Approximate Inhabited Area	0.4 km²	1 km²
The Urban Fabric (*not to scale*)		
Elevation map	6 m	(0-21) m
Morphology	Plain Geography	Plain Geography
Coastal Area	NO	NO
Buildings age (started from)	The late 1950s	1935
Buildings number	700 buildings approximately	1349 buildings approximately
Open Public spaces	Lak of open public space	Sufficient amount

To conclude, this chapter has investigated the built environment patterns in two traditional settlements in Egypt and Italy. It showed contact and differences points between them and provided a pilot experiment in the Egyptian case study to find the correlation between the built environment and electricity consumption pattern as an initial step. In line with the other chapters' outcomes, in order to achieve the main ambitious goal of developing a participatory framework to retrofit the built environment in traditional agricultural settlements in the Mediterranean region, one of the most sensitive regions to climate change, it faces many environmental challenges. Concomitantly, many promising potentials of the global objectives, Mediterranean, and national support towards the energy efficiency issues, which may accelerate solving a real-world problem and implement an on-ground practice, as has been discussed in (Chapter Four).

Data Availability Statement

The majority of data that support the findings of this study are openly available in the Research Gate repository at https://www.researchgate.net/project/Retrofitting-Built-Environment-in-Mediterranean-Region

Some data that support the findings of this study are available from the corresponding author upon reasonable request.

Chapter One References

Abdelkader, N., & Altouny, S. (1997). *The problematic of the fabric and the character (in Arabic)*. Alaraby. https://cpas-egypt.com/publication/wp-content/uploads/2021/06/11501-اشكالية-النسيج-و-الطابع.pdf

Abouaiana, A. (2021). Retrofitting Rural Dwellings in Delta Region to Enhance Climate Change Mitigation in Egypt. *Environmental and Climate Technologies*, *25*(1), 136–150. https://doi.org/10.2478/rtuect-2021-0009

Abouaiana, A. (2022a). *Lasaifar Albalad Questionnaire (In Arabic)*. https://doi.org/10.13140/RG.2.2.33383.32164

Abouaiana, A. (2022b). *Lasaifar Albalad Settlement Map, Kafr El-Sheikh, Delta Region, Egypt*. https://doi.org/10.13140/RG.2.2.34772.68487

Abouaiana, A. (2022c). *Pontinia Questionnaire (In Italian)*. https://doi.org/10.13140/RG.2.2.16606.10565

Abouaiana, A. (2022d). *Pontinia Settlement Map, Latina, Lazio Region, Italy*. https://doi.org/10.13140/RG.2.2.19673.19046

Abouaiana, A. A. A. (2016). *"Principles for Existing Rural House Sustainability in Delta Region (With Special Reference to Energy Efficiency)" (In Arabic)* [Cairo University, Giza]. https://doi.org/10.13140/RG.2.2.21412.71044

Abouaiana, A., & Mendonça, P. (2022). Retrofitting Dwellings in Traditional Coastal Settlements in Egypt and Portugal Using Nature-Based Solutions and Conventional Thermal Insulation Materials: Technical and Economic Assessment. *Journal of Architectural Engineering, Furthercoming*. https://doi.org/10.1061/(ASCE)AE.1943-5568.0000537

ACPRail. (2021). *Italy by Rail*. https://www.acprail.com/maps/trenitalia-map/ Accessed (23-09-2021)

Al-Din, S. S. M. (2017). The influence of Mediterranean modernist movement of architecture in Lefkosa: The first and early second half of 20th century. *Journal of Contemporary Urban Affairs*, *1*(1), 10–23.

Almeida, R., Ramos, N., Simões, M., & Freitas, V. (2013). Variability of energy and water consumption of school buildings. *2nd Central European Symposium on Building Physics*.

Anderson, J. E., Wulfhorst, G., & Lang, W. (2015). Energy analysis of the built environment—A review and outlook. *Renewable and Sustainable Energy Reviews*, *44*, 149–158.

Antonopoulos, C., Trusty, A., & Shandas, V. (2019). The role of building characteristics, demographics, and urban heat islands in shaping residential energy use. *City and Environment Interactions*, *3*, 100021.

ARERA. (2019). *ANNUAL REPORT SUMMARY - ANNUAL REPORT 2020 ON THE STATE OF SERVICES AND REGULATORY ACTIVITY*. Regulatory Authority for Energy, Networks and the Environment (ARERA). https://www.arera.it/allegati/relaz_ann/20/Summary_2020.pdf

Ascione, F., De Masi, R. F., de Rossi, F., Fistola, R., Sasso, M., & Vanoli, G. P. (2013). Analysis and diagnosis of the energy performance of buildings and districts: Methodology, validation and development of Urban Energy Maps. *Cities*, *35*, 270–283.

AUTOMAP. (2021). *Autostrade Italia - Highway routes and maps (In Italian)*. https://www.automap.it/autostrade/ (Accessed 23-09-2021)

Baglioni, I. (2015). Jordanian vernacular architecture. *Vernacular Architecture: Towards a Sustainable Future*, 105–110.

Berardi, U. (2013). Stakeholders' influence on the adoption of energy-saving technologies in Italian homes. *Energy Policy*, *60*, 520–530.

Bonfante, F. (2019). Spatialized corporatism between town and countryside. *SHS Web of Conferences*, *63*, 2003. http://dspace.epoka.edu.al/bitstream/handle/1/1037/186.pdf?sequence=1

Borghidilatina. (2021). *The farms of the Agro Pontino- Typology of the Rural House (In Italian)*. http://www.borghidilatina.it/main/i-poderi.htm (Accessed 06-10-2021)

Boslaugh, S. (2012). *Statistics in a nutshell: A desktop quick reference* (2nd ed.). " O'Reilly Media, Inc." https://books.google.com.eg/books?hl=en&lr=&id=Fc4fBgAAQBAJ&oi=fnd&pg=PR3&dq=Statistics+in+a+Nutshell:+A+Desktop+Quick+Reference+(In+a+Nutshell+(O%27Reilly))+2nd+Edition,+Kindle+Edition&ots=fjC8aMqAVq&sig=FIb952bWhLn3cC-BUMkLIT0mX3I&redir_esc=y#v=onepage&

BOTTONI, C. (2017). *Bonifica pontina di Carlo Bottoni [Pontine reclamation by Carlo Bottoni]*. Youtube. https://www.youtube.com/watch?v=Fsk7SNDt_pk

BOWE, G. (1961). ITALY AND THE" MEZZOGIORNO". *University Review*, 60–70.

Bramiana, C. N., Entrop, A. G., & Halman, J. I. M. (2016). Relationships between building characteristics and airtightness of Dutch dwellings. *Energy Procedia*, *96*, 580–591.

Brown, A. M. (2005). A new software for carrying out one-way ANOVA post hoc tests. *Computer Methods and Programs in Biomedicine*, *79*(1), 89–95.

Caltabiano, I. (2006). The traditional architecture in Sicily: the rural area around the volcano Etna. *Proceedings of the PLEA2006—The 23rd Conference on Passive and Low Energy Architecture, Geneva, Switzerland*, 6–8.

Candelise, C., & Ruggieri, G. (2020). Status and evolution of the community energy sector in Italy. *Energies*, *13*(8), 1888.

CAPMAS. (2017a). *Annual Bulletin of Electricity and Energy Statistics 2015/2016*. Central Agency for Public Mobilization and Statistics.

CAPMAS. (2017b). *Egypt Population, Housing, and Establishments Census 2017*. http://www.capmas.gov.eg/Pages/ShowPDF.aspx?page_id=/Admin/Pages Files/201710914947book.pdf

CAPMAS. (2019). *Population Census and Housing Conditions (Long Form) Sections and Centers Issue: May 2019 (In Arabic)*. Central Agency for Public Mobilization and Statistics%0A. https://www.capmas.gov.eg/Pages/Publications.aspx?page_id=7195&Year=23521

CAPMAS. (2021a). *Annual Bulletin of Electricity and Energy Statistics 2017/2018*. Central Agency for Public Mobilization and Statistics. https://www.capmas.gov.eg/Pages/Publications.aspx?page_id=5104&YearID=23418

CAPMAS. (2021b). *Egypt in Figures*. Arab Republic of Egypt. Central Agency for Public Mobilization and Statistics (In Arabic). https://www.capmas.gov.eg/Pages/StaticPages.aspx?page_id=5035

Caprotti, F. (2007a). Destructive creation: fascist urban planning, architecture and New Towns in the Pontine Marshes. *Journal of Historical Geography*, *33*(3), 651–679.

Caprotti, F. (2007b). *Mussolini's Cities: Internal Colonialism in Italy, 1930-1939*. Cambria Press. https://books.google.com.eg/books?hl=en&lr=&id=x4lN-d44CPIC&oi=fnd&pg=PR14&dq=Mussolini%27s+Cities&ots=gF0NJSdsOz&sig=3MZYxK8T5xfgQ3QUISBdxX8VQf4&redir_esc=y#v=onepage&q=Mussolini's Cities&f=false

Caputo, P., & Pasetti, G. (2017). Boosting the energy renovation rate of the private building stock in Italy: Policies and innovative GIS-based tools. *Sustainable Cities and Society*, *34*, 394–404.

Carozza, M., Mutani, G., Coccolo, S., & Kaempf, J. H. (2017). Introducing a hybrid energy-use model at the urban scale: the case study of Turin (IT). *Proceedings of the 3rd IBPSA-Italy Conference, CONF*.

Cellura, M., Ciulla, G., Guarino, F., & Longo, S. (2017). Redesign of a rural building in a heritage site in Italy: towards the net zero energy target. *Buildings*, *7*(3), 68.

Chen, S., Li, N., Guan, J., Xie, Y., Sun, F., & Ni, J. (2008). A statistical method to investigate national energy consumption in the residential building sector of China. *Energy and Buildings*, *40*(4), 654–665.

Cillis, G., Statuto, D., & Picuno, P. (2020). Vernacular Farm Buildings and Rural Landscape: A Geospatial Approach for Their Integrated Management. *Sustainability*, *12*(1), 4.

Clark Carey, J. P., & Carey, A. G. (1955). The South of Italy and the Cassa per il Mezzogiorno. *Western Political Quarterly*, *8*(4), 569–588.

CLIMATE-DATA. (2021). *CLIMATE: LAZIO*. https://en.climate-data.org/europe/italy/lazio-416/ Accessed (15-09-2021)

Collins, R., Kristensen, P., & Thyssen, N. (2009). *Water resources across Europe-confronting water scarcity and drought*. Univerza v Mariboru, Fakulteta za kmetijstvo in biosistemske vede.

Daglio, L., Boi, G., & Podda, R. (2020). Participated Strategies for Small Towns Regeneration. The Case of Oliena (Nu) Historic Centre. In *Regeneration of the Built Environment from a Circular Economy Perspective* (pp. 89–97). Springer, Cham.

David, V. (2017). *3 - Structure as Groups of Objects/Variables* (V. B. T.-D. T. in E. S. David (ed.); pp. 35–55). Elsevier. https://doi.org/https://doi.org/10.1016/B978-1-78548-239-7.50003-6

Dawodu, A., & Cheshmehzangi, A. (2017). Impact of Floor Area Ratio (FAR) on energy consumption at Meso Scale in China: case study of Ningbo. *Energy Procedia*, *105*, 3449–3455.

De Dominicis, F. (2019). Regionalism at all costs Nallo Mazzocchi Alemanni and the Bradano Valley Land Reclamation Project, 1955. *SHS Web of Conferences*, *63*, 2001.

De Joanna, P., Dabija, A. M., Passaro, A., Vaccaro, G., & Sfinteș, R. (2020). THE REASONS OF THE VERNACULAR ARCHITECTURE FOR THE REGULATION OF CONTEMPORARY INTERVENTIONS. TWO EXAMPLES OF RURAL ARCHITECTURE ON DANUBE DELTA AND THE VESUVIUS. *International Archives of the Photogrammetry, Remote Sensing & Spatial Information Sciences*.

De Santoli, L., Mancini, F., & Basso, G. Lo. (2019). Analysis on the potential of an energy aggregator for domestic users in the Italian electricity system. *AIP Conference Proceedings*, *2191*(1), 20062.

Dedinec, A., & Dedinec, A. (2016). Correlation of variables with electricity consumption data. *Proc. 6th Int. Conf. Inf. Soc. Technol.*, 1–6.

Delmastro, C., Mutani, G., Pastorelli, M., & Vicentini, G. (2015). Urban morphology and energy consumption in Italian residential buildings. *2015 International Conference on Renewable Energy Research and Applications (ICRERA)*, 1603–1608.

DePoy, E., & Gitlin, L. N. (2019). Introduction to research E-book: understanding and applying multiple strategies. In *Introduction to research E-book: understanding and applying multiple strategies*. Elsevier Health Sciences.

Di Figlia, L. (2016). Turnaround: abandoned villages, from discarded elements of modern Italian society to possible resources. *International Planning Studies*, *21*(3), 278–297.

Diener, R., & Meili, M. (2010). *Nile Valley. Urbanization of Limited Resources*. ETH Zurich. http://hdl.handle.net/20.500.11850/57429

DIGILAND. (2021). *TOWERS AND FARMHOUSES OF THE ROMAN COUNTRYSIDE (In Italian)*. https://digilander.libero.it/agronauta/casali.htm (Accessed 06-10-2021)

Diti, I. (2013). *Un modello multicriteriale di supporto alla pianificazione territoriale finalizzato alla classificazione del territorio rurale e alla caratterizzazione dell'Impronta Agro ambientale delle aree agricole periurbane. [A multi-criteria model to support territ* [alma]. https://doi.org/10.6092/unibo/amsdottorato/5445

East, M. (2017). Integrated approaches and interventions for the regeneration of abandoned towns in southern Italy. *Interaction of Communities, Residents and Activists*, 87–102.

EEHC. (2019). *Egyptian Electricity Holding Company: Annual Report 2018/2019* (p. 89). Egyptian Electricity Holding Company, Ministry of Electricity and Renewable Energy . http://moee.gov.eg/test_new/PDFReports/2018-2019AR.pdf

El-Kowrany, S. I., El-Zamarany, E. A., El-Nouby, K. A., El-Mehy, D. A., Ali, E. A. A., Othman, A. A., Salah, W., & El-Ebiary, A. A. (2016). Water pollution in the Middle Nile Delta, Egypt: an environmental study. *Journal of Advanced Research*, *7*(5), 781–794.

Elmenofi, G. A. G., El Bilali, H., & Berjan, S. (2014). Governance of rural development in Egypt. *Annals of Agricultural Sciences*, *59*(2), 285–296. https://doi.org/10.1016/j.aoas.2014.11.018

Elmustapha, H., Hoppe, T., & Bressers, H. (2018). Understanding stakeholders' views and the influence of the socio-cultural dimension on the adoption of solar energy technology in Lebanon. *Sustainability*, *10*(2), 364.

Elsaid, M. A. (2007). "Planning for sustainable rural development in Egypt." In *Ain Shams University, Faculty of Engineering, Cairo*. http://cpas-egypt.com/pdf/Marwa/English.pdf

European Commission. (2001). Manual of concepts on land cover and land use information systems. In *European Communities, Luxembourg* (Vol. 106). European Communities, European Commission. https://ec.europa.eu/eurostat/ramon/statmanuals/files/KS-34-00-407-__-I-EN.pdf

European Commission. (2021a). *Applying the Degree of Urbanisation A METHODOLOGICAL MANUAL TO DEFINE CITIES, TOWNS AND RURAL AREAS FOR INTERNATIONAL COMPARISONS : 2021 edition*. : Publications Office of the European Union, 2021. https://doi.org/10.2785/706535

European Commission. (2021b). *European Commission Eurostat NUTS - Nomenclature of territorial units for statistics Local Administrative Units (LAU)*. https://ec.europa.eu/eurostat/web/nuts/local-administrative-units (Accessed 19-09-2021)

Eurostat. (2021a). *European Commission Eurostat NUTS - Nomenclature of territorial units for statistics Local Administrative Units (LAU) - Dataset*. https://ec.europa.eu/eurostat/web/nuts/local-administrative-units

Eurostat. (2021b). *Eurostat | Electricity price statistics*. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Electricity_price_statistics#Electricity_prices_for_household_consumers (Accessed 18-06-2021)

EUROSTAT. (2021a). *European Commission- Eurostat- NUTS - Nomenclature of territorial units for statistics-Background*. https://ec.europa.eu/eurostat/web/nuts/background Accessed (16-09-2021)

EUROSTAT. (2021b). *Land use overview by NUTS 2 regions - Last update: 14-07-2021*. https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do (Accessed 16-10-2021)

Fathy, H. (1989). *Architecture of The Poor: Experience in Rural Egypt. (In Arabic).* American University in Cairo.

Forleo, M. B., Giaccio, V., Giannelli, A., Mastronardi, L., & Palmieri, N. (2017). Socio-economic drivers, land cover changes and the dynamics of rural settlements: Mt. Matese area (Italy). *European Countryside*, *9*(3), 435.

FORMICA, C. (2002). *FORME DI INSEDIAMENTO RURALE [FORMS OF RURAL SETTLEMENT]*. https://www.igmi.org/italia-atlante-dei-tipi-geografici/++theme++igm/atlante_tipi_geografici/pdf/insediarurale.pdf

Fratianni, S., & Acquaotta, F. (2017). The climate of Italy. In M. Soldati & M. Marchetti (Eds.), *Landscapes and Landforms of Italy* (pp. 29–38). Springer. https://doi.org/10.1007/978-3-319-26194-2_4

Frost, R. S. (1934). The reclamation of the Pontine Marshes. *Geographical Review*, *24*(4), 584–595.

FSI. (2021). *Italian State Railways*. https://www.fsitaliane.it/ (Accessed 15-09-2021)

Gazzetta Ufficiale. (2021). *DECREE OF THE PRESIDENT OF THE REPUBLIC 26 August 1993, n. 412. Art. 2 (Identification of the climatic zone and degree days) (In Italian).* https://www.gazzettaufficiale.it/eli/id/1993/10/14/093G0451/sg Accessed (14-09-2021)

Google Maps. (2009). *85 Via Aldo Moro Pontinia, Lazio Google - Street View - Oct 2009*. https://www.google.com/maps/@41.4044312,13.050471,3a,85.8y,15.12h,106.5t/data=!3m6!1e1!3m4!1scpXyHbUTJy_dYJ4x9X55qA!2e0!7i13312!8i6656 (Accessed 21-10-2021)

Google Maps. (2021). *Google Maps*. https://www.google.com/maps (Accessed 2021)

GOPP. (n.d.). *Presentation of the strategic plan project for Kafr El Sheikh governorate until 2032* (p. 65). Ministry of Housing, Utilities and Urban Communities represented by the General Organization for Physical Planning (In Arabic). http://gopp.gov.eg/wp-content/uploads/2010/10/-المخطط-الإستراتيجي-لمحافظة-كفر-الشيخ.pdf

GOPP. (2008a). *Development Strategy for the Governorates of the Republic: Delta Region (Dakahlia, Damietta, Kafr El-Shiekh, Monufia and Gharbia)*. Ministry of Housing, Utilities and Urban Communities represented by the General Organization for Physical Planning (In Arabic). http://gopp.gov.eg/wp-content/uploads/2013/03/2008- استراتيجية-التنمية-لمحافظات-الجمهورية-اقليم-الدلتا.pdf

GOPP. (2008b). *Governorate, Strategic Development of Republic Governorates: Suez Canal Region Port Said Governorate - Ismailiaa Governorate - Suez Governorate - South Sinai Governorate - AlSharkya*. Arab Republic of Egypt. Ministry of Housing, Utilities and Urban Communities represented by the General Organization for Physical Planning (In Arabic). file:///D:/Google Drive/00.Academic Google dRIVE/00.PDTA/00.Work/01_Existing_Traditional_Settlements_Pattern/01_01_Egypt/REF/Delta/VIP-Suiz Region.pdf

GOPP. (2012). *Greater Cairo Urban Development Strategy : Part I: Future Vision and Strategic Directions*. Ministry of Housing, Utilities, and Urban Communities (MHUC) represented by the General Organization for Physical Planning (GOPP). http://gopp.gov.eg/wp-content/uploads/2015/07/1CFV-EN.pdf

GOPP. (2013). *Re-demarcating Egypt's borders into development regions: Activating the directives of the National Strategic Plan for Urban Development*. Arab Republic of Egypt. Ministry of Housing, Utilities and Urban Communities represented by the General Organization fo[1] GOPP, "Re-demarcating Egypt's borders into development regions: Activating the directives of the National Strategic Plan for Urban D. http://theexecutivesforum.com/wp-content/uploads/2009/10/-ترسيم-حدود-مصر-إلى-أقاليم-تنموية.pdf

GOPP. (2014). *Tha National Urban Development Framework in the Arab Republic of Egypt*. Arab Republic of Egypt, Ministry of Housing, Utilities and Urban Communities, General Organization for Physical Planning. http://gopp.gov.eg/wp-content/uploads/2015/01/GOPP-PA_2014.pdf

GOPP. (2015). *The environmental perspective of the urban development strategy at the level of the Republic : Delta Region*. Ministry of Housing, Utilities and Urban Communities represented by the General

Organization for Physical Planning, General Administration for Environmental and Natural Studies (In Arabic).

GOPP. (2017a). *The project of preparing the strategic plan for urban development for Damietta Governorate* (p. 67). Ministry of Housing, Utilities and Urban Communities represented by the General Organization for Physical Planning (In Arabic). http://gopp.gov.eg/wp-content/uploads/2020/08/المخطط-الإستراتيجى-لمحافظة-دمياط.pdf

GOPP. (2017b). *The strategic plan for urban development for the Delta region*. Ministry of Housing, Utilities and Urban Communities represented by the General Organization for Physical Planning (In Arabic). http://gopp.gov.eg/wp-content/uploads/2020/08/المخطط-الإستراتيجى-لإقليم-الدلتا.pdf

GOPP. (2017c). *The strategic plan project for Dakahlia Governorate for the year 2032* (p. 47). Ministry of Housing, Utilities and Urban Communities Urban Planning Authority Urban Research and Studies Center The General Authority for Urban Planning, College of Regional and Urban Planning - Cairo University. http://gopp.gov.eg/wp-content/uploads/2010/10/المخطط-الإستراتيجي-لمحافظة-الدقهلية.pdf

GOPP. (2018). *The project of preparing the strategic plan for urban development for Menoufia Governorate* (p. 135). Ministry of Housing, Utilities and Urban Communities represented by the General Organization for Physical Planning (In Arabic). http://gopp.gov.eg/wp-content/uploads/2020/08/المخطط-الإستراتيجى-لمحافظة-المنوفية.pdf

GOPP. (2019). *The strategic plan for urban development for the Gharbia Governorate and the developmental features of its centers* (p. 114). Ministry of Housing, Utilities and Urban Communities represented by the General Organization for Physical Planning (In Arabic). http://gopp.gov.eg/wp-content/uploads/2020/08/المخطط-الإستراتيجى-لمحافظة-الغربية.pdf

Grano, M. C. (2014). Landscape, rural structures and popular architecture in the provinces of Potenza and Matera (In Italian). *Cultural Landscapes: Metodi, Strumenti e Analisi Del Paesaggio Fra Archeologia, Geologia e Storia in Contesti Di Studio Del Lazio e Della Basilicata (Italia). BAR International Series*, *2629*, 131–148. https://www.researchgate.net/publication/303932128_PAESAGGIO_STRUTTURE_RURALI_E_ARCHITETTURA_POPOLARE_NELLE_PROVINCE_DI_POTENZA_E_MATERA

Grifoni, P., Guzzo, T., & Ferri, F. (2014). Environmental sustainability and participatory approaches: The case of Italy. *Journal of Sustainable Development*, *7*(3), 1.

Gullino, P., Devecchi, M., & Larcher, F. (2018). How can different stakeholders contribute to rural landscape planning policy? The case study of Pralormo municipality (Italy). *Journal of Rural Studies*, *57*, 99–109.

Hauke, J., & Kossowski, T. (2011). *Comparison of values of Pearson's and Spearman's correlation coefficient on the same sets of data*.

HBRC. (2008). *Egyptian Code for Improving the Efficiency of Energy Use in Buildings, Part 1: Residential Buildings, ECP306-2005. (In Arabic).* Ministry of Housing, Arab Republic of Egypt.

Hsu, D. (2014). How much information disclosure of building energy performance is necessary? *Energy Policy*, *64*, 263–272.

Huebner, G., Shipworth, D., Hamilton, I., Chalabi, Z., & Oreszczyn, T. (2016). Understanding electricity consumption: A comparative contribution of building factors, socio-demographics, appliances, behaviours and attitudes. *Applied Energy*, *177*, 692–702.

IBM. (2021). *IBM SPSS Statistics 26 Documentation*. https://www.ibm.com/support/pages/downloading-ibm-spss-statistics-26

IEA. (2020). *Energy Efficiency 2020*. IEA.

Interreg EU. (2019). *GUIDELINE: PRACTICAL ADVICE ON HOW TO INVOLVE LOCAL STAKEHOLDERS IN ENERGY AND CLIMATE PLANNING AND SETTING UP A REGIONAL ENERGY TEAM : Activity: A.T.3.3 Developing tools and guidelines for vertical, horizontal and transsectoral integration of energy and*. Interreg Alpine Space. https://www.alpine-space.eu/projects/imeas/project-results/implementation/t3/d.t3.3.2---guideline---practical-advice-on-how-to-involve-local-stakeholders-in-energy-and-climate-planning.pdf

Ippoliti, E., Calvano, M., & Mores, L. (2014). 2.5 D/3D MODELS FOR THE ENHANCEMENT OF ARCHITECTURAL-URBAN HERITAGE. AN VIRTUAL TOUR OF DESIGN OF THE FASCIST HEADQUARTERS IN LITTORIA. *ISPRS Annals of Photogrammetry, Remote Sensing & Spatial Information Sciences*, *2*(5).

ISTAT. (2010). *2010 Agricultural Census*. http://dati-censimentoagricoltura.istat.it/Index.aspx?lang=en (Accessed 01-09-2021)

ISTAT. (2011). *15th Census of Population and housing 2011*. http://dati-censimentopopolazione.istat.it/Index.aspx (Accessed 01-09-2021)

ISTAT. (2019). *ISTAT WATER STATISTICS | Years 2015-2018*. https://www.istat.it/it/files//2019/03/Water-report.pdf

ISTAT. (2020). *ISTAT WATER STATISTICS | YEARS 2018-2019*. https://www.istat.it/it/files//2020/03/Water_report_2020.pdf

ISTAT. (2021a). *EDUCATION AND WORK > LABOR MARKET*. https://noi-italia.istat.it/pagina.php?id=3&categoria=16&action=show&L=0 (Accessed 01-09-2021)

ISTAT. (2021b). *Information system on quality of statistical production processes - home - General documents*. http://siqual.istat.it/SIQual/dettaglioIndagine.do?dispatch=docMetodologici&id=7777789&refresh=true&language=EN Accessed (25-09-2021)

ISTAT. (2021c). *Urban wastewater treatment plants*. http://dati.istat.it/?lang=en&SubSessionId=44bdbaf0-7768-4df8-ba17-dd7a3d238182 (Accessed 25-09-2021)

ISTAT. (2021d). *We Italy. 100 statistics to understand the country we live in (In Italian)*. National Institute of Statistics - Italy. https://noi-italia.istat.it/

ISTAT. (2022). *Welcome to I.Stat, the complete data warehouse for experts*. http://dati.istat.it/ (Accessed 25-01-2022)

Jacobs, M. H., & Buijs, A. E. (2011). Understanding stakeholders' attitudes toward water management interventions: Role of place meanings. *Water Resources Research*, *47*(1).

Jobert, T., & Karanfil, F. (2007). Sectoral energy consumption by source and economic growth in Turkey. *Energy Policy*, *35*(11), 5447–5456.

Khamis, H. (2008). Measures of association: how to choose? *Journal of Diagnostic Medical Sonography*, *24*(3), 155–162.

Kurian, M. (2017). The water-energy-food nexus: trade-offs, thresholds and transdisciplinary approaches to sustainable development. *Environmental Science & Policy*, *68*, 97–106.

Lam, T. C., Ge, H., & Fazio, P. (2015). Impact of curtain wall configurations on building energy performance in the perimeter zone for a cold climate. *Energy Procedia*, *78*, 352–357.

Larsen, M. A. D., & Drews, M. (2019). Water use in electricity generation for water-energy nexus analyses: The European case. *Science of the Total Environment*, *651*, 2044–2058.

Ledda, A., Serra, V., & De Montis, A. (2019). The Effect of Rural Buildings on Landscape Fragmentation in Natura 2000 Sites: A Case Study in Sardinia. *Sustainability*, *11*(17), 4695.

Lu, S., Zheng, S., & Kong, X. (2016). The performance and analysis of office building energy consumption in the west of Inner Mongolia Autonomous Region, China. *Energy and Buildings*, *127*, 499–511.

Luce e Gas Italia. (2021). *The Italian climatic zones and the periods of ignition of the heating systems (In Italian)*. https://luceegasitalia.it/2020/01/22/le-zone-climatiche-italiane-e-i-periodi-di-accensione-degli-impianti-di-riscaldamento/ Accessed (15-09-2021)

MacDonald, D., Crabtree, J. R., Wiesinger, G., Dax, T., Stamou, N., Fleury, P., Lazpita, J. G., & Gibon, A. (2000). Agricultural abandonment in mountain areas of Europe: environmental consequences and policy response. *Journal of Environmental Management*, *59*(1), 47–69.

Magagna, D., Hidalgo Gonzále, I., Bidoglio, G., Peteves, S., Adamovic, M., Bisselink, B., De Felice, M., De Roo, A., Dorati, C., & Ganora, D. (2019). *Water–Energy Nexus in Europe. Publications Office of the European Union, Luxembourg*.

Mahgoub, Y. (2001). The Transformation of Traditional Rural Settlements in Egypt. *The Second International Symposium in the Built Environment,"Traditional Environments in a New Millennium: Defining Principles and Professional Practices. Amasya- TURKEY*. https://www.slideshare.net/ymahgoub/the-transformation-of-traditional-rural-settlements-in-egypt

Maino, E., Benni, S., Torreggiani, D., Barbaresi, A., & Tassinari, P. (2016). A quantitative physiognomic analysis of contemporary farm buildings to improve awareness in rural planning. *Transactions of the ASABE*, *59*(2), 509–519.

Mamdouh, I. S., Abdo, M. M., Ahmed, N., Atiff, A., Abouaiana, A., & Salah, S. (2011). *"Studies in Sustainable Environmental Landscape Design at (EL-RMAYA CLUB)."* https://doi.org/10.13140/RG.2.2.12195.07209

Mangullo, S. (2015). *Dal fascio allo scudo crociato. Cassa per il Mezzogiorno, politica e lotte sociali nell'Agro Pontino (1944-1961) [From the beam to the crusader shield. Cassa per il Mezzogiorno, politics and social struggles in the Agro Pontino (1944-1961)]*. FrancoAngeli s.r.l., Milano, Italy. https://books.google.com.eg/books?hl=en&lr=&id=ql8KCgAAQBAJ&oi=fnd&pg=PA5&dq=Adottando+come+caso+di+studio+la+provincia+di+Latina+e+in+particolare+l'Agro+Pontino,+già+oggetto+durante+il+fascismo+di+un+ampio+intervento+di+bonifica+integrale,+il+volume+rico

MAP. (2021a). *Agro Pontina Museum- Post-remediation- (2178.jpg) - Agro Pontina Reclamation Consortium (In Italian)*. http://www.museoagropontino.it/attachments/2178.jpg (Accessed 04-10-2021)

MAP. (2021b). *Agro Pontina Museum- Post-remediation - Littoria: corso vittorio emanuele III - 26/4/1936 - Agro Pontina Reclamation Consortium (In Italian)*. http://www.museoagropontino.it/attachments/1728.jpg (Accessed 04-10-2021)

MAP. (2021c). *Agro Pontina Museum- Post-remediation -Balilla House - 26/4/1936 - Agro Pontina Reclamation Consortium (In Italian)*. http://www.museoagropontino.it/attachments/1729.jpg (Accessed 04-10-2021)

MAP. (2021d). *Agro Pontina Museum- Post-remediation -Trebbiatura del grano al podere 917 - 9/7/1937 - Agro Pontina Reclamation Consortium (In Italian)*. http://www.museoagropontino.it/attachments/1963.jpg (Accessed 04-10-2021)

MAP. (2021e). *Agro Pontina Museum- Pre-remediation - Hut at the pool by Gnif Gnaf - 11/1/1928 - Agro Pontina Reclamation Consortium (In Italian)*. http://www.museoagropontino.it/attachments/01401.jpg (Accessed 04-10-2021)

Maps-Italy. (2021). *Homepage - Transports -Italy transport map*. https://maps-italy.com/maps-italy-transports/italy-transport-map

Margione, E. (2018). ITALIANS NEW TOWNS AS AN EXPERIMENTAL TERRITORY FOR THE MODERN MOVEMENT IN ITALY. The case study of Oriolo Frezzotti and his architecture for public facilities in Littoria, Sabaudia and Pontinia. *REGIONALISM, NATIONALISM & MODERN ARCHITECTURE*, 202–220.

Martinez, A., & Choi, J.-H. (2017). Exploring the potential use of building facade information to estimate energy performance. *Sustainable Cities and Society*, *35*, 511–521.

Mechri, H. E., Capozzoli, A., & Corrado, V. (2010). Use of the ANOVA approach for sensitive building energy design. *Applied Energy*, *87*(10), 3073–3083.

MIT. (2021). *HOME*. https://www.mit.gov.it/ Accessed (25-09-2021)

MOEE. (2020). *The press conference to announce the selling prices of electrical energy during the next five fiscal years (2020/2021 - 2024/2025) (In Arabic)* (p. 27). Ministry of Electricity and Renewable Energy. http://enterprise.press/wp-content/uploads/2020/06/المؤتمر-الصحفى-لأسعار-الكهرباء-للخمس-سنوات-القادمة-1-2020-6-9.pdf

Monica, L., & Bergamaschi, L. (2019). From the Thirties to post-war reconstruction. The Land Reclamation Consortia and rural architecture in Italy. *SHS Web of Conferences 63, 03001 - MODSCAPES 2018*. https://doi.org/10.1051/shsconf/20196303001

MWRI. (2005). *Water for the future: National water resources plan for Egypt—2017*. Ministry of Water Resources and Irrigation Planning Sector. http://extwprlegs1.fao.org/docs/pdf/egy147082.pdf

Nasaruddin, A. N., Tee, B. T., Tahir, M. M., & Jasman, M. E. S. M. (2021). Data Assessment on the relationship between typical weather data and electricity consumption of academic building in Melaka. *Data in Brief*, *35*, 106797.

Nori, M. (2018). Rural Migrations and Mediterranean Agricultural Systems. *IEMed: Mediterranean Yearbook*, *2018*, 59.

Nori, M., & Farinella, D. (2020). *Migration, Agriculture and Rural Development: IMISCOE Short Reader*. Springer Nature.

OECD. (2020). *Investment Policy Reviews: Egypt 2020*. OECD Investment Policy Reviews, OECD Publishing, Paris. https://doi.org/10.1787/9f9c589a-en

OpenStreetMap. (2021). *Relation: Pontinia (8099190) Version #3 Nuove costruzioni Pontinia*. https://www.openstreetmap.org/relation/8099190#map=15/41.4100/13.0445 (Accessed 10-2021)

Pacheco-Torres, R., López-Alonso, M., Martínez, G., & Ordóñez, J. (2015). Efficient design of residential buildings geometry to optimize photovoltaic energy generation and energy demand in a warm Mediterranean climate. *Energy Efficiency*, *8*(1), 65–84.

Pagano, G., & Daniel, G. (1936). Italian rural Architecture. In *Milano: U. Hoepli*. (In Italian). https://digit.biblio.polito.it/4236/15/Architettura_rurale_italiana_G.Pagano_e_G.Daniel_compressed.pdf

Perpina Castillo, C., Kavalov, B., Ribeiro Barranco, R., Diogo, V., Jacobs-Crisioni, C., Batista e Silva, F., Baranzelli, C., & Lavalle, C. (2018). *Territorial Fact and Trends in the EU Rural Areas within 2015-2030*. Joint Research Centre (Seville site).

Picuno, P. (2012). Vernacular farm buildings in landscape planning: a typological analysis in a southern Italian region. *Journal of Agricultural Engineering*, *43*(3), e20–e20.

Picuno, P. (2016). Use of traditional material in farm buildings for a sustainable rural environment. *International Journal of Sustainable Built Environment*, *5*(2), 451–460.

Pontiniaweb. (2021). *The primitive house in the Pontine countryside: the lestra (In Italian)*. http://www.pontiniaweb.it/2010/03/30/labitazione-primitiva-in-agro-pontino-la-lestra/

Pontrandolfi, R. (2020). URBAN-RURAL:" TIBURTINO" DISTRICT IN ROME AND RURAL VILLAGE" LA MARTELLA" IN MATERA AS EMBLEMATIC CASES OF SETTLEMENTS DURING THE ITALIAN RECONSTRUCTION. *International Archives of the Photogrammetry, Remote Sensing & Spatial Information Sciences*.

Rahman, K. A., Leman, A. M., Mubin, M. F., Yusof, M. Z. M., Hariri, A., & Salleh, M. N. M. (2017). Energy consumption analysis based on energy efficiency approach: a case of suburban area. *MATEC Web of Conferences*, *87*, 2003.

Raicevich, S., Grati, F., Giovanardi, O., Sartor, P., Sbrana, M., Silvestri, R., Baino, R. T., Andaloro, F., Battaglia, P., & Romeo, T. (2020). The unexploited potential of small-scale fisheries in Italy: analysis and perspectives on the status and resilience of a neglected fishery sector. In *Small-Scale Fisheries in Europe: Status, Resilience and Governance* (pp. 191–211). Springer.

RECON. (2021). *RECON: Strumento per la valutazione economica delle Comunità di Energia Rinnovabile [RECON: Tool for the economic evaluation of Renewable Energy Communities]*. https://recon.smartenergycommunity.enea.it/# (Accessed 05-01-2022)

Rodrigues, F., Cardeira, C., & Calado, J. M. F. (2014). The daily and hourly energy consumption and load forecasting using artificial neural network method: a case study using a set of 93 households in Portugal. *Energy Procedia*, *62*, 220–229.

Santin, O. G. (2011). Behavioural patterns and user profiles related to energy consumption for heating. *Energy and Buildings*, *43*(10), 2662–2672.

Schachter, G. (1965). Rural life in southern Italy. *The American Journal of Economics and Sociology*, *24*(4), 413–424.

Scricco, F. (2014). *The foundation cities during fascism in Italy: the radial plan of Littoria*.

Sebti, M., Alkama, D., & Bouchair, A. (2013). Assessment of the effect of modern transformation on the traditional settlement 'Ksar'of Ouargla in southern Algeria. *Frontiers of Architectural Research*, *2*(3), 322–337.

Sena, B., Zaki, S. A., Rijal, H. B., Alfredo Ardila-Rey, J., Yusoff, N. M., Yakub, F., Ridwan, M. K., & Muhammad-Sukki, F. (2021). Determinant Factors of Electricity Consumption for a Malaysian Household Based on a Field Survey. *Sustainability*, *13*(2), 818.

Sharifi, A., & Yamagata, Y. (2016). Principles and criteria for assessing urban energy resilience: A literature review. *Renewable and Sustainable Energy Reviews*, *60*, 1654–1677.

Sharp, H., Finkelstein, A., & Galal, G. (1999). Stakeholder identification in the requirements engineering process. *Proceedings. Tenth International Workshop on Database and Expert Systems Applications. DEXA 99*, 387–391.

Smith, L. (2000). Stakeholder analysis: a pivotal practice of successful projects. *Project Management Institute Annual Seminars & Symposium*.

Sorrentino, F. (2013). Historic rural and urban settlements and new communities (In Italian). *Bloom: Bloom Trimestrale Di Architettura a Cura Del Dottorato Di Ricerca in Composizione Architettonica Della Facolta Di Architettura Di Napoli*, 58–62. https://www.academia.edu/48950439/Insediamenti_rurali_ed_urbani_storici_e_nuove_comunità

St, L., & Wold, S. (1989). Analysis of variance (ANOVA). *Chemometrics and Intelligent Laboratory Systems*, *6*(4), 259–272.

Statistics, S. S. (2021). *Pearson Correlation Coefficient Calculator*. https://www.socscistatistics.com/tests/pearson/

Sweedan, M. A., Elbatran, M. A., & Nazmy, N. M. (2007). The role of the state in the urban development of the Egyptian village (In Arabic). *Proceeding Of The Fourth ERD6 Conference Faculty Of Engineering, Shebin El-Kom Center of Rural 23-25 October 2007 Development*, 622–639. http://www.cpas-egypt.com/pdf/Neamat Nazmy/Research's/2.pdf

Tassinari, P., Carfagna, E., Benni, S., & Torreggiani, D. (2008). Wide-area spatial analysis: A first methodological contribution for the study of changes in the rural built environment. *Biosystems Engineering*, *100*(3), 435–447.

Tempesta, T. (2010). The perception of agrarian historical landscapes: A study of the Veneto plain in Italy. *Landscape and Urban Planning*, *97*(4), 258–272.

Tenzon, M. (2018). Rural modernity in post-war Southern Italy: the La Martella village in Matera. *The Journal of Architecture*, *23*(3), 498–522.

Terna. (2020). *electricity in the regions (L'ELETTRICITA' NELLE REGIONI)*. Terna S.p.A. https://download.terna.it/terna/9 - REGIONI_8d97c226f8f6c13.pdf

Territorial Cohesion Agency. (2021). *Agenzia per la coesione territorialeNational Strategy for "Inner Areas" SNAI*. https://www.agenziacoesione.gov.it/strategia-nazionale-aree-interne/?lang=en Accessed (19-09-2021)

Torabi Moghadam, S., Toniolo, J., Mutani, G., & Lombardi, P. (2018). A GIS-statistical approach for assessing built environment energy use at urban scale. *SUSTAINABLE CITIES AND SOCIETY*, *37*, 70–84. https://doi.org/10.1016/j.scs.2017.10.002

Torreggiani, D., & Tassinari, P. (2012). Landscape quality of farm buildings: The evolution of the design approach in Italy. *Journal of Cultural Heritage*, *13*(1), 59–68. https://doi.org/https://doi.org/10.1016/j.culher.2011.06.002

Tran, L. N., Gao, W., & Ge, J. (2021). Sensitivity analysis of household factors and energy consumption in residential houses: A multi-dimensional hybrid approach using energy monitoring and modeling. *Energy and Buildings*, *239*, 110864.

Treccani. (2021). *balilla - vocabulary online (In Italian)*. https://www.treccani.it/vocabolario/balilla/ (Accessed 04-10-2021)

Weiner, H. R. (1976). New towns in twentieth century Italy. *Urbanism Past & Present*, *2*, 13–23.

Wendt, P. F. (1962). Post World-War-II Housing Policies in Italy. *Land Economics*, *38*(2), 113–133.

Wiegel, R. L. (2009). *The Nile River Delta Coast and Alexandria Seaport, Egypt: A Brief Overview of History, Problems, and Mitigation*.

Woo, Y.-E., & Cho, G.-H. (2018). Impact of the surrounding built environment on energy consumption in mixed-use building. *Sustainability*, *10*(3), 832.

Wright, A. (2008). What is the relationship between built form and energy use in dwellings? *Energy Policy*, *36*(12), 4544–4547.

WWAP. (2014). *The United Nations World Water Development Report 2014: Water and Energy*. United Nations Educational, Scientific and Cultural Organization, 7, place de Fontenoy, 75352 Paris 07. https://sustainabledevelopment.un.org/content/documents/1714Water Development Report 2014.pdf

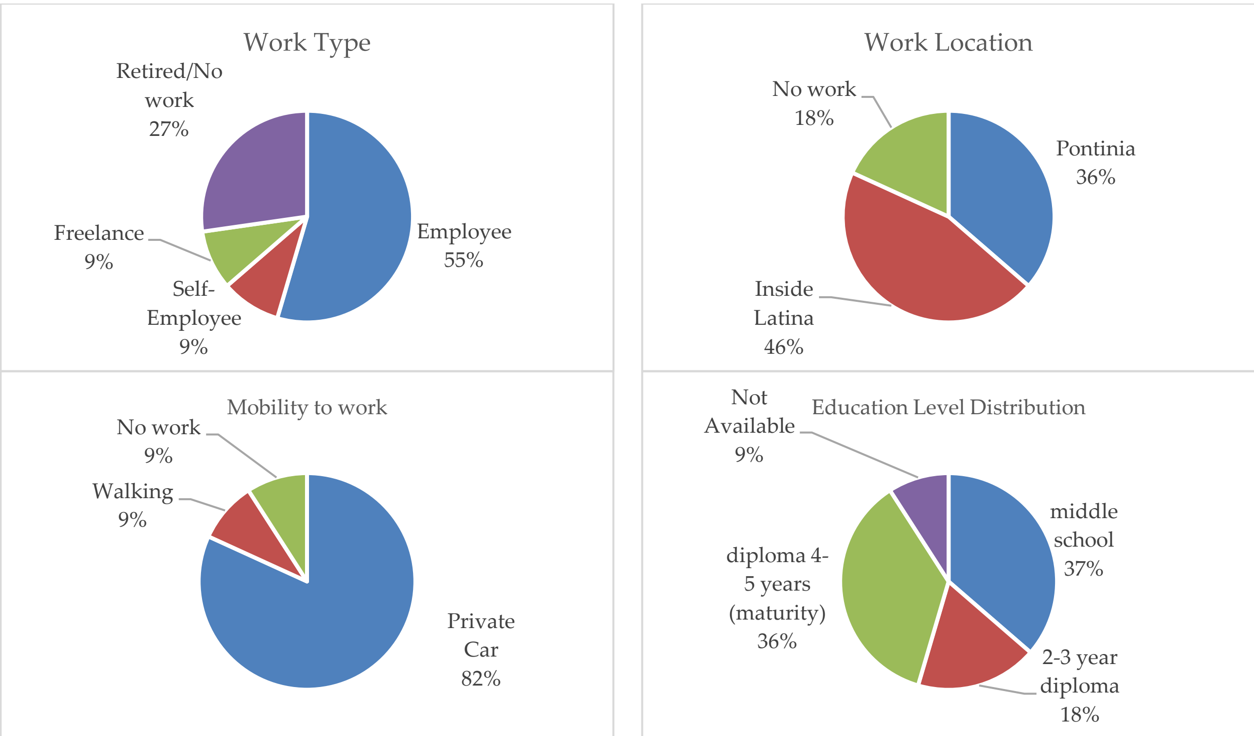
Wyatt, P. (2013). A dwelling-level investigation into the physical and socio-economic drivers of domestic energy consumption in England. *Energy Policy*, *60*, 540–549.

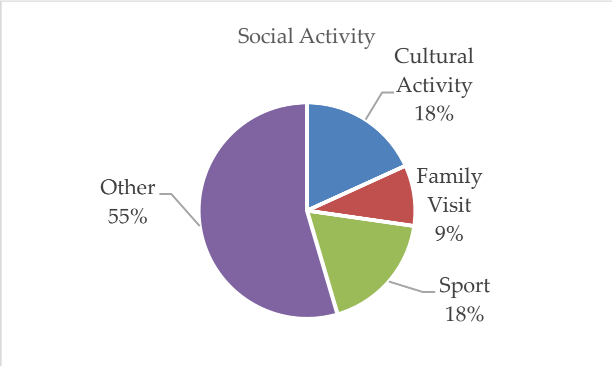
Zavalloni, M., D'Alberto, R., Raggi, M., & Viaggi, D. (2021). Farmland abandonment, public goods and the CAP in a marginal area of Italy. *Land Use Policy*, *107*, 104365. https://doi.org/https://doi.org/10.1016/j.landusepol.2019.104365

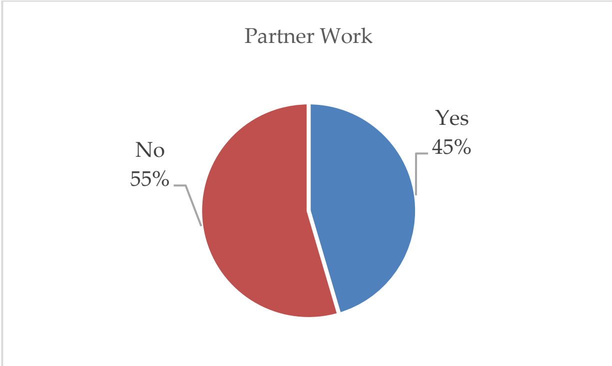
Zeghlache, H., & Alıkhodja, N. (2017). Retrofitting Assessment of Berber Dwelling: Case of Setif, Algeria. *Open House International*.

Zeidan, B. A. (2016). Groundwater monitoring, modeling and assessment in the Nile Delta. In *Unpublished chapter*. https://www.researchgate.net/publication/305109484_Groundwater_Monitoring_Modeling_and_Assessment_in_the_Nile_Delta

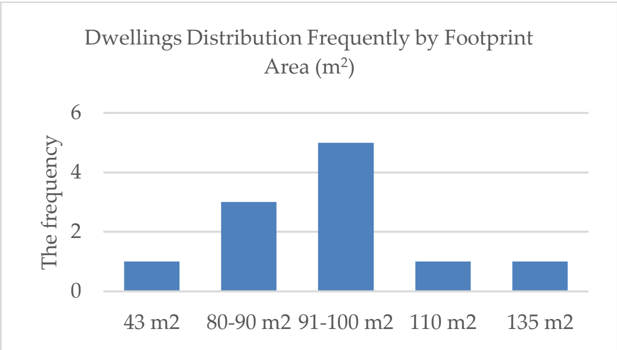
Annex (01-01) The respondents' socio-economic activities and dwelling characteristics, Pontinia.

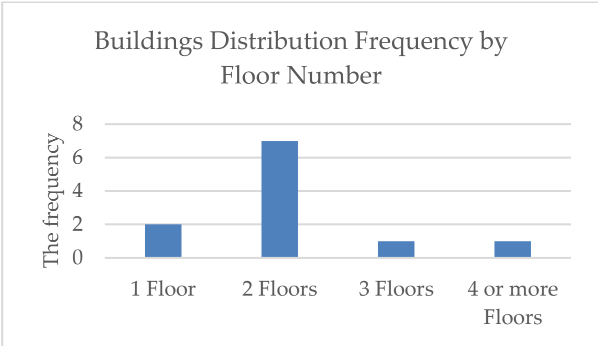


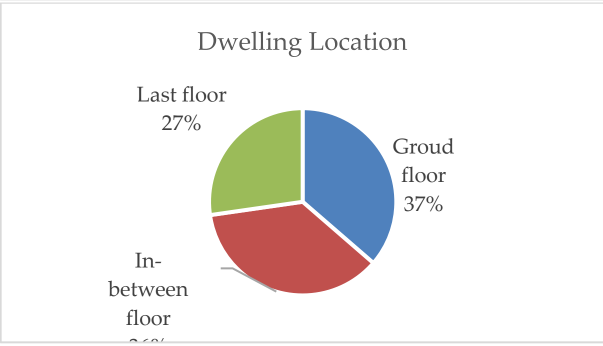


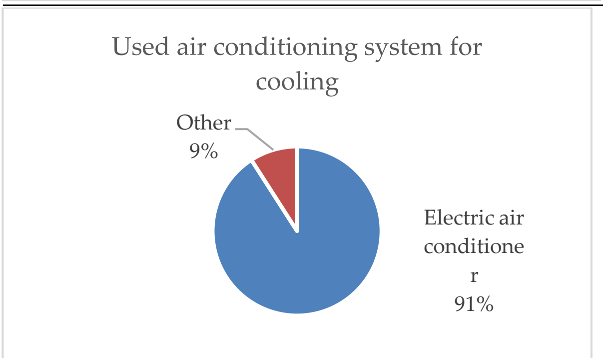


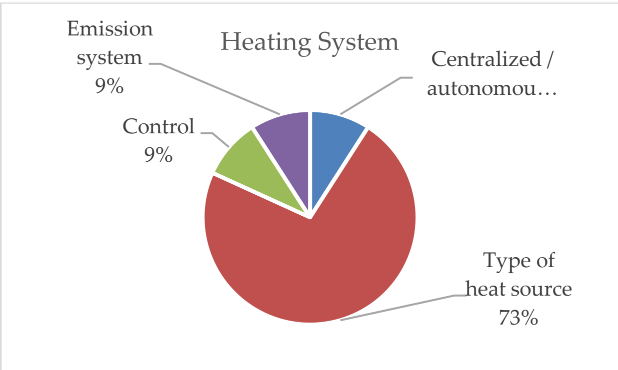
Annex (01-01)(continuous) The respondents' socio-economic activities and dwelling characteristics, Pontinia.

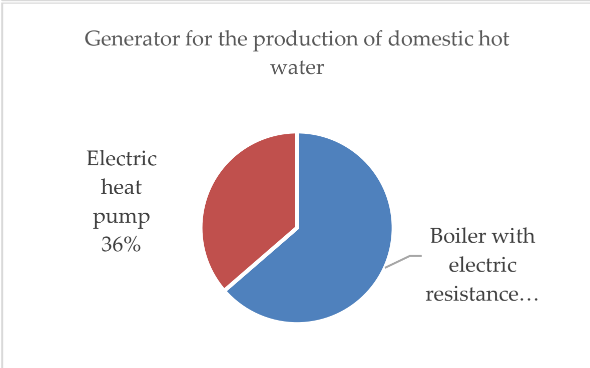


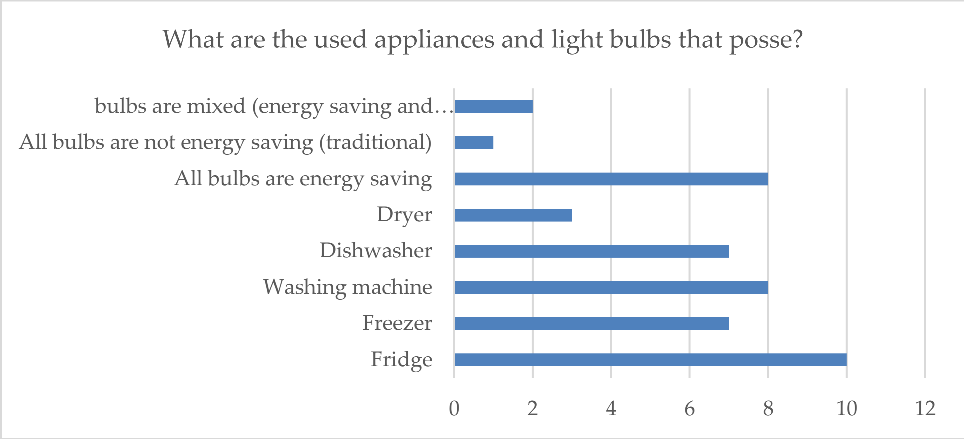


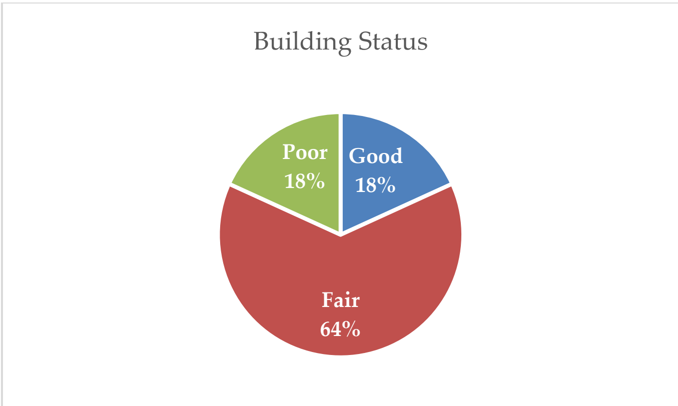









What are the used appliances and light bulbs that posse?
bulbs are mixed (energy saving and…
All bulbs are not energy saving (traditional)
All bulbs are energy saving
Dryer
Dishwasher
Washing machine
Freezer
Fridge
0
2
4
6
8
10
12


Building Status
Poor
18%
Good
18%
Fair
64%

II. Built Environment Retrofitting Practices in Traditional Settlement in Mediterranean Region: *A Systematic Literature Review (2011- 2021)*

Abstract: BACKGROUND

Built environment retrofitting in the Mediterranean region is a vast domain that includes numerous interventions from the policy levels to the technical solutions, using bottom-up, top-down, and mixed approaches. The majority are aligned with the directives and efforts towards energy-efficient and climate-neutral built environment in Europe and the Arabic Region, besides the global Sustainable Development Goals, namely, goals (3, 11, 12, and 13).

AIM

Beyond the quantified technical strategies, this study aims to diagnose the retrofitting practices in traditional settlements in Mediterranean countries in a decade, considering the stakeholders' involvement, which is crucial to ensure efficient development, renovation (European Commission, 2018c), and regeneration of the built environment.

METHOD

The study will be implemented in three stages: First, a top-down perspective of national energy efficiency plans with special reference to buildings in Egypt and Italy for their qualifying position as regional energy centers in the Mediterranean. Second, a systematic literature review (SLR) of the previous systematic review to explore whether the associated Phase III study was conducted, namely, SLR from a regional perspective, answers the following key question: What aspects were taken into consideration in the retrofitting strategies implemented in the region. The SLR considered items for the PRISMA checklist (preferred reporting items for systematic reviews and meta-analyses).

RESULTS

Section 1

The results showed that Egypt and Italy had made significant improvements in the energy and renewable energy (RE) sectors in the southern and northern Mediterranean, respectively, Despite Italy being preceded by nearly a decade. Accordingly, involving different stakeholders and relying on the RE technologies were concluded.

Section 2

A total (n=37) included paper out of (n=111) in the screening process. The results proved that no SLR studies were conducted in the research domain, namely, retrofitting the built environment in traditional settlements in the Mediterranean Region.

Section 3

SLR of the published peer-reviewed articles in recent ten years (January 2011-December2021) was conducted. The papers were searched in fifteen electronic databases in all available languages. The initial search resulted in (n=217) articles after removing duplication. After screening them, the eligible articles were (n=11). They are in the analysis stage, which will lead to further stages: theme dividing, quality assessment, and results synthesizing. As seen in figure A

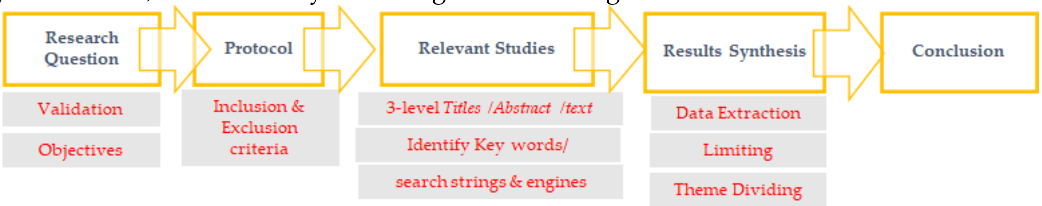


Figure (A) Visual summary of the Systematic literature review process.

The restricted SLR procedure, in line with Chapter One's findings (low electricity consumption of the rural dwelling in the Delta region), and the recent national initiatives in Itlay (Cappellaro et al., 2021), led to consider the energy community as one of the optimum approaches that can retrofit the built environment of the traditional settlements in the Mediterranean region, particularly in Egypt and Italy. Therefore, the chapter highlighted the best practices of the energy communities besides the recent national Italian initiative. The further chapter will describe the retrofitting practices' collaborative nature beyond the technical solutions.

SLR-keywords nexus: Limitations

Traditional Settlements were characterized in the (Introductory Chapter): *predominately rural, have farming, fishing, and foresty economic activities, the prevailing buildings' typologies are contemporary, and these settlements are neither historical and archeological nor touristic.*

Built environment was characterized as seen in figure B;

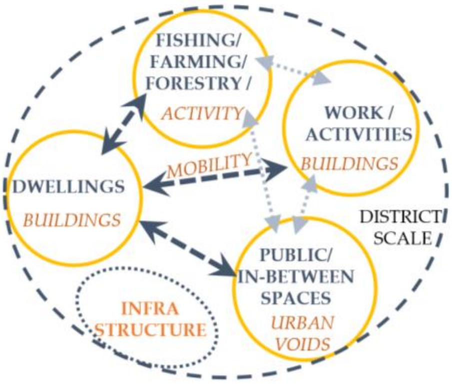


Figure (B) Focus on retrofitting aspects in the previous studies.

Keywords

Climate Change; Energy Efficiency; Evidence-Based Practices; Building Renovation

2.0 Energy Dilemma and Global Warming Introduction

The international community pays noticeable attention to energy efficiency representing three out of 17 Sustainable development goals, namely, goal 3, "Affordable and Clean Energy," Goal 12, Responsible Consumption and Production, and goal 11, "Sustainable Cities and Communities (United Nations, 2021).

2.1.1 Energy in Egypt Top-Down Perspectives

Egypt pays exceptional attention to achieving energy efficiency at many levels. Although the first attempt was by law 102 in 1986 to establish the New and Renewable Energy Development and Use Authority that follows the ministry of electricity. The past decade, particularly in 2014, witnessed significant improvements through many integrated directives started from integrating renewable energy with the ministry, restructuring the electricity tariff to remove energy subsidies to create the right price, besides encouraging investment in renewable energy (RE) in all sectors (OECD, 2020).

In 2012 the national energy efficiency action plan (NEEAP) phase 1 was established to improve energy (e.g., saving public lighting, improving electrical appliances, and improving energy plants). It provided a bottom-up approach with limited applications (NEEAP Egypt, 2012), such as the missing energy-saving component in the agriculture and transportation sectors (Elrefaei & Khalifa, 2014).

For these reasons, in 2016, phase two was released with a holistic approach considering the laws and many buildings (e.g., industrial and educational). The main aims are to be an energy efficiency (EE) hub of leading the region toward low CO_2 policies, achieving energy supply security, integrating the improvement of energy use efficiency into the energy, environment, and economic policies towards mitigating climate change. It is implemented in three milestones, as shown in table (02-01). Table (02-02) summarizes some applications of the NEEAP.

Table (02-01) The three milestones of NEEAP implementation (MOEE, 2018).

Milestone	Short Description
Preparation (2015-2020)	• Database preparation. • Raising Awareness; • Building capacity; • Preparing the institutional framework.
Medium-term (2020-2025)	• Providing indicators and measurements of EE; • Establishing training centers; • Financial support for EE; • Publishing annual reports; • Reach to all sectors, such as education, agriculture, and industries.
Long-term (2025-2035)	• Establishing a national center for EE development; • Development EE strategies and policies; • Open the market for EE activities.

Table (02-02) Some domains of NEEAP applications (MOEE, 2018).

Industrial sector	• Relying on solar energy application in heating processes; • And low carbon technology in industrial application.
Schools	• Including energy efficiency issues in the curricula to provide sufficient information; • Urging the Educational Buildings Authority to provide energy codes; • Installing PV panels and solar water heaters.
Civil society	• Raising awareness through (TV, radio, digital, and outdoors marketing); • Events to explain the benefits of electricity laws. Promoting by distribution companies; • Providing mobile applications for reporting energy losses and inefficient energy cases such as lighting bulbs during the day.
Building capacities	• Collaboration with academic bodies; • Establishing training programs and centers.

The Egyptian Supreme Council of Energy was reformed to supervise energy development strategies to support national economic and social development plans and achieve efficient use of resources. It leads many organizations and committees. Figure (02-01) shows the hierarchy of the NEEAP bodies. Table (02-03) summarises actors' major roles.

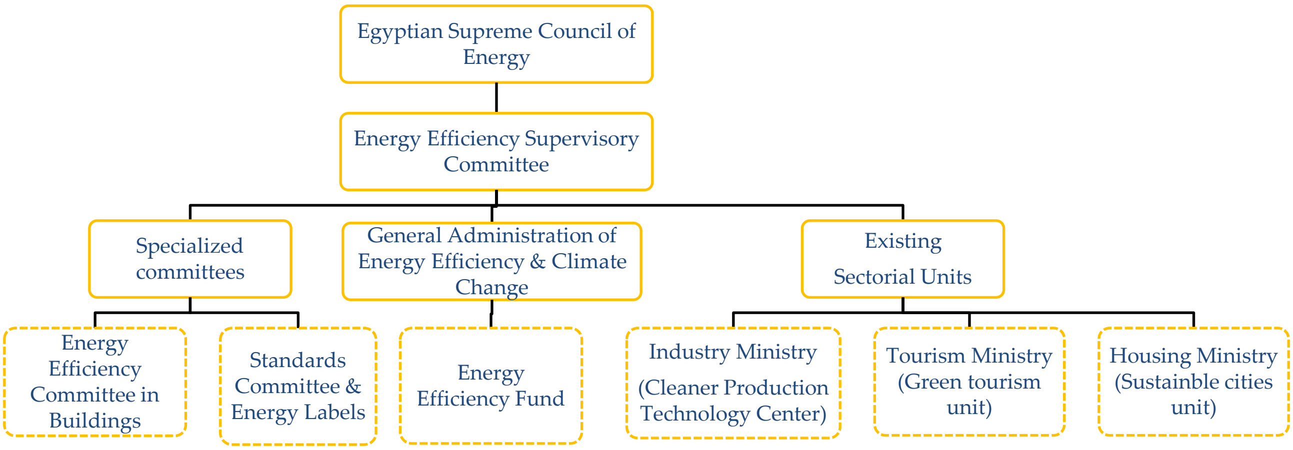


Figure (02-01) Institutional hierarchy for energy efficiency activity since 2009. Based on (MOEE, 2018).

Table (02-03) Institutional framework description for energy efficiency activity. Based on (MOEE, 2018).

Organization	Some of the responsibilities description
Energy Efficiency Supervisory Committee	• General supervision of the implementation of the national plan for electric energy efficiency in all its details approved by the Supreme Council
General Administration of Energy Efficiency & Climate Change	• Provide funding, prepare databases, coordinate with the concerned parties, publish and prepare periodic reports.
Standards Committee & Energy Labels	• Proposals review, following-up, and implementation at the micro-level
Energy Efficiency Committee in Buildings	• Identify legal, institutional, and economic challenges and propose solutions to activate the Energy Efficiency Code.
Sectorial Units	• Existing in three ministries (planned to generalize in all of them); • Developing capacity building programs within the sector; • Follow up on the implementation of energy efficiency measures.

Within the NEEAP at buildings levels, The Egyptian Energy Codes for residential buildings (HBRC, 2008a) and commercial buildings (HBRC, 2008b) were launched in 2006, providing the minimum guidelines for designing and retrofitting buildings to achieve energy efficiency under different local climatic in Egypt. Many studies investigated code aspects pre-releasing (Hanna, 2004) and post-releasing (Hanna, 2011; Hanna, 2013; Hanna, 2015).

In the same domain, the local rating system Green Pyramid Rating System (GPRS) was launched officially in 2018, contributing to achieving sustainability by decreasing the adverse influences of buildings on the environment. It certifies all buildings in the early design stage until major refurbishment, based on seven main classifications, such as water and energy efficiency, achieves indoor air quality and added value (HBRC, 2018). Although these codes exist, many Egyptian architects and architecture firms lack awareness about them, apart from the large-scale firms and architects with postgraduate studies (Abouaiana & Mohamadin, 2018). Moussa (2019) emphasized this finding as the major obstacle to using the GPRS in Egypt

In 2016, Egypt Vision 2030 was launched in line with sustainable development goals the balanced regional development. With the involvement of all stakeholders from development partners, keep abreast of alterations in the national, regional, and international contexts. It gives prominence to addressing the climate change influences via the sustainable ecosystem that supports resilience. As well as energy represents two of its nine objectives, objective 5, Sustainable Environment, and Objective 7, Egyptian Peace and Security (MPED, 2021).

The Integrated and Sustainable Energy Strategy for Egypt until 2035 (ISES 2035) was adopted by the Ministry of Electricity and Renewable Energy to achieve energy security and make suitable renewable energy source development conditions engaging all sectors (IRENA, 2018). It enhances the ambitious goal to create a regional energy hub in Egypt among African, Asian and European countries. Producing electricity in the past decade reflects the improvements in the electricity sector in Egypt, as seen in Figure (02-02). Figure (02-03) shows the milestones of the energy efficiency efforts in Egypt.

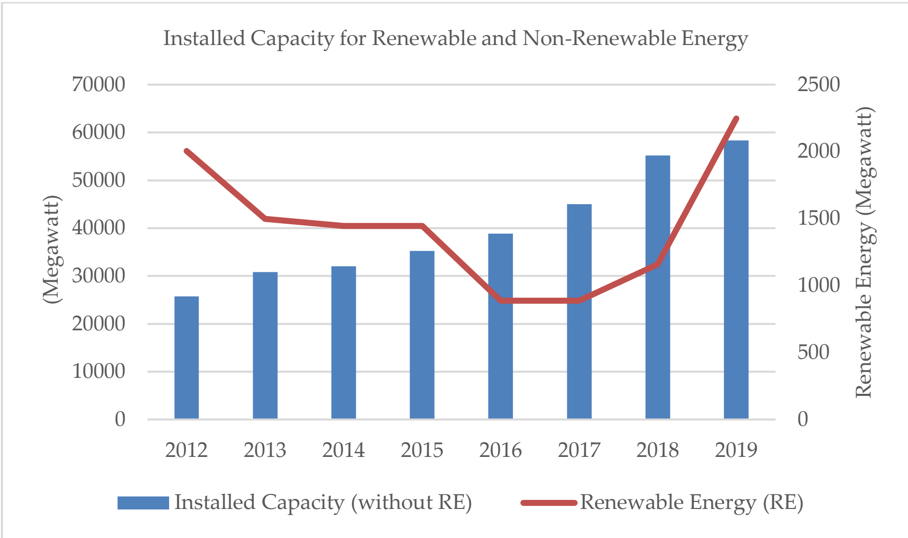


Figure (02-02) Electricity production from by energy source through a decade. The Figure shows the dramatic growth of the installed capacity; it has been doubled between 2012 and 2019. The renewable energy share is anticipated to cover 43% of the total production in 2035 (EEHC, 2019) (the author) based on official reports.

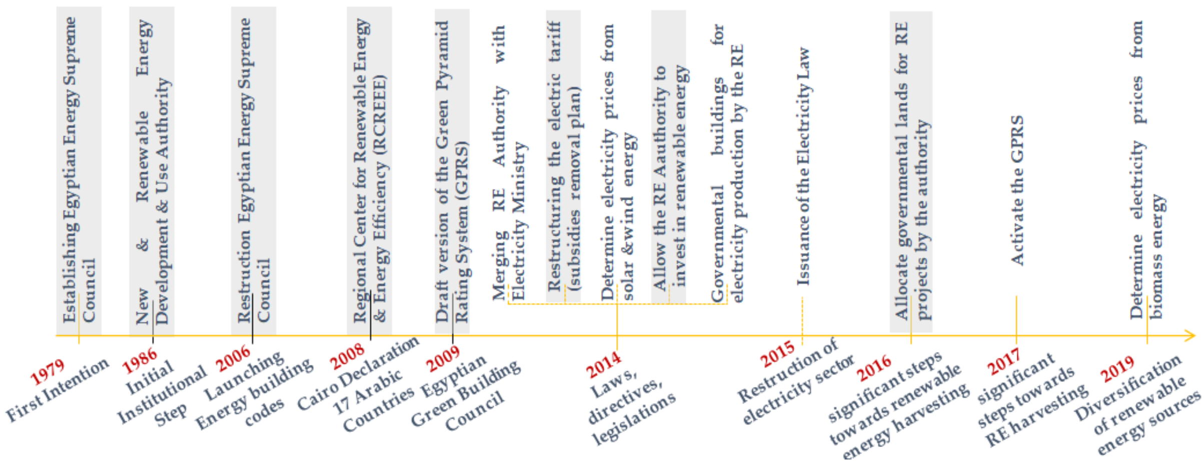


Figure (02-03) Milestones of the energy efficiency efforts in Egypt.

In the Arab League context, The Regional Center for Renewable Energy and Energy Efficiency (RCREEE) was established to enhance energy efficiency and renewable energy harvesting in Arab countries (RCREEE, 2021b). It provides many multi-disciplinary practices in Egypt, such as knowledge management projects (BUILD_ME) for zero-emissions buildings (BUILD_ME, 2021) and (COOL-ME) projects to lessen cooling demand (RCREEE, 2021a).

In a Mediterranean context, in collaboration with RCREEE, a recent project funded by the European Commission so-called The Mitigation Enabling Energy Transition in the Mediterranean region (meetMED) (meetMED, 2019) aims to accelerate the clean energy transition by involving stakeholders, locals, decision-makers and energy experts from 13 countries like New & Renewable Energy Authority of Egypt (NREA), and The National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) in Italy. The project launched the second phase in April 2021 towards low carbon economy transition and climate-resilient socioeconomic contexts (meetMED, 2021b). It is in line with the European Green Deal[1] , which set the ambitious goal to reach net-zero greenhouse gas emissions by 2050 (meetMED, 2021a).

2.1.2 Energy in Italy Top-Down Perspectives

In 1973 Egypt Israel war played a crucial war when King Faisal cut off oil supplies to the West. As a response, the international community has made extensive moves toward the energy issue, as well as Italy paid considerable efforts started from 1981 after approving the National Energy Plan (PEN) (Pierantoni & Bruzzi, 1981) that aimed to decrease the oil dependency, ensuring the low-cost industrial-economic growth. This coincided with the establishment of the public body, National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA), which developed over the past decades. It aimed (in 2015) to provide services, technological innovation, and research in the sector to the inhabitants, public and private segments in the environment, sustainable economic development, and energy sectors (ENEA, 2021a).

The building sector is the most important factor in the built environment. It plays an essential role in decreasing greenhouse gas emissions by 80-95 % by 2050 (European Commission, 2012), and it has the cost-effective potential to reduce emissions (European Commission, 2020c). Thus, EU directives shoved off towards energy efficiency -as well as buildings- started from Directive 2002/91/EC Energy Performance of Buildings Directive (EPBD) in 2002, developed by the in-force Directive 2010/31/EU (European Commission, 2010). It promotes existing buildings renovation that is classified based on the buildings' value and envelope area percentage, besides nearly Zero Energy Buildings (nZEB). Other technical terms energy-efficiency related in buildings are defined, such as deep renovation and cost-effective deep renovation.

The revised EPBD Directive 2018/844 aimed to decarbonize building stocks before 2050 - in line with the United Nations Framework Convention on Climate Change (COP 21) (European Commission, 2018b)- promoting achieving besides considering other factors such as well-being, healthy environment, innovation, and smart readiness (European Commission, 2018b) to support the modernization of all buildings with smart technologies (European Union, 2019). the current status of implementation of the EPBD in Italy was described by (Costanzo et al., 2018). The European Portal for Energy Efficiency in Buildings highlights these best practices across the EU (BUILD UP, 2021).

Back to the local context, although 75% of the existing EU's buildings are inefficient (European Commission, 2020c). The primary energy intensity in Italy is about 18% lower than the EU average (MISE, 2013), with the aim of the long-term renovation strategy to refurbish (0.7 and 2.9 %) of the residential and non-residential buildings annually (European Commission, 2020a).

[1] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en (Accesed 18-05-2021)

Aligned with EU directives (energy efficiency and renewable energy by 2030 EU and building stock decarbonization by 2050), the Italian Energy Efficiency Action Plans (EEAP) - since first published in 2007- founded a strategic plan of energy efficiency measures in all sectors, including buildings (European Commission, 2011). Tax relief benefits on energy-saving could be taken as an instance (European Commission, 2017) such as EcoBonus, which encourages refurbishment and renovation of the existing buildings with a deduction of up to 65% (MEF, 2016) which has been improved recently to reach 110% that encourages some interventions like the integrity with photovoltaic systems in buildings (MISE, 2021).

Recently, other strategies confirmed the critical role of energy efficiency practices, such as the National Energy Strategy (NES) in 2017 (ENEA, 2018), the integrated National Energy and Climate Plan (NECAP)[2] (Energia and Clima 2030) that was implemented by the main public bodies operating on energy and environmental issues (MISE, 2019a). MISE report (MISE, 2009) summarized the regional and national legalizations laws between 1980-2010 regarding energy-related duties and electricity production and transmission authorization procedures in the Italian regions. In the aftermath of the pandemic crisis, Italy's National Recovery and Resilience Plan (NRRP) was presented in line with Next Generation EU Plan (NGEU) (Gazzetta Ufficiale, 2021)

In the same realm, In the aftermath of the pandemic crisis, for instance, the government provides urgent measures related to the fund complementary to the National Recovery and Resilience Plan Decree-Law n. 59/ 2021 (Gazzetta Ufficiale, 2021), which supports the energy efficiency interventions by 3 million euros for the year2021, 7 million euros for the year 2022, and 10 million euros for each of the years from 2023 to 2026 (Gazzetta Ufficiale, 2021). Furthermore, other studies discussed the energy consumption patterns and development in the modern era of Italy quantitively (Malanima, 2006) and qualitatively (Felicetti, 2018). Figure (02-04) shows the milestones of Italy's energy efficiency national efforts

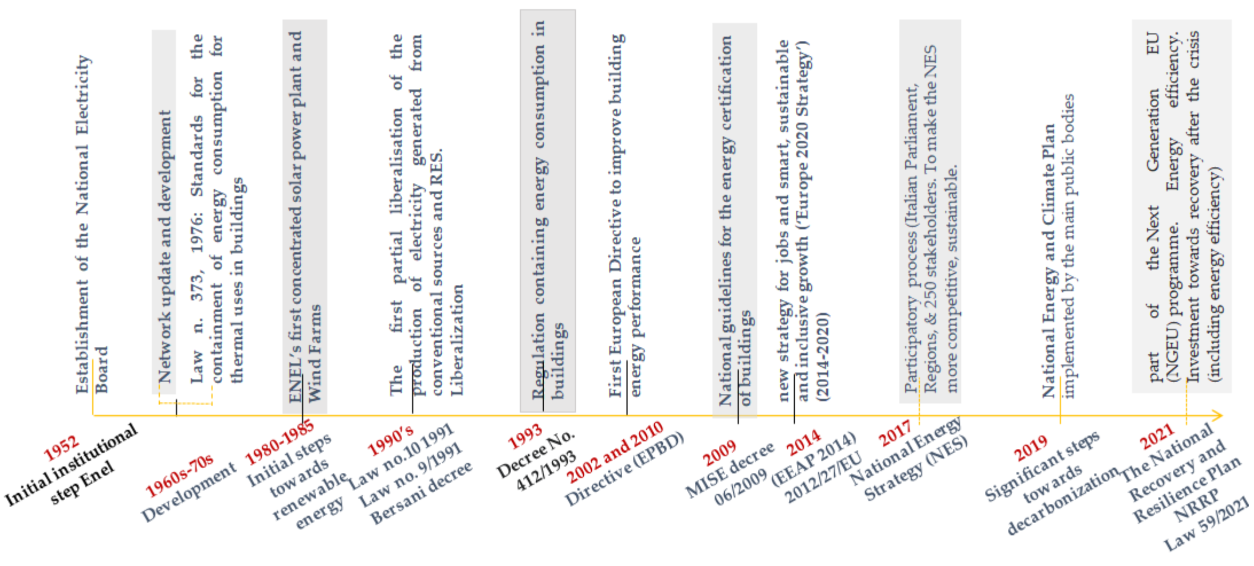


Figure (02-04) Some milestones of Italy's energy efficiency national efforts.

2.1.3 **Building Improvements Trends and Terms: at Glance**

Energy Retrofitting (ER) refers to adapting the latest technologies or features to obsolete systems (Shaikh et al., 2017; Asarpota & Nadin, 2020). Aminian (2018) defined the upgrading strategies of the existing buildings.

[2] Exmplainatory document that shows how to achiveve the 2030 by the Italian Government to the European Commission (Bianco & Marmori, 2022).

Retrofitting buildings are vital in built environment regeneration, such as improving the aesthetic qualities of buildings and property values.

In a new policy by the EC, Renovation Wave for Europe discussed comprehensive sustainable renovation interventions for smart buildings, integration with renewable energy, nature-based solutions, and technologies. As well as, buildings were planned in a decade to be "microcosms towards more resilient," their envelope will host smart and digitalized appliances and improve biodiversity, buildings will be a common experience complementing publicly accessible charging infrastructure. (European Commission, 2020b).

The emerging technologies (ET) can decrease one-half of the energy use in residential and commercial buildings, which can be integrated with building envelopes, building systems, lighting, and appliances (EERE, 2021). Moreover, ET is crucial to improving buildings' decarbonization, including IoT and software (DIGITALEUROPE, 2020). Besides the considered trends, directives, and legalizations that should be overlooked in the retrofitting practices, a systematic literature review will be conducted from the contrarywise perspective, as discussed in the next section.

2.2 The Systematic Literature Review

Reviewing the previous studies is an evidence-based practice. They have many techniques and different purposes. Systematic Literature Review (SLR) is one of them (Grant & Booth, 2009) (Jesson et al., 2011). It is a holistic search for the relevant scientific research on a particular topic, with structured methodologies (Cook et al., 1997) that is essential as a premise of different research types to provide guidelines, practices, policies, and knowledge development (Snyder, 2019). The implemented SLR was revised (Snyder, 2019; Muka et al., 2020). Examples of relevant traditional literature review studies (Paul & Criado, 2020; Hao et al., 2020).

2.3 Method

2.3.1 Research question validation and the Objectives

This SLR was carried out according to the PRISMA checklist (Page et al., 2021), the Preferred Reporting Items for Systematic Reviews, and Meta-Analyse, which emerged in 2009 (Liberati et al., 2009). It can be applied across various research domains. The study was employed to identify the chapter question relevance, search keywords that meet the objectives, the electronic databases, the research process, and the first round of articles selection, the following, articles assessment, extracting data, and the qualitative results synthesizing.

The review will be implemented into three major hierarchical stages. The first is at a micro-scale following a top-down approach that determines the national energy efficiency plans and measures in Egypt and Italy, in line with the global perspectives, with a particular reference to the buildings, as discussed in the introduction. Secondly, an initial systematic review was conducted to determine whether the same topic has been previously reviewed, using the relevant keywords that lead to comprehensive results. Thirdly, conducting a systematic literature review based on the developed protocol.

The main aim is: what are the considered aspects in carrying out the built environment retrofitting practices in the relevant contexts. The main objectives are to identify *i)* the stakeholders and their roles, responsibilities, influence, and interest? *ii)* What are the used approaches, tools, and methods? *iii)* What are the implemented technical solutions "best practices" relevant to the study's focus? *iv)* To what extent do these interventions valorize the traditional identity of a place. Figure (02-05) shows a visual summary of the hierarchy of the research method.

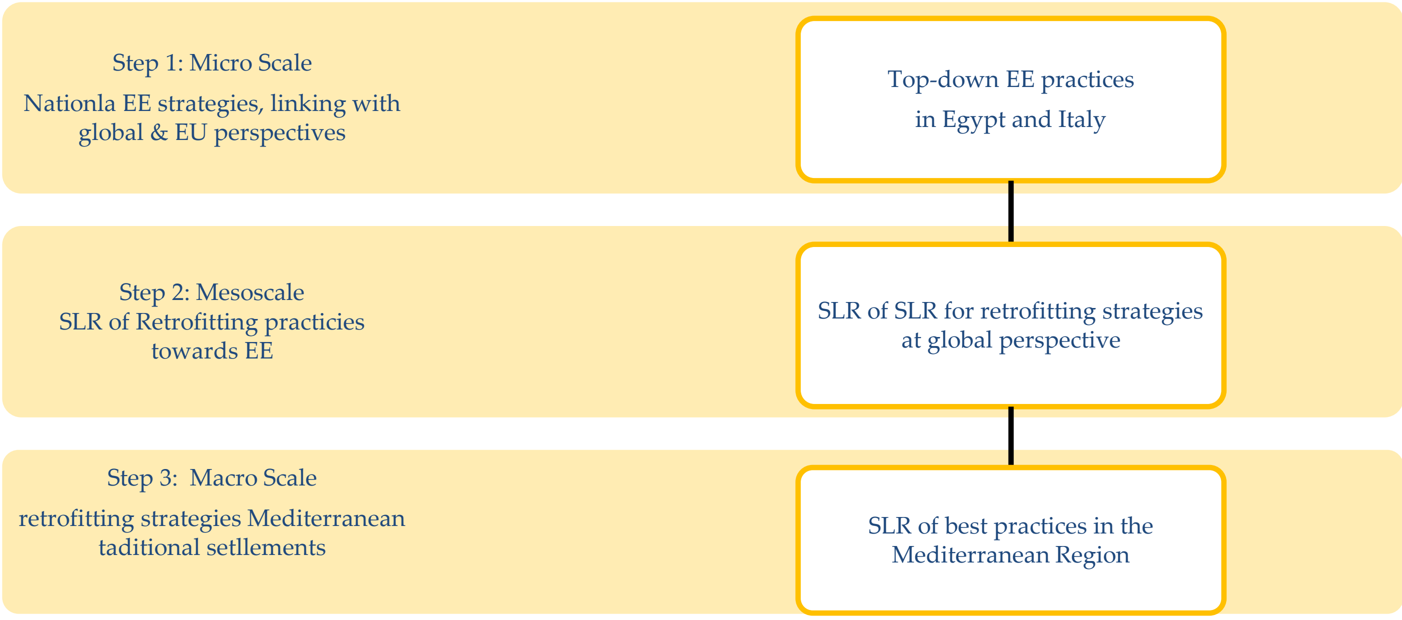


Figure (02-05) Visual summary of the hierarchy of the research method.

2.3.2 Systematic review of the systematic review (Muka et al., 2020)

In the first step, in Muka et al.'s 24-step guide for conducting SLR (Muka et al., 2020), an online search should be employed to determine whether the same topic has been reviewed previously, as well as it is a common technique in different research areas such as tourism (Pahlevan-Sharif et al., 2019). For this reason, an initial search was conducted on the Scopus database; the protocol followed the PRISMA checklist. All published articles and review articles in the English language between (2011-2022) were investigated.

The selected keywords include three categories covering the study domain firstly, "*Systematic Review*" and "*Systematic Literature Review*." The second term is "*Retrofitting*," and its synonym that the study argues cover different aspects between the built environment and buildings, namely "*Renovation,*" "*Refurbishment*," "*Renovation,*" "*Regeneration*," and "*Development*" the third group focuses on "*Energy Efficiency*" and "*Energy Saving*." Using a simple Boolean (AND and OR).

The study neglected the terms of the context "*Mediterranean*" and "*Traditional Settlements*" and the "*Built Environment*." At this same time, the "development" term was added in order to widen the results. The search is implemented on the title, abstract, and keywords, represented as (TITLE-ABS-KEY). The developed protocol was implemented in December 2021 as the following:

TITLE-ABS-KEY ((retrofitting OR renovation OR refurbishment OR regeneration OR development) AND ("systematic literature review" OR "systematic review") AND ("energy efficiency" OR "energy saving")) AND (LIMIT-TO (DOCTYPE , "re") OR LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2011)) AND (LIMIT-TO (LANGUAGE , "English"))

The search process identified 111 articles[3] exported to a (RIS) file available on Google Drive[4]. Next, the screening process of the title, keywords, and abstract was carried out using Rayyan online tool (https://www.rayyan.ai/) (RAYYAN, 2021), which accelerates the studies selection process and saves

[3] The reasrarch has been implemented twice first during May 2021
[4] https://drive.google.com/file/d/1x7zywurQqJTbWC96JDn4ZSVBdAGWKGLQ/view?usp=sharing (Accessed 01-06-2021)

screening time by 40% compared to similar ones (Ouzzani et al., 2016), as well as it leads a collaboration among the reviewers' team. The excluded article was 74 in this stage because "systematic review" was missed in the title, which should be mentioned clearly.

The research was implemented twice in May 2021during the writing of the chapter. The search was updated in December 2021 while writing the conclusion, To ensure that all the SLR studies have been investigated. The results indicated new 26 studies, 1 study in 2020, and 25 in 2021. These studies have been reviewed as well as the comparison can easily be monitored between Rayyan and WOS, as seen in Figure (02-06).

Figure (02-06) Auto classification by the Rayyan platform and WOS database. Thank the mining and classification techniques that facilitate implementing the evidence-based practices.

Secondly, the eligibility criteria assessed the remaining 37 articles were exported to a Google Sheet[5]. The primary bibliographic data have been shown. Each article has been coded with serial numbers (P_SLR_no.), downloaded, and read one by one. The full articles have been uploaded to Rayyn Review Platform. The results showed that some of these articles had reviewed energy efficiency practices from different perspectives apart from the research's domain. Table (02-04) summarizes the eligible articles.

Table (02-04) The possible systematic literature review of the systematic literature review studies

Sn.	*Year*	*Authors (no. and names), and Citation No. (from Google scholar)*			*Journal*	Title
01	*2019*	*3*	*Bartolini, M., Bottani, E., & Grosse, E. H.*	*45*	*Journal of Cleaner Production*	Green warehousing: Systematic literature review and bibliometric analysis
02	*2021*	*3*	*E Borri and G Zsembinszki and LF Cabeza*	*2*	*Applied Thermal Engineering*	Recent developments of thermal energy storage applications in the built environment: A bibliometric analysis and systematic review
03	*2018*	*4*	*Lopes, C., G and Vicente, R and Azenha, M and Ferreira, T M*	*5*	*Sustainable Cities and Society*	A systematic review of Prefabricated Enclosure Wall Panel Systems: Focus on technology driven for performance requirements
04	*2020*	*3*	*I Costa-Carrapiço, R Raslan & JN González*	*13*	*Energy and Buildings*	A systematic review of genetic algorithm-based multi-objective optimisation for building retrofitting strategies towards energy efficiency
05	*2020*	*4*	*TB Garlet, JLD Ribeiro, F de Souza Savian &JCM Siluk*	*1*	*Solar Energy*	Value chain in distributed generation of photovoltaic energy and factors for competitiveness: A systematic review
06	*2016*	*4*	*Haby, M M, Chapman, E, Clark, R & Galvão, Luiz A.C.*	*4*	*Revista Panamericana de Salud Pública*	Energy interventions that facilitate sustainable development and impact health: An overview of systematic reviews
07	*2015*	*4*	*Khan, R U, Khan, S U., Khan, R A & Ali, S*	*15*	*Proceedings of the Pakistan Academy of Sciences*	Motivators in green IT-outsourcing from vendor's perspective: A systematic literature review
08	*2021*	*6*	*Kim, H., Choi, H., Kang, H., An, J., Yeom, S., & Hong, T.*	*4*	*Renewable and Sustainable Energy Reviews*	A systematic review of the smart energy conservation system: From smart homes to sustainable smart cities
09	*2021*	*6*	*Lang, M., Lane, R., Zhao, K., Tham, S., Woolfe, K., & Raven, R.*	*0*	*Journal of Cleaner Production*	Systematic review: Landlords' willingness to retrofit energy efficiency improvements}

[5] The link is available at https://docs.google.com/spreadsheets/d/19AsM7-hp-LSSW4rweVCS-t0FtZWijn_KM6khjZIahj4/edit?usp=sharing (Accessed 01-06-2021). The file can be edited by the institutal email of Sapienza University.

10	*2020*	*5*	*Lin, Y., Zhong, S., Yang, W., Hao, X., & Li, C. Q.*	*3*	*Journal of Cleaner Production*	Towards zero-energy buildings in China: A systematic literature review
11	*2021*	*5*	*Mendoza-Pitti, L., Calderón-Gómez, H., Vargas-Lombardo, M., Gómez-Pulido, J. M., & Castillo-Sequera, J. L.*	*2*	*IEEE Access*	Towards a Service-Oriented Architecture for the Energy Efficiency of Buildings: A Systematic Review
12	*2020*	*3*	*Mintsis, E., Vlahogianni, E I., & Mitsakis, E*	*9*	*Journal of Transportation Engineering*	Dynamic Eco-Driving near Signalized Intersections: Systematic Review and Future Research Directions
13	*2020*	*3*	*Mohd Chachuli, F. S., Ahmad Ludin, N., Mat, S., & Sopian, K.*	*2*	*Journal of Renewable and Sustainable Energy*	Renewable energy performance evaluation studies using the data envelopment analysis (DEA): A systematic review
14	*2017*	*7*	*Moretti, M., Djomo, S. N., Azadi, H., May, K., De Vos, K., Van Passel, S., & Witters, N.*	*73*	*Renewable and Sustainable Energy Reviews*	A systematic review of environmental and economic impacts of smart grids
15	*2020*	*4*	*Osobajo, O. A., Oke, A., Omotayo, T., & Obi, L. I.*	*3*	*Smart and Sustainable Built Environment*	A systematic review of circular economy research in the construction industry
16	*2021*	*4*	*Pessoa, S., Guimarães, A. S., Lucas, S. S., & Simões, N.*	*0*	*Renewable and Sustainable Energy Reviews*	3D printing in the construction industry - A systematic review of the thermal performance in buildings
17	*2021*	*2*	*Quan, S. J., & Li, C.*	*0*	*Renewable and Sustainable Energy Reviews*	Urban form and building energy use: A systematic review of measures, mechanisms, and methodologies
18	*2020*	*4*	*Roman, N. D., Bre, F., Fachinotti, V. D., & Lamberts, R.*	*15*	*Energy and Buildings*	Application and characterization of metamodels based on artificial neural networks for building performance simulation: A systematic review
19	*2019*	*3*	*Sandin, S., Neij, L., & Mickwitz, P.*	*9*	*Energy, Sustainability and Society*	Transition governance for energy efficiency - Insights from a systematic review of Swedish policy evaluation practices
20	*2020*	*8*	*Sepasgozar, S., Karimi, R., Farahzadi, L., Moezzi, F., Shirowzhan, S., M Ebrahimzadeh, S., & Aye, L.*	*9*	*Applied Sciences*	A Systematic Content Review of Artificial Intelligence and the Internet of Things Applications in Smart Home
21	*2020*	*2*	*Sihag, N., & Sangwan, K. S.*	*13*	*Journal of Cleaner Production*	A systematic literature review on machine tool energy consumption
22	*2021*	*4*	*Siksnelyte-Butkiene, I., Streimikiene, D., Balezentis, T., & Skulskis, V.*	*0*	*Sustainability*	A Systematic Literature Review of Multi-Criteria Decision-Making Methods for Sustainable Selection of Insulation Materials in Buildings
23	*2018*	*4*	*Sovacool, B. K., Noel, L., Axsen, J., & Kempton, W.*	*89*	*Environmental Research Letters*	The neglected social dimensions to a vehicle-to-grid (V2G) transition: A critical and systematic review
24	*2015*	*3*	*Tanwar, S., Kumar, N., & Rodrigues, J. J.*	*133*	*Journal of Network and Computer Applications*	A systematic review on heterogeneous routing protocols for wireless sensor network
25	*2021*	*3*	*Tariq, S., Hu, Z., & Zayed, T.*	*2*	*Journal of Cleaner Production*	Micro-electromechanical systems-based technologies for leak detection and localization in water supply networks: A bibliometric and systematic review
26	*2018*	*5*	*Thomson, H., Craig, P., Hilton-Boon, M., Campbell, M., & Katikireddi1, S. V.*	*20*	*Systematic reviews*	Applying the ROBINS-I tool to natural experiments: An example from public health} - Systematic Reviews
27	*2019*	*1*	*Ulpiani, G.*	*19*	*Applied Energy*	Water mist spray for outdoor cooling: A systematic review of technologies, methods and impacts.
28	*2020*	*4*	*Vrchota, J., Pech, M., Rolínek, L., & Bednář, J.*	*11*	*Sustainability*	Sustainability outcomes of green processes in relation to industry 4.0 in manufacturing: Systematic review
29	*2020*	*3*	*Wuebben, D., Romero-Luis, J., & Gertrudix, M.*	*4*	*Sustainability*	Citizen science and citizen energy communities: A systematic review and potential alliances for SDGs
30	*2020*	*7*	*Zhang, W., Zhao, C., Cao, W., Sun, S., Hu, C., Liu, J.,&Zhao, Y.*	*3*	*Environmental Science and Pollution Research*	Removal of pollutants from biogas slurry and CO2 capture in biogas by microalgae-based technology: a systematic review
31	*2021*	*3*	*Šūmakaris, P., Korsakienė, R., & Ščeulovs, D.*	*0*	*Energies*	Determinants of Energy Efficient Innovation: A Systematic Literature Review
32	*2021*	*2*	*Ozarisoy,B. & Altan, H.*	*2*	*Energy and Buildings*	Systematic literature review of bioclimatic design elements: Theories, methodologies and cases in the South-eastern Mediterranean climate
33	*2021*	*4*	*Aguilar, J., Garces-Jimenez, A., R-Moreno, M.D. & García, R.*	*3*	*Renewable and Sustainable Energy Reviews*	A systematic literature review on the use of artificial intelligence in energy self-management in smart buildings
34	*2021*	*4*	*Pereira, V., Santos, J., Leite, F. & Escórcio, P.*	*1*	*Energy and Buildings*	Using BIM to improve building energy efficiency–A scientometric and systematic review
35	*2021*	*11*	*Kandeal, A.W., Algazzar, A.M., Elkadeem, M.R., Thakur, A.K., Abdelaziz, G.B., El-Said, E.M., Elsaid, A.M., An, M., Kandel, R., Fawzy, H.E. & Sharshir, S.W.*	*0*	*Solar Energy*	Nano-enhanced cooling techniques for photovoltaic panels: A systematic review and prospect recommendations
36		*11*	*Ranjha, M.M.A., Irfan, S., Lorenzo, J.M., Shafique, B., Kanwal, R., Pateiro, M.,*	*3*	*Processes*	Sonication, a potential technique for extraction of phytoconstituents: A systematic review

		Arshad, R.N., Wang, L., Nayik, G.A., Roobab, U. & Aadil, R.M.			
37	2	*Lee. K. & Jepson, W.*	13	*Desalination*	Environmental Impact of desalination: A systematic review of life cycle

To explain more why the articles were excluded, those who discussed a specific context, such as reviewing ZEB in China (P_SLR_10), or specific domain, such as networking and computer application (P_SLR_24), pollution control (P_SLR_30), water network infrastructure (P_SLR_25), desalination (P_SLR_37) and vehicle applications and driving models (P_SLR_12). Next, the topics related to energy policies and frameworks, such as the role of energy to accelerate sustainability and enhancing well-being (P_SLR_06). Socio-economic aspects have been reviewed: circular economy in the construction sector (P_SLR_15), dwellers' willingness to retrofit (P_SLR_09), and the contribution of the citizen science-energy community to SDGs (P_SLR_29).

At the built environment scale in urban contexts, Thermal Energy Storage (TES) applications are investigated in buildings, districts, and roads and bridges (P_SLR_02), besides emerging technologies for smart cities and buildings (P_SLR_08), and to achieve outdoor thermal comfort by utilizing water mist sprays. In terms of energy infrastructure improvement, smart grids are discussed in (P_SLR_14) and photovoltaic technologies (P_SLR_05).

At the scale of the buildings, Green warehousing micro-themes were reviewed (P_SLR_14), facilitate the decision-making of improving building envelope by insulation (P_SLR_22), in addition to the integration of innovation in buildings envelope to improve their performance (P_SLR_03, and 31), and energy emerging technologies in the energy management of buildings (P_SLR_33, 34 and 35) including the historical ones (P_SLR_11).

To conclude, no SLR studies reviewed the built environment retrofitting in the Mediterranean region's traditional (rural) settlements. Nevertheless, another observation, these SLR studies have been increasing notably in the recent two years, as seen in Figure (02-07), which indicates the essential need for these kinds of studies.

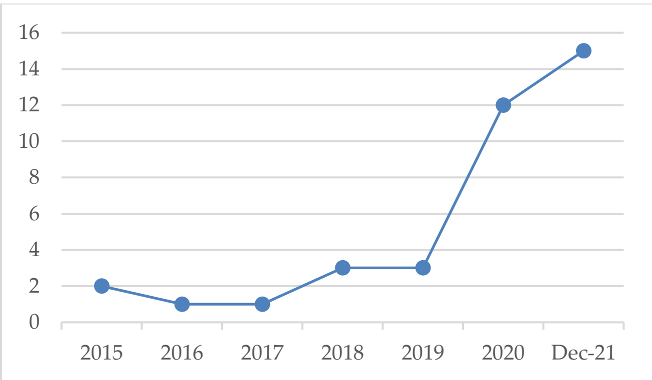


Figure (02-07) The amount of screened published articles by year.

2.3.3 The Systematic Review: Eligibility Criteria

In the second step, the SLR was conducted following the PRISMA checklist. As regard, a protocol has been developed. The study used the Rome Digital Library System of Sapienza University (SBS) powered by EBSCOhost (Sapienza University, 2021), which leads to searching different electronic sources simultaneously using the maximum number of keywords. The search selected peer-reviewed article journals, assuming that they are high-quality publications—otherwise, conference proceedings, book chapters, and MSc. and Ph.D.

thesis were excluded. Furthermore, they should be primary sources published in journals within a decade (between 2011 and 2022) in all available languages and electronic databases.

They have to address the specific problem and answer at least one research question. Moreover, they had to report energy efficiency improvement strategies or practices in the built environment (buildings or surrounded environment) in the Mediterranean region. Any study covering traditional, vernacular, rural, historical, and agriculture-based settlements was included, apart from those discussed in the cultural heritage contexts and buildings (listed buildings and protected areas), besides the tourism communities. The articles which undefined the contexts or provided general guidelines were included. In contrast, papers that evaluated policies were excluded. Table (02-05) summarizes the inclusion and exclusion criteria.

Table (02-05) The eligibility criteria of the conducted SLR

Aspect	Inclusion Criteria	Exclusion Criteria
Document Type	• Peer-reviewed journal articles; • Primary research.	• MSc, & Ph.D. Thesis; • Conference proceedings; • Book chapters and Grey literature.
Year Range	• Between (January 2011- January 2022)	• Before 2011 and after January 2022
Ultimate context and intimate context	• At least a Mediterranean country; • General European context; • Undefined context; • Rural, traditional and vernacular; • Farming or fishing societies.	• Not a Mediterranean context; • Historical centers or buildings; • Cultural heritage or listed context; • Touristic context; • Urban or suburban contexts.
Relevance to the objectives	• The articles address a specific problem and answer the research question/s.	• The article discusses a specific topic not relevant to the research questions.
Language	• All available languages.	
Research topic	• Retrofitting built environment; • Case studies and best practices; • Guidelines of strategies; • Top-down, bottom-up, and mixed.	• Review policies or energy efficiency programs; • Chemical or physical development of materials • Impact assessment of energy policies.

2.3.4 Search Strategy

The search was carried out twice in June 2021 and checked in January 2022 and through the SBS platform. All of the 15-available digital databases were searched: Scopus, IEEE Xplore Digital Library, Directory of Open Access Journals, Springer Nature Journals, Emerald Insight, Academic Search Index, Supplemental Index, Complementary Index, Business Source Complete, GreenFILE, EconLit, MEDLINE, Science Citation Index, MathSciNet, and Historical Abstracts. The study included all available languages data and databases.

In order to construct the search string, the research context's keywords were defined. They can be divided into five groups. The first is "retrofitting," based on the determined technical terms, such as "renovation" and "regeneration." The second keyword is "energy efficiency." As discussed in the background of this chapter in the global perspectives and EU directives, energy efficiency and climate change go hand in hand. Thus, they were included.

In terms of the context, the third is the Mediterranean, which includes all of the state members besides the Mediterranean climate. Fourthly, the "traditional" which are defined in the Introduction Chapter as "rural," "vernacular," and "historical." Besides "settlement," which could be (e.g., "society" or "community"). Finally, the built environment which divided into intangible and physical. Table (02-06) shows the keywords of the search string.

Table (02-06) Terms synonym and combination, using (AND and OR) simple Boolean

Research's Aspects	Keyword (AND boolean)	Associated Synonyms (OR boolean)
Intervention	Retrofitting	• Renovation, refurbishment, regeneration.
Why?	Energy Efficiency	• Energy-saving, climate change mitigation, climate change adaptation, and climate neutrality.
Where?	Mediterranean	• Mediterranean Region, Mediterranean Climate, and the 22 countries.
Which Scale?	Traditional Settlement	• Rural, vernacular, historical, society, community, village, and district
Activities?	Built Environment	• Buildings, dwellings, mobility, infrastructure, outdoor space, and economic activities.

The search query can be shown as follows:

(retrofit OR retrofitting OR refurbishment OR renovation OR regeneration**) AND (** "energy efficiency" OR "energy saving" OR "energy-efficien*" OR "climate change mitigation" OR "climate change adaptation" OR "climate mitigation" OR "climate adaptation" OR "climate neutrality"**) AND (** "built environment" OR dwelling* OR building* OR mobility OR transport* OR infrastructure OR farm* OR fish* OR agriculture* OR "urban void" OR "outdoor space" OR "public space" OR "in-between space"**) AND (** Mediterranean OR Egypt OR Italy OR Palestine OR Albania OR Algeria OR Bosnia OR Herzegovina OR "Bosnia-Herzegovina" OR "Bosnia and Herzegovina" OR Croatia OR Cyprus OR France OR Greece OR Lebanon OR Libya OR Malta OR Monaco OR Montenegro OR Morocco OR Slovenia OR Spain OR Syria OR Tunisia OR Turkey OR Israel **) AND (** rural OR traditional OR settlement* OR historical OR vernacular OR community OR communities OR society OR societies OR district OR village**)**

2.3.5 Results and Study Selections

The initial search process on SBS between January 2011 and December 2021 determined 651 studies (Academic Journals, EBooks, Conference Articles, Books, and Magazines). Once applying the Peer Review filter, the publications decreased to 235 (220 journal articles and 14 conference proceedings), then by the SBS auto-detection, a total number of 18 duplications. The outcome file in (.RIS) format is available in Google Drive[6] has been exported to Rayyan online platform to start the screening procedure of title, abstract, and keywords. Rayyan has detected two duplications and removed them, and 215 studies have remained. Figure (02-08) summarizes the number of publications on each database.

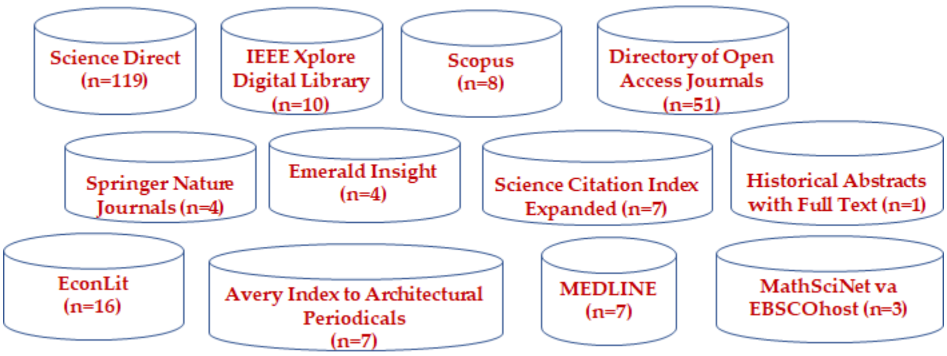


Figure (02-08) The amount of the publication on each database.

[6] https://drive.google.com/drive/folders/1cmfd3CU54Vu5dk7XMg-cygSDy_ACNp7L?usp=sharing (Accessed 08-01-2022)

After the initial screening process, the exclusion step is implemented as follows: reviewing the title, abstract, and keywords for particular (exclusion) terms. Figure (02-09) shows an example extracted from Rayyan. Figure (02-10) shows the relevant weight of the text mining of the uploaded papers.

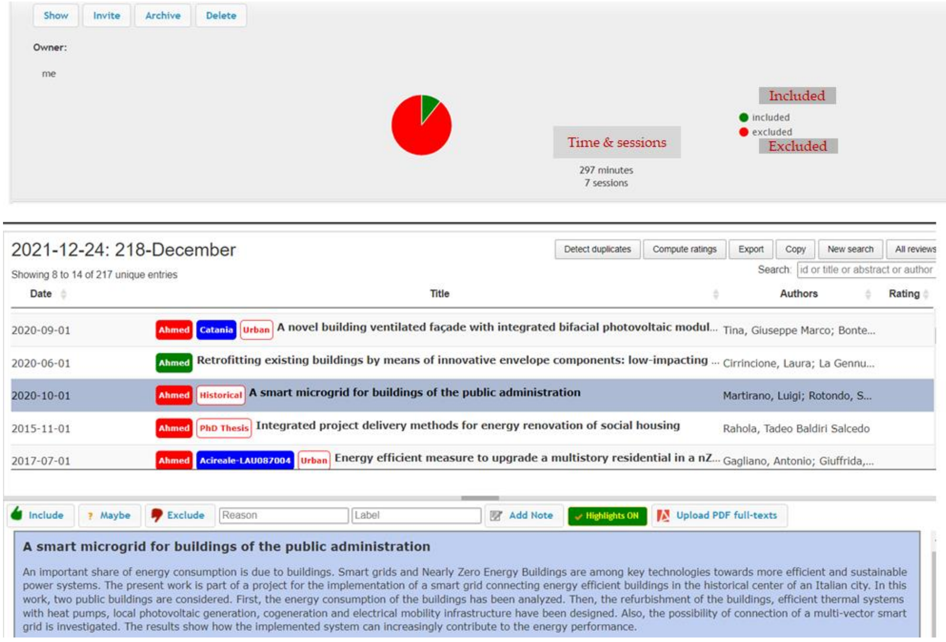


Figure (02-09) Screening process example, extracted from Rayyan. It allows reviewing each paper (title, abstract, keywords, publisher, and authors), adding notes and PDF files. The interface shows a summary of screening time and the number of sessions on the top. On the bottom, each paper can be labeled and decided to be included or excluded, or maybe.

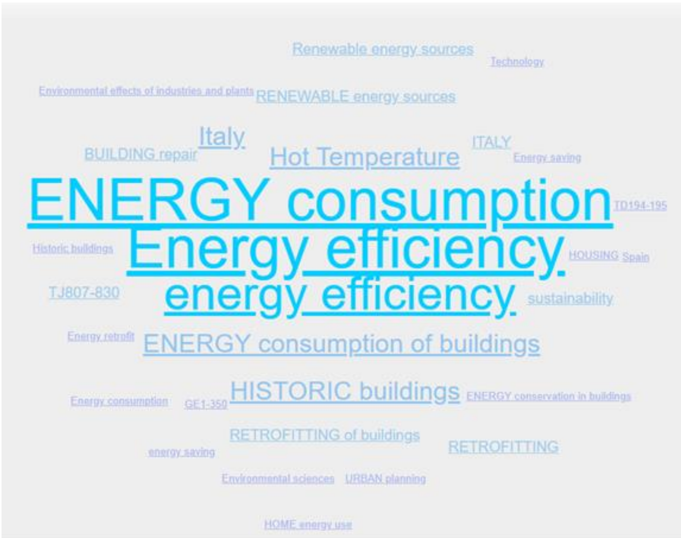


Figure (02-10) Text mining by Rayyan.

The criteria of exclusion paper, all the irrelative papers have been eliminated for many reasons, first the articles that investigated the historical buildings or cultural heritage papers. Second, those discussing the interventions in urban contexts, such as urban districts, neighborhoods, smart cities, and suburban areas. Third, the specific topics are not relative to the retrofitting and the non-Mediterranean context.

In case it is not possible to decide the eligibility criteria from the abstract, the remaining articles have been screened one by one, mainly the methodology, results, and conclusion, to ensure that papers meet the eligibility criteria, apart from some papers that were read carefully.

For instance, the abstract indicated a case study in Sicily, Italy (in general rural), so the paper itself screened, and the case study was Vittoria town. Then, a search on the Degree of Urbanisation classification in Europe (European Commission, 2021) has been implemented, which is coded Vittoria as (Towns and Suburbs), which means it does not belong to the study focus. Figure (02-11) shows a visual example of investigating the case study.

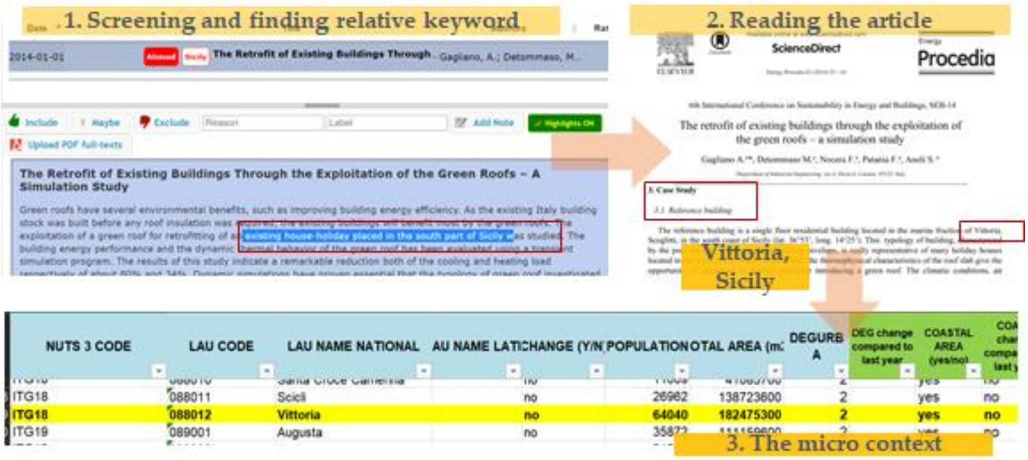


Figure (02-11) Example of exclusion criteria of a paper.

Likewise, in the study (Cavallo & Visentin, 2021), Island Poveglia, Veneto Region indicated as (Rural settlement). By applying another search, it was found on an abandoned Island. Finally, many papers have discussed unrelated topics such as fuel poverty in the EU (Charlier & Legendre, 2021) the shipping industry (Allal et al., 2018). Figure (02-12) shows the PRISMA flowchart of the selection process.

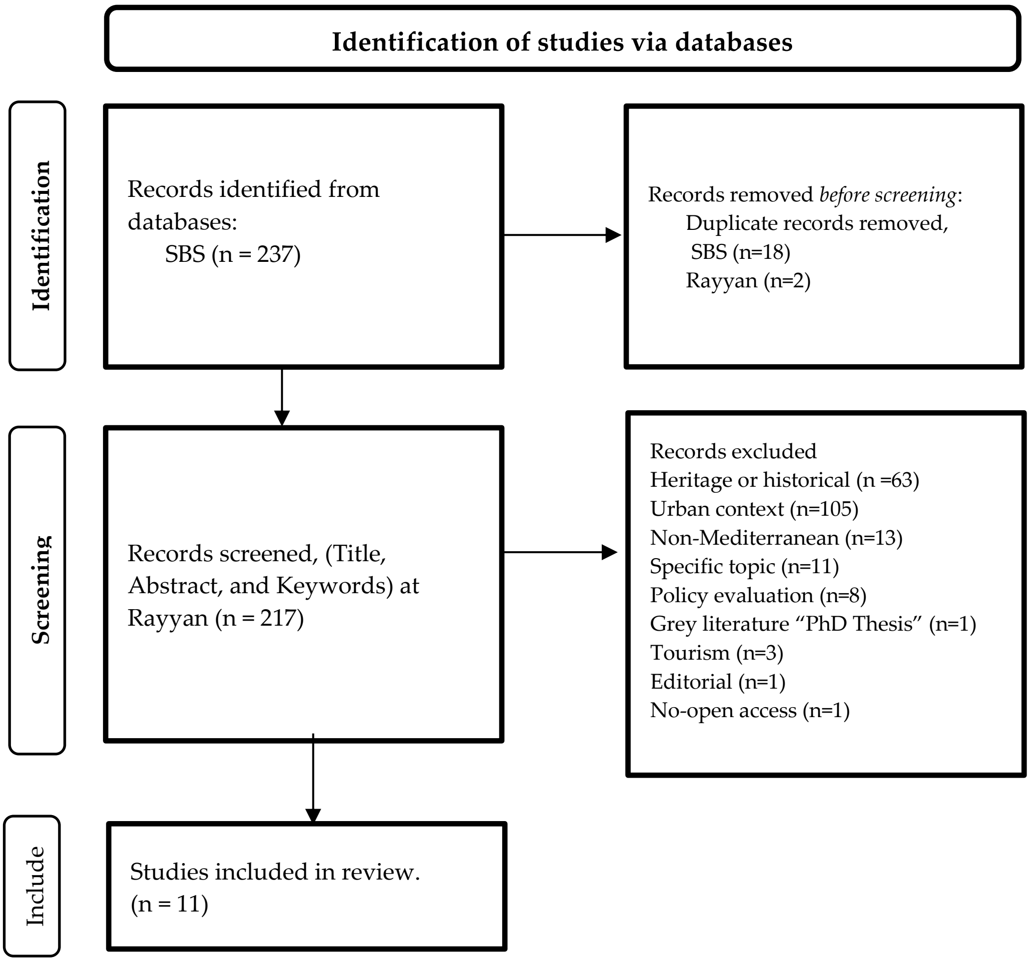


Figure (02-12) the PRISMA flow diagram of the selection of the articles

2.3.6 Data Extraction

In line with the objectives, the extracted data are divided as follows:

- The bibliographical data;
- Geographical location, context, and scale;
- Study type, method, tools, and findings (from the articles);
- Technical terms; keywords, and approaches;
- Answeres of the research question and sub-questions;
- General comments by the Author.

The included papers were exported to a Google Sheet; available at: https://docs.google.com/spreadsheets/d/1JmFQ4m_ARii_i_RCe85JhnBnNX0MUvVLJd6P6GDKTi0/edit?usp=sharing The file can be accessed and edited by Sapienza Universit. Table (02-07) shows the 11 included articles resulting from the SLR.

Table (02-07) The included systematic literature review studies and the rationale behind the selection.

ID	*Year*	*Authors (no. and names), and Citation No. (from Google scholar)*			*Journal*	Title	Rational behind inclusion (brief)
01	*2021*	*1*	(Abouaiana, 2021)	*0*	*Environmental and Climate Technologies*	Retrofitting Rural Dwellings in Delta Region to Enhance Climate Change Mitigation in Egypt	Retrofitting practice in Lasiafar Albalad Village
02	*2021*	*5*	(Mejías et al., 2021)	*0*	*Energies*	Energy Savings after Comprehensive Renovations of the Building: A Case Study in the United Kingdom and Italy	Discussing a
03	*2021*	*3*	(Hasgül et al., 2021)	*0*	*Journal of Cultural Heritage Management and Sustainable Development*	Vernacular rural heritage in Turkey: an intuitional overview for a new living experience.	Employing traditional retrofitting techniques inspired by rural architecture to valorize the place and regenerate the built environment
04	*2019*	*3*	(Hegazy et al., 2019)	*0*	*Journal of Urban Regeneration & Renewal*	Effect of building forms on energy consumption in coastal rural communities in Egypt	Retrofitting solutions by changing the dwelling form, typology, and position in the Delta region in Egypt
05	*2018*	*3*	(Mutani et al., 2018)	*6*	*Heliyon*	Improving energy sustainability for public buildings in Italian mountain communities.	Integrating using local resources (agro-waste) with active means as retrofitting sultions in TS in Italy.
06	*2018*	*7*	(Rocchi et al., 2018)	*23*	*Energy & Buildings*	Sustainability evaluation of retrofitting solutions for rural buildings through life cycle approach and multi-criteria analysis.	Natural materials inspired by vernacular architecture as retrofitting solution to valorize and improve energy performance
07	*2017*	*3*	(Cristina et al., 2017)	*7*	*Energy Procedia*	Evaluation of refurbishment alternatives for an Italian vernacular building considering architectural heritage, energy efficiency and costs	Retrofitting solution to improve energy performance and to re-use the building
08	*2016*	*4*	(Principi et al., 2016)	*29*	*Energy & Buildings*	Evaluation of energy conservation opportunities through Energy Performance Contracting: A case study in Italy.	Passive retrofitting solution within a European project in TS
09	*2015*	*3*	(Bolliger et al., 2015)	*8*	*Energy Procedia*	Finding the Balance between Energy Efficiency Measures and Renewable Energy Measures in Building Renovation: An Assessment Based on Generic Calculations in 8 European Countries	Assessment tool to support retrofitting decision-making at national level in Italy
10	*2015*	*5*	(Stazi et al., 2015)	*59*	*Energy & Buildings*	The effect of high thermal insulation on high thermal mass: Is the dynamic behaviour of traditional envelopes in Mediterranean climates still possible?	Retrofiting the Italian rural dwellings of the 1900s
11	*2015*	*2*	(Pisello & Cotana, 2015)	*5*	*Procedia Engineering*	Thermal-energy and Environmental Impact of	Passive retrofitting in the agriculture-based

The table indicated that the Italian academic affiliations predominated by 59%, followed by five countries by 8% for each study. As a result, 59% of the case studies were implemented in Italy (9 traditional settlements in different regions), followed by two case studies in two traditional settlements in the Delta region in Egypt, and a traditional settlement in Tukey, finally, generic contexts in Italy, UK, and Europe. They were implemented between 2015 and 2021. Figures (02-13) and (02-14) highlight the characteristics of the articles.

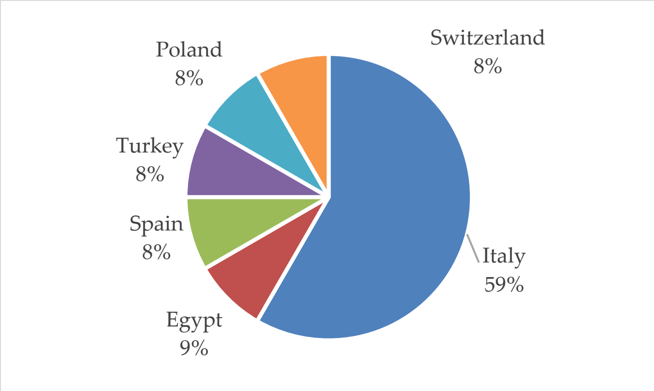


Figure (02-13) The authors' affiliation by country.

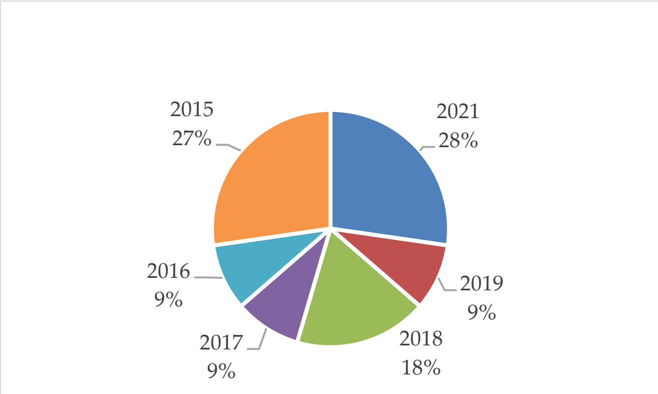


Figure (02-14) Included articles distribution by year.

2.3.7 Limitations

The systematic literature review resulted from 11 peer-reviewed papers (5% of the total articles). This occurred because of the rigid restriction of the inclusion criteria, which searched a combination of 63 keywords within four domains between January 2011 and December 2021. Besides the exclusion criteria, which reject, for instance, 49% of the papers discussed numerous techniques in the urban contexts, and 29% of the articles discussed the historical and cultural heritage domains.

The majority of the included studies aimed to quantify the energy-saving in buildings by proposing retrofit solutions on the envelope or integrating renewable energy, 64% of them were implemented from a multi-disciplinary approach predominated by the architecture and building engineering domains (technical or environmental) with another domain (economic) but without significant contribution. Table (02-08) diagnoses the included articles.

Table (02-08) The characteristics of the included articles.

	ID01	ID02	ID03	ID04	ID05	ID06	ID07	ID08	ID09	ID10	ID11
Scale											
Building	x	x			x	x	x	x	x		
Multi-building			x							x	x
District				x							
Approach											
Small-Dimension Economy:											
Farming	x										
Fisheries				x	x	x	x				x
Forestry			x		x						
Valorize place identity	x		x		x	x	x				x
Retrofitting stage											
Pre-	x	x	x	x	x	x	x	x	x	x	x
Post-		x								x	
Retrofitting solution											
Passive	x	x	x	x	x	x	x	x	x	x	
Active					x			x	x		
Approach											
Bottom-Up	x			x	x	x	x		x	x	x
Top-Down											
Mixed		x	x					x			
Type											
Quantitative	x	x	x	x	x	x	x	x		x	x
Qualitative									x		
Method											
Multi-objective optimization	x					x	x	x			x
Multi-criteria discision			x			x					
Field study	x	x	x	x	x		x	x	x	x	
Theoretical		x	x						x		
Analytical			x		x	x					x
Inductive	x	x	x	x	x	x	x	x	x	x	
Conductive											
Comparative Analysis									x		
Tools											
Simulation	x			x	x	x	x	x		x	x
Workshop			x								
monitoring		x	x					x		x	
Assessment tool									x		
Cross-disciplinarity											
Mono-				x							
Multi-	x	x			x		x		x	x	x
Inter-						x					
Trans-			x					x			
Stakeholders											
Researchers	x	x	x	x	x	x	x	x	x	x	x
Local community	x	x	x					x			
EU Project		x									
Local authority			x		x			x			
Expert						x		x		x	
Academic bodies			x								
NGO								x			

2.3.8 Results Synthesis

The systematic literature review aims to discover the implemented practices in the built environment retrofitting practices in the traditional settlements in the Mediterranean country using a combination of 63 keywords from four themes. To investigate what are the carried out intervention, the studies *i)* the stakeholders and their roles, responsibilities, influence, and interest? *ii)* What are the used approaches, tools, and methods? *iii) iv)* To what extent do these interventions valorize the traditional identity of the place.

In Egypt, The highest relevant study was provided by the Author (Abouaiana, 2021). He provided a techno-economic optimization of retrofitting a typical dwelling in a traditional settlement in the Delta region. By applying the pervasive construction and insulation materials using simulation and modeling. He proved the potential of reducing one-third of the electricity consumption. However, the economic analysis demonstrated that these interventions are not feasible until 17 years after retrofitting the building. At the same time, he investigated the social acceptance of the results in Lasiafar Albald village (Chapter One). The majority were reluctant to retrofit their dwellings due to the high initial cost. The study highlighted the role of the prevailing traditional wooden window with a window to wall ratio (WWR) of 10% in improving energy performance compared to the highest WWR.

Thus the Author argues it could be a foundation base as a renovation solution that can preserve the traditional identity and boost the local economy. Figure (02-15) shows the manufacturing of the traditional fenestrations "*Sheesh*."

Figure (02-15) A local industry in Kafr Alsodan traditional settlement, Kafr Elsheikh Governorate (the Author).

Another study provided by Hegazy et al. (Hegazy et al., 2019) aims to help architects and urban planners to forecast the outcomes of their design decision for the rural dwellings in the fisheries-based traditional settlement in the Delta region. Their monodisciplinary intervention investigated the role of different alternatives of the dwellings' position, area, and height on energy-saving using simulation tools. They concluded that attached buildings with small areas had consumed more electricity than semidetached and detached houses with large areas. Traditional identity preservation is not explicit.

Nevertheless, as concluded in Chapter One, the attached dwelling typology represents a major pattern in the rural settlements in the Delta region, and from the on-site investigation, the study indicated a low consumption of the rural dwellings (21 kWh/m^2/annually). Therefore, although both studies are within the same intimate contexts, the author argues they were limited to the theoretical approaches that can support the early design decision-making rather than providing a real retrofitting solution that can benefit the locals. Mainly, as concluded in (Chapter Four), the engaged experts in the initial workshop in Lasiafar Albalad have raised many questions about the on-ground applications. However, Abouiana's results can be a strong foundation point to deepen the study.

In Italy, five studies discussed the retrofitting solutions in traditional settlements. Cristina et al. (Cristina et al., 2017) have provided a quantitative study to retrofit a private rural building in a rural settlement in the Piedmont region to improve energy performance and enhance economic revenue (the building will be re-used to lodge) and valorize the traditional identity. The building was constructed from the traditional brick structure. They used simulation tools to optimize different solutions from an economic perspective. The stakeholders were the research team who led the process. They showed the importance of using local materials as a passive strategy to renovate the building and considering the local building regulations (Energy and Ambient Agency of Turin, Environmental Energy Annex) to achieve the thermal transmitting target.

The second case provided by Rocchi et al. (Rocchi et al., 2018). They developed a multi-methodological approach using simulation tools consisting of techno-economic and decision-making tools to a passive retrofitting solution on the building. The results optimized the energy efficiency and thermal comfort optimization with the environmental and economic life cycle analysis. The stakeholders were the research team who led the intervention, with the external experts providing preference information related to the technical intervention.

The third case was implanted by Mutani et al. (Mutani et al., 2018). In five typical traditional mountain settlements (farming-based and forestry-based societies) in Piedmont regions in Italy. They applied to five non-residential buildings. Inspired by the context, they integrated the biomass from the agriculture waste with solar energy systems to provide a techno-economic optimization of the operation energy consumption using modeling and simulation integrated with GIS. The study enhanced the Energy Community concept by following the law and legalizations integrated the available renewable energy to meet heating demand. The study engaged the decision-makers who provided the law consultancy, namely the Interministerial Decree of 26 June 2015 (Application of the methodologies for calculating energy performance and defining the prescriptions and minimum requirements for buildings).

The fourth study was provided by Principi et al. (Principi et al., 2016). They created new business models for energy efficiency intervention in the public sector within a European project called MARTE to mobilize financing to achieve energy efficiency in healthcare buildings. They suggested passive solutions, namely, fenestration renovation and integrating external thermal insulation composite system ETICS to the building envelope, utilizing the on-site measurements, modeling, and simulation. The engaged stakeholders consist of the experts (energy auditors), owners who will benefit from the retrofitting, NGOs providing simulation tools energy models to define the benchmarks, and the Marche municipality supporting the initiatives and facilitating the sustainability practices. The importance of reviewing the national standards and measurements has been highlighted.

Finally, Stazi et al. (Stazi et al., 2015) integrated the experimental activities and analytical simulations during their investigation of the 1900s dwellings (nature-based structure) in a rural settlement In central Italy. They assessed five schemes to insulate different opaque elements of the buildings (wall, roof, and ground) with and without a ventilation layer. They highlighted that the insulation layer from the internal wall side was the worst quantified energy-saving solution. However, it is maintained easier than the external side. Their findings supported the expert's questions (described in the previous part).

In Turkey, Hasgül et al. (Hasgül et al., 2021) have discussed mountainous rural vernacular communities. They intended to valorize the local identity by employing the traditional architecture in the new spatial needs, considering the role of the rural areas from the perspective of leisure and entertainment. For this reason, they provided a transdisciplinary approach between the local authority, the academic bodies (the architectural department students) to facilitate the technical intervention (spatial analysis), the North Anatolian Development Agency (who are responsible for providing the related guidelines), the local people.

The implemented approach is similar to the study of Mutani et al. in the mountain traditional Italian settlement, apart from students participating and the clear intention to valorize the cultural identity. It is a common approach in retrofitting the too small-dimension economy settlements pattern. From the fact of the link between the cultural heritage and the historical realms on the one hand and the rural context on the other, it indicates the importance of engaging these stakeholders. As well as, the author argues it is the easiest part to elaborate on: the more specific context provides more restricted guidelines, such as discussed by Battisti (Battisti, 2016).

Hence, as emerged from this discussion, the question to be asked is who are the right stakeholders and what are the academic capabilities and qualifications of the research team to lead the retrofitting process? So that the compass of this chapter does not deviate from the SLR rigid procedure, Chapter Three will discuss these approaches from the literature review.

In a general Mediterranean rural context, Mejías et al. (Mejías et al., 2021) aimed to quantify energy savings based on the national measurement and verification standard (technical interventions). They considered other factors in the practices, real-time measurement, and monitoring, which can be considered the first on-ground practices rather than the simulation tools. Moreover, they intended to assess the residents' electrical consumption awareness. This methodology proved that the building sector's energy consumption in Italy could be reduced by 38% (the estimated percentage was 67%). The project was implemented within the European project https://dreeam.eu/about/.

By linking this intervention with the same kind such as Principi et al. practices within the MARTE transdisciplinary project (Colangelo, 2018), a vital fact has emerged, namely the high support by Scientific incubators and academic bodies such as the European Commission internationally and the Ministry of Higher Education and Scientific Research in Egypt locally, the high success of a project to solve (again on-ground) real-world problems.

Bolliger et al. (Bolliger et al., 2015) have provided standard calculations to examine the trade-offs and interactions between energy efficiency and renewable energy measures, using INSPIRE Assessment tool (European Commission, n.d.) to support retrofitting decision-making. They concluded that renewable energies might achieve environmental goals more cost-efficiently in building refurbishment.

Therefore, by focusing on the national initiatives in Egypt and Italy (as representatives of Mediterranean countries, the integration of the on-site investigation in Egypt characterized the low energy consumption of the dwellings at the small scale (input one). The indicated concept of energy community resulted from the SLR (input two), as discussed by Mutani et al. The chapter concludes that the energy community concept can represent the trend of retrofitting the traditional settlements in the built environment. Remarkably, the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA)[7], as a national initiative in the representative Mediterranean country (input three), presented in April 2021 the energy community approach as described in the guideline The Energy Community "*La comunità energetica.*" (Cappellaro et al., 2021).

2.3.8.1 Energy Communities: at Glance

The guideline has defined the energy community as the self-consumption of energy as a coalition of users who, through voluntary membership of a legal entity, collaborate to produce, consume, and manage energy through one or more local energy plants. Each community has its specific characteristics, but they all share the same goal: to self-produce and provide affordable renewable energy to its members. The principles on which an energy community is founded are the decentralization and localization of energy production. Through the

[7] In collaboration with the the University of Bologna and the Agency for Energy and Sustainable Development of Modena (AESS).

involvement of citizens, businesses, businesses, and other realities of the territory, it is possible to produce, consume and exchange energy with a view to self-consumption and collaboration.

To make an energy community: the self-consumption of energy can be achieved at three levels, individual, collective, and community. First, the citizen self-consumption that has a renewable energy production plant and self-consumes the self-produced energy. The system efficiency, combined with the conscious use of the energy produced and the reduction of waste, contributes to energy savings, bringing environmental as well as economic benefits. Second, collective self-consumption is made up of a plurality of consumers located within a building in which one or more plants are powered exclusively by renewable sources.

Third, in the energy community, participants must produce energy for their consumption with plants powered by renewable sources. To share the energy produced, users can use existing distribution networks and use forms of virtual self-consumption. Energy communities' self-consumption has two types. Renewable Energy Community (CER), in line with DIRECTIVE (EU) 2018/2001 (European Commission, 2018a), is based on the notion of autonomy among the members and the need for them to be close to the generation plants. In addition to Citizen Energy Community (CEC), in line with DIRECTIVE (EU) 2019/944 (European Commission, 2019), manages the electricity (it does not provide for the principles of autonomy and proximity). Figure (02-16) visualizes the concept of the three levels.

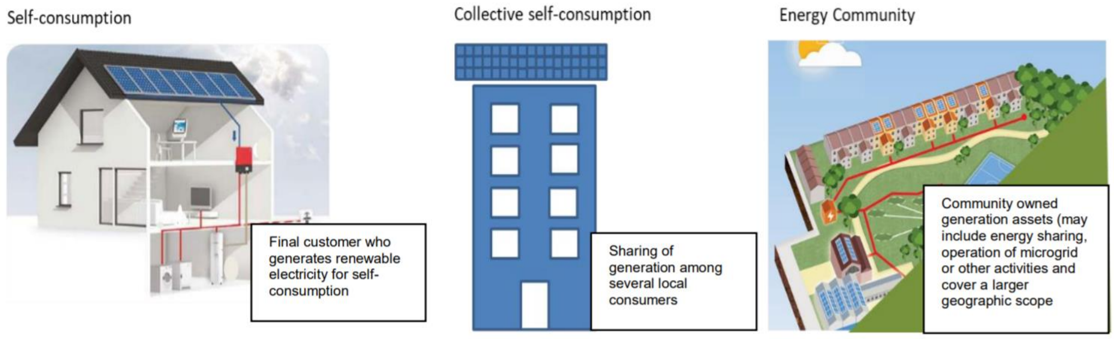


Figure (02-16) Visual summary of self-consumption, collective self-consumption, and energy community concepts, adapted from (CEER, 2019). Thus, in general, energy communities can enhance sustainable living by using and intelligently managing the available resources and sharing them, which improves sociality.

Many technologies support an energy community that facilitates consumption monitoring and helps community users save and consume energy more efficiently and intelligently, such as energy storage technologies for managing and storing energy from renewable sources. In addition, emerging technologies (sensors, internet of things, and cloud computing) enable monitoring and remote homes (smart homes). Figure (02-17) visualizes the monitoring cycle.

Figure (02-17) A visual summary elaborates on emerging technologies' role in monitoring and remote energy consumption, adapted from (Cappellaro et al., 2021). The energy box makes a home smart by communicating with the sensors to collect data and transmit them through the internet to a cloud platform. These big data are analyzed to provide the user with suggestions for optimizing his consumption. The EU commission highlit the crucial role of emerging technologies in transforming the whole building value chain, including energy performance(DIGITALEUROPE, 2020).

The energy communities can provide numerous benefits. First, the economic benefits include saving on the monthly electricity bills, financial earnings on the energy produced from renewable resources, and tax concessions and deductions like EcoBonus 110%[8] (Section 2.1.2). Second, the environmental benefits include reducing CO2 emissions, mitigating climate change, and finally mitigating energy poverty.

According to the guide entitled "Community Energy A practical guide to reclaiming power" (Giovannini, 2020), Some essential questions that led to selecting the optimal technical solution can be grouped as the availability of natural resources. Second, What is the technology that has the highest return on investment and gets support from the local authorities. Third, To what extent can the local network sell the generated power.

In Europe, energy communities practices are growing steadily, particularly in the European realm. For instance, Heeten rural settlement in the Netherlands is an energy community consisting of 47 families. Their main objective was to decrease the peaks and stress on the local distribution network. All households offer to log on to the smart meter information and produce energy from the PV to understand the local energy streams better. Some households have rooftop photovoltaic (PV) installations, and some are equipped with a 5 kWh battery behind the meter (Reijnders et al., 2020). Figure (02-18) shows an example of energy production from renewable energy in Europe.

[8] It is a deduction equal to 110% of the expenses related to specific energy efficiency measures and anti-seismic measures on buildings, by implementing at least one of the main interventions, such as thermal insulation interventions of opaque surfaces (the building envelope), with an incidence greater than 25% of the gross dispersing surface, interventions on the common parts of buildings for the replacement of existing winter air conditioning systems or through the replacement of autonomous heating systems with high-efficiency heat pumps, besides installing photovoltaic systems, up to 20 kWh and for a total cost of € 48,000.

Figure (02-18) An aerial view of wind turbines in suburban areas, Vienna, Austria (taken by the Author).

In the Mediterranean context, In France, The “Fermes de Figeac” cooperative has created “Ségala Agriculture et Energie Solaire” SAS to develop photovoltaics on the roofs of livestock buildings in its territory. The values of solidarity, cooperation, and pooling, were implemented among 110 farmers between 2009 and 2010[9]. The initiative to install solar roofs on farm buildings was initiated mainly as a reaction to the high feed-in-tariff in France, which aimed to Revitalize the rural area where agricultural activities are on the decline and Guarantee regular income for regular income farmers. (SAS, 2010).

In Spain, Som Energia is a citizen energy co-operative initiative to construct renewable energy projects and supply renewable energy (solar PV, biogas, hydropower). The members are fully responsible for the funding and the decision-making. Figure (02-19) shows some citizen cooperation within the Som Energia. In Portugal, a local community of 16 citizens started in 2013 to invest in a small solar panel, so-called Coopernico (Coopernico, 2021), by renting the roofs of socially-orientated buildings for its PV projects. It generated all of the electricity from renewable energy sources, which boosts the local economy and enhances social values.

Figure (02-19) Citizen cooperative approach to buy and install rooftop solar panels in the Som Energia energy community project, Spain, adapted from (IRENA Coalition for Action, 2021)

In Italy, a recent reference entitled “Community Energy Map: a survey of the first experiences of renewable energy communities” (Vidovich et al., 2021) has discussed in detail the growing energy community concept

[9] 6.9 MWp of photovoltaic roofs.

in Italy. It divided the energy communities into three models: public lead, pluralistic, and community energy builder. Table (02-09) summarizes the analytical clustering of energy community models.

Table (02-09) Analytical clustering of Energy Community models, adapted from (Vidovich et al., 2021).

	Public Lead Model (Cluster 1)	Pluralist Model (Cluster 2)	community energy builders Model (Cluster 3)
Type of community and stakeholders	Local public-private proposers (vital role of the public actor)	Application of horizontal community models.	Virtual intermediation between local projects and individual consumers.
Benefits generated	Public-private mix for the creation of collective and local benefits	Citizens, members, and prosumers; Coalitions of local actors.	Alternative energy consumption models; Action on savings for consumers.
Engagement and participation processes	Top-down processes	Bottom-up processes.	Heterogeneity of approaches between top-down and bottom-up.
Selected best practices	CommOn Light (Comune di Ferla, 2021); Energy City Hall (Magliano Alpi, 2021)	Energy and solidarity community of East Naples (Fondazione Con il Sud, 2021); Alpine energy community of Tirano (LEGAMBIENTE, 2021a).	Enel X, (ENEL, 2021); Renewable Energy Community of Biccari (LEGAMBIENTE, 2021b)

In this line, ENEA has developed the RECON online tool (RECON, 2021), which implements a rudimental energetic and economic analysis in the residential sector. Based on "basic data of electricity consumption, plants characteristics, and some factors related to the investment" (ENEA, 2021b). It is worth mentioning that, in case of insufficient data, like consumption data, by the nature of the traditional settlements -as indicated in the SWOT analysis in the Introductory Chapter, the RECON simulator can predict them based on ad-hoc algorithms. Furthermore, this tool describes "*energy communities for the ecological shift and to contrast climate change, empowering inhabitants to interact with the energy market as "prosumers," i.e., people who produce and consume their own renewable energy*." (ENEA, 2021c). Figure (02-20) visualizes the consumer and prosumer concepts.

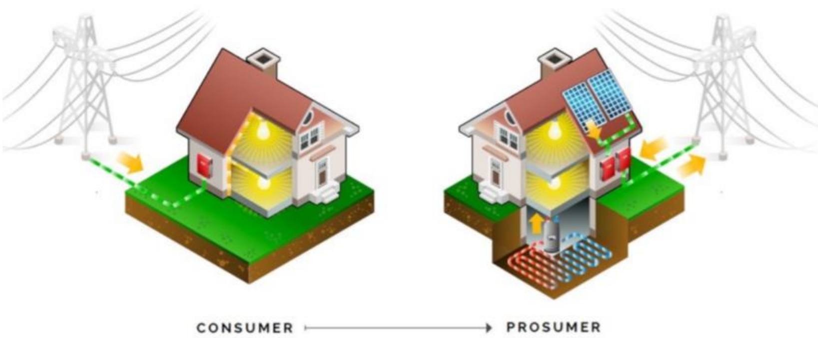


Figure (02-20) A visual summary shows the prosumer and consumer concepts adapted from (Barroco et al., 2020). The prosumer term refers to the user who is not limited to the passive role of consumer (consumer) but actively participates in the various stages of the production process (producer) and manages the energy flows. The prosumer is someone who owns his energy production plant (at any scale), which can consume a part of it, feed the local network, and exchange with other consumers, which return directly as economic benefits.

The Energy City Hall project combines building retrofit and community development through innovative energy management models from these Italian top-down practices. The project's development responds to the desired energy transition objectives by the local administration, which sets out the development of innovative models of territorial development based on energy, to combine the advantages of energy requalification with incentives for CERs. The project aims to demonstrate that with existing legislation, it is already possible to create a CER if technical feasibility and willingness to innovate by the administrative machinery of the local authority are satisfied. The second objective is technical, activating energy transition processes, reducing the cost of bills, involving citizens, creating local development, and reducing CO_2 emissions, as defined before.

The stakeholders are the Municipality of Magliano Alpi, Energy Center of the Polytechnic of Turin (the technical guide), Cassa di Risparmio di Cuneo (Bank to participate in funding). This experiment will benefit from various sources, such as the Fraccaro Law in 2019 (MISE, 2019b), which provides a contribution of 50,000 Euros (€) for the years (2021- 2024) to the municipalities under 5000 inhabitants. The photovoltaic system has been installed on the Town Hall's roof, besides another 20 kWp on another public building. Figure (02-21) shows the first step in establishing CER in an Italian rural settlement.

Figure (02-21) Installed PV on the municipality building in Magliano Alpi rural settlement (Magliano Alpi, 2021). The municipality led the implementation of a pilot project (top-down practice).

A similar top-down approach has been implemented in Tirano town (9011 inhabitants), where the municipality of Tirano has led the process (promoter of the pilot project). Also, the project, commissioned by the Tirano municipality, provides for articulated governance and can count on the contribution of various local actors. The constitution of the CER takes shape in a context that benefits from an innovative district heating system that covers 6.5 km of network, with 1200 families reached by the service and 80 employees, and which can already count on an energy self-production system that - on the basis of the analyzes carried out by RES - it stands at 50% of the loads to be met for the local community. The acceleration of the decarbonization objectives meets a strong institutional commitment to community-building on a path of self-production and self-consumption.

It is worth mentioning that the cooperative suppliers play a notable role in energy communities such as ènostra (Ènostra, 2021), in Biccari energy community, a rural settlement in the Apulia region (2720 inhabitants), which has carried out feasibility studies to construct the plants and to provide the technical skills to assess the development of the CER. Also, institutional bodies like the Regional Agency for housing and living (facilitate the process) by installing photovoltaic systems on two condominiums under their management[10]. The municipality has led the process likewise the past examples. Figure (02-22) shows an example from the Biccari energy community.

Figure (02-22) Some photovoltaic systems in the CER of Biccari, adapted from (Vidovich et al., 2021)

From a bottom-up perspective, with the absence of the local municipality, the Agricultural condominium of Ragusa, Sicily, as an agriculture energy community, the stakeholder here consist of Enel X to provide the technologies and materials (photovoltaic panels and inverters, managing the system operation), besides the local bank, which has understood the added value of this initiative for the local economy (providing loans). Therefore, the primary intervention is to construct a photovoltaic system and an online platform to manage the community (typical local energy communities' characteristics).

Finally, In Egypt, in 2017, in line with the ISES 2035 (Section 2.1.1), the Industrial Modernisation Centre (Ministry of Trade and Industry) launched the national initiative Solar Cell on-grid Systems (Egypt-PV) (Egypt-PV, 2018a). The project aims to support the spread of small photovoltaic cells, especially decentralized generation stations that are installed on the top roofs of residential and non-residential buildings, and the establishment of centers to provide support and technical support.

Although no clear definition of energy community was observed, this initiative can facilitate supplying renewable energy to the different building types in different settlements patterns. The project is sponsored by the United Nations Development Programme (UNDP) (UNDP Egypt, 2017). For instance, in residential buildings, Domestic customers can get technical support up to 500 kW, The presence of a net energy exchange meter from the distribution company. It is available for multi-family dwellings and single-family buildings. The criteria are available on (Egypt-PV, 2018b). In Egypt, some small initiatives have been implemented in remote and desert areas, such as in Bahariya Oasis, the Western Desert, that relied on solar-powered water pumping for agriculture purposes. Figure (02-23) shows this example.

[10] This point helps find a volunteer body in Lasaifar Albalad settlement in the Egyptian case study to provide a role model on their building to increase tendency in the village (see Chapter Four).

Figure (02-23) An example of small-scale self-consume energy for agriculture purposes in remote desert areas in the western desert in Egypt (KarmSolar, n.d.)

2.4 Conclusion

Energy retrofitting practices play a significant role in achieving sustainable development goals and mitigating climate change, particularly in Mediterranean countries. From an inductive perspective, Egypt and Italy are stabilizer countries in the Arabic region (Southern Mediterranean Sea) and European realm (Northern Mediterranean Sea), both pay considerable attention to this issue. The national action plans interact with each sector and provide a set of measurements to improve energy efficiency in the buildings, the major element in the built environment. Another differentiation between both contexts is that almost Italy is ahead of Egypt in energy efficiency applications, widening the outputs by a decade. However, the energy sector has been improving in Egypt, namely since restructuring the electricity sector in 2014.

In Egypt, there are two essential facts. First, the energy efficiency building code suggests the minimum requirements to improve energy performance in existing buildings (retrofitting) and the early design stage in different climate zones, such as the Delta region (the ultimate context within this study). As it is known the significant variance in the macro and microclimate in the same village (i.e., Lasaifar Albalad), It makes sense that retrofitting a dwelling surrounded by vast agricultural land is totally different from retrofitting a dwelling in a compacted urban fabric. Second, working on the rural settlements requires additional consideration in terms of the cultural perspective, the social nature of peasants, the lack of sufficient data, the small-dimensions economy, and the infrastructure. Likewise, in Italy, in fact, it is a general characteristic of the traditional settlement around the world.

Thus this chapter aims to investigate the possible retrofitting solutions in these settlements are? Those are not historical and cultural heritage. For this reason, the chapter conducted an SLR to SLR to investigate whether the aim was implemented before or not between January 2011 and December 2021. Among (n=37) possible SLR articles, the results indicated that no study investigated the SLR of retrofitting the built en in traditional settlements in the Mediterranean region.

Consequently, the chapter defined four keywords related to the research domain, focusing on the traditional settlement, combined with 63 terms. Afterward, the scholarly databases through SBS powered by the EBSCOhost database were searched for peer-reviewed articles presenting these terms combinations within their keywords, abstract, and title. The search was implemented within the same decade and indicated a total number of 11 eligible studies.

Thank Rayyan platform that categorizes the included papers. By reviewing the pre-filtering eligible papers (217 papers), It is noticed that the heritage and historical contexts are too relevant to the traditional rural settlement (Introduction Chapter has defined them), which reflects the importance of the current rural landscape in the country's cultural perception. It is also observed that Italy has made significant contributions to historical and cultural heritage publications by 49% (30 papers out of 63). Predominated by the following authors: Laura Pisello, Anna, University of Perugia, Italy (9 puplications), Cotana, Franco, University Perugia, Italy (8 puplications), and Gagliano, Antonio, University of Catania, Italy (5 Publications).

Energy Procedia journal has the highest share of the studies with 22%, followed by Sustainable Cities and Societies by 11%, Sustainability by 8%, Energy Policy by 5%, then Journals of Building Engineering, Energy, Cleaner Production, TECHNE, and Procedia Engineering by 2% of each approximately. Figure (02-24) shows the distribution of the articles by the journal name.

Journal	
Energy Procedia	48
Sustainable Cities and Society	23
Sustainability	10
SUSTAINABILITY	9
Energy Policy	9
Journal of Building Engineering	6
Energy	5
Journal of Cleaner Production	5
Techne : Journal of Technology for Architecture and Environ...	4
Procedia Engineering	4
Energies	4
Energy & Buildings	3
Energy Efficiency	3
Energies (19961073)	3
Transportation Research Procedia	2
Rivista Economica del Mezzogiorno	2
Applied Thermal Engineering	2
ENERGIES	2
Buildings	2
Journal of Facade Design and Engineering	2
Journal of Cultural Heritage	2

Figure (02-24) Articles distribution by journal name, extracted from Rayyan.

In this chapter, the restricted SLR (micro-scale of the study) results led to identifying the trend and filling the gap in retrofitting the built environment in the traditional rural settlements at the microscale, which is implemented in four contexts in Italy (9 settlements), Egypt (two settlements), and Turkey (one settlement). They could be grouped into two categories. First is the direct implementation of energy efficiency measurements in buildings using passive retrofitting solutions on the building envelope. Second, integrating these implementations with renewable energy presented by Mutani et al. in five traditional settlements in Italy, besides their provided concept (energy communities).

Therefore, the results showed that using conventional insulation materials reduces energy consumption like using nature-based, valorizing the place's traditional identity. Despite the high initial cost of these implementations and the limited practices in the early design phase using the simulation tools. Thus, it requires deep monitoring, post-retrofitting assessment, and more elaboration about the whole process should be provided to solve a real-world problem. Simultaneously, the energy community concept is an optimum approach to retrofitting the built environment. Primarily they can provide enviro-socio-economic benefits to local residents as well as the local authorities. Moreover, the prosumers play a considerable role in achieving the transition to clean energy.

Energy communities can experiment with innovative roles in the social, ethical, and civic fields, structuring themselves through local governance with direct responsibility, on the basis of which citizens, associations, and entrepreneurial realities share a set of principles, rules, and procedures concerning the management and community governance, towards self-management and sharing resources objectives. Which enhances the Collaborative economy (that facilitate the exchange of goods and services between the participating members)

To conclude, energy communities help inhabitants and local authorities to invest in energy efficiency and renewable energy. The participatory approach of citizens in ECR can boost the local economy and grow job vacancies. As well as conquering the social barriers to accepting the retrofitting, the author argues it enhances the belonging to the place, particularly in the case of Lasaifar Albalad, who pays and decides to possess the project. As a concept, energy community projects can provide the potential to retrofit the built environment. However, the complexity of the energy retrofitting practices requires interlocking collaboration among the different stakeholders with different levels of interest, power, and influence, simultaneously managing these relations, which requires a deep investigation beyond the technicalities of the energy retrofitting.

Chapter Two References

Abouaiana, A. (2021). Retrofitting Rural Dwellings in Delta Region to Enhance Climate Change Mitigation in Egypt. *Environmental and Climate Technologies*, *25*(1), 136–150. https://doi.org/10.2478/rtuect-2021-0009

Abouaiana, A., & Mohamadin, M. (2018). *The Role of Egyptian Residential Buildings Energy Code in Enhancing Sustainable Development in Egypt : Evaluation of Nine Years of Practice* (H. Elshaarkawy, S. Zahiri, & J. Clough (eds.); Issue September 2018, pp. 517–526). Proceedings of SDBE2018: International Conference for Sustainble Design of the Built Environment. https://doi.org/10.5281/zenodo.4025302

Aguilar, J., Garces-Jimenez, A., R-Moreno, M. D., & García, R. (2021). A systematic literature review on the use of artificial intelligence in energy self-management in smart buildings. *Renewable and Sustainable Energy Reviews*, *151*. http://10.0.3.248/j.rser.2021.111530

Allal, A. A., Mansouri, K., Youssfi, M., & Qbadou, M. (2018). Toward a review of innovative solutions in the ship design and performance management for energy-saving and environmental protection. In *2018 19th IEEE Mediterranean Electrotechnical Conference (MELECON), Electrotechnical Conference (MELECON), 2018 19th IEEE Mediterranean* (pp. 115–118). IEEE. https://doi.org/10.1109/MELCON.2018.8379078

Aminian, A. (2018). *"An Experimental Model-Based Energy-Oriented Retrofit in Alignment with the Enterprise Architecture Framework Strategy."* Sapienza University di Roma, Rome.

Asarpota, K., & Nadin, V. (2020). Energy strategies, the urban dimension, and spatial planning. *Energies*, *13*(14), 3642.

Barroco, F., Borghetti, A., Cappellaro, F., Carani, C., Chiarini, R., D'Agosta, G., Sabbata, P. De, Napolitano, F., Nigliaccio, G., Nucc, C. A., Corredor, C. O., Palumbo, C., Pizzuti, S., Pulazza, G., Romano, S., Tossani, F., & Valpreda, E. (2020). *LE COMUNITÀ ENERGETICHE IN ITALIA Una guida per orientare i cittadini nel nuovo mercato dell'energia [THE ENERGY COMMUNITIES IN ITALY A guide to guide citizens in the new energy market]* (F. Barroco, F. Cappellaro, & C. Palumbo (eds.)). ENEA. https://doi.org/10.12910/DOC2020-012

Battisti, A. (2016). LINEE GUIDA DI INDIRIZZO MIBACT PER IL MIGLIORAMENTO DELL'EFFICIENZA ENERGETICA NEL PATRIMONIO CULTURALE DELL'ARCHITETTURA E DEI CENTRI E NUCLEI STORICI E URBANI [MIBACT GUIDELINES FOR IMPROVING ENERGY EFFICIENCY IN THE CULTURAL HERITAGE OF ARCHITECTURE A. In *LE PROSPETTIVE SULLA RIGENERAZIONE, RECUPERO, RIQUALIFICAZIONE ENERGETICA E AMBIENTALE DEL PATRIMONIO EDILIZIO ESISTENTE E VINCOLATO*. https://www.settimanabioarchitettura.it/PDF_sessioni/14 nov MAT/BATTISTI.pdf

Bianco, V., & Marmori, C. (2022). Modelling the deployment of energy efficiency measures for the residential sector. The case of Italy. *Sustainable Energy Technologies and Assessments*, *49*, 101777.

Bolliger, R., Ott, W., & von Grünigen, S. (2015). Finding the Balance between Energy Efficiency Measures and Renewable Energy Measures in Building Renovation: An Assessment Based on Generic Calculations in 8 European Countries. *Energy Procedia*, *78*, 2372–2377. http://10.0.3.248/j.egypro.2015.11.191

BUILD_ME. (2021). *Working towards a climate-friendly building sector in the MENA region*. https://www.buildings-mena.com/

BUILD UP. (2021). *Practices*. https://www.buildup.eu/en/practices

Cappellaro, F., Palumbo, C., & Trincheri, S. (2021). *La Comunità Energetica - Vademecum 2021 [The Energy Community-Vademecum 2021]* (ENEA (ed.)). https://doi.org/10.12910/DOC2021-011

Cavallo, F. L., & Visentin, F. (2021). AN ISLAND FOR EVERYONE. Poveglia as contested public space in the Venetian Lagoon. *Shima*, *15*(1). https://doi.org/10.21463/shima.107

CEER. (2019). *Regulatory Aspects of Self-Consumption and Energy Communities. CEER Report. Ref: C18-CRM9_DS7-05-03 25 June 2019*. https://www.ceer.eu/documents/104400/-/-/8ee38e61-a802-bd6f-db27-4fb61aa6eb6a

Charlier, D., & Legendre, B. (2021). Fuel poverty in industrialized countries: Definition, measures and policy implications a review. *Energy*, *236*, 121557.

Colangelo, C. (2018). *The Energy and Mobility Fund of Marche Region: the role of MARTE project*. https://ec.europa.eu/energy/sites/ener/files/documents/1.2_marte_cinzia_colangelo_final.pdf

Comune di Ferla. (2021). *Comunità Energetica Rinnovabile – CommOn LIght [Renewable Energy Community - CommOn LIght]*. https://www.comune.ferla.sr.it/portal/servizi/ambiente/comunita-energetica-rinnovabile-common-light/ (Accessed 06-01-2022)

Coopernico. (2021). *We own our energy*. https://www.coopernico.org/ (Accessed 05-01-2022)

Costanzo, E., Martino, A., Varalda, G. M., Antinucci, M., & Federici, A. (2018). *EPBD implementation in Italy status in December 2016*. https://www.epbd-ca.eu/wp-content/uploads/2018/08/CA-EPBD-IV-Italy-2018.pdf

Cristina, B., Paolo, C. S., & Spigliantini, G. (2017). Evaluation of refurbishment alternatives for an Italian vernacular building considering architectural heritage, energy efficiency and costs. *Energy Procedia*, *133*, 401–411. http://10.0.3.248/j.egypro.2017.09.370

DIGITALEUROPE. (2020). *Digital building transformations for Europe's green renovations: Sustainable living and working*. https://www.digitaleurope.org/wp/wp-content/uploads/2020/12/DIGITALEUROPE_Digital-building-transformations-for-Europe's-green-renovations_Sustainable-living-and-working.pdf

EEHC. (2019). *Egyptian Electricity Holding Company: Annual Report 2018/2019* (p. 89). Egyptian Electricity Holding Company, Ministry of Electricity and Renewable Energy . http://moee.gov.eg/test_new/PDFReports/2018-2019AR.pdf

Egypt-PV. (2018a). *"Industry Modernization": The solar cell systems project is one of the pioneering projects [In Arabic]*. https://egypt-pv.org/تحديث-الصناعة-مشروع-نظم-الخلايا-الش/ (Accessed 05-01-2022)

Egypt-PV. (2018b). *Small Solar Cell Systems Project - Egypt PV - Procedures Manual for the Domestic Sector [In Arabic]*. Industrial Modernisation Centre, Ministry of Trade and Industry. https://egypt-pv.org/wp-content/uploads/2018/07/دليل-الإجراءات-للقطاع-منزلي.pdf

Elrefaei, H., & Khalifa, M. A. (2014). A Critical Review on the National Energy Efficiency Action Plan of Egypt. *JNRD-Journal of Natural Resources and Development*, *4*, 18–24.

ENEA. (2018). *ENERGY EFFICIENCY ANNUAL REPORT Executive summary: ANALYSYS AND RESULTS OF ENERGY EFFICIENCY POLICIES IN ITALY*. https://www.enea.it/it/seguici/pubblicazioni/pdf-volumi/2018/raee-2018-executivesummary-en.pdf

ENEA. (2021a). *ENEA: About us*. https://www.enea.it/en/enea/about-us

ENEA. (2021b). *Energy: Energy communities, from ENEA innovative solutions and models*. https://www.enea.it/en/news-enea/news/energy-energy-communities-from-enea-innovative-solutions-and-models (Accessed 05-01-2022)

ENEA. (2021c). *Energy: Online ENEA guide on energy communities*. https://www.enea.it/en/news-enea/news/energy-online-enea-guide-on-energy-communities (Accessd 05-01-2022)

ENEL. (2021). *Debutta in Sicilia la prima comunità energetica agricola italiana di autoconsumo collettivo [The first Italian agricultural energy community of collective self-consumption makes its debut in Sicily]*. https://www.enel.com/it/media/esplora/ricerca-comunicati-stampa/press/2021/06/debutta-in-sicilia-la-prima-comunit-energetica-agricola-italiana-di-autoconsumo-collettivo (Accessed 06-01-2022)

Ènostra. (2021). *Chi siamo [Who we are]*. https://www.enostra.it/ (Accessed 06-01-2022)

European Commission. (n.d.). *INSPIRE KNOWLEDGE BASE INSPIRE tools*. Retrieved December 12, 2021, from https://inspire.ec.europa.eu/inspire-tools (Accessed 12-12-2021)

European Commission. (2010). DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 May 2010 on the energy performance of buildings (recast). *Official Journal of the European Unionof the European Union*, *53*, 23. https://doi.org/10.3000/17252555.L_2010.153.eng

European Commission. (2011). *Italian Energy Efficiency Action Plan: Summary. Ref. Ares(2011)841746 - 02/08/2011*. http://www.buildup.eu/sites/default/files/content/IT - Energy Efficiency Action Plan %28Synthesis%29 EN.pdf

European Commission. (2012). Consolidated text: Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/ECText with EEA relevance. *Official Journal of the European Union*, *55*, 104. https://doi.org/10.3000/19770677.L_2012.315.eng

European Commission. (2017). *Italian Energy Efficiency Action Plan*. https://ec.europa.eu/energy/sites/default/files/documents/it_neeap_2017_en.pdf

European Commission. (2018a). Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (Text with EEA relevance.). *Official Journal of the European Union*. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG

European Commission. (2018b). DIRECTIVE (EU) 2018/844 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency (Text with EEA relevance). *Official Journal of the European Union*, *61*, 17. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2018.156.01.0075.01.ENG

European Commission. (2018c). Regulation (EU) 2018/1999 of the European Parliament and of the Council of

11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council,. *Official Journal of the European Union*, *61*(L 328). https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L:2018:328:FULL&from=EN

European Commission. (2019). DIRECTIVE (EU) 2019/944 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (recast) (Text with EEA relevance). *Official Journal of the European Union*. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019L0944

European Commission. (2020a). *COMMISSION STAFF WORKING DOCUMENT Assessment of the final national energy and climate plan of Italy* (SWD(2020) 911 final). https://ec.europa.eu/energy/sites/ener/files/documents/staff_working_document_assessment_necp_italy.pdf

European Commission. (2020b). *COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A Renovation Wave for Europe - greening our buildings, creating jobs, improving lives COM/2020/662 final* ({SWD(2020) 550 final}). https://ec.europa.eu/energy/sites/ener/files/eu_renovation_wave_strategy.pdf

European Commission. (2020c). *COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Stepping up Europe's 2030 climate ambition: Investing in a climate-neutral future for the benefit of our*. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0562&from=EN

European Commission. (2021). *European Commission Eurostat NUTS - Nomenclature of territorial units for statistics Local Administrative Units (LAU)*. https://ec.europa.eu/eurostat/web/nuts/local-administrative-units (Accessed 19-09-2021)

European Union. (2019). *Commission Recommendation (EU) 2019/1019 of 7 June 2019 on building modernisation (Text with EEA relevance.)* (p. 59). https://op.europa.eu/en/publication-detail/-/publication/b98262c4-93ee-11e9-9369-01aa75ed71a1

Felicetti, L. (2018). *Italian energy policy 1987-2018: historical developments and the international dimension*.

Fondazione Con il Sud. (2021). *Progetti sostenuti ‣COMUNITÀ ENERGETICA E SOLIDALE DI NAPOLI EST - Comunità Energetica e Solidale di Napoli Est [Projects supported ‣ENERGY AND SOLIDARITY COMMUNITY OF EAST NAPLES - Energy and Solidarity Community of East Naples]*. https://www.fondazioneconilsud.it/ (Accessed 06-01-2022)

Gazzetta Ufficiale. (2021). *DECREE-LAW 6 May 2021, n. 59 (In Italian)*. https://www.gazzettaufficiale.it/eli/id/2021/05/07/21G00070/sg

Giovannini, S. (2020). *Community Energy A practical guide to reclaiming power*. Energy Cities. https://energy-cities.eu/publication/community-energy/

Grant, M. J., & Booth, A. (2009). A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Information & Libraries Journal*, *26*(2), 91–108.

Hanna, G. B. (2004). Residential Energy Code for New Buildings in Egypt. *CIB World Building Congress, Building for the Future*.

Hanna, G. B. (2011). Energy efficiency building codes for Egypt. *Journal of Energy and Power Engineering*, *5*(12).

Hanna, G. B. (2013). Sustainable energy potential in the Egyptian residential sector. *Journal of Environmental Science and Engineering. B*, *2*(6B), 374.

Hanna, G. B. (2015). Energy Efficiency Building Codes and Green Pyramid Rating System. In Ali Sayigh (Ed.), *Renewable Energy in the Service of Mankind Vol I* (pp. 597–608). Springer. https://www.springerprofessional.de/en/renewable-energy-in-the-service-of-mankind-vol-i/2427878?tocPage=1

Hao, L., Herrera-Avellanosa, D., Del Pero, C., & Troi, A. (2020). What Are the Implications of Climate Change for Retrofitted Historic Buildings? A Literature Review. *Sustainability*, *12*(18), 7557.

Hasgül, E., Olgun, İ., & Karakoç, E. (2021). Vernacular rural heritage in Turkey: an intuitional overview for a new living experience. *Journal of Cultural Heritage Management and Sustainable Development*, *11*(4), 440–456. https://doi.org/10.1108/JCHMSD-01-2020-0021

HBRC. (2008a). *Egyptian Code for Improving the Efficiency of Energy Use in Buildings, Part 1: Residential Buildings, ECP306-2005. (In Arabic).* Ministry of Housing, Arab Republic of Egypt.

HBRC. (2008b). *Egyptian Code for Improving the Efficiency of Energy Use in Buildings, Part 2: Commercial Buildings (In Arabic).* Ministry of Housing, Arab Republic of Egypt. (In Arabic).

HBRC. (2018). *Green Pyramid Rating System – GPRS, For New Buildings and Major Renovation* (Version 2). Ministry of Housing, Arab Republic of Egypt.

Hegazy, I. R., Moustafa, W. S., & Akl, M. H. (2019). Effect of building forms on energy consumption in coastal rural communities in Egypt. *Journal of Urban Regeneration & Renewal*, *12*(3), 269–285.

IRENA. (2018). *Renewable Energy Outlook: Egypt*. International Renewable Energy Agency. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Oct/IRENA_Outlook_Egypt_2018_En.pdf

IRENA Coalition for Action. (2021). *Community Energy Toolkit: Best practices for broadening the ownership of renewables*. International Renewable Energy Agency. https://www.irena.org/publications/2021/Nov/Community-Energy-Toolkit-Best-practices-for-broadening-the-ownership-of-renewables

Jesson, J., Matheson, L., & Lacey, F. M. (2011). *Doing your literature review: Traditional and systematic techniques*.

Kandeal, A. W., Algazzar, A. M., Elkadeem, M. R., Thakur, A. K., Abdelaziz, G. B., El-Said, E. M. S., Elsaid, A. M., An, M., Kandel, R., Fawzy, H. E., & Sharshir, S. W. (2021). Nano-enhanced cooling techniques for photovoltaic panels: A systematic review and prospect recommendations. *Solar Energy*, *227*, 259–272. https://doi.org/10.1016/j.solener.2021.09.013

KarmSolar. (n.d.). *A GLIMPSE OF OUR JOURNEY Leading Solar Energy Innovation in Egypt since 2011*. Retrieved January 6, 2022, from https://www.karmsolar.com/about-us (Accessed 06-01-2022)

Lee, K., & Jepson, W. (2021). Environmental impact of desalination: A systematic review of Life Cycle Assessment. *Desalination*, *509*. https://doi.org/10.1016/j.desal.2021.115066

LEGAMBIENTE. (2021a). *Comunità energetica Alpina di Tirano [Alpine energy community of Tirano]*. https://www.comunirinnovabili.it/comunita-energetica-alpina-di-tirano/ (Accessed 06-01-2022)

LEGAMBIENTE. (2021b). *Comunità Energetica Rinnovabile di Biccari [Renewable Energy Community of Biccari]*. https://www.comunirinnovabili.it/comunita-energetica-rinnovabile-di-biccari/ (Accessed 06-01-2022)

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P. A., Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *Journal of Clinical Epidemiology*, *62*(10), e1–e34.

Magliano Alpi. (2021). *Community Operating Group Energy Renewables*. https://cermaglianoalpi.it/?lang=en (Accessed 05-01-2022)

Malanima, P. (2006). Energy Consumption in Italy in the 19th and 20th Centuries. *A Statistical Outline*.

meetMED. (2019). *Energy Efficiency and Renewable Energy Strategies and Policies*. Mitigation Enabling Energy Transition in the MEDiterranean region Together We Switch to Clean Energy. https://www.rcreee.org/sites/default/files/meetmed_report_a1_1_final_191009.pdf

meetMED. (2021a). *MEDENER and RCREEE launch the 2nd phase of the EU Funded project "meetMED II"* (p. 9). MEDENER and RCREEE. https://meetmed.org/wp-content/uploads/Press-Release_EN_FR_AR.pdf

meetMED. (2021b). *The meetMED project*. https://meetmed.org/about/

MEF. (2016). *Ministry of Economy and Finance: 2016 Stability Law (In Italian)*. https://www.mef.gov.it/focus/Legge-di-Stabilita-2016/

Mejías, O. A., Montalvo, C., García-Berrocal, A., Cubillo, M., & Gordaliza, D. (2021). Energy Savings after Comprehensive Renovations of the Building: A Case Study in the United Kingdom and Italy. *Energies*, *14*(6460), 6460. https://doi.org/10.3390/en14206460

MISE. (2009). *National Renewable Energy Action Plan in line with Directive 2009/28/EC*. http://www.buildup.eu/sites/default/files/content/national_renewable_energy_action_plan_italy_en.pdf

MISE. (2013). *Italy's National Energy Strategy: for a more competitive and sustainable energy*. https://www.mise.gov.it/images/stories/documenti/SEN_EN_marzo2013.pdf

MISE. (2019a). *INTEGRATED NATIONAL ENERGY AND CLIMATE PLAN*. Ministry of Economic Development, Ministry of the Environment and Protection of Natural Resources and the Sea, and Ministry of Infrastructure and Transport. https://www.mise.gov.it/images/stories/documenti/it_final_necp_main_en.pdf

MISE. (2019b). *Norma Fraccaro, contributi per 500 milioni di euro in favore dei Comuni [Norma Fraccaro, contributions of 500 million euros in favor of the Municipalities]*. https://www.mise.gov.it/index.php/it/198-notizie-stampa/2039722-contributi-per-500-milioni-di-euro-in-favore-dei-comuni-per-progetti-di-efficientamento-energetico-e-sviluppo-territoriale-sostenibile (Accessed 06-01-2022)

MISE. (2021). *Ministry of Economic Development: Superbonus and Sismabonus 110% - Implementing decrees*. https://www.mise.gov.it/index.php/it/incentivi/energia/superbonus-110

MOEE. (2018). *National Plan to Improve Electricity Energy Efficiency (2018-2020) (In Arabic)*. Ministry of Electricity and Renewable Energy , Egypt. http://www.moee.gov.eg/test_new/DOC/p.pdf

Moussa, R. R. (2019). The reasons for not implementing Green Pyramid Rating System in Egyptian buildings. *Ain Shams Engineering Journal*, *10*(4), 917–927.

MPED. (2021). *EGYPT'S VISION 2030*. https://mped.gov.eg/EgyptVision?lang=en

Muka, T., Glisic, M., Milic, J., Verhoog, S., Bohlius, J., Bramer, W., Chowdhury, R., & Franco, O. H. (2020). A 24-step guide on how to design, conduct, and successfully publish a systematic review and meta-analysis in medical research. *European Journal of Epidemiology*, *35*(1), 49–60.

Mutani, G., Cornaglia, M., & Berto, M. (2018). Improving energy sustainability for public buildings in Italian mountain communities. *Heliyon*, *4*(5), e00628. https://doi.org/10.1016/j.heliyon.2018.e00628

NEEAP Egypt. (2012). *Arab Guideline to Improve Electric Power Efficiency and Rational Use of Electricity of the End User Energy Efficiency Plan in the Electricity Sector*. National Energy Efficiency Action Plans (NEEAP) for Egypt, LAS-RCREEE-Med-EMIP, 2012. https://taqaway.net/documents/national-energy-efficiency-action-plans-neeap-egypt-las-rcreee-med-emip-2012

OECD. (2020). *Investment Policy Reviews: Egypt 2020*. OECD Investment Policy Reviews, OECD Publishing, Paris. https://doi.org/10.1787/9f9c589a-en

Ouzzani, M., Hammady, H., Fedorowicz, Z., & Elmagarmid, A. (2016). Rayyan—a web and mobile app for systematic reviews. *Systematic Reviews*, *5*(1), 1–10.

Ozarisoy, B., & Altan, H. (2021). Systematic literature review of bioclimatic design elements: Theories, methodologies and cases in the South-eastern Mediterranean climate. *Energy & Buildings*, *250*. http://10.0.3.248/j.enbuild.2021.111281

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, *372*, n71. https://doi.org/10.1136/bmj.n71

Pahlevan-Sharif, S., Mura, P., & Wijesinghe, S. N. R. (2019). A systematic review of systematic reviews in tourism. *Journal of Hospitality and Tourism Management*, *39*, 158–165.

Paul, J., & Criado, A. R. (2020). The art of writing literature review: What do we know and what do we need to know? *International Business Review*, *29*(4), 101717.

Pereira, V., Santos, J., Leite, F., & Escórcio, P. (2021). Using BIM to improve building energy efficiency – A scientometric and systematic review. *Energy and Buildings*, *250*. https://doi.org/10.1016/j.enbuild.2021.111292

Pierantoni, F., & Bruzzi, L. (1981). A review of the Italian fast reactor programme. *IAEA*, 68–75. https://inis.iaea.org/collection/NCLCollectionStore/_Public/15/056/15056826.pdf

Pisello, A. L., & Cotana, F. (2015). Thermal-energy and Environmental Impact of Cool Clay Tiles for Residential Buildings in Italy. *Procedia Engineering*, *118*, 530–537. http://10.0.3.248/j.proeng.2015.08.472

Principi, P., Roberto, F., Carbonari, A., & Lemma, M. (2016). Evaluation of energy conservation opportunities through Energy Performance Contracting: A case study in Italy. *Energy & Buildings*, *128*, 886–899. http://10.0.3.248/j.enbuild.2016.06.068

Ranjha, M. M. A. N., Irfan, S., Lorenzo, J. M., Shafique, B., Kanwal, R., Pateiro, M., Arshad, R. N., Wang, L., Nayik, G. A., Roobab, U., & Aadil, R. M. (2021). Sonication, a potential technique for extraction of phytoconstituents: A systematic review. *Processes*, *9*(8). https://doi.org/10.3390/pr9081406

RAYYAN. (2021). *Rayyan | Intellegigent systematic review*. https://www.rayyan.ai/

RCREEE. (2021a). *COOL-ME Project: Scaling-up sustainable cooling in the Middle East*. https://www.rcreee.org/project/cool-me-project-scaling-sustainable-cooling-middle-east/4779#:~:text=the Middle East-,COOL-ME Project%3A Scaling-up sustainable cooling in the,visible effects of climate change.

RCREEE. (2021b). *Who We Are*. https://www.rcreee.org/content/who-we-are

Reijnders, V. M. J. J., van der Laan, M. D., & Dijkstra, R. (2020). Energy communities: a Dutch case study. In *Behind and Beyond the Meter* (pp. 137–155). Elsevier.

Rocchi, L., Menconi, M. E., Grohmann, D., Paolotti, L., Boggia, A., Kadziński, M., & Miebs, G. (2018). Sustainability evaluation of retrofitting solutions for rural buildings through life cycle approach and multi-criteria analysis. *Energy & Buildings*, *173*, 281–290. http://10.0.3.248/j.enbuild.2018.05.032

SAS. (2010). *Ségala Agriculture Énergie Solaire [Ségala Agriculture Solar Energy]*. https://energie-partagee.org/projets/segala-agriculture-energie-solaire/ (Accessed 05-01-2022)

Shaikh, P. H., Shaikh, F., Sahito, A. A., Uqaili, M. A., & Umrani, Z. (2017). *Chapter 9 - An Overview of the Challenges for Cost-Effective and Energy-Efficient Retrofits of the Existing Building Stock* (F. Pacheco-Torgal, C.-G. Granqvist, B. P. Jelle, G. P. Vanoli, N. Bianco, & J. B. T.-C.-E. E. E. B. R. Kurnitski (eds.); pp. 257–278). Woodhead Publishing. https://doi.org/10.1016/B978-0-08-101128-7.00009-5

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, *104*, 333–339.

Stazi, F., Bonfigli, C., Tomassoni, E., Di Perna, C., & Munafò, P. (2015). The effect of high thermal insulation on high thermal mass: Is the dynamic behaviour of traditional envelopes in Mediterranean climates still possible? *Energy & Buildings*, *88*, 367–383. http://10.0.3.248/j.enbuild.2014.11.056

Šūmakaris, P., Korsakienė, R., & Ščeulovs, D. (2021). Determinants of energy efficient innovation: A systematic literature review. *Energies*, *14*(22). https://doi.org/10.3390/en14227777

UNDP Egypt. (2017). *HOME ALL PROJECTS GRID CONNECTED SMALL-SCALE PHOTOVOLTAIC SYSTEMS (PVS)*. https://www.eg.undp.org/content/egypt/en/home/projects/grid-connected-small-scale-photovoltaic-systems--pvs-.html (Accessed 07-01-2022)

United Nations. (2021). *#Envision2030: 17 goals to transform the world for persons with disabilities*. https://www.un.org/development/desa/disabilities/envision2030.html

Vidovich, L. De, Tricarico, L., & Zulianello, M. (2021). *COMMUNITY ENERGY MAP Una ricognizione delle prime esperienze di comunità energetiche rinnovabili [COMMUNITY ENERGY MAP A survey of the first experiences of renewable energy communities]*. FrancoAngeli s.r.l., Milano, Italy. https://www.researchgate.net/publication/357017651_COMMUNITY_ENERGY_MAP_Una_ricognizione_delle_prime_esperienze_di_comunita_energetiche_rinnovabili

III. Transdisciplinary Retrofitting Approach Using Agile Methodology

Abstract

Transdisciplinarity is essential to deal with high complexity collaborative practices of Energy retrofitting, particularly in the traditional settlements. From these challenges, the conflict among the collaboratives.

Aim:

Thus, this study aims to provide a transdisciplinary framework to organize the collaboration work among stakeholders, which led to implementing of efficient strategies to retrofit the built environment, using agile methodology practices because it proved a success in software development projects.

Hypothesis:

The agile project management approach can organize the relation between the team to mitigate the uncertainty and the unnecessary re-work besides dealing with the institutional barriers.

Methodology:

Creating and developing the conceptual framework integrates agile methodologies in software engineering and project management within the energy retrofitting practices. Based on the relevant theoretical concepts about the three domains.

Thus, the chapter proposes a transdisciplinary collaborative framework related to energy retrofitting in the traditional settlement in Egypt and Italy. That enhances organizing the team between stakeholders using the agile methodology practices (scrum tool) during the early stage of collaboration and project planning. That is integrated with the on-site study (Chapter One) and relevant practices in the Mediterranean context in this systematic literature review that has been discussed in (Chapter Two) At the same time, a comparison with other participatory approaches has been provided.

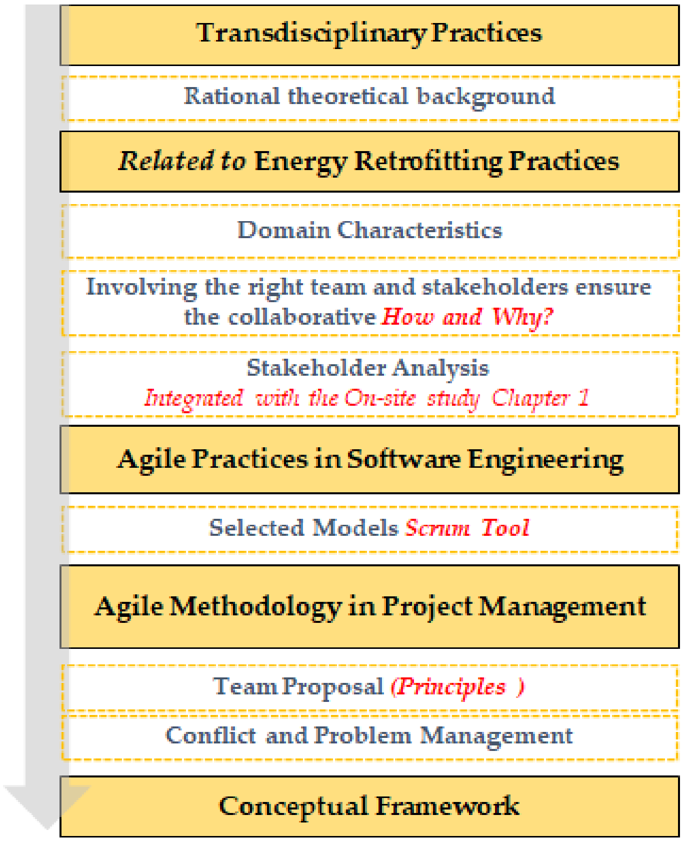
Limitations:

- The conceptual framework is limited to the micro contexts (Lasaifar Albalad and Pontinia Settlements). However, the inductive methodology may apply to similar patterns in the Mediterranean Region;
- Second, the practice is limited to the planning and decision-making of the framework;
- Third, the pilot real-case scenario has been implemented in Lasaifar Albalad only.

Keywords

Cross-Disciplinarity; Energy Retrofitting; Scrum Framework; Stakeholders Analysis; Team Management.

Visual Summary



3.1 What is and Why Cross-Disciplinarity?

Cross-disciplinary is that implicate two or more disciplines. It is the dominant concept of a particular discipline on the others without integration (de Groot, 1992). It is essential to reopen scientific approaches and methods to engage different types of expertise. Cross-disciplinary research can build robust associations among academics and non-academics (Evely et al., 2010). Examples of these concepts are trans-, inter-, and multi-disciplinarity to deal with the complicated challenges of sustainable development (Toomey et al., 2015), besides the participatory approach (OECD, 2020a) intra-disciplinary, poly-disciplinarity (de Groot, 1992), and pluri-disciplinarity.

3.1.1 Disciplinary Interaction Levels

As the first step from a linguistic perspective, to clarify the similarity between the disciplinarity levels and concepts, the original words came from the Latin language, where “Uni-” or mono- means single, “Multi-” means many, “Intra-” means within (that something happens within a single thing), “Inter-” refers to among (more than one thing), and finally, “Trans-” means across (Latin Dictionary, 2021) (Merriam-Webster, 2021). Figure (03-01) summarizes the English definitions of the current technical terms based on their Latin origin.

Latin Word	Uni "mono"	Multi	Intĕr	Intra	Trans
Meaning	One; Single; alone	Multitude; Many; Mass	Between; Among; During	Within; Inside; Under	Across; Over; Beyond

Figure (03-01) The Latin origin of the cross-disciplinarity terms. For a better understanding of the similarity among them).

In the second step, multi-studies discussed the historical emergence of these concepts. de Groot (de Groot, 1992) has defined the "*Uni-disciplinarity*" as the single discipline operating such a scientific dilemma from a theoretical or practical case studies perspective. Thus, instantaneously once more than discipline working together, but without significant contributions, it is called "*Multi-disciplinarity*." If the results of this collaboration were more than the sum of every discipline, that is the "*Inter-disciplinarity.*" Finally, he defined "*Trans-disciplinarity*" as the multi-level coordination between different disciplines in professional practices and research based on the general intuitions and emerging understanding of epistemology dimensions. The same definitions have been confirmed by Rosenfield (Rosenfield, 1992).

According to a recent report by the Organisation for Economic Co-operation and Development (OECD) (OECD, 2020a), the first Interdisciplinary Research and Education seminar was organized in 1970 by them to address the societal challenges using transdisciplinary research (TRD).

The report defined "*Trans-disciplinarity*" as incorporating academic researchers from diverse fields with non-academic participants to flourish the epistemology and theory to fulfill the same objective. It mentioned that each TDR project is unique. However, the projects identified within a vast domain based on the required resolved problem consisting of many factors: disciplines miscellany, integration level, the existence of the unscholarly stakeholders, and collaboration with them, and finally, the timeframe concerning knowledge types. The report discussed best practices of a 28 TDR example worldwide, focusing on various dimensions such as identifying stakeholders, lessons learned, and policies implementation. Finally, the report defined the "*Participatory*" approach as "*Transferring knowledge between academic and non-academic without integration.*"

Ramadier (2004) discussed the concepts from the urban studies perspective. He stated that "*Multi-disciplinarity*" Aims to contiguities the conceptual frameworks associated with various disciplines, with the advantage of focusing on a particular topic from different angles and opinions such as conferences and symposiums. It contributes to generating sub-disciplines and new certainty echelons.

Based on this, "*Inter-disciplinarity* " builds a mutual framework for the collaborated disciplines under the same field to create a synthesis. Alternatively, to work on common questions and the achievement of shared results (Lawrence, 2010). It can be implemented at an individual scale, as well as it is predominate by guidelines and ideologies of a specific discipline, such as psychology which leads to urban studies (Hillier & Iida, 2005).

Ramadier defined "*Trans-disciplinarity*" as identifying the different formulae and the search for unity in produced knowledge that can be joined together. It is characterized generally by the specificity of transdisciplinarity in integrating two conflicting movements of disciplinary thinking, namely, "*the compartmentalization of knowledge, and the existence of relationships between the disciplines.*" In other words, it necessitates constant cooperation throughout the professional practice stages, linking with theories (Lawrence & Després, 2004).

3.1.2 Disciplinary Interaction Practices: at Glance

In the domain of policy, education, services, and health research, the definitions objectives of the emerged concepts have been discussed by Choi & Pak (Choi & Pak, 2006). They emphasized the role of the approaches to resolve the fields' complex challenges. Furthermore, they limited "*Multi-disciplinarity*" within the boundaries of the collaborated disciplines, relying on their knowledge limits. While "*Inter-disciplinarity*" examines and synchronizes connections between disciplines into an integrated whole. Finally, "*Trans-disciplinarity*" is the full integration between, on the one hand, health science, on the other, with the social and natural ones in human society and cultural contexts beyond the conventional borders.

In the health domain, Schary & Cardinal (2015) showed the differences between Intra- and Inter-disciplinary research, where the "*Intra-disciplinary*" is the combination of two or more diverse sub-fields under their major one, in a single study or multiple studies that derive the determinants and concepts from these sub-disciplines together within the same study design, aim, and methodology. It requires concerted efforts and views of all participants throughout the preparation of the study.

Other studies discussed disciplinary interaction concepts from different perspectives, such as in the Education field (Cook-Sather & Shore, 2007; Gibbs, 2015; OECD, 2020b), tourism and hospitality (Volgger & Pechlaner, 2014), ecosystems, and land science (Zscheischler & Rogga, 2015; Schönenberg et al., 2017; Zscheischler et al., 2018; Zscheischler, 2021) urban health and well being (Battisti et al., 2020), livestock production (Faverjon et al., 2019) agriculture (Greenhalgh et al., 2019) industry (Gericke et al., 2013), business management (Schaltegger et al., 2013) psychology (Collin, 2009), and indoor environmental sciences (M. Ortiz et al., 2020).

To conclude, it is evident that numerous studies discussed the disciplinary interaction concepts from different perspectives. The author argues they could be categorized into four milestones, starting from the early debate over the conceptual term within the 1920s to 1940s in social science, which had many forms, such as integration across disciplines, integrative, and the interactionist framework (Julie Thompson Klein, 1990). Second, in the 1950s, promoting interdisciplinarity in numerous ways (Morris & Seeman, 1950) was followed by a significant milestone, namely in the OECD seminar in 1970. Finally, during the following four decades, many definitions and sub-concepts have emerged in broad domains, which led us to investigate, in the following sections, the relation with the energy retrofitting practices: domain characteristics, collaboration nature, and the obstacles.

3.2 Energy Retrofitting Practices

Energy Retrofitting (ER) refers to adapting the latest technologies or features to obsolete systems (Shaikh et al., 2017; Asarpota & Nadin, 2020). It is extensively identified as a relevant strategy that interacts with all walks of life, from the micro- to macro-scale, in different contexts, directly or indirectly, to achieve numerous objectives and benefits for the environment and humans.

Examples of these benefits: include achieving sustainable development objectives (Liang et al., 2015), promoting sustainable urban regeneration of the built environment (Soares, 2017; Pittau et al., 2019), decreasing natural resource exploitation (Gajić et al., 2021), delivering the low-carbon transition (Cucchiella & Rotilio, 2021), besides, enhancing the quilty of life of people (Jia et al., 2021), increasing their productivity

(Duran & Lomas, 2021), improving mental health and well-being (IEA, 2019; Ortiz et al., 2019), boosting the economy (Krarti & Dubey, 2018), creating jobs (Meijer et al., 2012), and achieving gender equity (Habtezion, 2016).

3.2.1 Energy Retrofitting and Cross-disciplinarity: Systematic Literature Review

By focusing on energy retrofitting practices in the cross-disciplinarity, a literature review study conducted in December 2021, using a simple Boolean (AND and OR) that includes two main keywords, first the research domain (energy retrofitting), second the synonyms of the (cross-disciplinarity) concept that concluded from the theoretical background. Among 72 papers, the study included relevant 18 papers and excluded Kerr's P.hD dissertation (Kerr, 2018) and the book of Palazzo & Benelli (Palazzo & Benelli, 2020) due to limited access. More about conducting literature review studies have been discussed in (Chapter Two). The included studies have been summarized in Annex (03-01).

(transdisciplinar* OR trans-disciplinar* OR "trans disciplinar*" OR interdisciplinar* OR inter-disciplinar* OR "inter disciplinar*" OR intradisciplinar* OR intra-disciplinar* OR "intradisciplinar*" OR multidisciplinar* OR multi-disciplinar* OR "multi disciplinar*" OR pluridisciplinar* OR pluri-disciplinar* OR "pluridisciplinar*" OR monodisciplinar* OR mono-disciplinar* OR "monodisciplinar*" OR unidisciplinar* OR uni-disciplinar* OR "uni disciplinar*" OR crossdisciplinar* OR cross-disciplinar* OR "cross disciplinar*") **AND** ("energy retrofit" OR "energy retrofitting")

Sibilla & Kurul (Sibilla & Kurul, 2020), in their literature review study, "*Transdisciplinarity in energy retrofit,*" concluded the essential need for more collaborative approaches in energy retrofitting as well as knowledge exchange and emerging technologies can facilitate transdisciplinarity. Noteworthy, they concluded 136 studies using fewer keywords (energy efficiency, transdisciplinary, and multidisciplinary) because they were investigating different scopes (practices in the buildings and urban context, generally). In contrast, this chapter requires mentioning the term clearly in at least one of the titles, keywords, and abstract.

The other studies have discussed the cross-disciplinarity in energy retrofitting practices from several perspectives, in cultural heritage buildings (conservation) (Haas et al., 2013), harvesting solar energy (Polo López et al., 2021), in higher education buildings (Pereira et al., 2021), and the office buildings for thermal improvement (Galbiati et al., 2021), and for seismic retrofitting and economically (Guleroglu et al., 2020). Besides integration with structural behavior (Ceroni et al., 2015; Ascionea et al., 2017). In conventional buildings, techno-economic perspectives are provided to retrofit student dormitory nZEB target (Assimakopoulos et al., 2020), school buildings (Asdrubali et al., 2021), auditoriums integrated with Seismic retrofitting (De Angelis et al., 2021).

Other studies discussed stakeholders' involvement. For example, Carbonaro et al. (2016) engaged the academic bodies (research centers) with manufacturing to develop energy-efficient nature-based thermal plaster. Berardi (2015) integrates phase change materials in a private research university's building envelope in the USA. In M. Ortiz et al.'s literature review study (M. Ortiz et al., 2020), they emphasized the essential need for interdisciplinary indoor-environmental sciences, energy sciences, and occupant behavior. DellaValle et al. (2018) suggested a social-science interdisciplinary approach to help develop behavior change strategies to enhance the effectiveness of retrofit programs of social housing in Italy. Ferrante (2014) and Serrano-Jimenez et al. (2017) have investigated socio-techno-economic interventions on a multi-building scale.

As discussed in the paper "solutions & tools for the conservation compatible energy retrofit of historic buildings" (Haas et al., 2013), they provided a methodology to support the European project Efficient Energy for EU Cultural Heritage Project (3ENCULT, 2014). They identified the stakeholders as the "*Local Case Study Team,*" which consists of the building owner, local offices that serve the given subject (such as protection of monuments and heritage offices), conservation, technical, implementation, and urban development experts who have the sufficient knowledge of the study domains, besides the industry partners who facilitate the process. Although the scope is the cultural heritage that is not relevant to this study, the methodology can be beneficial to select the stakeholders within this study. Particularly almost the same method was valid in a similar project in a different context in Iran (Mirzakhani et al., 2021) and to support decision-making in urban regeneration practices (Baker & Moncaster, 2017). Annex (03-02) summarizes some of the 3ENCULT's case studies.

In an urban context, to support decision-making in the early stages, Gabrielli & Ruggeri (Gabrielli & Ruggeri, 2019) have developed an interdisciplinary methodology through a comprehensive approach (risk analysis economics, energy modeling, and statistical analysis) for planning and managing the operation of energy retrofitting in broad building portfolios to achieve urban regeneration and the aging population. Torabi Moghadam & Lombardi (2019) provided an interdisciplinary approach to urban energy from the environmental, technical, economic, and societal points of view of planning as a result of a workshop discussion between the involved stakeholders (spatial decision experts, representatives of local authority, architect, and the researcher). It indicated that the more engagement, the broader outcomes, despite the absence of locals in the process.

3.2.1.1 Synthesis and Results

The systematic literature review explores whether the researchers included one or more of the cross-disciplinary technical terms (in title, abstract, and keywords), how they conducted their interventions, and who are the involved stakeholders. It is different from Sibilla & Kurul's approach, which discusses the concept beyond the technical terms. Most of the studies have been led by the research team/s. Who came from one or more disciplines such as buildings physics, structural and architectural engineering to achieve energy retrofitting besides one or more goals such as cultural preservation, seismic retrofitting, users' thermal comfort, and economic feasibility. The majority of practices have been implemented from a bottom-up perspective in the Mediterranean region context, namely, in Italy (7 studies), Spain, Greece, and Turkey.

Generally, numerous studies have discussed the exact interventions without mentioning the technical term (in title, abstract, and keywords), like mono-disciplinarity in reference (El-Darwish & Gomaa, 2017; Al-Yasiri & Szabó, 2020), the multi-disciplinarity in references (Abouaiana, 2021; D'Agostino et al., 2022; Omar et al., 2022), and the trans-disciplinarity in reference (Ongpeng et al., 2022). This may indicate the polemical of these growing concepts' insufficient awareness and interest, or it may reflect the deep interlocking between the scientific topics.

For instance, Losasso (2021) discussed an interdisciplinary approach resulting from a collaboration between the academic bodies (Department of Architectures of the University of Naples) and the local municipality to regenerate a historical center in Naples city such as enhancing energy efficiency, historical conservation, and improve air quality. The practice includes actors, urban designers, conservation, morphological. Tucci et al. (Tucci et al., 2018) supported this holistic approach when they highlighted the essential need to consider the relationship between the building and the surrounding built environment systems during regeneration practices, including energy retrofitting, which should be implemented from a multi-disciplines and based on the latest technological developments, such as the innovative chemical-physical characteristics of building materials (Hausladen & Tucci, 2017).

Another interdisciplinary example was discussed within the MEETHINK project (Trombadore, 2017). To stimulate a multilevel governance model by linking regional with local authorities and involving policymakers, technicians, infrastructure and energy providers, research centers, and locals. Through information and communications technology (ICT) platforms as a data-sharing tool to support the decision-making between private and public stakeholders concentrated on three domains related to energy-efficient buildings and mobility and renewable energy.

To conclude, the academic progress in cross-disciplinarity is sluggard (J. J. Cohen et al., 2021), and there is a lack of cross-disciplinarity in all domains (Thompson et al., 2017), including energy research (Schmidt & Weigt, 2015), as supported by Sibilla & Kurul (Sibilla & Kurul, 2020), who stated that improving energy performance in buildings from narrow perspectives is obsolete. Moreover, the retrofitting practices are highly complex (Ruggeri et al., 2020; Okorafor et al., 2021).

Therefore, early collaboration between the stakeholders is essential to facilitate the process (Parrish, 2013; Almeida et al., 2014; Battisti, 2017; Ongpeng et al., 2022). The European Regulation (EU) 2018/1999 supported this statement by advocating involving all stakeholders in any development (European Commission, 2018).

3.2.2 Energy Retrofitting Collaboration's Obstacles

Despite the vast benefits of energy retrofitting, numerous studies defined this complexity in obstacles and barriers that accompany energy retrofitting from different perspectives, such as legalizations, policies, landlords' behavior, culture, techno-economic factors, lack of investor confidence, and business engagement (Gillich & Sunikka-Blank, 2013; Alam et al., 2016; Fylan et al., 2016; Buessler et al., 2017; Khairi et al., 2017; D'Oca et al., 2018; Oguntona et al., 2019; Fasna & Gunatilake, 2019; Alam et al., 2019; Peel et al., 2020; Prabatha et al., 2020; Liu et al., 2021; Lang et al., 2021; Palumbo Fernández et al., 2021; Butt et al., 2021; Jia et al., 2021). They deeply discussed these factors based on the literature and case studies in many countries worldwide. It reflects the importance of considering multiple layers concomitantly during these practices.

For instance, Pitt & Bassett (2013) suggested collaboration in environmental planning to raise local's awareness, concomitantly assisting local governments in "crowd-source" knowledge about sustainability issues (clean energy). Furthermore, the role of local authorities is crucial to improving energy efficiency and integrating renewable energy in their municipal buildings and properties as role models. They highlighted the negative correlation between city size and local's (community members and official elected ones) resistance to adopting energy efficiency initiatives. Likewise, the author argues that the smaller settlements pattern, like the rural, has the higher locals' resistance.

Gultekin et al. (2014) emphasized integrating researchers with technical teams (architects and MEP engineers) to support the decision-making in the design-build projects, namely, to employ energy-efficient systems during retrofitting buildings. In the same vein, Mlecnik et al. (2019) concluded that the lack of knowledge retrofitting adopters in the UK of the basic tenets and marketing requirements, like quality assurance, led to losing customer confidence and trust. They highlighted the role of the "intermediaries" such as energy distribution authorities and banks in improving the process.

Miah et al. (2015) provided a small-scale transdisciplinary [1] framework between academia and industry in the UK to improve energy efficiency in a factory building. The principal researcher led the project. The main barrier in this kind of project was miscommunication (physical or virtual meetings). The role of researchers is demonstrated by diagnosing the industrial challenges on the ground. Vice versa, industrial practitioners shall provide the research projects and funding. Zuhaib et al. (2017) supported these findings on

[1] Although it was a "small-dimension," the author argues that based on the theoretical definitions by Rosenfield and OECD -mentioned earlier, inter-disciplinary would be the most appropriate terms of this kind of research.

a large scale in the Irish retrofit industry, who highlighted the obstacle of information gap among the stakeholders and the expenditure behavior of clients that focus on the low initial cost.

In their literature review related to sustainability Hamdan et al. (Hamdan et al., 2021) concluded that collaboration in projects builds a sufficient internal variety to deal with external disturbances and challenges. They characterized the collaboration of stakeholders in four stages. First, conceptualization to identify the stakeholders and well-define the problem. Second, preparation, such as the practitioners' awareness of the temporal uncertainty, rules groundings, compromising the interest (balanced aims and common concerns among them). Third, implementation includes exchanging learning and experience to fill gaps and avoid performance contradictions. Fourth, closure such as diffusion of the new outcomes improve existing policies and standards and enhance reluctant actors due to ambitious energy interventions.

Focusing on the obstacles among stakeholders in the cross-disciplinary energy research, Sibilla & Kurul emphasized *"the fragmentation between different disciplines"* as the most significant barrier, besides a set of conflicts among the team, such as inefficient procedures, lack of evaluation, institutional restrictions, authority, and miscommunication, as a result of problematically ambiguous terms (J. J. Cohen et al., 2021). Moreover, they argued that emerging technologies have an essential role in facilitating this collaboration.

In an integral scene, the European University Association highlighted the importance of education, with a particular reference to the post-graduate studies to support the EU plans in the energy domain through an interdisciplinary approach to better understanding those energy-related perspectives driven by knowledge from all disciplines that pillared on technical experience, teaching skills, and stakeholder interaction (European University Association, 2017). It is evident that the researchers play a notable role in leading, grounding theories, and assessing the energy retrofitting process, particularly in the absence of the authorities' roles (Pitt & Bassett, 2013), with few conditions, high research skills existence, staking with real-world problems, and professional experience, that is predominated by knowledge exchange.

In conclusion, energy retrofitting practices barriers can be categorized into two parts: the techno-socio-economic aspects, and the second related to the stakeholders, in how and why to engage them in the process. Thus, ensuring the process's success led to selecting the "*right team members*" (Zedan & Miller, 2018) and the right stakeholder rather than the available ones. Then organize their relationship and solve the anticipated conflict.

3.3 Stakeholders Management Process

Regarding the Project Management Institute (PMI), the stakeholder is defined as "*an individual, group, or organization that may be influenced by or perceive itself to be affected by a decision, activity, or outcome of a project*" (Smith, 2000). In other words, the process of classification by "*interests, involvement, interdependencies, influence, and potential impact on project success*." The benefit of this process enables the project team to identify the appropriate focus for engagement of each stakeholder or group of stakeholders (PMI, 2017a).

Stakeholder management is one of the primary keys to project success generally used for managing organizations' stakeholders. Stakeholder engagement in such a project type is essential to solving interconnected real-world problems (Bryson, 2004; Nguyen et al., 2018). In other words, to determine the interaction among the interested parties efficiently. The concept is originated in the policy and management domain in the early 1930s (Brugha & Varvasovszky, 2000). The initial step of project communication management is to identify the people and organizations (stakeholder identification) who possibly impact (positively or negatively) and have an interest in the project. Then to be classified (stakeholder classification) based on similar interests, and claims, to their roles and attributes.

3.3.1 Stakeholders Identification

The PMI defined the stakeholder management process into four steps: identifying stakeholders, planning, managing, and monitoring their engagement. It provided five tools to identify stakeholders based on five factors, expert judgment, and meetings, besides gathering, interpreting, and analyzing the data. Table (03-01) presents the PMI factors to identify the stakeholders.

Table (03-01) The PMI aspects to identify the stakeholders in the organizations and the projects (the author) based on (PMI, 2017a).

Aspect	Highlighting
Expert judgment	a) The previous experience in any domain (knowledge, discipline, and area) related to the given topic; b) The ability to understand the project's politics, environment, and structure; c) The adjacent knowledge to the project objectives; d) Understanding the politics and power structures in the organization.
Data gathering	a) By brainstorming, surveys, and questionnaires.
Data analysis	a) Stakeholder analysis: by analyzing the stakeholders listing and ordering stakeholders based on their roles in the projects or positions in the organization, expectations, knowledge level, contribution, and support level (attitudes); b) Document analysis: Investigating the previous implementations (lessons learned) and evaluating the existing project documentation (all the documents generated over the project life cycle).
Data representation methods (Bourne, 2016; PMI, 2017a)	To classify the stakeholders regarding their impact on the environment or members of any project, such as: a) Standard 2X2 matrix: according to stakeholder's level of power (low, medium, or high), interest in the outcomes (low or high), support (negative, neutral or positive), and influence (low or high); b) Three-dimensional models: such as the stakeholder cube, attitude (blocker or backer), interest (passive or active), power (powerful or irrelevant).
Meetings	Towards a better understanding of the necessary project stakeholders. By relying on small-group discussions and workshops (physically or virtually via the internet).

According to The International Organization for Standardization ISO, ISO 21500 is a professional methodology that provides project management best practices, including stakeholder classification, particularly in complex projects[2] (Stellingwerf & Zandhuis, 2013), such as the energy retrofitting practices. Figure (03-02) shows the ISO 21500 stakeholder classification. Table (03-02) defines them and their roles in complex projects.

[2] It defined a complex project as any related-public project that includes the infrastructure and deals with governmental constraints.

Figure (03-02) ISO 21500's stakeholder classification in complex projects. (the author) based on (Stellingwerf & Zandhuis, 2013).

Table (03-02) Definitions of some actors and their roles in complex projects. (the author) based on (Stellingwerf & Zandhuis, 2013).

Stakeholder	Role
Sponsor (*Government representative*)	That launches the project, provides the funds, and becomes the 'owner' of the deliverables at the end to ensure that the benefits are achieved, which makes the government spending defendable; Who has a direct connection with the project manager to deal with any issues.
Contractor	Firms or organizations that implement the work and realize the project goal.
Steering committee	Senior managers from the governmental and practical sides ensure successful delivery within the given restrictions and identify the previously unknown potential.
Governmental experts	The individuals with the proper knowledge of the federal regulations (e.g., European Union) and local government.
Internal and external auditors	To ensure the fulfillment of organizational and legal constraints, such as financial barriers.
General public	The end-user of the final product of a public project.

According to Reed et al. (2009), stakeholder analysis is classified into three approaches: normative (stakeholder participation is regarded as an ethical issue), descriptive, and instrumental, which investigates how stakeholder participation can be used to achieve an organization's performance objectives. Each approach has a different typology and tools. They have provided systematic steps to identify stakeholders, which started from the broad part, brainstorming among focus groups to categorize the stakeholders, and ended with the detailed part, solving the fringe stakeholders' concerns. In between, many steps such as interviews with a broad spectrum of stakeholders, snowball sampling with initial stakeholders, suggested stakeholders from the selected stakeholders themselves. Figure (03-03) illustrates Reed's approach.

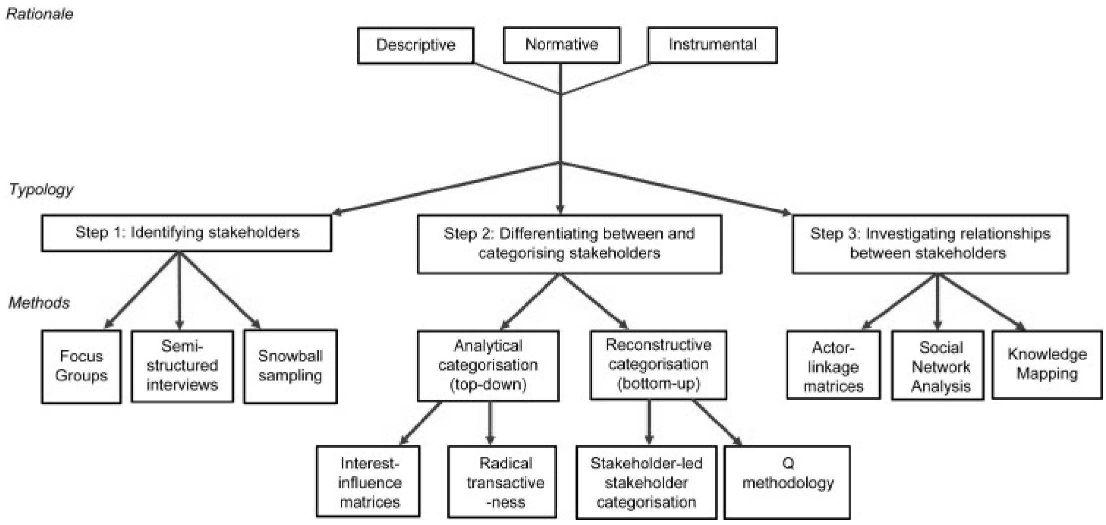


Figure (03-03) Reed's summary of the different typologies and methods to identify the stakeholders. (Reed et al., 2009).

3.3.2 Stakeholders Classification

Many studies have attempted to classify the "right" stakeholders involved in the built environment regeneration and energy retrofitting projects in the rural commons. First, the stakeholders can be classified into primary and secondary. The primary stakeholders who contribute financially and functionally to any development process. The secondary stakeholders are engaged indirectly but are essential during the development (Hamdan et al., 2021). This classification is suitable for rural regeneration practices (Usadolo & Caldwel, 2016), as they indicated that stakeholders should be included: agricultural extension representatives, technicians, and beneficiaries. Li et al. (Li et al., 2021) have emphasized this selection in rural China, and they highlighted the importance of collecting the opinions of the end-users (farmers) in addition to engaging the promoters and suppliers of the given intervention (in this case, the rural toilet retrofitting) to enrich the findings.

Secondly, building retrofitting domain classification. For instance, Xue et al. (2022) classified the stakeholders into three groups. First, the public sector focuses on energy objectives achievement (like the local municipality (Berardi, 2013), risks mitigation, and regulations. Second, the private sector focuses on financial profits. Third, the locals (people) usually explore the retrofitting benefits' technical and economic benefits. The participating and non-participating stakeholders in the adoption and implementation of energy retrofits were suggested in the reference (Fasna & Gunatilake, 2020). Figure (03-04) shows the possible involved stakeholders in the buildings' energy retrofitting practices.

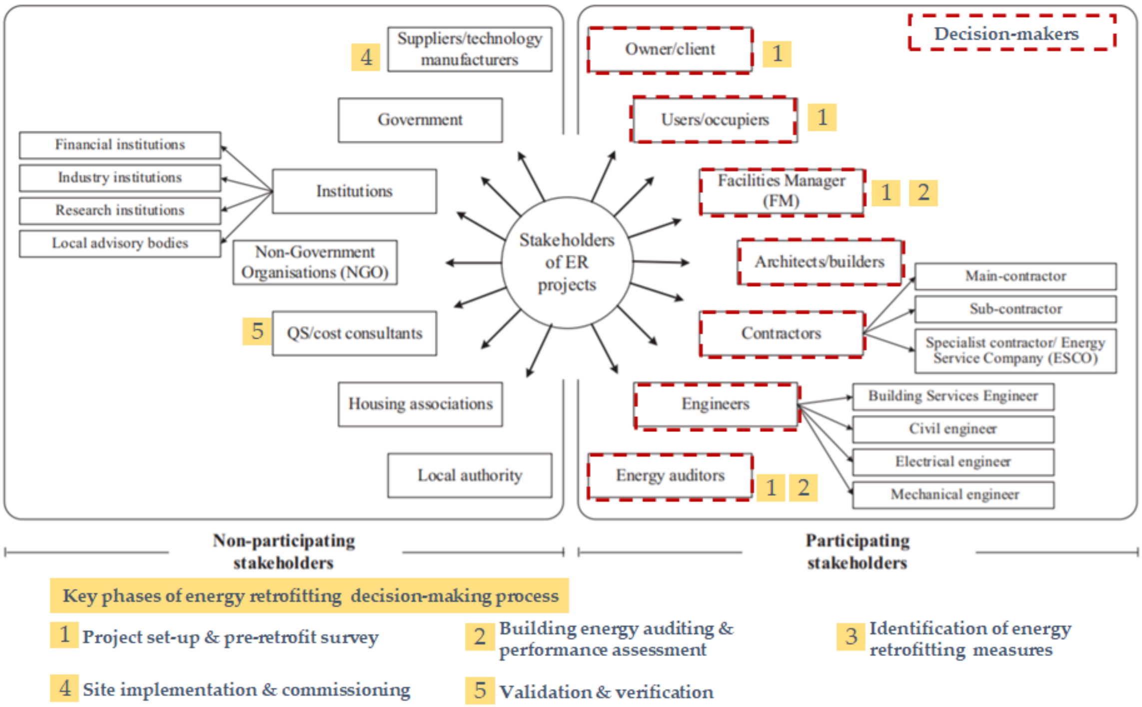


Figure (03-04) Shows the stakeholders involved in the buildings' energy retrofitting practices (Fasna & Gunatilake, 2020; Fasna & Gunatilake, 2019). The classification includes the internal/primary stakeholders or the external/secondary ones, noting that they limited the decision-makers to the technical team for retrofitting hotel buildings. Therefore, the scale of intervention (building) and the type (hotels) play a notable role in stakeholder identification.

Ongpeng et al. (Ongpeng et al., 2022) have underlined the role of the academic bodies (researchers and professors), practitioners (engineers, architects, urban planners, energy consultant engineers, and environmentalists), and finally, the end-users who belong to the case study or have their interest. The end-user does not necessarily have to be local. To clarify, according to the study of Franzò et al. (Franzò et al., 2019) about energy efficiency retrofitting measurements in Italy, they demonstrated the users as "energy users" who receive the benefit, the public or governmental sides was The Italian Regulatory Authority for Energy (ARERA), who is responsible to the regulation.

Colvin et al. (Colvin et al., 2016) discussed a different approach within the environmental domain, and they suggested a small sample of 20 participants from two groups, the experts (land-use change) and the community (locals and agricultural extension). They argued that the sum of participants' years of experience (300 years) is sufficient to be involved. However, they provided supportive aspects to identify these stakeholders: geographical location (within the given project's scope), interests (understanding the socio-ecological of the given topic), influence, intuition (by the practitioners, based on their past experiences), and using the traditional media and social media (to screen the interested parties and relative issues). The stakeholders should include practitioners from the field's experts and community. The total sample has been agreed that "*conflict between groups is a factor in their engagement processes*." Y. Liu et al. (2022) mentioned that understanding development purpose values could mitigate the conflict.

In the same context, Duggan et al. (2013) have identified the stakeholders integrated with the computational models initiated by identifying conventional stakeholder baseline groups based on the domain's practice and shared concepts, followed by the Intuitive and Evidence-Based categorizations into topics of interest across the determined stakeholders and analysis of data. Similarly, Gregory et al. (2020) have discussed different perspectives during their practical workshop about considering the political impact (power of influence) besides taking stakeholders seriously rather than identifying and engaging them. As well as involving the "*local*" stakeholders are essential to help the local authorities in energy plans such as "*reach internationally agreed climate goals.*" (Hettinga et al., 2018). Vogwell (Vogwell, 2003) has divided them into internal ones staking in the project and impacting it, and external ones who have the interest (not organization).

As described in a recent project, INTER VENTURES[3], Jaansoo (Jaansoo, 2019) has provided a methodology to identify the stakeholders by answering several questions, as seen in Table (03-03). She suggested criteria to help the "*Project Partners*"[4] decide which stakeholders to engage and how by profiling the stakeholders. Figure (03-05) illustrates the stakeholder profiling example.

Table (03-03) Stakeholders analysis elements (Jaansoo, 2019)

Aspect	Description
Interest	What is the stakeholders' willingness to engage in the process?
Influence	What is the influence of the stakeholder on the results? Whom do they impact?
Expertise	Has the stakeholder sufficient expertise on the given project?
Orientation	The stakeholder perspective on the project's results is collaborative or not?
Vulnerability	To what extent will the project impact the stakeholder?
Trust	To what extent is the mutual trust between the project partner and the stakeholder?

Stake-holder	Influence	Interest	Expertise	Orientation	Vulnerability	Capacity	Trust
A	**High:** Stakeholder is a key shaper of opinion in this field	**High:** Stakeholder has high interest and willingness to engage with this project	**High:** Stakeholder's knowledge in the issue is of value to the Project Partner	**High:** Proactive Stakeholder	**High:** the Project will directly impact the life of this Stakeholder	**Low:** the Stakeholder has few resources for engagement	**Low:** mutual trust is low
B	Medium	Low	Medium	Low	Medium	Medium	High
C	Low	Medium	Low	Medium	Low	High	Medium

Figure (03-05) An example of stakeholder profiling to help analyze the stakeholders (Jaansoo, 2019).

Eventually, numerous techniques help analyze the stakeholders in terms of interaction, influence, such as Stakeholder Power-Interest, Figure (03-06), RASCI Chart for responsibilities and roles, Stakeholder Attitudes, and Stakeholder Salience model. Many models and techniques have been elaborated in references (Schmeer, 2000; Bourne, 2016).

[3] The project aims to create competitive regional ecosystems within vast European areas (funded by the EU) (Interreg Europe, 2019).

[4] It is noteworthy that, although the criteria are limited to helping the project partners (nine bodies) who are already involved, the author argues that the process can be beneficial to our study context.

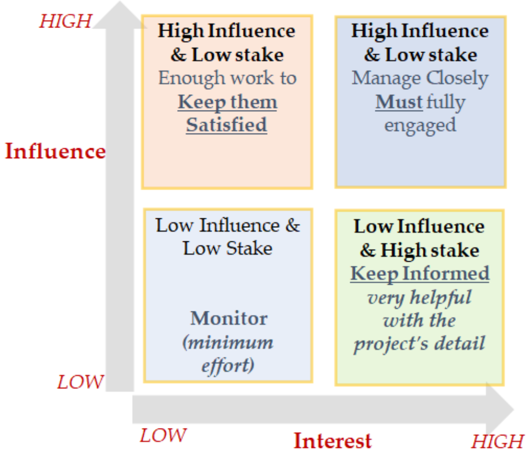


Figure (03-06) Power-Interest matrix based on the influence and interest

3.3.3 Selecting the Stakeholders in Lasaifar Albalad and Pontinia

The stakeholders in this study are selected based on four aspects, the theoretical background and the practices in different domains in line with the objective of the study, the results of talks and interviews with the different population samples in the on-site investigation in Lasaifar Albalad village (Chapter One) besides a past relevant study implemented by the author (Abouaiana, 2021), and finally by the scientific observation, intuition, and experiences in both professional and academic in rural commons in the regions of Lazio and Delta. The considered stakeholders in this study were discussed in (Chapter Four). Figure (03-07) summarizes the considered inputs that led to the stakeholders in this study.

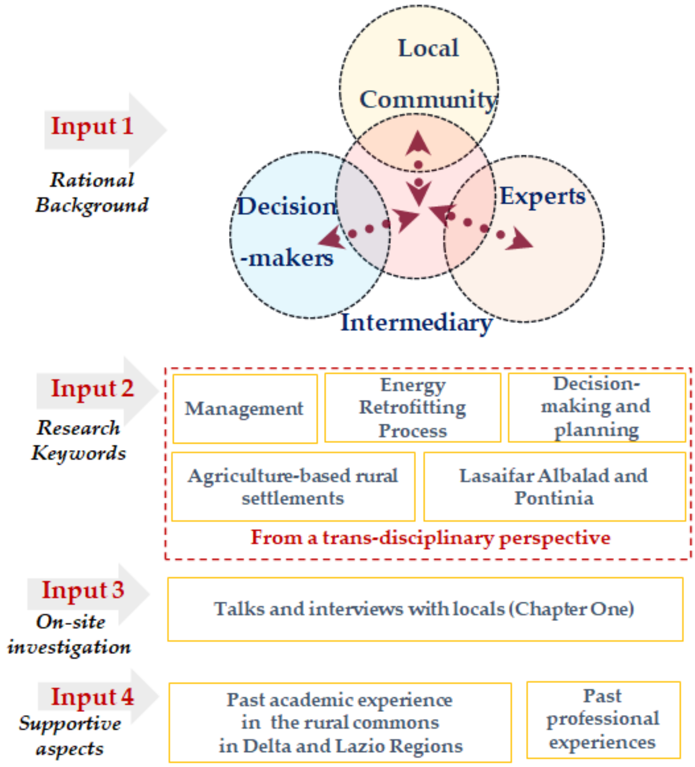


Figure (03-07) The considered inputs that led to the stakeholders in this study.

3.3.3.1 Input One: The Rational Background

In general, from a project management perspective, the PMI enhanced the role of expert judgment, brainstorming, meeting, and data collection to determine the stakeholders. Besides analyzing these data using different tools and techniques based on influence and power. In the same domain, Serrador (2009) has underlined the role of the experienced project management team in "*identifying and managing the internal and external stakeholders to determine the project requirements and expectations of all parties involved.*".

In conclusion, in general, and in the energy regeneration vein, many studies and approaches demonstrated stakeholder importance at any level, the micro-scale (within the organizations or the firms or one building) and macro-scale (small and complex projects). Meanwhile, it has three forms. First, the high-engaged stakeholders (internal or primary) provide a highly active contribution that impacts the study's objective. Secondly, the low-engage stakeholders (external or secondary) indirectly affect the decisions, such as the locals interviewed to explore their awareness or point of view about the interventions. Thirdly, supportive stakeholders (sponsors or intermediaries) such as the NGOs as facilitators.

For example, the architect and sustainable building practitioners with the building owner might be enough to retrofit small private buildings. Depending on the adequate awareness of technicalities (e.g., energy regulations), otherwise, a person aware of legislation should be involved. In particular that the author has implemented a survey previously to assess the awareness of the national energy code among the architectural firms in the Egyptian context (Abouaiana & Mohamadin, 2018). The findings showed that the majority of the architects, mainly in the small firms[5], did not hear about the code before. So the researchers can enhance these practices, particularly the architects who hold post-graduate degrees.

On the contrary, on the macro-scale, the stakeholder in public projects should include the relevant academic body, technical team, governmental representative, and local authorities related to the context, such as conservation bodies in cultural heritage or agriculture associations of the rural communities (precisely like our study). In addition, the owner (client or user) might be a resident, a local municipality, or an organization, and the "*right*" interested parties (e.g., local supplier and private sector).

To clarify, the type of intervention helps engage the interested local supplier, such as relying on passive solar techniques with the high solar irradiance in Egypt, then solar energy provider would be beneficial. Likewise, relying on the aerodynamics techniques in rural settlements in Italy due to high wind speed and vast agricultural areas (Francese et al., 2017) or using wooden biomass in rural mountain settlements in Italy (Mutani et al., 2018). This argument supported the experiment of Colvin et al. to maximize scientific and practice experience in determining the stakeholders according to the existing situation.

3.3.3.2 Inputs Two, Three, and Four

In line with the study states, "management approach to retrofit energy efficiency in the agriculture-based rural settlements in Egypt and Italy." The intervention aims at two practices. First, to support the decision-making of the bottom-up technical intervention that is intended to be implemented in case studies. From this perspective, the project should involve experts from the project sub-domains. To answer: who has the

[5] They contribute notably to a high share of design-build private residential projects.

influence, interest, and power to achieve the objectives? Who can prevent achieving them? Why do the projects need them?

For more elaboration, the stakeholders should include the "users" from the geographical area (Lasaifar Albald and Pontinia) from the experienced local representatives such as farmers, residents, employees. They can act as social and cultural experts regarding contributions, strategies, acceptance, and informing the residents. In Italy's rural development practices, "*the stakeholders' samples should represent different backgrounds*."(Sardaro et al., 2021). In Egypt, although the intervention is in line with the recent initiative Decent Life (Haya Karima, 2021), the author emphasizes that a governmental body should be involved in the process. The author interviewed many locals in Lasiafar Albalad village in April 2021 as an initial step to the intervention to discuss, describe the project interventions, and brainstorm. Figure (03-08) shows a memorial photo between the author and the locals during the project discussion.

In this meeting, the author discussed face-to-face with a small sample of the manager and four inhabitants (two farmers, an employee, and a business owner) about the aim of the study and the expected findings, their point of view, the existing village's situation (with focus on energy issue) and the national sustainable strategies. In addition, the same aspects have been discussed with many locals by phone calls. It is worth mentioning that the mainstream of the interviewed locals was enthused to help in developing their village. However, they were reluctant to bear any financial burdens.

(1) (2)

Figure (03-08) Shows the early collaboration, and open discussions between the author and the stakeholders in Lasaifar Albalad implemented in April 2021 to describe the overall goal. Panel 1: the Agricultural Extension Center from outside (taken by the Author). Panel 2: shows the Author with the agriculture association's manager and a local (taken by an employee). In addition, many on-site investigations related to retrofitting dwellings in Lasaifar Albalad have been carried out (Abouaiana, 2016; Abouaiana, 2021).

To describe the stakeholders who should be engaged: Firstly, the sponsors will add value to the projects (local authorities and the private sector). First, the public-related-agriculture authorities are prominent actors, like the agriculture association in Lasaifar Albalad, which represents the local governments and are significant actors in the national sustainable rural development initiatives such as Decent Life in Egyp.

Likewise, in Italy, the agriculture consortium in Pontinia represents the national policies, such as the EU rural action plan to support increasing environmental, climatic, social resilience (Reterurale, 2021) development of energy efficiency in the agriculture communities (European Commission, n.d.), especially with the outstanding support by the Common Agricultural Policy "*il Piano Strategico Nazionale*" (CAP 2023 –

2027)[6] to the local municipalities (like Pontinia) towards energy transition and fighting climate change (Mazzocchi et al., 2021; ARSIAL, 2021; MISE, 2019). From this fact, there is a potential of engaging the municipality of Pontinia.

Secondly, the private sector sponsors can provide funds technical support. Vice versa, they benefit from a good reputation and marketing. The author has already contacted two suppliers to engage them in the process. The first is a startup developing biomaterials from agro-waste (Mycellium, 2021) (the Delta region is a primary agro-waste source)[7]. The other sponsor is a solar energy supplier. Both agreed to participate in any activity related to the project, as well they high-interested in participating in a probable collaboration in the local and European contexts.

Thirdly, the academic experts or the technical team consists of academic bodies interested in leading the research, as indicated in the cross-disciplinary energy retrofitting practices. Namely, the architect and urban planner deal with building and built environment conditions, the environmental engineers deal with the energy science and renewable energy issues, and a project manager provides the relevant technical support. Finally, the agriculture associations can facilitate agricultural scientific needs.

Fourthly, the intermediary stakeholders can facilitate the project's success and raise awareness inside the village and the Delta region, namely, local programs producer in a daily TV program (Good Morning Delta) on the official national TV of the Delta region (Channel Six)[8]. Finally, an NGO from the village can assist in organizing the workshops. Social media platforms can act as disseminators.

Consequently, this study suggested a transdisciplinary core team to fulfill the ambitious objective of managing and organizing the interlocking relation between the stakeholders in the early stage of built environment retrofitting decision-making. It provides a mixed approach between the Bottom-Up (research practice) and the Top-Down (in line with the national initiatives and engaging/informing the decision-maker). The collaborators are experts and decision-makers, academic, non-academic, to flourish the epistemology (OECD, 2020a) as follows:

- The academic researchers, predominated by sustainable architecture and sustainable rural commons principles representing in Sapienza University, Department of the Planning, Design, and Technology of Architecture (PDTA) (high interest);
- The technical experts from the social, applied, and natural sciences, namely, an architect, an urban planner, an environmental researcher, and a project manager (high-interested);
- Humanities are represented in the experienced locals as cultural experts (high-influence);
- The relevant private sector and local suppliers (high interest and will benefit);
- The local authority representing the agriculture official bodies (high-power and high-influence);
- NGO and sponsors (facilitators and will benefit);

[6] The 2023-27 CAP is a new regulation proposal. The regulatory framework not yet defined and consolidated. The first version for the national strategy will be provided by 31 December 2021 by the Italian Ministry of Agricultural, Food and Forestry Policies (Mipaaf) (MiPAAF, 2021).

[7] The author recently investigated the role of the novel material as an insulation dwellings envelope in another rural settlement in the Kafr El Sheik Governorate (Lasiafar Albalad belongs to it) (Abouaiana & Mendonça, 2022).

[8] The potential is that the author has been involved a few times in the national TV to evaluate the environmental aspects of national urban development projects in the Delta region and raise the local society's awareness towards these practices, which may help in this practice.

- local community and farmers (influencer and will benefit).

The involved stakeholders have been presented in (Chapter Four). Figure (03-09) illustrates the proposed transdisciplinary collaboration.

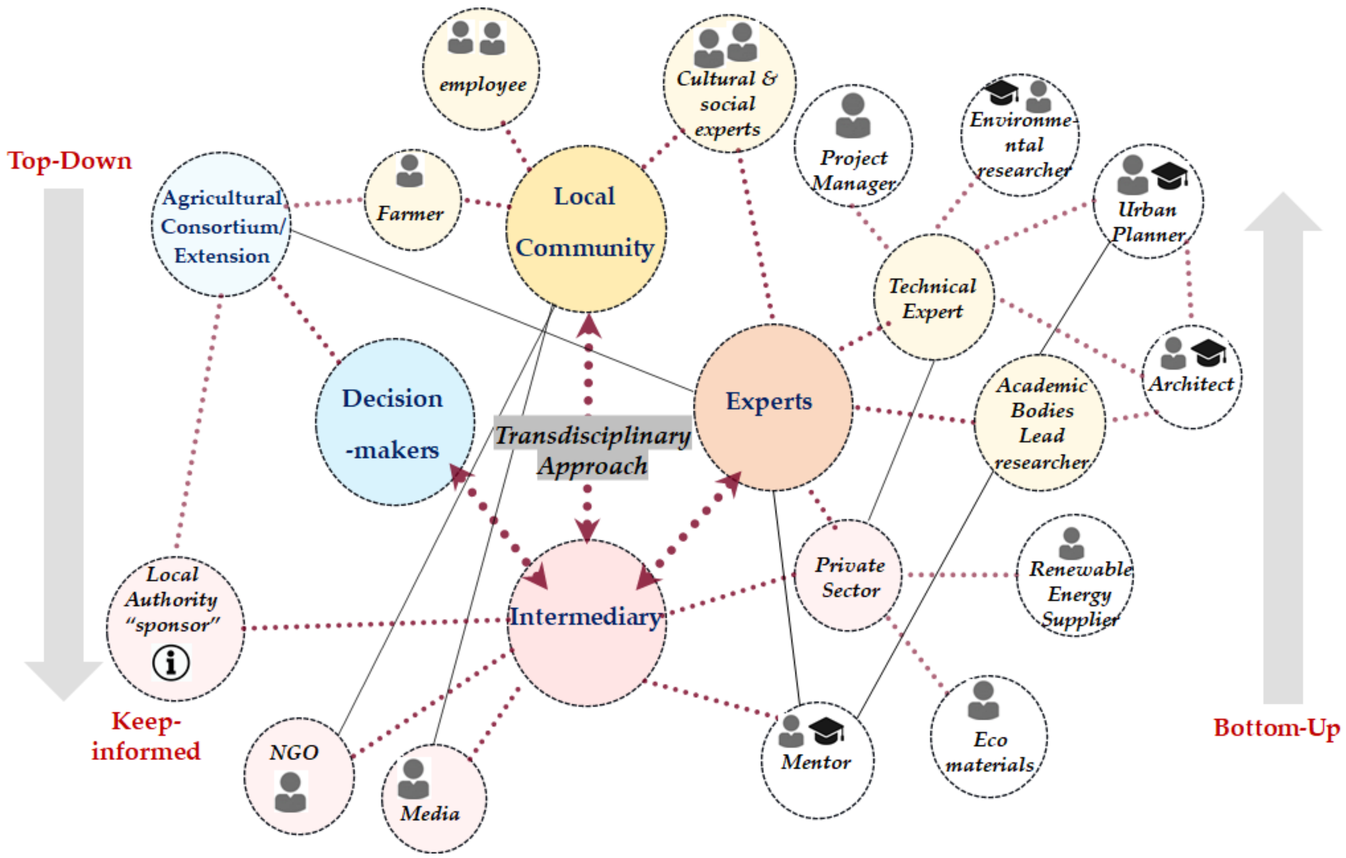


Figure (03-09) The suggested transdisciplinary framework and the engaged stakeholder's roles. Each stakeholder belongs to one or two groups. For instance, the "media" stakeholder is a resident. The lead researcher is an architect.

3.4 Teamwork Management

"Team" is defined as the interaction or collaboration between two or more individuals to achieve shared objectives through organized tasks distributed organizationally relevant tasks with different roles and responsibilities (Kozlowski & Ilgen, 2006). Team management is a systematic procedure of monitoring members' work progress to ensure success. This process occurs within the projects (PMI, 2017a). In other words, the integration of versatile skills based on communication, conflict management, negotiation, and leadership.

According to Note (2016b), a successful project requires a good project manager, and skilled team characteristics are essential to project accomplishment. He has identified 70 essential traits in the project manager and the differentiation between the leader and the manager. For instance, the manager controls making the decision (who dictates when and how). Vise versa, the leader is passionate about facilitating the decisions (who persuades what and why). A similar description of the "servant leader" has been provided by PMI (PMI, 2017b).

The study of S. G. Cohen & Bailey (1997) has defined collaborative work into three groups, Project Team that produce one-time outputs in a limited time (new plan and new system), Parallel Team for problem-solving and improvement-oriented activities, and Work Teams. In the same realm, Choi & Pak (2007) have developed a framework for implementing multiple disciplinary practices to determine the need for collaborative work (teamwork). The framework consists of eight strategies for successful and efficient collaborative work. Figure (03-10) summarizes the strategies and the main characteristics. Although they focused on the health field, the author argues that this framework can benefit different domains.

Team	Enthusiasm	Accessibility	Motivation
Qualified team; Maturity.	Commitment; Guidelines availability.	Team proximity; Connectivity.	Inducements; Efficient time and funding.
Workplace	**Objectives**	**Role**	**Kinship**
Institutional pillars.	Mutual mission and vision.	Multitude; Many; Mass	Communicat-ios; Fruitful criticism.

Figure (03-10) Suggested guidelines, so-called TEAMWORK, to support the selected team's collaboration in the multiple disciplinary practices. (the author) based on (Choi & Pak, 2007).

In software engineering, traditional project management suffers almost from one problem, the introduction of superfluous product features (like Microsoft Word) or what so-called "scope bloat." It exists in all software types. For instance, 80%of the product's features are not infrequently used (Layton et al., 2020). Beyond the technical definition, the project manager or the leader plays an essential role in facilitating the project activities, like the lead researcher who should resolve the project conflicts.

3.4.1 Conflict Management

"*Conflict is inevitable in groups and organizations*" (A., 1994), among humans (Rahim, 2017), and in a project environment (PMI, 2017a). For instance, in software engineering, team conflict is considered a foremost factor that can ensure project failure (Nunkoo & Sungkur, 2021). It is generally enhanced by solid project management practices, such as responsibilities description and communication planning. Fortunately, if the conflict is appropriately managed, variations of opinion can lead to increased innovation and enhanced decision-making. It becomes advantageous (constructive) (Nunkoo & Sungkur, 2021), and the diversity may build better teams (Silveira & Prikladnicki, 2019), promotes brainstorming and discussions that lead to critical assessment (Jehn, 1995), and enables team members to think across concepts towards better performance and enhance results (Villax & Anantatmula, 2010).

Transdisciplinarity is characterized by conflict (Julie T Klein, 2008). The collaborative team works investigated widely from several perspectives such as (health care, project management, economics, education, and software engineering). The literature has demonstrated numerous aspects that affect conflict in collaboration, such as cultural diversity (Jackson, 1991; Millhous, 1999), members satisfaction (De Dreu & Weingart, 2003), poor communications, and work allocation (Chan & Chen, 2010), trust (Bagshaw et al., 2007), vagueness and authority (Tosi, 1994), and lack of team coordination (Nunkoo & Sungkur, 2021). Figure (03-11) summarizes the conflict management process.

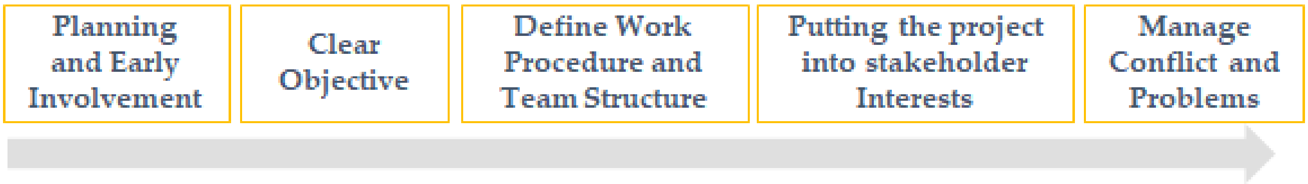


Figure (03-11) summarizes the work management (the author) based on (Thamhain, 2016). Managing conflict and resolving barriers is an essential step during the implementation phase.

For example, Guan (Guan, 2007), in the projects environment, stated that conflict occurs for many reasons related to the project procedure, personalities, such as the different perceptions of members (technical), various perspectives of the purpose and scope (objectives), misunderstanding of the work style preferences (personality), variances of the tasks' sequencing (prioritizing), and poor planning. Besides the geographic scatter of the team members (a commonly affected aspect during including stakeholders) (Colvin et al., 2016).

Snedaker (Snedaker, 2005) has emphasized that managing people from diverse cultures turn into standard technology that brings together people globally. She highlighted some typical barriers and provided guidelines to deal with them. To clarify, those related to different languages (e.g., understanding the local culture, proper name pronouncing), feedback to team members (e.g., the situation that requires feedback to achieve the results), and avoiding questions on the received feedback (even the wrong). Because in some cultures, it means disrespect and gender, value, and generational differences. The author supports this argument from a behavioral perspective because sometimes (specifically in small-scale architectural firms in Egypt), constructive feedback or criticism is interpreted as a personal offense. Thus understanding team conflict enables to resolve the causes, not the symptoms (Verma, 1998).

Conflict management is essential to align the stakeholders on the project's objectives, description, and requirements (PMI, 2017a). According to the Food and Agriculture Organization (FAO) training manual (Arops & Beye, 1997), the emerging conflicts should be resolved, possess unique skills to react to conflict situations, and create an open climate for communication between conflicting parties. Figure (03-12) summarizes the elements that impact conflict resolution.

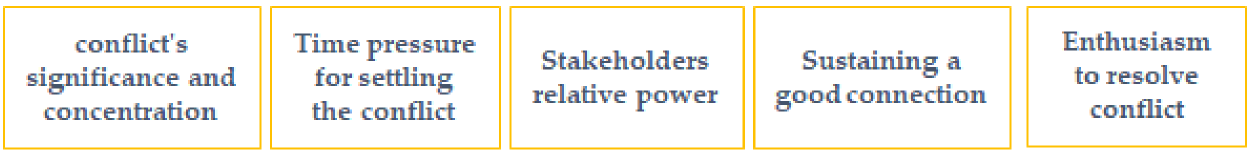


Figure (03-12) The aspects which impact conflict resolution. (the author) based on (PMI, 2017a)

Numerous studies have discussed the common five strategies that can resolve conflict management. Namely, avoidance, compromising, obliging, forcing, and collaboration strategies. (Arops & Beye, 1997; Lee, 2008; Daly et al., 2010; Parida et al., 2013; Prieto-Remón et al., 2015; PMI, 2017a)

In short, First, withdrawal or avoidance style is proper either when conflicts are irrelevant or when the other party is obstinate because of rigid behavior. This strategy helps in the non-important issues. Receding from a potential or an actual conflict condition postpones it to be organized or resolved by others. However, it has low cooperation and low confrontation (a lose-lose situation).

Second, the compromising style is when both sides have the same power level to set their conflicts aside to solve the pending conflict and reach a common ground. This style pays a median concern for self, and the other is (a lose-lose situation). Third, the forcing style is when one party who has high power dominates to satisfy their own concerns account of the others (a win-lose situation).

Fourth, the obliging style is associated with accepting the other party's concerns to sustain the relationship, not the process. It Focuses on the compatibility points and prioritizes the collective interest rather than the individual. It pays low concern for self and high concern for others (a lose-win situation).

Finally, the collaboration enables each member to understand the other side's visions, reasons, and motives by sharing information cooperation to synthesize the optimum solutions and solve problems that can satisfy the conflicting parties and enhance the process. In addition, it pays high concern for personal goals and relationships (a win-win situation). Figure (03-13) shows the techniques to resolve the conflict.

Withdraw / avoid	Retreating from an actual or potential conflict situation; Postponing it to be organized or resolved by others (lose-lose).
Compromise /reconcile	Compromising the solutions among the participants (The worst technique it led to lose-lose situation) (lose-lose).
Obliging / Smooth Accommodate	Focus on compatibility points; Prioritizing the collective interest rather than the individual (lose-win).
Force /direct	Enforcing the standpoint on the others (by the power of influence) (win-lose).
/ problem solve Collaborate	Encompassing various opinions and visions from varying angles; harmony and dedication among members (win-win).

Figure (03-13) The techniques to resolve the project conflict. (the author) based on (PMI, 2017a).

In line with the study aim, the collaborative style is the appropriate approach where the research leader suggests possible technical solutions and framework, with the engaged stakeholders who are enthused to contribute to enhancing their own built environment and feedback on the process. Both intend to share insights and standpoints to support the national strategies for energy efficiency retrofitting. The potential concern of integrating this ambitious framework within the Egyptian national strategies for two reasons, the local networking by the author with the decision-makers in the Delta region then the government encourages the youth to provide their ideas directly to the presidency website (PresidencyEg, 2021). Likewise, in Pontinia, which is supported, for instance, by the Horizon Europe program, clusters five and six within the second pillars of climate, energy, agriculture, and environment (European Commission, 2021).

The PMBOK Guide (PMBOK Guide, Sixth Edition) provided a systematic way to solve the project's problem, including the conflict, by identifying boundaries and limits. Then, splitting the problem into small items to be ease-resolved. Finally, collecting the available data and inputs, integrated with analyzing the causes and putting the possible scenarios to select the proper solution to be evaluated. Figure (03-14) shows the systematic procedure for resolving projects' problems.

Identifying	Specify the problem/s
Definition	smaller, manageable problems
Investigation	Data Collection
Analysis	Root causes
Solving	Appropriate solution selection
Solution checking	Evaluation

Figure (03-14) The techniques to resolve the project's generic problems (the author) based on (PMI, 2017a).

The guide has demonstrated the importance of exchanging information (communication) through available means such as physical and virtual meetings, project documentation, e-mails, and social media platforms. Hence, determining the agreed-upon communication strategy for stakeholders and project requirements, for instance, preparing a communication plan that ensures the information flow and the delivery of messages, so-called Project communications, describes all the communication life cycle, such as creating, collecting, and tracking. It is worth mentioning that digital communications in the aftermath of the pandemic led to a high level of interactions, which will play a crucial role in this study.

In the Italian context, at a glance, Prata & Ercoli (Prata & Ercoli, 2010) have argued that Italy is an unusual country in Europe in every aspect, including projects management, which is characterized by continuous changes like in planning. That gives a rudimental indicator to understand the local Italian culture, to be noted while implementing the practical part of this thesis in Italy. Although Zein (Zein, 2016) has supported this, the author disagrees with their arguments for two reasons. First, these findings are limited to the particular projects on an enterprises' scale. Second, the author is involved in an ongoing Italian national academic research project[9] and observed a well-organized work plan. The author believes and advocates that understanding culture can enhance communication and project performance (such as daily life situations, language, music, and movies).

"*Si fueris Romae, Romano vivito more*[10]." attributed to Saint Ambrose.

As a sequence of the mandatory transdisciplinary collaboration in traditional settlement retrofitting, it is evident that the complex and interlocking relations among the stakeholders are a real challenge. Solving conflict is one of the most critical aspects that consumes time (Madalina, 2016). Therefore, this study argues that Agile Methodology will provide a successful framework for solving the anticipated problem and organizing their relation.

---

[9] The PRIN 2017-2020: TECH-START is a national project in a collaboration between six academic and research bodies partners. It aims to refurbish the existing building stock, dwellings, spaces, material, and energy flow by a deep investigation of the relationship between "open space – building" systems and key-enabling technologies to design smart environments for climate mitigation, supported by digital technologies and low-cost IT devices, managing of data knowledge, scenarios simulation, strategies and models, pilot projects experimentation (Research Gate, 2020; SITdA, 2020).

[10] literally means "*If you are in Rome, live according to the Roman custom.*"

3.5 Agile Methodology – Introduction

"Agile" term refers to "*moving quickly*" (Balaji & Murugaiyan, 2012). It is a justified, engineering-based approach (Dybå & Dingsøyr, 2008), and a mindset in every aspect of life, "the capability to creation and reaction to change," agile methodology area group of project management approach. That is indicated by a massive collaboration where the team works together thoroughly toward a common objective while taking full responsibility for the outcome (Inayat et al., 2015; Theocharis et al., 2015).

Agile Manifesto is a document, formally called the "Manifesto for Agile Software Development, "produced by 17 developers in 2001. The "Agile Alliance" developers sought an amendment to the software development processes that they saw as cumbersome, unresponsive, and too focused on documentation requirements. The manifesto consists of four pillars (people, communications, deliverables, flexibility). In addition, it pays exceptional attention to organizing and managing the relations between stakeholders (team and customer) efficiently, producing products with the highest priority in the highest value, client satisfaction, and continuous acclimatization due to inputs fluctuations and variations (Agile Manifesto, 2001; APM, 2021; Beck, Beedle, et al., 2001;Highsmith & Cockburn, 2001). Figure (03-15) illustrates the agile methodology basics and disciplines.

BASICS	**organizes& manages teamwork relations efficiently**	**producing products highest priority value**	**client satisfaction**	**acclimatization due fluctuations & variations**
12 PRINCIPLES	highest priority is to satisfy the customer	Business, people & developers must work together daily	Working software is the primary measure of progress.	Simplicity--the art of maximizing the amount of work not done--is essential.
	Welcome requirements change even late development.	Build projects around motivated individuals. Give them environment, support & trust	Promotes SD. (sponsors, users& developers, should maintain a constant pace indefinitely.	The best designs & requirements, emerge from self-organizing teams.
	Deliver working software frequently, 2weeks ~ 2 months, (preference to the shorter timescale).	face-to-face the most effective method conversation to convey information	Continuous attention to technical excellence & good design enhances agility.	team reflects on how to become more effective, then adjusts its behavior accordingly.

Figure (03-15) Agile Methodology Concept (the author) based on (Agile Manifesto, 2001). The figure showed the importance of cooperation among stakeholders. Teamwork is vital to agile product development. Therefore, creating good products requires cooperation among all team members (stakeholders).

3.5.1 Agile and Traditional Methodologies: at Glance

"*When the waterfalls, it cannot go back up*" (Conrad, 2011). Thus, the waterfall methodology (the traditional approach) employs a consequent or linear method for software development (Thesing et al., 2021). That tolerates high costs and risks that affect information management efficiency, and the customers are excluded (López-Alcarria et al., 2019). The agile methods counterpoise these risks (McKnight, 2014), namely the un-stable requirements during all the phases of developing and delivering the product in a short time and within the budget. It is a documentation-driven and heavyweight process. (Agile Alliance, 2021a).

In project management, the waterfall approach is a linear and straightforward process. Simply, when the step finishes, the next starts. The requirements and data are being collected and documented from the beginning, including the expected outcomes. Figure (03-16) shows the conventional and agile life cycle in project management.

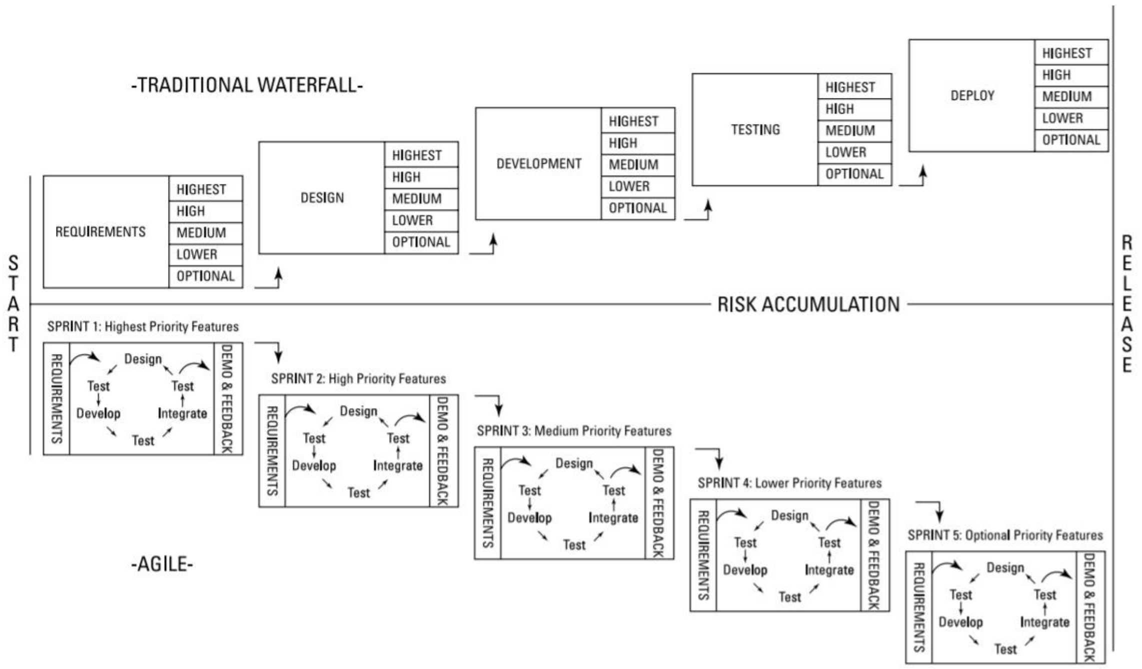


Figure (03-16) The conventional and agile life cycle in project management (PMI, 2017a). The entire process of the traditional way is sub-divided into many small iterations in the agile one.

The traditional way is a detailed, long-term project plan with a single timeline, a conclusive project procedure, and rigid team roles that simultaneously improve all elements. The tasks assigned by the project manager are to be implemented by the team members within a timeframe. A strict hierarchy regulates the team members. The clients participate in the project's beginning to tell the requirements, maybe in-between to follow up the progress and the project's end to receive the deliverables, which are fully completed be seen succeed entirely or not succeed. Viceversa is the agile approach. The process is divided into short phases based on iterations and multiple deliveries. The team is multi-disciplinary. The customer is involved as an active contributor. Changes in deliverables are anticipated and less impactful. It is a more collaborative and transparent approach (Fair, 2012; Hartson & Pyla, 2019; Layton et al., 2020; Thesing et al., 2021).

Is the traditional way wrong? The author argues, definitely no. It is a matter of limitations, context, political situation, the whole scene. To clarify in a practical scene, Rodov & Teixidó (Rodov & Teixidó, 2016) stated both techniques could be blended for the project's sake. For example, while implementing an agile project, the traditional mindset is highly recommended when the managers define "*the minimum viable product and the product backlog*." Sometimes, the traditional way can predefine the cycle, milestones, and deliverables throughout the development model (Archer & Kaufman, 2013) (compliance to the process) (Depaire, 2019). – more about agile is presented in (sections 3.5 and 3.6).

For instance, in the Egyptian context, in the architectural practices at small-scale firms, the traditional approach is the "right" style, where the design team (architectural, structural, and electro-mechanical) engineers have the experience that emerged from the amount of delivered similar projects, such as understanding the client's culture and behavior[11], aware of the regulation, building techniques, as well as

[11] A too relevant example is the majority of the clients require "realistic" high rendered images (3D interior design) during the design phase as a mandatory quality issue, vice versa in the Italian market from the equivalent firms- based

the contractors and the laborers. It indicates the proper style based on the requirements (features), cost, and time triangle. The author argues that the traditional way is more appropriate for small projects with limited stakeholders and direct requirements like retrofitting a farm building or a dwelling. Contrariwise the more complicated project and the multi-engaged stakeholders require an experiment-based agile approach. Figure (03-17) shows the comparison between the agile and the waterfall methodologies.

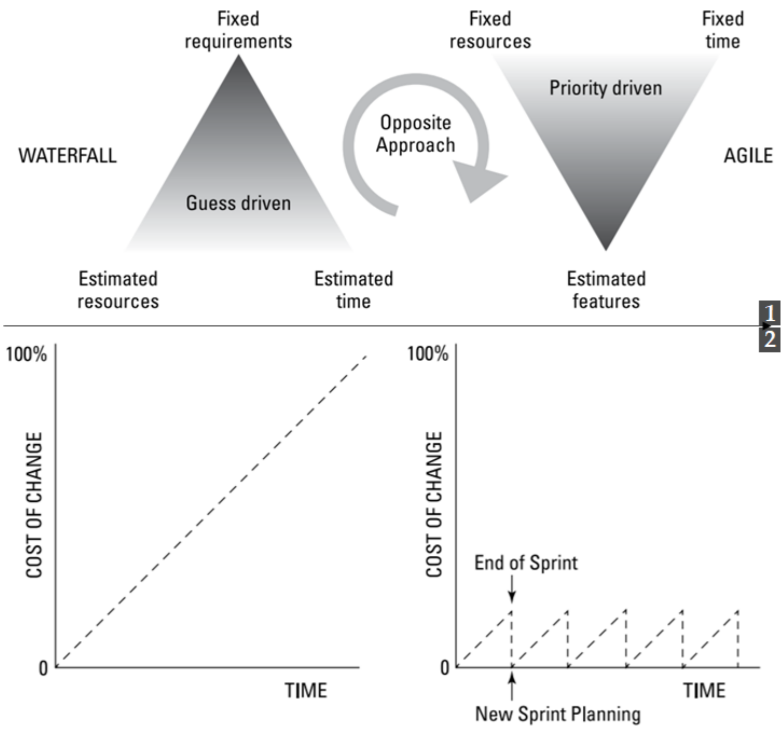


Figure (03-17) Comparison between conventional and agile methods. Panel 1: summarizes the theoretical concept. Panel 2: shows the opportunity to change (cost and time) (Layton et al., 2020).

3.5.2 Traditional Energy Retrofitting Projects Management

The Natural Resources Department, Government of Canada (CNRC, 2016) has provided a guideline for retrofitting the non-residential buildings in four steps. First (data collection) to evaluate the potential for renovation building to identify the proper solutions. Second (selecting the optimum technical), to develop a plan, incorporating appropriate timing with a compelling business case. Third (implementation), preparing the management plan, including selecting the qualified contractor, building communication with the team and the owner, plays a crucial role in project success in regular project meetings to inform the owner of progress updates and sharing project management information. At the same time, the team should predict the possible risks related to scope, time, and cost (a traditional way). Fourthly (monitoring), maintaining the post-retrofit performance to enhance the return on investment. The guide referred to the PMBOK Guide in the management process.

---

on the Author observation- the clients can accept a "good" rendered and sketches (visual production quality not the design quality).

The Institute for Sustainability, UK (Institute for Sustainability, 2009) has provided guidelines for managing low carbon retrofit projects (Prewett, 2011). The guidelines emphasized the weakness of traditional energy reduction approaches within the construction industry, such as lack of interest for the clients, lack of awareness from the technical team, lack of post-retrofitting monitoring, and limiting testing to check performance because of the linear sequence of the process. Therefore, he suggested a project retrofitting coordinator (rather than a project manager) responsible for supporting all the involved stakeholders within the project life cycle, efficient communication, and availability to take the decisions whenever needed. Any within the project can act the role, such as architects, building surveyors, energy engineers, and construction managers. Simultaneously, the coordinator should be aware of the local energy regulations and able to transfer the cutting-edge innovations into the project, which supports the recommendation of Hausladen & Tucci.

Another traditional approach to retrofit building has been provided by Rhoads (Rhoads, 2010). Started from defining the aim of retrofitting, identifying the stakeholders and the roles, engaging clients in determining the goals, exploring the obstacles (typical agile practice), controlling the financial plan, optimizing the proper retrofitting solution, selecting appropriate technology, then delivering and post-retrofitting assessment.

Fox (Fox, 2003) has discussed the retrofitting project management within the firms. He stated that retrofitting requires more particular consideration than any domain. Retrofit projects face additional risks, such as overtime, costs, and unforeseen (external) events. The management and engineering efforts are higher than the efforts in building new projects. Thus, the team members and project managers should have sufficient experience and interest and interact efficiently with others within the team and outside. They should have a clear definition of objectives, roles, and authorities and be aligned with the project. An additive feature, in large projects, engaging another discipline (business management) will support the technical intervention. In terms of communication, he advocated regular and short review meetings to discuss the issues rather than resolving the problems. Finally, top management should support the retrofitting team by enabling them to make rapid decisions within the agreed responsibility and authority.

3.5.3 Agile Methodology Practices – Software Engineering

Agile methods are a set of practices in software engineering that include many frameworks, such as eXtreme Programming (Fojtik, 2011), Lean (Staats et al., 2011), Crystal Methodologies (Strode, 2006), and Scrum (Hron & Obwegeser, 2022). They are indicated by a massive collaboration (Inayat et al., 2015; Theocharis et al., 2015). Moreover, it focuses on the social factors of software engineering as a mainstream practice in the field (Hoda et al., 2017) instead of the conventional waterfall approach. Dybå & Dingsøyr have discussed some of these methods.

The first example is the Lean methodology originated in the industry and products development. The terminology was coined in the 1990s. It is globally used in manufacturing (Toyota), E-commerce (eBay) (Poppendieck & Poppendieck, 2003; Womack et al., 2007), and in the construction industry, it promotes the removal of waste or errors and non–value-adding in engineering processes (Freire & Alarcón, 2002). Recently it has been implemented widely in healthcare and public administration (Kadarova & Demecko, 2016).

The fundamental principle is how Lean amplifies the business value and lessens any tasks related to product development. In short, the main characteristics are: to eliminate unnecessary things that affect completing the product, make flexible decisions, make decisions in the late stage of the project concerning the aim and time frame because it will be based on facts, and avoid uncertainty as much as can. In addition, personal skills such as working independently and enthusiasm are critical and solving problems by long-term solutions, not just solving symptoms. It occurs using tools and approaches such as "*Kanban*" (Rahman et al., 2013; Ahmad et al., 2018; Powell, 2018). Figure (03-18) shows the procedure of the Kanban tool in Lean product development.

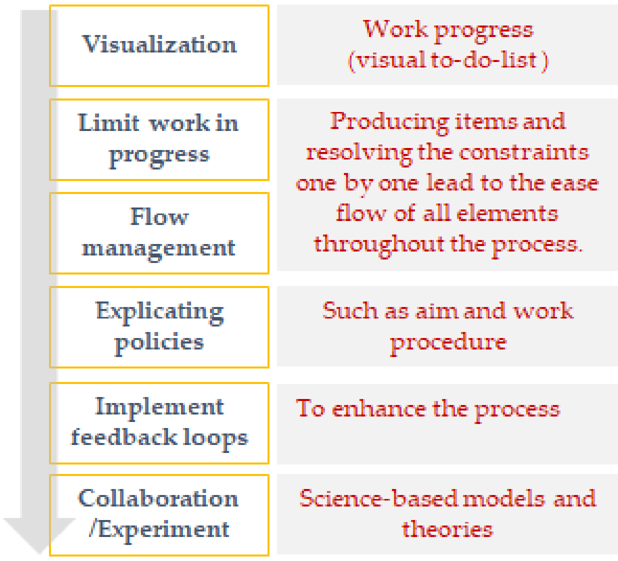


Figure (03-18) Practices of the lean approach "Kanban" within the Agile methodology.

The last example is the eXtreme Programming (XP) approach, one of the shared Agile tools, much more suitable for developing small-dimension projects. It is characterized by vital communication with the customer. The team tests the output from the first day (extreme) to get rapid feedback and make changes either due to new technologies or by the customers to achieve their satisfaction. It maximizes team collaboration (Ibrahim et al., 2020; Extreme Programming, 2021). Finally, it provides software in a low-cost and short time, utilizing the best engineering approaches, values, and systems in a disciplinary way (extreme software development) (Beck, Hendrickson, et al., 2001).

The stakeholders are the team, The Customer, business decisions regarding the single project person, the customer is responsible for defining Stories as each story is a feature in the product that achieves a goal of actual value in work (not a technology), The Developer realizes the stories have different skills (like scrum). The Tracker developers spend part of their time filling this different role each week. Finally, The Coach has experience (outside consultant). The project is running by dividing it into short iterations, each of which has to deliver production-quality software that contains newly implemented story cards.

The approach consists of six principles: first, the Planning Game is the way to ensure everyone's participation in planning, and the conditions are determined from which each story can be credited (e.g., ranking the clients according to sale processes). Launching Small Releases helps the team and the customer fully view the product. Second, The Management, all ways to improve the work environment, such as communications and the dedicated workspace. Third The Design, the value is in the final product. Fourth, Coding [12], the core of the practice that delivers solutions and inspects the problems, confirms the practice of collective ownership, meaning that the code produced by everyone must be within specific standards and measurements that have been are agreed upon before preparing the code to make it accessible for everyone to

[12] Code defined as a system of rules to convert information

understand—finally, Testing the product from starting. Figure (03-19) Summriezes eXtreme Programming approach elements.

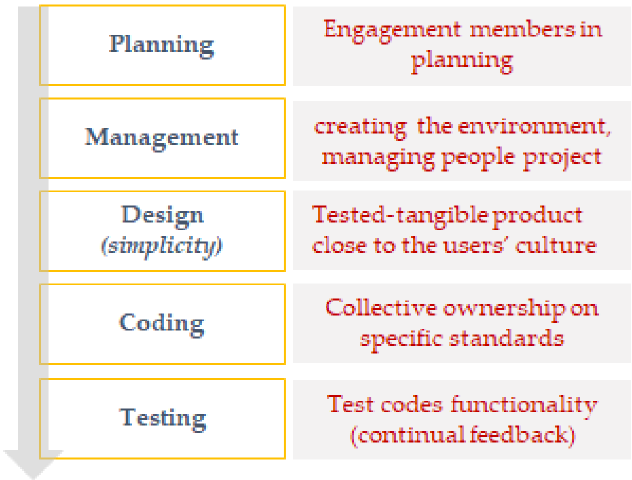


Figure (03-19) The approach of the eXtreme Programming tool within the Agile methodology (the author).

To conclude, Agile is continuous development and a resilient methodology. That has many tools. Scrum framework will be employed during the proposed conceptual framework as the second domain (Section 3.6).

3.5.4 Agile Methodology Practices – Project Management

Theoretically, to determine which approach is adequate for the project? According to the *Agile Practice Guide* by the PMI (PMI, 2017b). Each project has four types of life cycle selection. First, the Iterative life cycle allows feedback for the noncomplete project. Second, the Incremental life cycle provides completed deliverables for immediate use by the customer. Third, the Agile life cycle integrates Iterative and Incremental to give early feedback to better plan the next step and rectify comments. Fourth is the Hybrid life cycle. The Guide helps the project leaders and team members to face the uncertainty of achieving project requirements using current knowledge and technology.

The Guide demonstrates three elements to create an Agile environment. Firstly, Prepare Mindset determines how the project member can act in an agile and transparent manner, what they can deliver rapidly to get feedback, and how they can act? How can a servant-leadership (empower team) approach benefit fulfilling goals? Second, therefore the leaders play a crucial role in team empowerment, in other words, as agility facilitators. How to persuade them, ask them for the contribution (create the environment), remove the organizational obstacles, are paving the way to contribute lead to the most effective team—third, related to team structure. The attribute of the efficient, agile team can be dedicated members by:

- Focusing on 100% (e.g., multi-tasks in two projects, the focus dropped to 20-40%);
- Cross-functional team members, known as multidisciplinary (Alexander et al., 2005), by internal feedback to integrate all the work activity;
- The capability to manage the work environment (strong communication, knowledge sharing, and working together with commitment);
- The stable work environment, besides preserving and expanding the intellectual capital. Finally, an example of self-management is that they can select the appropriate workplace (physical or virtual) in the geographic scatter. Figure (03-20) summarizes creating an agile environment's procedure.

Agile Environment Creation		
Setting the mindset *Initial questions*	Servant Leader (facilitator) *Stakeholders' role*	Team members *Stakeholders' role*
How to perform in an Agile way?	Describe the purpose (engage the team with the project goal)	Focusing (100% dedication)
How to deliver the project quickly?	Create the environment (persuade ,encourage, ask for contribution)	Self-management
How to receive a rapid feedback?	Remove barriers /Focusing on results	Depend on each other to achieve results
How to empower the team?		Full agreement of the work method

Figure (03-20) The steps of creating an agile environment (the author) based on (PMI, 2017b)

While delivering an Agile project (implementation) requires four phases:

- The project charter is essential to describe how the team works together regarding the vision, purpose, method, tools, team values, norms, and rules;
- The standard practices (similar to the discussed Scrum practices) allow learning from the past practice to enhance the current one by preparing and refining the backlog;
- Challenges troubleshooting, such as unclear aims, requirements, and tools;
- Quantitative and qualitative measurements facilitate the transition to agile. These metrics contain meaningful information that provides a historical track record that delivers value on regular work. Figure (03-21) summarizes carrying out an agile environment's procedure.

Agile Environment Implementation			
Project Charter	Common Practices	Troubleshooting Obstacles	Measurements
Team Values	Retrospective and Backlog	Unclear (aim, tool, etc.)	Qualitative / Quantitative
Responsibilities	Monitoring and Review	Delay / Complexity	Metrics
Work Agreement	Iterations for feedback	Defects / Uncompletion	Models / Charts

Figure (03-21) The steps of implementing an agile environment (the Author) based on (PMI, 2017b)

The agile transformation has been discussed widely at the practices level (transitioning from traditional to agile). For instance, in their systematic review, Dikert et al. (Dikert et al., 2016) have demonstrated challenges that prevent applying the methodology, like change resistance. Rashid & Khan (Rashid & Khan, 2018) have stated that Agile methods are emerging as best practices for sustainable and green software development globally. The team members focus more on achieving many aspects: time efficiency, computing resources, rich communication and collaboration, minimal documentation, polymorphic design, green and sustainable product life cycle management, and continuous validation. Thus it can be applied to the energy retrofitting practices domain.

3.6 How does Scrum Model Work? (Layton & Morrow, 2018; Scrum, 2021)

Scrum "*refers to rugby huddle, and the players come together to possess the ball*" (Layton et al., 2020). Thus, it could be defined as the team working together thoroughly toward a common objective while taking full responsibility for the outcome. It is a circular and straightforward process with a continuous examination and adaptation. In other words -regarding the Scrum Glossary- to "*help people, teams and organizations generate value* *through adaptive solutions for complex problems*."(Schwaber & Sutherland, 2020). The Scrum cycle consists of six items Figure (03-22) summarizes Scrum approach elements.

Figure (03-22) The approach of the Scrum tool within the Agile methodology, the left column shows the practices of the project within length does not exceed one month, and the right one shows suggested synonyms. It is not a sequential procedure (e.g., the daily meeting and assessment can modify the requirements)

Before describing the figure regarding the Scrum Guide (Scrum Guide, 2020), it is essential to define the Sprint term. It is the core of Scrum, where ideas are converted to value. Each project consists of several sprints. Each sprint is implemented with a length of one month or less to create coherence. The figure shows the necessary work to fulfill the product (project) objective, as follows:

- Started by determining the requirements to ameliorate the product;
- Second, the Product Backlog orders these needs into a list (the single source of work pledged by the team);
- Third, in the Planning phase, the stakeholders (sometimes external experts) discuss the list to boost certainty and understanding by answering the essential questions why, what, and how to do the work;
- Fourth, Daily Scrum is the daily 15-minute meeting to discuss work progress and set the next-day plan;
- Fifth Sprint Review, to review the Sprint progress that may adjust the Product Backlog;
- Finally, Sprint Retrospective develops ways to raise efficiency (Scrum Guide, 2020). Another approach mixed between Kanban and Scrum is called Scrumban. Some mixed tools have been discussed recently by (Zorzetti et al., 2022).

Scrum is a framework that can be employed in any field or business (project management and software engineering). It determines the stakeholders' roles (framework) rather than guiding how to accomplish the tasks (methodology). The project life cycle is divided into small and repeated segments (sprints) until completing the product (service). It is a dynamic environment where each member carries out different artifacts within a particular event. Therefore, Scrum is an interlocking matrix that can be grouped into three pillars: stakeholders, artifacts, and events (ceremonies). Figure (03-23) illustrates the Scrum pillars.

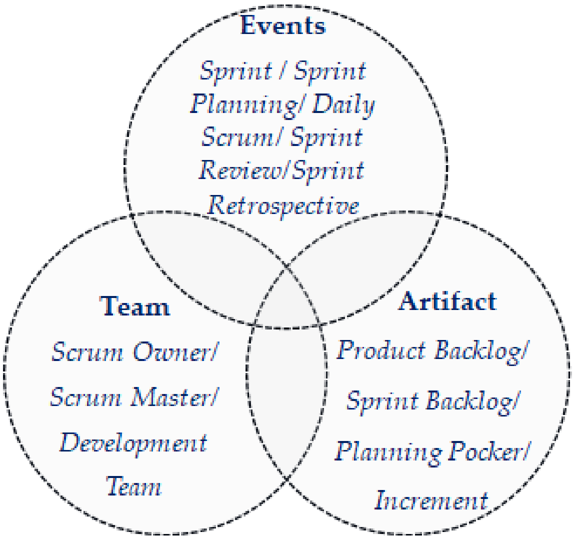


Figure (03-23) The components of the Scrum framework. Localizing these concepts to the study's context has been demonstrated in (Chapter Four, Table 04-02).

3.6.1 The First Pillar: The Team

The first pillar is the team (involved stakeholders), consisting of the Product (Scrum) Owner (hereafter PO) (a person -like a manager- he/she may represent many stakeholders), Scrum Master (hereafter SM), and the Development Team (hereafter, DT) (the professional practitioners). The team should consist of (3-9) members, including the SM and the PO. The projects can also consist of many scrum teams regarding the nature, goal scale, and requirements. It is evident that the smaller the team members, the higher the communication and productivity. The PO is responsible for setting the agile environment, namely, stating the vision from a top-down, creating the roadmap, total responsibility of the product log set, and the aims of the iterations Sprints, who has the task of understanding the project from a top-down perspective. The PO is a concept, a process rather than a person.

Therefore, the author argues that the PO can act as "a maestro" and an intermediary stakeholder for many reasons. First, he leads the research project (like the nature of the cross-disciplinarity energy retrofitting practices). Second, he should be aware of the relevant technicalities, practices, and policies. Third, keeping the end-users (local community) satisfied and interested in the anticipated benefits. Concurrently he tries to align this interest with the decision-maker scope as much as possible. The PO also is accountable for developing the product roadmap. A holistic strategic plan supports the product vision (Schuurman, 2017). The road map is built upon many steps, be implemented, break down the requirements, prioritize them. Figure (03-24) The Product Backlog management.

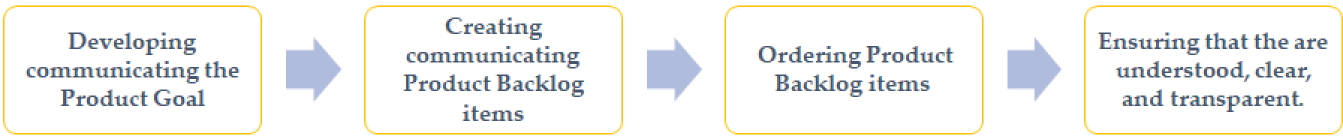


Figure (03-24) The Product Backlog management (the author) based on (Schwaber & Sutherland, 2020).

The SM is the servant-leader responsible for handling the environment and team jointly and defining the characteristics of the requirements, either products or an outcome in any topic such as energy retrofits, to facilitate the entire process. The SM could be an external stakeholder expert who enhances the performance and communications of the maestro and team, like a project manager, university professor, and regulations expert.

The vision statement is the product (service or an outcome) goal and its association with the organization (project or company) strategy. "*It should be internally focused with no marketing fluff*" (Layton & Morrow, 2018). The author argues that the marketing fluff may indicate bias (which may occur by a top-down stakeholder) or conflict of interest (i.e., by an engaged supplier), one of the risks of engaging the local suppliers, which are both possible threats that should be observed during the intended intervention (Chapter Four).

The DT is a talented member, is self-organized should have multi-disciplinary skills responsible for receiving the main goal from the PO, developing the project, creating the micro plans for the Sprint, ordering the Sprint Backlog, and testing it. Consequently, with mentoring from the SM, the main aim is to define each requirement to be done. The team in the software engineering domain is limited to the technical developer responsible for developing and delivering the technical product.

The members ensure the effectiveness, such as assessing the user acceptance and performance. Then, integrating the outcome with the whole system and creating the necessary documentation (like technical and user), the output is defined as (Done-work) approved in the Sprint Backlog. It is noteworthy that once the output in the Sprint is a "*marketable feature*," it is called Release to the end-user (market, stakeholder, real-world use, and for receiving feedback).

Likewise, by projecting the Scrum practices to this study context (energy retrofitting practices), the involved stakeholders (the suggested core team) help achieve the project goal. Scrum promotes cross-functionality and the team's multi-disciplinary skills. Therefore, this study finds the cross-functionality (within Scrum) as trans-disciplinarity because this study engaged the locals and the non-academic, which is considered a contact point between two domains that help achieve the study's aim. Table (03-04) summarizes the involved stakeholders and their roles.

Table (03-04) The stakeholder and their roles in the Scrum framework.

Stakeholder	Role/s
Product Owner (PO)	• Developing the vision, creating the roadmap[13], and communicating the plan; • Approving the user stories and prioritizing them in the product backlog; • Setting release and sprint goals; • Ensuring the visibility of the product backlog to the members; • Approving or rejecting the sprint's results; • Identify the next sprint's product backlog; • Available for an immediate response (ensuring the work optimization); • The responsibility of dealing with the business-side stakeholders
Scrum Master (SM)	• Assisting the PO (defining the vision) and teaching Scrum principles; • Coaching and the team (can be the scientific mentoring); • Following the process (in the daily meetings). What was achieved in the past day? What will the team do today? What are the obstacles? • The responsibility of dealing with the nonbusiness-side stakeholders (contractors and vendors).
Team Developer (DT)	• Developing the plan within the Sprints and the Sprint Backlog; • Daily adaptation of the plan to meet the Sprint Goal; • Encouraging quality by holding to a Definition of Done[14]; • Holding each other accountable as professionals
External Stakeholders	• The end-users and the investors

[13] The vision statement and product road map are not a part of the scrum framework. However, it helps the process, as common agile practice.

[14] The Definition of Done (DoD) It is a checklist of the work types the team is expected to end effectively before stating the work is possibly shippable (Agile Alliance, 2021b).

3.6.2 The Second and Third Pillars: The Artifact and Events

The second pillar is the artifact of the project documenting. The Product Backlog (PB) is the only source for tasks that the teamwork should respect. It is an emergent, ordered list of what is needed to improve the product, in other words, and to determine how the Product Goal will be achieved. It is the only source for issues that the team should respect. The PO is responsible and owns to collect and prioritize user story items.

These items take many formats. The small items (user stories) and midsize items (epics) are defined as "*a large user story that cannot be presented as defined within a single iteration or is large enough that it can be split into smaller user stories. There is no standard form to represent epics*" (Agile Alliance, 2021b). Finally, conceptual items (features or initiatives) are the collection of related epics or user stories in the same conceptual area, the features also known as the capabilities that the customers did not have before. The PO prepares a prioritized list of the stakeholders' requirements (needs) in which so-called user stories. For example, each story should state: As a Stakeholder (role), I want (a goal), so that (benefit). Figure (03-25) shows an index card (User Story) example. Figure (03-26) summarises the Backlog items hierarchy.

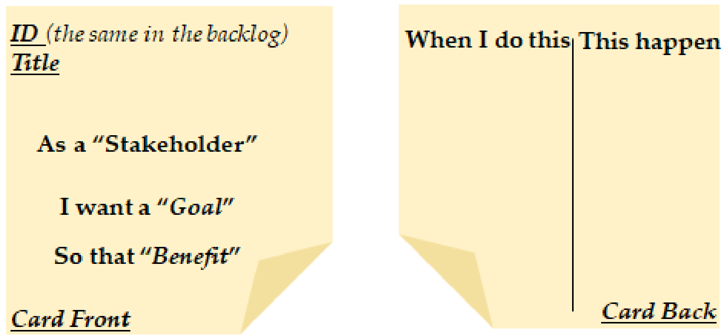


Figure (03-25) An example of an index card's format for writing the user story (the author) based on (Layton & Morrow, 2018). It should be in simple language, customer-focused.

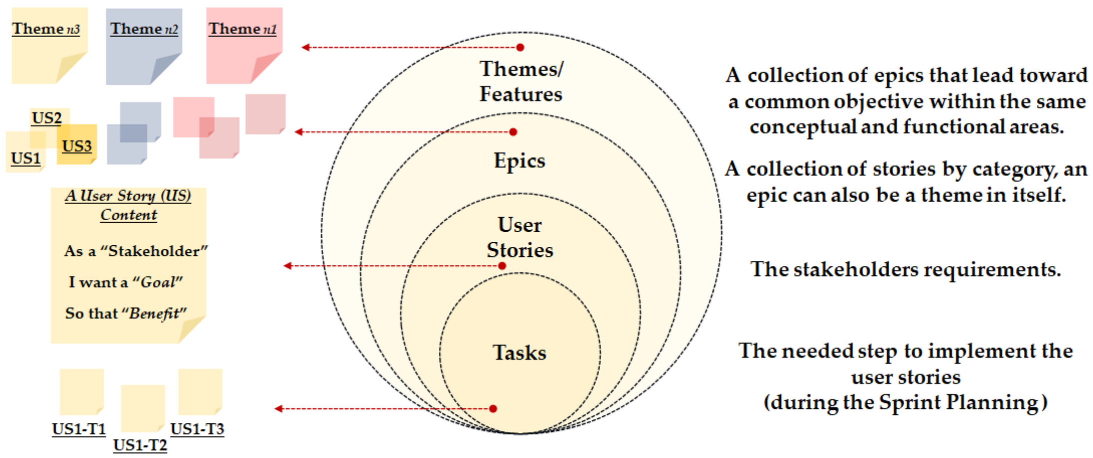


Figure (03-26) The hierarchy of the Product Backlog items (the author).

For instance, the author implemented previous research in Lasaifar Albalad village to explore the local's willingness to retrofit their dwellings (Abouaiana, 2021). A local responded, " *I want to renovate my dwelling, and I can not pay the initial cost, but I can pay monthly installments*." It can be considered a user story, which can be collected with others to make an epic under the theme of (the economic feasibility of the retrofitting solutions).

The user story may also be, (*as* an agriculture extension officer, *I need* the farmers *to* hurry up in receiving the new solar irrigation pumps provided by the government to save energy) or (*as* a researcher, *I need* to inform the local commune/administrative unit while implementing the workshop *to* get the security approval and possible support). Different user stories enable the PO to refine and estimate the boundaries of the project details (e.g., required time).

Any member within the team can write the user story, the PO collects and discusses them with the entire team one by one. Then the team can accept or reject the user stories due to the Acceptance Criteria (looking at the problem from the customer perspective). A common scenario-oriented approach that describes the criteria is the Given/When/Then format (Maryna & Dmitriy, 2020). The underlined assumed user story above could be taken as an example. The **Given** is (I do not have the security approval) **when** (I meet the stakeholders in Lasaifar Alsbalad) **then** (I should engage an employee from the local administrative unit or a politician from a political party). Then, the team should accept the user stories included in the PB.

Each item in PB should have a set of elements, started by ordering them with an ID number (to enable tracking them), activity description, estimation of the required effort to implement it, and sub-categorize the activities, such as enhancement of the outputs maintaining to decrease the “technical debt” of the project. Then, the scrum team prepares these requirements for the sprints based on this procedure. The target outcomes are the scope clarity, acceptance of all requirements, accepting all necessary risks and trying to mitigate them, and sizing the requirements within the Sprints—this so-called Product Backlog refinement.

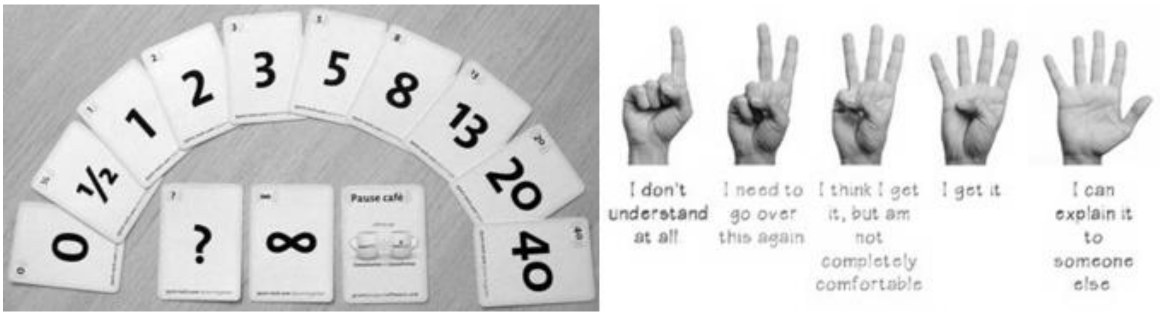
The PB refinement is how the scrum team better understands the items and prepares them for further Sprints. It is implemented based on many steps, including the formatting where the PO shows a requirement to the members, asks questions, and discusses possible challenges and strategies. This process consumes 10% of the total sprint length (1-4 weeks). It frequents as needed. Some agile techniques enable the PO to review the user stories, such as INVEST. Figure (03-27) highlights the INVEST tool as an agile practice within the eXtreme Programming tool.

Independent	Retreating from an actual or potential conflict situation; Postponing it to be organized or resolved by others.
Negotiable	They should capture the core of the requirements within the team’s discussion (the conversation is the aim, the index cards the tools).
Valuable (Vertical)	They should depict the values to the customer rather than the technical stages implemented by the team.
Estimable	Towards a good approximation of the further effort during the project.
Small	The smaller stories, the easier estimation, the lower time and effort to complete.
Testable	Encompassing various opinions and visions from varying angles; harmony and dedication among members

Figure (03-27) The INVEST technique to qualities user stories (the author) based on (SolutionsIQ, n.d.; Layton & Morrow, 2018).

After creating the PB and divide into Sprints, comes the DT (involved teamwork) turn. As this study defined, the team itself is transdisciplinary because it proposed involving different stakeholders, including the non-academic (Chapter Four, Table 04-01). Many aspects demonstrate cross-disciplinarity, such as avoiding titles or enhancing equality among members. The author argues this practice may increase authority conflict (e.g., between locals and a governmental representative). Nevertheless, the Scrum Guide indicated shadowing as a typical scrum practice. When two developers or members are working together, one implements and the other observes and learns, which may categorize the team members themselves and avoid this expected conflict.

Another shared practice is Estimation. Again, the team estimates the requisite effort while preparing the PB using the story point technique Fibonacci Scale. To clarify, "*the ability of estimation many Items from the Product Backlog can be worked off within a Sprint to achieve the Done-work by the sprint's end*"(Streule et al., 2016; Muldoon, 2013), using estimation poker cards. First, each team member assigns a card with the estimated difficulty of each requirement. After that, they show the cards together at the same time. The exact estimation means moving toward the following requirement. In case of the varies estimation, the lowermost and the higher should clarify the reasons then pick a new number (three rounds per the requirement) until the agreement. Otherwise, Fist of five techniques provides rapid estimation; it supports this first one. Then, the story point is complete. Figure (03-28) illustrates the techniques.



(1) (2)

Figure (03-28) The estimation techniques in the Scrum framework to estimate the required effort to complete a user story or a task. Panel 1: Poker planning (Pinterest, 2021). Panel 2: The fist of five techniques (B., 2020). Other ones have been discussed in (Sliger, 2012).

In the estimation, the higher number is not better than the lowers. It is a grouping technique that should be integrated with another common practice (Velocity) to reliably plan the releases and sprints and understand the required time to complete the PB items. It is a key Scrum metric to measure the amount of work implemented in one sprint (average amount of PB turned into an Increment). For example, to plan the first sprint (Sprint Zero) in a six-member team, they have provided 120 User Stories (requirements), and in the past project, this team implemented (12) User Stories in the Sprint per week. Thus the team members may need (10) sprints and (10) weeks to complete the project. Simply the amount of work completed in previous sprints led to estimating the amount of work in the future sprints.

In line with the thesis, a technical issue emerged, namely, this a novel retrofitting project in the traditional settlements in the Mediterranean region, as proved in the systematic literature review (Chapter Two), with a proposed core team, no previous sprint to estimate how many the User Stories and the amount of work, and the time. As a result, this study developed Scrum Zero (Scrum 0), and no reference indicated this issue before (specifically in energy retrofitting). In order to validate the developed concept, the author has contacted an expert software engineer[15] to discuss Scrum issues, including this one. In this case, in line with the adaptive nature of Scrum, the estimation should be finetuned based on experience (waterfall approach), which supports the argument of integrating the management approach (Section 3.5.1).

The next stage is Release Planning, which offers a pivotal place for the project team to assemble. Based on the goal, the number of sprints can be determined. Each release plan has a release goal (if any

[15] The author acknowledges the technical support (four online discussion sessions) from engineer Mohamed ElSerngawy https://ca.linkedin.com/in/mohamed-elserngawy-46637510, about the scrum practices in the software domain.

requirement is not associated with the goal is kept in the PB until it supports another goal). All goals should be prioritized. Figure (03-29) shows an example of a priority matrix.

Figure (03-29) Eisenhower priority matrix (Meekels, 2017).

Release Planning is ordering the features from the highest priority to the lowest to release timing for specific product functionality. It is a high-level timeframe for realizing a group of product requirements, from the highest priority features to the lowest ones. The feature order can be employed by answering three questions, why is this requirement necessary? Which requirement has the high risk to be addressed first? Finally, what is the minimum set of (the must-have) features to achieve the customer values and quality expectations? It is the so-called minimum viable product (MVP). Each release has to achieve the release goal, a set of Sprints that varies based on the release goal.

The Sprint life cycle consists of five events (ceremonies), Sprint Planning, Daily Scrums, Development Time, Sprint Review, and Sprint Retrospectives. In general, after setting the goal of Sprints by the PO, the team should understand the goals. Then the implementation phase, where the team works together. That coordinates the tasks daily in the daily scrum. Next, the Sprint Review explains the working product (by the sprint's end) to be ready for delivery or to receive feedback (from the stakeholders) to improve it. Finally, the Sprint Retrospective is provided to the internal stakeholder (the team) to evaluate the work by the end of each sprint. Figure (03-30) shows the User Stories life cycle in the PB and within the Sprints to achieve the Sprint goal.

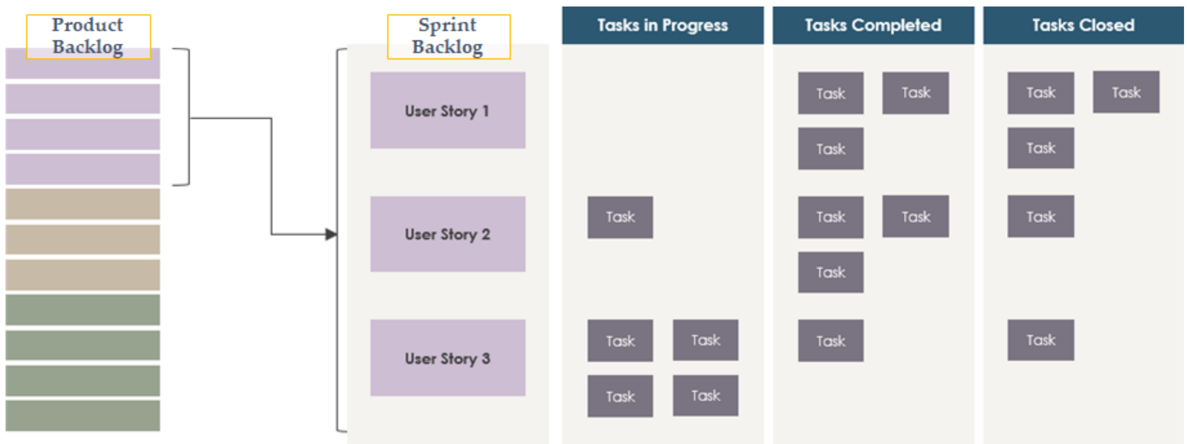


Figure (03-30) An example of the sprint backlog. to achieve the sprint goal (Visual Paradigm, n.d.)

The aim of the Daily Scrum[16] is to follow up and coordinate the daily tasks (focusing the coordination is not on solving the problem) between the SM and the DT. Each team member should state what has been accomplished yesterday, what is today's focus, and the anticipated barriers. Some techniques can improve the Daily Scrum meetings. For instance, standing up meetings is shorter than sitting down *by 34%* (Layton & Morrow, 2018). Table (03-05) shows the stakeholders' roles within the Daily Scrum. Figure (03-31) shows a real example of the Daily Scrum meetings in energy retrofitting practices.

Table (03-05) Stakeholders' roles within the Daily Scrum

Stakeholder	Role/s
Product Owner (PO)	• Describe (in brief) to the stakeholders what has been done, what is remaining, and how the team achieved the goal; • Receive feedback.
Scrum Master (SM)	• Facilitating the meeting and keeping on time.
Team Developer	• Demonstrate and clarify the completed user stories.
Secondary Stakeholders	• Adress the questions and provide feedback (from a psychological perspective, the feedback increases the team engagement in the project).


Figure (03-31) Real examples of the sprint meetings in energy retrofitting practices (PassReg, 2015). The visible task board is an efficient tool that shows the user stories life cycle within the sprint in four columns (status) To-Do the pending requirements, In Progress, Accepted (Reviewed), and Done. The project has been discussed in (section 3.6.3.1)

The Sprint Review comes by the Sprint's end to collect feedback on what the Team has finished and inspect the overall roadmap PB. It is about the product meeting the user's needs. The Sprint Review meeting should include all the stakeholders. For instance, in the research context, the core team will provide a vision of how the tasks are accomplished, so it makes sense to engage the secondary or the external stakeholders. The Sprint Retrospective concludes the Sprint. Thus, it is an action-oriented approach to improving the Team improving their skills.

[16] *A technique to scale Scrum up to large groups (over a dozen people), consisting of dividing the groups into Agile teams of 5-10. Each daily scrum within a sub-team ends by designating one member as "ambassador" to participate in a daily meeting with ambassadors from other teams, called the Scrum of Scrums." Or "Meta Scrum."* (Agile Alliance, 2021b)

3.6.3 The Scrum in Energy Retrofitting

3.6.3.1 A Relevant Practice in Europe

The Passive House Regions with Renewable Energies project (PassREg) project (PassREg, 2015c) directly reaches out to regions and municipalities through its 14 project partners to increase awareness of Passive House plus renewable solutions amongst key actors, providing role models to make accessible applied solutions and to build capacity. The project was supported by Intelligent Energy Europe, which aimed to support initiatives and best practices in the EU (European Union, 2014).

The internal stakeholders consisted of versatile actors, the research units to promote and contribute to innovation in sustainable development and energy efficiency in building technology led by the Bauhaus Institute, suppliers providing support during the implementation, NGO and fundraising, academic bodies like the Energy Department of Politecnico di Milano, and local authorities such as Municipality of Cesena, Italy, and finally, a regional association of micro-scale building professionals and architects, originated in the Netherland, so-called "*DNA in de bouw*."

Within a set of pilot "beacon" energy retrofitting projects all over the EU to meet zero energy standards, the DNA group provided a client-centered and cooperative approach to engage the parties in the building procedure, namely the local architect, engineer, local contractor's planners, installer, and the client (the owner of the target building) within the decision-making stage. The approach integrated the energy efficiency practices, construction methods, and the Scrum framework called the Scrum cross-functional team.

The multi-disciplinary team works together in short iterations (sprints) to fulfill the goal. Following every sprint, a result was delivered. They described that all members are at the same level (no titles), the communication is friendly, immediate, informal, and open. The scrum team meets daily for at least one short session (Daily Scrum) to check progress and issues. Interaction and people are the highest priority over the processes, the essential member experience. Reacting to change is vital, not following the plan. They explained the essential role of the meeting with the owner to sketch out scenarios, and vice versa, help the team solve complicated design challenges (Product Backlog), divided into sub-problems to be resolved sub-strategies (IEE PassREg, 2015a; IEE PassREg, 2015b; Passipedia, 2015).

A renovated house in Den Bosch City, Netherland, could be taken as an example (PassReg, 2015). The "DNA in de bouw" group was responsible for enabling the strategies in which the best practice solutions and made widely available (for sharing knowledge on Passive House technology), integrated with construction systems, to provide a role model for education and inspiration, in line with the project objectives. Besides that, the main goal was to increase customer satisfaction, shorten delivery times, reduce investment costs and risks of failure in achieving the nZEB (nearly zero-energy buildings) ambitious projects (PassREg, 2015b). Figure (03-32) shows the target renovated building.

Figure (03-32) A retrofitted building in Den Bosch City, using an agile methodology (PassREg, 2015a).

The procedure can be brief into five steps. Firstly, the communication with the client to discuss the problems and define technical implementations and economic aspects. Second, ordering the main aspects (Features and Epics), such as structural, building envelope characteristics, and energy sources insulation. Third, the possible strategies for every dimension are listed (User Stories), such as replacing the bulbs or integrating solar panels. Fourth, optimizing and evaluating the selected strategies against different criteria and discussed extensively by the DT, where the different perspectives enhance the discussion (Sprint Planning). Finally, the client will have a clear vision of what is implementing. Figure (03-33) shows the implemented process in line with the Scrum framework.

Figure (03-33) The implementation of the Scrum framework in the PassREg project (the author). As deduced from the project documents, the client was involved in the brainstorming and the Product Backlog stages (initial meeting with the team, goal description, and problem discussion). However, their intervention did not show the role of the client in the further stages started from the Sprint Planning, also because it stated means "*the architect/ engineer tried to act the role of the owner during the intervention.*"

The study observed that the results succeeded in achieving the goal in terms of high customer satisfaction, project costs, increased creativity, and "*little documentation burden*." This occurred regarding "*the openness culture of complete, continuous learning, trust in and respect for each other, and a lack of hierarchy*." In addition to the regular meetings between the technical team.

Although trust and authority are two features of teamwork conflict, the DNA group attributed the success to both factors. Furthermore, it makes sense because the limited team members (almost like the proposed team within our study) belong to the same organization and have the fund to implement the retrofitting strategies on a single building scale (which is absolutely different from our study), which represents another challenge to our study which requires careful consideration.

Another observation from the project's timetable, Figure (03-34), shows the sequence of the time frame was going linearly (the traditional way), and it is not clear enough how the discussion with the team back looped into planning (the iterative nature of the agile). It may also indicate that applying the core of Scrum's key elements can be enough.

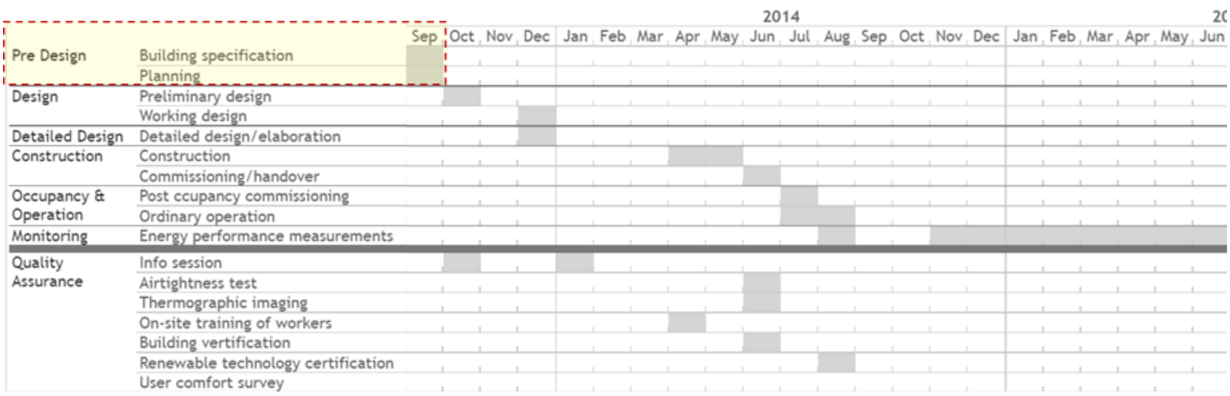


Figure (03-34) The energy retrofitting practices implementation schedule in Den Bosch City (PassREg, 2015a). The building's owner/s is engaged in the planning phase (highlighted). The activities sequence is linear (traditional way).

The major challenge was the lack of theoretical and practical knowledge of Passive House technology among the contractors and installers. Nevertheless, they highlighted the role of energy service companies in dealing with economic issues. These outcomes may support the hypothesis of this research that engaged local suppliers related to the energy efficiency industries.

3.6.3.2 Scrum in Energy Projects: Grey Literature Review

The grey literature or evidence are informally organized materials like governmental reports and conference papers, academic dissertations published by non-traditional publishers such as companies, private sector, government, and NGOs and are usually available through the internet web (J. O'Brien, 2014; Jewell, 2018). Although they are characterized by low quality[17] and low accessibility (Corlett, 2011), they may provide data not found within commercially published literature, providing an essential disseminating forum (Paez, 2017). Particularly the emerging domain (Agile) within the past two decades, with the notable lack of studies of the Scrum practices in energy retrofitting.

An energy manager expert wrote an article entitled "Scrum in energy Projects" (Ayoub, 2021). He advocated applying the scrum framework to energy projects, as well as he provided a basic example to the Scrum team consisting of two members, the PO is the (Energy Manager) who are working on the PB, which consists of many User Stories (list of energy features). The SM breaks down these features into one or more releases. Each release includes Sprint backlogs to be implemented in short period milestones through the project. Figure (03-xx) shows an example of a suggested energy upgrading project.

Ceremonies	Output	Output Example (LED upgrade Sprint)
Sprint Planning	Sprint Backlog (This is a list of user stories that have been committed to for the next sprint.)	Upgrading old lighting to High efficient LED.
Daily Scrum	Where the team discusses what they have completed since the previous meeting, what they're working on, and anything that might be blocked or needs support.	One floor is completed. Access to other 4 floors is pending - to be facilitated. Add occupancy and dimming remote control capabilities.
Sprint Review	The team invites stakeholders to a sprint review meeting where the features that were completed in the sprint are demoed and feedback is requested.	LED upgrades including dimming is successfully completed at all pre-determined locations.
Retrospective (Team meeting without the stakeholders)	An action plan is created, and these items are implemented over the course of the next sprint, and reviewed for efficacy in the next sprint retrospective.	Enhance the procedure of survey and data collection of existing Lighting fixture types and counts- for accurate future estimates.
Release Planning	Confirm system integration and validation.	Carry out the upgrades on other locations (Scale up) with more control features.

Figure (03-35) An example of the energy upgrading outputs within a Scrum project energy (the author) has abbreviated it from (Ayoub, 2021).

[17] The author observed that the grey literature in the Scrum framework practices in software engineering and project management provided significant contributions in terms of more clarification examples that supported the original scientific references.

A Dutch company called the Agile Scrum Group advocated applying Scrum in building construction (Agile Scrum Group, n.d.-b). They emphasized the role of cross-functionality in Scrum to achieve a common goal in the short term. Where the completed work is delivered to the customer and any inspection, to receive the feedback, they defined the Sprint as (an agreed period) (Agile Scrum Group, n.d.-b). The group developed a Scrum checklist to help the teams apply the Scrum methodology. However, they shortened the process into four stages Sprint Planning, Daily Scrum, Sprint Meeting, and Retrospective Meeting. The checklist is available at (Agile Scrum Group, n.d.-a) upon the Author's request. The original file is in Dutch. Annex (03-03) shows a translated version by the author using Google Translator.

The Group provided an example of applying Scrum in construction. In order to deliver a floor in a building, all necessary disciplines are present and mutually coordinate the work daily to give each other a brief update and ask for help if necessary. Then, the team can quickly respond to the emerging changes. The customer is always involved in the different phases of the work, and decisions can be made quickly, or adjustments can be made. Moreover, Scrum guarantees that a product or service is delivered that meets all expectations that adjustments can easily be made during the process.

3.7 Agile and Participatory Methodologies

The participatory approaches are crucial for energy transition (Chilvers et al., 2018). In Europe, Lowe et al. (Lowe et al., 1998) have highlighted the different levels of community participation. Public meetings are a useful way of publishing projects and providing open debate. The role of the media is to provide for information dissemination. They have presented vital tools for promoting participation in rural development projects. Figure (03-36) shows the participation of key tools in the rural development practices.

Tools	When?			Towards Whom?		
	Initial Stage	Development Stage	Implementation Stage	Local Leaders	Organisations/ Interest Groups	General Public
Public Meetings	■	▲	□	■	■	■
Adult Education and Training	□	■	■	□	■	■
Village appraisals	□	■	▲	□	■	▲
Exhibitions and Fairs	■	▲	□	■	■	■
Media and Telecommunications	■	▲	▲	■	■	■

■ *Key factor* ▲ *Partial factor* □ *Very limited factor*

Figure (03-36) Participation key tools in the rural development practices (Lowe et al., 1998).

In Egypt, the European Union Joint Rural Development Programme (EU-JRDP, 2016) aimed to support the agricultural infrastructures and the capacities of existing active rural associations, co-operatives, and unions of producers working in sectors of interest in terms of sustainable local resources management and providing innovative solutions. The project rural development intervention under the European Neighborhood Programme for Agriculture and Rural Development (ENPARD) (EU NEIGHBOURS, n.d.) collaborates with the Egyptian governmental bodies and the Italian Development Cooperation.

It provided a participatory planning approach by engaging people and groups. Through multi-stakeholder workshops (Egyptian Ministry of Agriculture), the governorates representatives, local development research centers, NGOs, local communities, an association of farmers, and community-based associations. Then by prioritizing to select the optimum intervention to get the financial support. They concluded that all stakeholders (representing different segments) should be involved. It emphasized the conflicting nature among the stakeholders (supporting this research argument). Besides, the role of the facilitator (intermediary stakeholders, as presented within this chapter) is beneficial to support the process of acknowledging responsibilities and reconciliation among different actors.

In the Italian scene, Grifoni et al. (Grifoni et al., 2014) have provided four classifications of the participatory approaches, participation by feedback which aims to keep the public informed and provide their point of view through public surveys, focus groups, questionnaires. Second, consultation, obtain the knowledge (used by the policymakers s in order to understand the needs and work towards an expected outcome. Third, participation in negotiating aims to decrease conflicts and compromise participation of the benefit group representatives. Finally, online interaction participation aims to "peer-to-peer learn by knowledge sharing.". It lets a significant engagement of citizens to enhance their awareness and involvement using ICT tools and social media platforms.

The study intended to assess the potential and limitations of the Italians' participation in the environmental issues, through intensive discussions with selected experts from the Italian centers, like ENEA and the National Research Council (CNR). They concluded that the Italians' participation is "*poorly addressed*" from the micro-scale (citizens) until the macro one (policies and technicalities), and bottom-up participation actions are still in the early stages. Chilvers et al. (Chilvers et al., 2018) have supported this finding in the energy practices in the EU in terms of inadequate community participation besides the lack of practices quality.

Although the author, according to his scientific observation in Egypt, Italy, and Portugal, agrees with them somehow (as a general well-known Mediterranean characteristic), simultaneously, he argues[18] the "conscious" architect, in addition to being a researcher, is responsible for ensuring the success of such intervention following the scientific approaches, guidance by experts, and enthusiasm. This argument supports the findings of the role of the researchers in leading the energy retrofitting practices (as discussed in section 3.2). In the same line, Cisilino & Monteleone (Cisilino & Monteleone, 2020) have supported this argument by providing a bottom-up participatory approach in the rural Italian settlements through a multi-stakeholder workshop in line with the national policies, which is similar to this thesis approach.

Heck (Heck, 2003) has advocated the participatory approach by providing a tool to urban planners or any "implementer" who works in any domain of rural area at any scale. However, he meant rural poverty. He discussed some generic obstacles to participatory approaches, such as the political conditions of the project area and the country. Socio-cultural impediments, in other words, how to enhance local belonging to possessing development. Legislative and administrative obstacles like bureaucratic laws, and the conventional one-way communication (top-down), which is proved its failure (without bottom-up) (FAO, 2005).

In order to consider these barriers, the author implemented broad discussions with the citizens in both Lasaifar Al-Balad and Pontinia. The shining side is that the locals expressed their interest in developing their village, as well as the author conveyed through this research two main factors. First, we can renovate our built environment and find a way to avoid any financial burdens. More details have been indicated in (Chapter Four), in line with the scientific observation and Abouaiana's findings. Furthermore, after a deep on-site investigation and face-to-face discussion with the locals, it was easy to identify the influencers in both contexts, highlighting the critical role of contacting the locals on the ground (as one of the transdisciplinary characteristics).

To elaborate more, in Lasaifar Albalad, it was much easier than in Pontinia (at the beginning only) to implement any intervention. For many logical reasons, the Author is originally from this village. He implemented previous studies in the village, so he grounded for this intervention a few years ago.

In Pontinia, the field study can be divided into two phases. First, the remote investigation on social media platforms result was frustrating. No interaction with any locals took place, considering that the pandemic restrictions were the most significant barrier. Quite the opposite in the second stage, after implementing the on-site study in Pontinia, the result was very encouraging (in terms of collaboration rate). The face-to-face interviews led to some key influencers, namely a politician (who has the influence and the power). As a sequence, he participated in informing both locals (on social media) and the mayor and councilor for public works in the municipality of Pontinia, who offered to help with this research. Another important engaged actor was a local supplier in the photovoltaic (who has a high interest).

Back to the previous literature, the agricultural European Innovation Partnership (EIP-AGRI, 2015) highlighted these approaches that have already been conducted in agricultural initiatives in Europe, which pay special attention to allowing scientists, farmers, and other experts to collaborate to develop new environmentally sustainable practices friendly and economically sustainable enhance resource efficiency (European Commission, 2020).

They demonstrated four criteria for mapping engagement methods and tools, covering all activities linked to scientific research and innovation. First, tool/method application levels include policy interpretation, program development, definition, and research. Figure (03-37) illustrates the engagement defined.

Policy Formulation	The practical application of defining the framework conditions for the research and innovation activities, such as making policies and definition the instruments.
Program development	is the process of defining the research content. To involve the possible stakeholders (i.e., program committees, research committees).
Project Definition	Engaging local community (from a versatile background) for a specific intervention to ensure the social acceptance
Societal Engagement	To increase the amount of practical information for research, elaborating of regulating matters in the process facilitates carrying out the research results.

Figure (03-37) The four levels of the method's application engagement, adapted from (the Engage2020 Consortium, 2014).

Second, involving the societal groups in these applications, such as civil society organizations, decision-makers, locals, researchers, affected citizens, consumers, employees, users, and the industrial sector. Third, to determine the public involvement levels through cooperation, consulting, dialogue, involvement, collaboration, meeting, participation, empowerment, and direct decision. Finally, address the "*Grand Societal Challenge*" (e.g., sustainability, climate, and energy efficiency). Figure (03-38) shows practical public engagement tools.

Dialogue	Promoting "two-way" communications between the participants to facilitate exchanging the point of views.
Involving	To better understand of the public concerns and needs
consulting	To deliver public feedback for decision-makers.
Collaboration	To evaluate and assess the ideal result
Empowerment	the participants gain specific skills in the engagement process.
Direct-Decision	When final decision-making is in the hands of the public

Figure (03-38) Recommended two-way communication forms, instead of the traditional one-way in the public engagement approach, adapted from (the Engage2020 Consortium, 2014). The same definitions have been emphasized in reference: (Stober et al., 2021)

Having said that, they defined the stakeholders into the direct participants (the engaged stakeholders in the process) and beneficiaries (the users of the results of the method). This supported the same finding of this study the stakeholders' classification has many definitions like (primary/secondary) and (internal/external) but with the same function (Section 3.3.2). In line with this research, the participation level allocates within the three domains of program development (developing an energy community practice, see Chapter Two), project definition, and research activities (along with this study). The policy formation is an input. In terms of the communication form, this research promotes collaborative and involving forms (to resolve the anticipated conflicts).

Simultaneously, the guide provided 57 participatory methods and tools, such as the participatory action research (Ottosson, 2003) that ground the knowledge to meet community needs. Community-driven development (World Bank, 2022) puts the resources under the local community's direct management, which leads to effective services delivery. Mini-publics (Deliberative) workshops (Jacquet, 2017). Scientific weeks and events (Segev et al., 2021), interviews to discover the individual participant's views, normative positions, skills, needs, and motivations. Finally, a scenario workshop (Nygrén, 2019) or Design Charrette (Pilemalm & Timpka, 2008) to assess different solutions to a specific problem based on dialogue and collaboration between a group of local citizens stakeholders, experts, and policymakers in the planning phase.

The Engage2020 Consortium has analyzed these approaches in terms at many levels. Namely, the technical term, description, objective, results, stakeholder level, engaged stakeholder (e.g., local, researcher, and decision-maker), the geographical scope of the intervention (international, EU, national, regional, and local), the societal challenges (e.g., energy efficiency, climate, and food security), time frame, and examples.

In closing, this study provided a novel conceptual agile framework to organize the relation and resolve the anticipated problems among the "right" stakeholders in energy retrofitting practices through a participatory and collaborative approach, in particular geographical Mediterranean contexts (Lasaifar Albalad and Pontinia). However, numerous studies generally discussed the participatory approaches from different perspectives in similar contexts to the research one, namely sustainable rural development in agriculture-based communities.

The majority of the participatory approaches have discussed how to implement and obtain a participatory approach from a technical perspective, oriented towards the stakeholders and project elements. Although this intervention was initiated from a bottom-up perspective (in line with the top-down policies, initiative, and legalization), the small repeated interactions of the agile way, specifically Scrum, helped develop the outcomes of the early stage of this research. The project's initial step (Chapter Four) was implemented in an agile way.

3.8 Conclusion

Built environment energy retrofitting is a crucial element to promote sustainable development objectives, mitigate climate change, and improve the quality of life. Therefore, the academic community pays great attention to energy efficiency. For example, academic publications on the energy efficiency domain have increased significantly in the past two decades (de la Cruz-Lovera et al., 2019). Meanwhile, the nature of the energy retrofitting practices is too complex due to internal or external factors, not like any domain (Fox, 2003).

For the internal aspects, numerous studies have characterized numerous obstacles that negatively impact the process, related to technicalities such as in awareness of the energy managers about the proper solution, and in the implementation such as over cost, exceeding the time frame, energy project management, clients' willingness to retrofitting, and lack of local regulations. While the unforeseen external factors such as market fluctuations, financial crises, political transformations, or the pandemic.

What requires an intensive focus from various standpoints to mitigate these uncertainties. For this reason, integrating the efforts of academic bodies and practitioners across the different disciplines besides the local community (transdisciplinarity) can contribute efficiently to solving real-world related-energy problems. The researchers and academic bodies play a significant role in leading the multidisciplinarity energy retrofitting practices as "*knowledge brokers.*" (Starkey & Madan, 2001).

The transdisciplinarity approach is essential, particularly in large-scale projects and in distinguished environments with their own limitations like the traditional and rural commons, which are essential contributors to stabilizing their macro contexts (Phillips, 2019). That influences the global environmental scene (top of the pyramid), such as climate change, and the individuals (base of the pyramid), like paying much in energy bills. Thus, engaging the stakeholders, academic, non-academic, practitioners, and decision-makers, in other words, involves the right actors, enhance the effectiveness of the bottom-up interventions, which are, besides the sufficient abilities of the researchers, support the national policies (Leal Filho & Brandli, 2016). Figure (03-39) summarizes how the bottom-up interventions support the policies.

Figure (03-39) The decision-making pyramid (European Commission, 2015).

Although the vast benefits of trans-disciplinarity, it is ambitious because it conceptualizes how to work, not what to do in detail for a specific project, and how to manage the interlocking relationship between the collaborators. This Study proposes a transdisciplinary approach by following systematic procedures to rationalize this ambition.

First, by exploring intimate contexts representing typical traditional settlements patterns in the Mediterranean region due to the poor energy performance and the high threat to climate change. Therefore, some retrofitting practices have been proposed based on the on-site investigation (Chapters One and Four) and the results of (Chapter Two).

As a sequence, many aspects have determined those stakeholders, namely the stakeholder analysis. For instance, the PMI methodology describes how to involve the right stakeholders. The ISO classification answers who should be involved in the literature review in similar energy and urban development domains, the discussion with locals, and the academic and professional experience. As a result, a core retrofitting team has been suggested consisting of the academic bodies with high interest, Local authorities, those who have the influence, the local community who will benefit, and NGOs who can facilitate the interventions.

Then team management principles have been discussed to ensure managing the stakeholder appropriately. That is started by preparing a clear management model, objectives, and tools. In parallel, following an integrated style to mitigate the conflict between the team is called a win-win situation. In one condition, the team has some characteristics to help this collaboration: personal attitude, awareness of the local energy legalizations, awareness of the local culture of both the residents and government representatives, and technical solutions. It is evident that managing this type of research and collaborative work requires a flexible and resilient way.

Hence, the agile approach is suggested to provide efficient small-dimension transdisciplinary practices. Likewise, it proved a success in software engineering. The Agile mindset is a methodology focused on enhancing frequent inspection and adaptation encourages teamwork self-organization. It has many tools and models. Scrum framework will be the selected tool for many reasons. In general, the annual survey among practitioners from 100 countries demonstrated it is the most popular approach, 66% of the respondents use Scrum, and 15% use modified scrum models (Digital.ai, 2020). In addition, it proved effective in other realms, such as education (Hicks & Foster, 2010), construction industry (Streule et al., 2016) non-software production industries (Cano et al., 2021).

In the study context, the agile scrum method paves the way to resolve the expected conflict between team members (such as miscommunication and cultural diversity). Besides, it compromises dealing with the high-level obstacles by (in this case, the interest of the decision-maker with the research objective), requiring to clear the vision and mitigating the uncertainty of the (intervention goal and among the stakeholders), guiding the project's "servant leader" (the lead researcher) to how to educate, and monitor the team, and evaluate the process.

Scrum utilizes an incremental and iterative way to mitigate the uncertainty (predict the risks) and engages the members who have sufficient skills to carry out work. Scrum model is an empirical-based approach characterized in general by three features: transparency. All project limits should be visible to the team to ensure that the project aligns with the work procedure's goals (inspection to explore any emerging problems for adapting to the obstacles instantly and correcting the compass.

This agile life cycle occurs through a dynamic environment based on repeat-until-correct and partial deliverable tasks to receive participatory feedback (from the stakeholders) the achieve the end-user value (local community, supporting the national policies, and the academic enthusiasm). Figure (03-40) shows the Scrum framework.

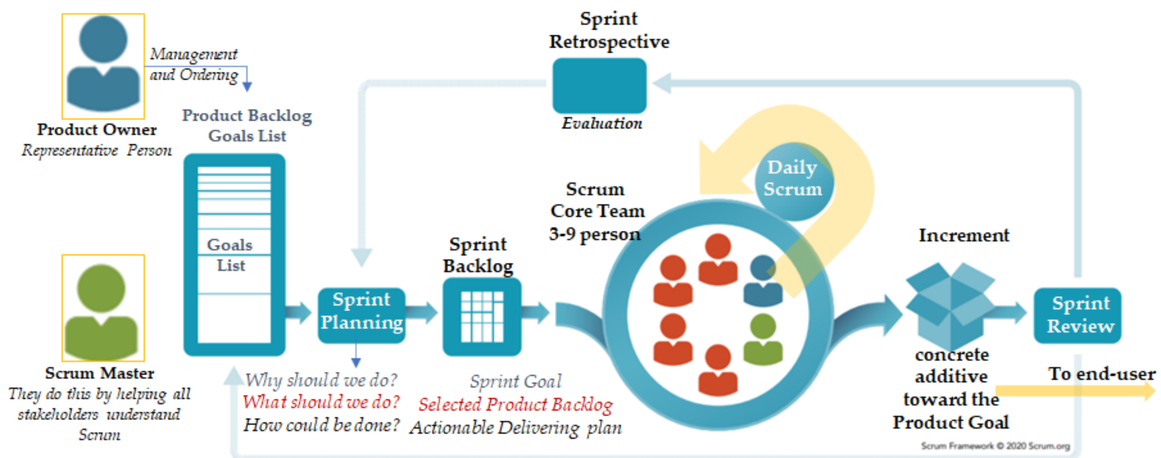


Figure (03-40) The Scrum framework (the author), based on (Scrum, 2021). The figure summarises the process and the involved stakeholders. The chapter's contribution is a novel definition of the proposed team, including academics, local authorities, and locals (the scrum team usually consists of technical experts). The "Product" is re-defined as the required intervention in the villages of Lasaifar Albalad and Pontinia, resulting from chapters one and two.

The figure summarizes the concept of the Scrum framework. In line with The Study and the described roles of the stakeholders in the different practices. Each energy retrofitting project has a lead researcher responsible for "leading" the research to set the main objective and the vision. At the same time, each energy project requires a coordinator aware of the Scrum principles and assists both the DT and PO. Both skills are mandatory for the research leader. Thus, the author will act as a PO and SM under general supervision from a high-experienced mentor in academic, architectural, and urban fields.

Before engaging the stakeholders, clear outlines (Chapter Four) will be prepared to describe the aims and put a detailed vision of the framework (PO's role). Then, explain what Scrum is and how it will be used along with the intervention (SM's role). Finally, a set of requirements will be provided and prioritized. Figure (03-41) illustrates an example of a PB within an energy retrofitting project.

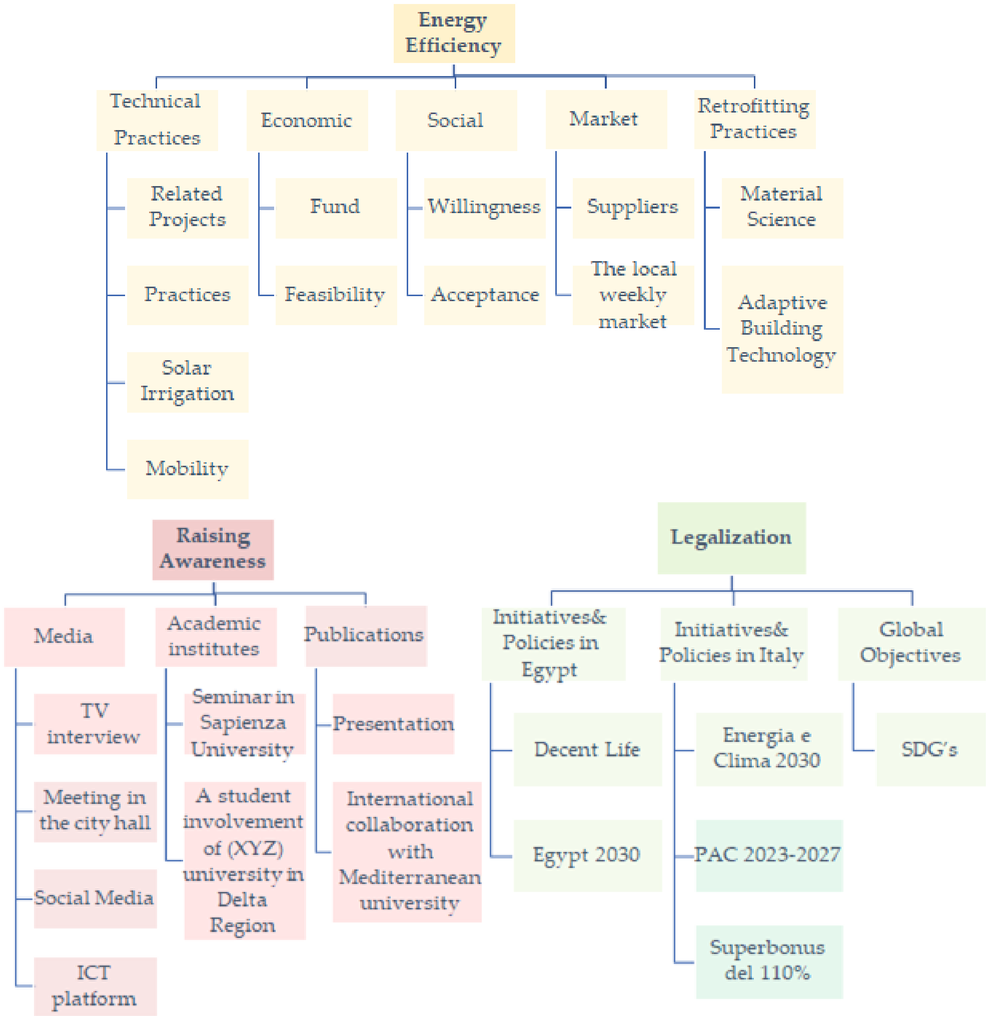


Figure (03-41) An example of a PB within an energy retrofitting project (the author). The accepted User Stories will be collected from the stakeholders and grouped under epics and main themes. The expected suggestions from the various stakeholders (beyond the research limits suggestions) will enhance and refine the framework.

3.8.1 Conceptual Framework Novelty

In theory, this research is one of the first to provide integration of an agile mindset in retrofitting rural built environments in the Mediterranean region. By elucidating the interconnectedness with the nature of the energy retrofitting practices, where conceptualizing the uncertainty associated with it can be reduced. Showing how this can be achieved is argued under three domains to develop for agile transdisciplinarity conceptual framework. Through defining a problem and purpose, conducting, developing a methodology, collecting data, and the final analysis (Suman, 2014).

The first category is energy retrofitting. It localizes the takes global challenges at a micro-scale by investigating the practices advocating more coordination between actors from a transdisciplinary perspective, manifests the acquaintances among the ability to involve the local community, decision-makers, academic bodies, and experts, which need to enhance the energy efficiency, mitigate climate change and valorize the local identity with resilient strategies.

The second category is the project management domain. Improve the skills of the team members to understand the nature of projects, life cycle, management approaches, and how to ensure project success (team, work environment, and process). Hence, the framework promotes the integration to satisfy the needs of the team and the client and fill the gap by showing effective communication ways, avoiding conflict, and demonstrating the required soft skills of the team from a managerial viewpoint. Furthermore, understanding the local socio-cultural aspects underlined a new approach to identifying the stakeholders.

The third category is software development. The scrum model provided practical steps to develop software products (which are advanced due to the rapid technological revolution). Thanks to the rapid acclimatizing way that eradicates superfluous things, provide adaptable choices, effacing along the life cycle the given issue (services and products), establishing broad lines between the team to improve their relationship.

By seizing the opportunity of the academic researchers as knowledge brokers, main actors, and essential intermediaries in this early stages that support the energy transition process (Kivimaa et al., 2019). The following step is to validate the conceptual framework and upgrade it as a tool for on-ground intervention, showing how it could contribute to planning implementation and what the deliverables were. Figure (03-42) shows the conceptual framework.

The figure shows the conceptual framework within the intervention life cycle. First, planning the focus group, setting the outlines, the main objective, identifying the stakeholders). Second, implementation includes collecting the requirements (User Stories), discussing the outlines, monitoring the interaction level, receiving feedback about the given issues and the framework itself. Finally, to reach the delivery stage that concludes realistic visualization of the framework is how to adopt transdisciplinary practices and the boundaries and advantages of adjusting agile methods in collaborative work. The results provide a model that can be generalized in similar contexts, leading to de facto intervention, as discussed in (Chapter Four).

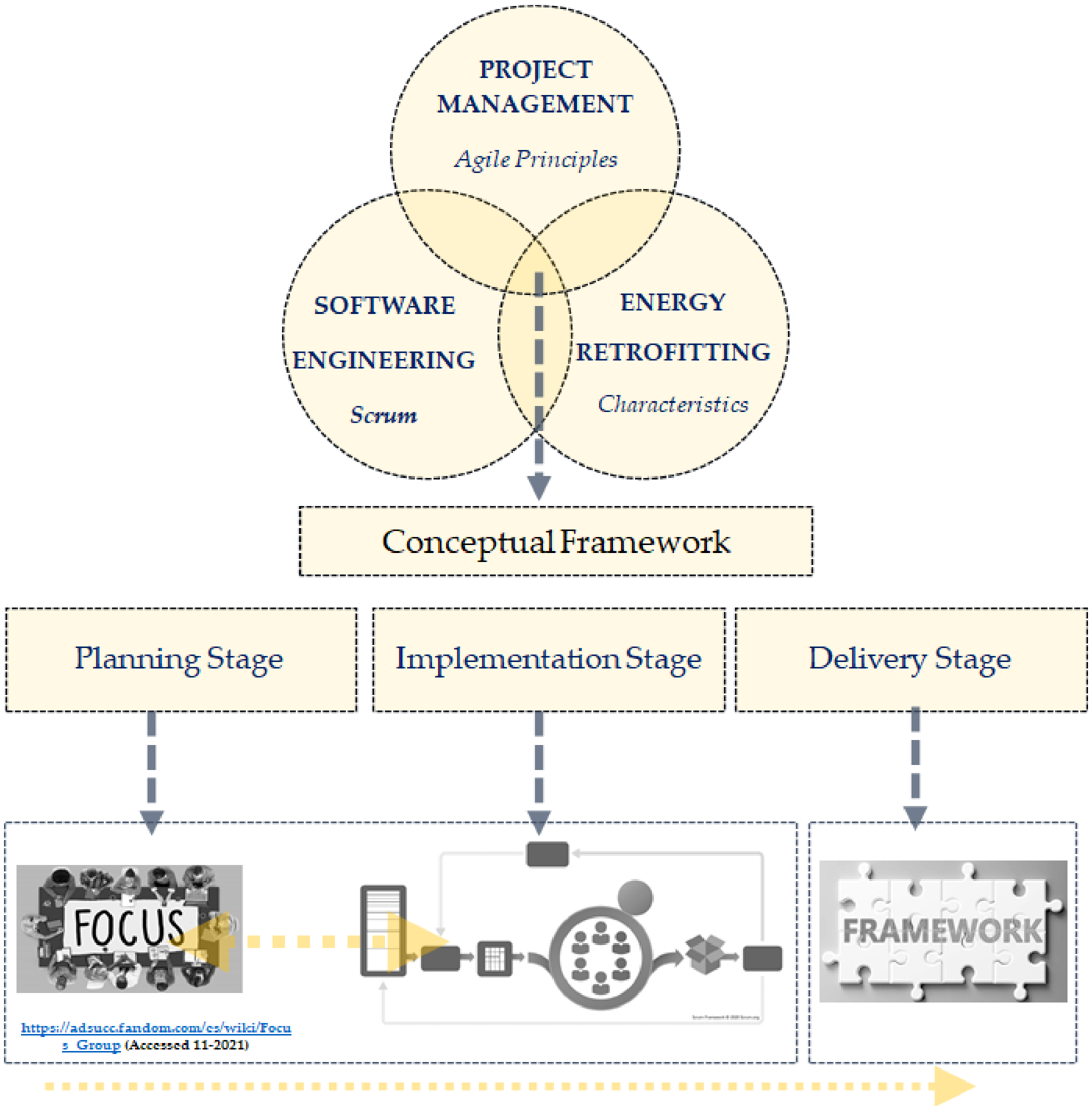


Figure (03-42) The developed conceptual framework within the intervention life cycle. The aim is to investigate their perception, awareness, agreement, and standpoint about the conceptual framework elements. This occurred within a workshop to explain the methodology, then discuss the stakeholders and overall assessment. Finally, the back looping to refine the framework.

As an initial Sprint, the decision-making and evaluation process will be a one-week Sprint. In the early stage of energy retrofitting practices in Lasaifar Albalad and Pontinia villages, the conceptual framework will be evaluated using a qualitative method (focus group) to refine the procedure and to evaluate strategies and concepts (EFSA-EU, 2021). Besides, determining the participants' preferences (from those identified as stakeholders) represent different backgrounds, geographically from the villages and the external stakeholders. The digital platforms facilitate the meetings.

Chapter Three References

3ENCULT. (2014). *Partnership Partners*. https://www.3encult.eu/en/partners/default.html (08-11-2021)

A., J. K. (1994). ENHANCING EFFECTIVENESS: AN INVESTIGATION OF ADVANTAGES AND DISADVANTAGES OF VALUE-BASED INTRAGROUP CONFLICT. *International Journal of Conflict Management*, *5*(3), 223–238. https://doi.org/10.1108/eb022744

Abouaiana, A. (2021). Retrofitting Rural Dwellings in Delta Region to Enhance Climate Change Mitigation in Egypt. *Environmental and Climate Technologies*, *25*(1), 136–150. https://doi.org/10.2478/rtuect-2021-0009

Abouaiana, A. A. A. (2016). *"Principles for Existing Rural House Sustainability in Delta Region (With Special Reference to Energy Efficiency)" (In Arabic)* [Cairo University, Giza]. https://doi.org/10.13140/RG.2.2.21412.71044

Abouaiana, A., & Mendonça, P. (2022). Retrofitting Dwellings in Traditional Coastal Settlements in Egypt and Portugal Using Nature-Based Solutions and Conventional Thermal Insulation Materials: Technical and Economic Assessment. *Journal of Architectural Engineering*, *28*(2), 05022005. https://doi.org/10.1061/(ASCE)AE.1943-5568.0000537

Abouaiana, A., & Mohamadin, M. (2018). *The Role of Egyptian Residential Buildings Energy Code in Enhancing Sustainable Development in Egypt : Evaluation of Nine Years of Practice* (H. Elshaarkawy, S. Zahiri, & J. Clough (eds.); Issue September 2018, pp. 517–526). Proceedings of SDBE2018: International Conference for Sustainble Design of the Built Environment. https://doi.org/10.5281/zenodo.4025302

Agile Alliance. (2021a). *GLOSSARY - Extreme Programming (XP)*. https://www.agilealliance.org/glossary/xp/#q=~(infinite~false~filters~(postType~(~'post~'aa_book~'aa_event_session~'aa_experience_report~'aa_glossary~'aa_research_paper~'aa_video)~tags~(~'xp))~searchTerm~'~sort~false~sortDirection~'asc~page~1) (Accessed 0

Agile Alliance. (2021b). *GLOSSARY Agile Glossary Learn the unique terminology used in Agile development from the experts at Agile Alliance.* https://www.agilealliance.org/agile101/agile-glossary/ (02-11-2021)

Agile Manifesto. (2001). *Manifesto for Agile Software Development*.

Agile Scrum Group. (n.d.-a). *Scrum Checklist Slim SamenWerken [Scrum Checklist Smart Collaboration]*. Agile Scrum Group, Netherland. https://agilescrumgroup.nl/wp-content/uploads/ASG_Scrum-Checklist.pdf?utm_source=activecampaign&utm_medium=email&utm_campaign=Scrum_Checklist

Agile Scrum Group. (n.d.-b). *Scrum in de Bouw [Scrum in Construction]*. Retrieved December 15, 2021, from https://agilescrumgroup.nl/scrum-in-de-bouw/ (Accessed 15-12-2021)

Ahmad, M. O., Dennehy, D., Conboy, K., & Oivo, M. (2018). Kanban in software engineering: A systematic mapping study. *Journal of Systems and Software*, *137*, 96–113. https://doi.org/10.1016/j.jss.2017.11.045

Al-Yasiri, Q., & Szabó, M. (2020). Incorporation of phase change materials into building envelope for thermal comfort and energy saving: A comprehensive analysis. *Journal of Building Engineering*, 102122.

Alam, M., Zou, P. X. W., Sanjayan, J. G., Stewart, R. A., Sahin, O., Bertone, E., & Wilson, J. L. (2016). Guidelines for Building Energy Efficiency Retrofitting. *Sustainability in Public Works Conference 24 – 26 August 2016*. https://sbenrc.com.au/app/uploads/2015/11/GuidelinesBuildingEnergyEfficiencyRetrofitting_PublicWorksConf_Patrick-Zou1.pdf

Alam, M., Zou, P. X. W., Stewart, R. A., Bertone, E., Sahin, O., Buntine, C., & Marshall, C. (2019). Government championed strategies to overcome the barriers to public building energy efficiency retrofit projects. *Sustainable Cities and Society*, *44*, 56–69.

Alexander, J. A., Lichtenstein, R., Jinnett, K., Wells, R., Zazzali, J., & Liu, D. (2005). Cross-functional team processes and patient functional improvement. *Health Services Research*, *40*(5p1), 1335–1355.

Almeida, M., Rodrigues, A., Cabral, I., Ferreira, M., Coelho, A., & Machado, G. (2014). *Deep energy retrofit of vernacular housing*. *November*, 32–36. https://repositorium.sdum.uminho.pt/handle/1822/43389

APM. (2021). *APM - the chartered body for the project profession*. https://www.apm.org.uk/ (Accessed 17-11-2021)

Archer, S., & Kaufman, C. (2013). Accelerating outcomes with a hybrid approach within a waterfall environment. *PMI® Global Congress 2013—North America, New Orleans, LA.* https://www.pmi.org/learning/library/outcomes-hybrid-approach-waterfall-environment-5839

Arops, V. N., & Beye, G. (1997). Management of agricultural research: A training manual, Module 4: Leadership, motivation, building and conflict management. *Rome, Italy: UN Food and Agricultural Organization*.

ARSIAL. (2021). *Renewable energy in agriculture: investment and deployment Partner self-assessment document AGRORES project COD PROG: S3.a.1 Lazio Region*. Interreg Europe. https://www.interregeurope.eu/fileadmin/user_upload/tx_tevprojects/library/file_1632312968.pdf

Asarpota, K., & Nadin, V. (2020). Energy strategies, the urban dimension, and spatial planning. *Energies*, *13*(14), 3642.

Ascionea, F., Ceronib, F., Masi, R. F. De, Rossib, F., & Pecceb, M. R. (2017). Historical buildings: Multidisciplinary approach to structural/energy diagnosis and performance assessment. *Applied Energy*, *185*, 1517–1528. http://10.0.3.248/j.apenergy.2015.11.089

Asdrubali, F., Venanzi, D., Evangelisti, L., Guattari, C., Grazieschi, G., Matteucci, P., & Roncone, M. (2021). An Evaluation of the Environmental Payback Times and Economic Convenience in an Energy Requalification of a School. *Buildings*, *11*(12), 12. https://doi.org/10.3390/buildings11010012

Assimakopoulos, M.-N., De Masi, R. F., Fotopoulou, A., Papadaki, D., Ruggiero, S., Semprini, G., & Vanoli, G. P. (2020). Holistic approach for energy retrofit with volumetric add-ons toward nZEB target: Case study of a dormitory in Athens. *Energy & Buildings*, *207*, N.PAG-N.PAG. http://10.0.3.248/j.enbuild.2019.109630

Ayoub, M. (2021). *SCRUM IN ENERGY PROJECTS April 8, 2021*. https://www.aeegta.org/blog/2021/4/5/scrum-in-energy-projects (Accessed 12-12-2021)

B., T. W. of M. (2020). *Fist to Five Poster*. https://www.teacherspayteachers.com/Product/Fist-to-Five-Poster-322309 (20-11-2021)

Bagshaw, D., Lepp, M., & Zorn, C. R. (2007). International research collaboration: Building teams and managing conflicts. *Conflict Resolution Quarterly*, *24*(4), 433–446.

Baker, H., & Moncaster, A. (2017). *The Role of Stakeholders in Masterplan Regeneration Decisions*.

Balaji, S., & Murugaiyan, M. S. (2012). Waterfall vs. V-Model vs. Agile: A comparative study on SDLC. *International Journal of Information Technology and Business Management*, *2*(1), 26–30.

Battisti, A. (2017). Revitalization and refurbishment of minor historical centers in the Mediterranean. In A. Sayigh (Ed.), *Mediterranean Green Buildings & Renewable Energy Selected Papers from the World Renewable Energy Network's Med Green Forum* (pp. 235–244). Springer. https://doi.org/10.1007/978-3-319-30746-6_17

Battisti, A., Marceca, M., & Iorio, S. (2020). *Urban Health: Participatory Action-research Models Contrasting Socioeconomic Inequalities in the Urban Context*. Springer Nature. https://doi.org/10.1007/978-3-030-49446-9

Beck, K., Beedle, M., Van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., Grenning, J., Highsmith, J., Hunt, A., & Jeffries, R. (2001). *Manifesto for agile software development*.

Beck, K., Hendrickson, M., & Fowler, M. (2001). *Planning extreme programming*. Addison-Wesley Professional.

Berardi, U. (2013). Stakeholders' influence on the adoption of energy-saving technologies in Italian homes. *Energy Policy*, *60*, 520–530.

Berardi, U. (2015). The development of a monolithic aerogel glazed window for an energy retrofitting project. *Applied Energy*, *154*, 603–615. http://10.0.3.248/j.apenergy.2015.05.059

Bourne, L. (2016). *Stakeholder relationship management: a maturity model for organisational implementation*. CRC Press.

Brugha, R., & Varvasovszky, Z. (2000). Stakeholder analysis: a review. *Health Policy and Planning*, *15*(3), 239–246.

Bryson, J. M. (2004). What to do when stakeholders matter: stakeholder identification and analysis techniques. *Public Management Review*, *6*(1), 21–53.

Buessler, S., Badariotti, D., & Weber, C. (2017). Evaluating the complex governance arrangements surrounding energy retrofitting programs: The case of collective ownership buildings in France. *Energy Research & Social Science*, *32*, 131–148. https://doi.org/10.1016/j.erss.2017.05.007

Butt, B., Jones, R. V, & Fuertes, A. (2021). Opportunities and barriers to business engagement in the UK domestic retrofit sector: An industry perspective. *Building Services Engineering Research and Technology*, *42*(3), 293–305.

Cano, E. L., García-Camús, J. M., Garzás, J., Moguerza, J. M., & Sánchez, N. N. (2021). A Scrum-based framework for new product development in the non-software industry. *Journal of Engineering and Technology Management*, *61*, 101634. https://doi.org/10.1016/j.jengtecman.2021.101634

Carbonaro, C., Tedesco, S., Thiebat, F., Fantucci, S., Serra, V., & Dutto, M. (2016). An integrated design approach to the development of a vegetal-based thermal plaster for the energy retrofit of buildings. *Energy & Buildings*, *124*, 46–59. http://10.0.3.248/j.enbuild.2016.03.063

Ceroni, F., Ascione, F., Masi, R. F. De, rossi, F. de', & Pecce, M. R. (2015). Multidisciplinary Approach to Structural/Energy Diagnosis of Historical Buildings: A Case Study. *Energy Procedia*, *75*, 1325–1334. http://10.0.3.248/j.egypro.2015.07.201

Chan, L. H., & Chen, C. (2010). Conflict from teamwork in project-based collaborative learning. *Performance Improvement*, *49*(2), 23–28.

Chilvers, J., Pallett, H., & Hargreaves, T. (2018). Ecologies of participation in socio-technical change: The case of energy system transitions. *Energy Research & Social Science*, *42*, 199–210.

Choi, B. C. K., & Pak, A. W. P. (2006). Multidisciplinarity, interdisciplinarity and transdis-ciplinarity in health research, services, education and policy: 1. Definitions, objectives, and evidence of effectiveness. *Clinical and Investigative Medicine*, *29*(6), 351–364. https://pubmed.ncbi.nlm.nih.gov/17330451/

Choi, B. C. K., & Pak, A. W. P. (2007). Multidisciplinarity, interdisciplinarity, and transdisciplinarity in health research, services, education and policy: 2. Promotors, barriers, and strategies of enhancement. *Clinical and Investigative Medicine*, E224–E232.

Cisilino, F., & Monteleone, A. (2020). Designing Rural Policies for Sustainable Innovations through a Participatory Approach. *Sustainability*, *12*(21), 9100.

CNRC. (2016). *Major energy retrofit guidelines for commercial and institutional buildings : principles*. Natural Resources Canada. https://publications.gc.ca/site/eng/9.811806/publication.html

Cohen, J. J., Azarova, V., Klöckner, C. A., Kollmann, A., Löfström, E., Pellegrini-Masini, G., Polhill, J. G., Reichl, J., & Salt, D. (2021). Tackling the challenge of interdisciplinary energy research: A research toolkit. *Energy Research & Social Science*, *74*, 101966.

Cohen, S. G., & Bailey, D. E. (1997). What makes teams work: Group effectiveness research from the shop floor to the executive suite. *Journal of Management*, *23*(3), 239–290.

Collin, A. (2009). Multidisciplinary, interdisciplinary, and transdisciplinary collaboration: Implications for vocational psychology. *International Journal for Educational and Vocational Guidance*, *9*(2), 101–110.

Colvin, R. M., Witt, G. B., & Lacey, J. (2016). Approaches to identifying stakeholders in environmental management: Insights from practitioners to go beyond the 'usual suspects.' *Land Use Policy*, *52*, 266–276.

Conrad, E. (2011). *Chapter 8 - Domain 8: Application Development Security* (E. B. T.-E. H. C. Conrad (ed.); pp. 129–145). Syngress. https://doi.org/10.1016/B978-1-59749-566-0.00008-4

Cook-Sather, A., & Shore, E. (2007). Breaking the rule of discipline in interdisciplinarity: Redefining professors, students, and staff as faculty. *Journal of Research Practice*, *3*(2).

Corlett, R. T. (2011). Trouble with the gray literature. *Biotropica*, *43*(1), 3–5.

Cucchiella, F., & Rotilio, M. (2021). Planning and prioritizing of energy retrofits for the cities of the future. *Cities*, *116*. http://10.0.3.248/j.cities.2021.103272

D'Agostino, D., Minichiello, F., Petito, F., Renno, C., & Valentino, A. (2022). Retrofit strategies to obtain a NZEB using low enthalpy geothermal energy systems. *Energy*, *239*, 122307.

D'Oca, S., Ferrante, A., Ferrer, C., Pernetti, R., Gralka, A., Sebastian, R., & Veld, P. op 't. (2018). Technical, Financial, and Social Barriers and Challenges in Deep Building Renovation: Integration of Lessons Learned from the H2020 Cluster Projects. *Buildings*, *8*(12), 174. https://doi.org/10.3390/buildings8120174

Daly, T. M., Lee, J. A., Soutar, G. N., & Rasmi, S. (2010). Conflict-handling style measurement: A best-worst scaling application. *International Journal of Conflict Management*.

De Angelis, A., Tariello, F., De Masi, R. F., & Pecce, M. R. (2021). Comparison of Different Solutions for a Seismic and Energy Retrofit of an Auditorium. *SUSTAINABILITY*, *13*(16), 8761. https://doi.org/10.3390/su13168761

De Dreu, C. K. W., & Weingart, L. R. (2003). Task versus relationship conflict, team performance, and team member satisfaction: A meta-analysis. *Journal of Applied Psychology*, *88*(4), 741–749. https://doi.org/10.1037/0021-9010.88.4.741

de Groot, W. T. B. T.-S. in E. S. (Ed.). (1992). Chapter 2 A Discipline for Interdisciplinarity. In *Environmental Science Theory* (Vol. 52, pp. 36–73). Elsevier. https://doi.org/10.1016/S0166-1116(08)72155-1

de la Cruz-Lovera, C., Perea-Moreno, A.-J., de la Cruz-Fernández, J. L., G. Montoya, F., Alcayde, A., & Manzano-Agugliaro, F. (2019). Analysis of Research Topics and Scientific Collaborations in Energy Saving Using Bibliometric Techniques and Community Detection. In *Energies* (Vol. 12, Issue 10). https://doi.org/10.3390/en12102030

DellaValle, N., Bisello, A., & Balest, J. (2018). In search of behavioural and social levers for effective social housing retrofit programs. *Energy & Buildings*, *172*, 517–524. http://10.0.3.248/j.enbuild.2018.05.002

Depaire, B. (2019). *Lecture Notes for Project Management [Lecture Notes]*. Hasselt University, Project Management (3897). https://bookdown.org/content/e12712f9-eea3-49cb-ad8d-a3e908f52a2f/

Digital.ai. (2020). *15th State of Agile Report Agile adoption accelerates across the enterprise*. https://digital.ai/resource-center/analyst-reports/state-of-agile-report

Dikert, K., Paasivaara, M., & Lassenius, C. (2016). Challenges and success factors for large-scale agile transformations: A systematic literature review. *Journal of Systems and Software*, *119*, 87–108. https://doi.org/10.1016/j.jss.2016.06.013

Duggan, D. E., Farnsworth, K. D., & Kraak, S. B. M. (2013). Identifying functional stakeholder clusters to maximise communication for the ecosystem approach to fisheries management. *Marine Policy*, *42*, 56–67.

Duran, Ö., & Lomas, K. J. (2021). Retrofitting post-war office buildings: Interventions for energy efficiency, improved comfort, productivity and cost reduction. *Journal of Building Engineering*, 102746.

Dybå, T., & Dingsøyr, T. (2008). Empirical studies of agile software development: A systematic review. *Information and Software Technology*, *50*(9–10), 833–859.

EFSA-EU. (2021). *Engagement Toolkit Methods, tips and best practices to design effective participatory processes*. European Food Safety Authority. https://www.efsa.europa.eu/sites/default/files/documents/engagement-toolkit.pdf

EIP-AGRI. (2015). *Participatory approaches for agricultural innovation*. European Commission. https://ec.europa.eu/eip/agriculture/sites/default/files/eip-agri_brochure_participatory_approaches_2015_en_web.pdf

El-Darwish, I., & Gomaa, M. (2017). Retrofitting strategy for building envelopes to achieve energy efficiency. *Alexandria Engineering Journal*, *56*(4), 579–589.

EU-JRDP. (2016). *About- Our Approach*. http://www.eu-jrdp.org/about/ (Accessed 12-01-2022)

EU NEIGHBOURS. (n.d.). *https://www.euneighbours.eu/en*. Retrieved January 12, 2022, from https://www.euneighbours.eu/en (Accessed 12-01-2022)

European Commission. (n.d.). *A long-term vision for the EU's rural areas Building the future of rural areas together*. Retrieved December 11, 2021, from https://ec.europa.eu/info/strategy/priorities-2019-2024/new-push-european-democracy/long-term-vision-rural-areas_en (Accessed 11-12-2021)

European Commission. (2015). *uality of rural development policy and its implementation*. European Network for Rural Development. https://web.archive.org/web/20210621113039/https://enrd.ec.europa.eu/sites/default/files/publi-enrd-rr-19-2015-en.pdf

European Commission. (2018). Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council,. *Official Journal of the European Union*, *61*(L 328). https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L:2018:328:FULL&from=EN

European Commission. (2020). *European Commission > EIP-AGRI > About EIP-AGRI*. https://ec.europa.eu/eip/agriculture/en/about (Accessed 01-01-2022)

European Commission. (2021). *Home Research and innovation Funding Funding opportunities Funding programmes and open calls Horizon Europe*. https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en (Accessed 20-12-2021)

European Union. (2014). *Intelligent Energy Europe Programme (IEE)*. https://ec.europa.eu/cip/iee/index_en.htm (Accessed 16-12-2021)

European University Association. (2017). Energy transition and the future of energy research, innovation and education: an action agenda for European universities. *Int. J. Prod. Res*, *53*, 59. https://eua.eu/downloads/publications/energy-transition.pdf

Evely, A. C., Fazey, I., Lambin, X., Lambert, E., Allen, S., & Pinard, M. (2010). Defining and evaluating the impact of cross-disciplinary conservation research. *Environmental Conservation*, *37*(4), 442–450.

Extreme Programming. (2021). *Extreme Programming: A gentle introduction*. http://www.extremeprogramming.org/ (Accessed 01-11-2021)

Fair, J. (2012). Agile versus Waterfall approach is right for my ERP project? *PMI® Global Congress 2012—EMEA, Marsailles, France.* https://www.pmi.org/learning/library/agile-versus-waterfall-approach-erp-project-6300

FAO. (2005). *An approach to rural development: PARTICIPATORY and NEGOTIATED TERRITORIAL DEVELOPMENT (PNTD)*. Rural Development Division Food and Agriculture Organization of the United Nations (FAO). https://www.fao.org/3/ak228e/ak228e.pdf

Fasna, M. F. F., & Gunatilake, S. (2019). Overcoming barriers for building energy efficiency retrofits: insights from hotel retrofits in Sri Lanka. *Built Environment Project and Asset Management*.

Fasna, M. F. F., & Gunatilake, S. (2020). Involvement of stakeholders in the adoption and implementation of energy retrofits in hotel buildings. *International Journal of Energy Sector Management*.

Faverjon, C., Bernstein, A., Grütter, R., Nathues, C., Nathues, H., Sarasua, C., Sterchi, M., Vargas, M.-E., & Berezowski, J. (2019). A transdisciplinary approach supporting the implementation of a big data project in Livestock production: An example from the Swiss Pig production industry. *Frontiers in Veterinary Science*, *6*, 215.

Ferrante, A. (2014). Energy retrofit to nearly zero and socio-oriented urban environments in the Mediterranean climate. *Sustainable Cities & Society*, *13*, 237–253. https://login.ezproxy.uniroma1.it/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=edo&AN=97139607&lang=it&site=eds-live&scope=site

Fojtik, R. (2011). Extreme Programming in development of specific software. *Procedia Computer Science*, *3*, 1464–1468. https://doi.org/10.1016/j.procs.2011.01.032

Fox, C. (2003). *The Engineering and Management of Retrofit Projects in the Process Industries*. European

Construction Institute (ECI). http://www.eci-online.org/wp-content/uploads/2015/12/ECI-PM3-Engineering-and-Management-of-Retrofit-Projects-in-the-Process-Industries.pdf

Francese, D., Adamo, E., & Khanmohammadi, S. (2017). Micro-Aeolic in Residential Districts: A Case Study in Sant'Arsenio (South-western Italy). In Al. Sayigh (Ed.), *Mediterranean Green Buildings & Renewable Energy* (pp. 369–377). Springer.

Franzò, S., Frattini, F., Cagno, E., & Trianni, A. (2019). A multi-stakeholder analysis of the economic efficiency of industrial energy efficiency policies: Empirical evidence from ten years of the Italian White Certificate Scheme. *Applied Energy*, *240*, 424–435.

Freire, J., & Alarcón, L. F. (2002). Achieving lean design process: Improvement methodology. *Journal of Construction Engineering and Management*, *128*(3), 248–256.

Fylan, F., Glew, D., Smith, M., Johnston, D., Brooke-Peat, M., Miles-Shenton, D., Fletcher, M., Aloise-Young, P., & Gorse, C. (2016). Reflections on retrofits: Overcoming barriers to energy efficiency among the fuel poor in the United Kingdom. *Energy Research & Social Science*, *21*, 190–198. https://doi.org/10.1016/j.erss.2016.08.002

Gabrielli, L., & Ruggeri, A. G. (2019). Developing a model for energy retrofit in large building portfolios: Energy assessment, optimization and uncertainty. *Energy & Buildings*, *202*, N.PAG-N.PAG. http://10.0.3.248/j.enbuild.2019.109356

Gajić, D., Peulić, S., Mavrič, T., Sandak, A., Tavzes, Č., Malešević, M., & Slijepčević, M. (2021). Energy Retrofitting Opportunities Using Renewable Materials—Comparative Analysis of the Current Frameworks in Bosnia-Herzegovina and Slovenia. *Sustainability*, *13*(2), 603.

Galbiati, G., Medici, F., Graf, F., & Marino, G. (2021). Methodology for energy retrofitting of Modern Architecture. The case study of the Olivetti office building in the UNESCO site of Ivrea. *Journal of Building Engineering*, *44*. http://10.0.3.248/j.jobe.2021.103378

Gericke, K., Qureshi, A. J., & Blessing, L. (2013). Analyzing transdisciplinary design processes in industry: An overview. *International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*, *55928*, V005T06A031.

Gibbs, P. (2015). *Transdisciplinary professional learning and practice*. Springer. https://books.google.com.eg/books?hl=en&lr=&id=-OkXBgAAQBAJ&oi=fnd&pg=PP5&dq=Transdisciplinary+Professional+Learning+and+Practice&ots=8HZPFJoBID&sig=m9OZddJTLj3aHc7Ex4Uay8UaQfM&redir_esc=y#v=onepage&q=Transdisciplinary Professional Learning and Practice&f

Gillich, A., & Sunikka-Blank, M. (2013). Barriers to domestic energy efficiency–an evaluation of retrofit policies and market transformation strategies. *Proceedings of the ECEEE Summer Study, Hyeres, France*, *7*.

Greenhalgh, G., Alexander, K. S., Larson, S., Thammavong, P., Sacklokham, S., Thephavanh, M., Sinavong, P., Moglia, M., Perez, P., & Case, P. (2019). Transdisciplinary agricultural research in Lao PDR. *Journal of Rural Studies*, *72*, 216–227.

Gregory, A. J., Atkins, J. P., Midgley, G., & Hodgson, A. M. (2020). Stakeholder identification and engagement in problem structuring interventions. *European Journal of Operational Research*, *283*(1), 321–340. https://doi.org/10.1016/j.ejor.2019.10.044

Grifoni, P., Guzzo, T., & Ferri, F. (2014). Environmental sustainability and participatory approaches: The case of Italy. *Journal of Sustainable Development*, *7*(3), 1.

Guan, D. (2007). Conflicts in the project environment. *PMI® Global Congress 2007—Asia Pacific, Hong Kong, People's Republic of China*. https://www.pmi.org/learning/library/project-environment-eleven-project-conflicts-7348

Guleroglu, S. K., Karaguler, M. E., Kahraman, I., & Umdu, E. S. (2020). Methodological approach for performance assessment of historical buildings based on seismic, energy and cost performance: A Mediterranean case. *JOURNAL OF BUILDING ENGINEERING*, *31*.

Gultekin, P., Anumba, C. J., & Leicht, R. M. (2014). Case study of integrated decision-making for deep energy-efficient retrofits. *International Journal of Energy Sector Management*.

Haas, F., Franzen, C., Exner, D., Troi, A., & Frey, W. (2013). 3ENCULT Monument Information System: The "Raumbuch"-principle extended to energy issues. In *2013 Digital Heritage International Congress (DigitalHeritage), Digital Heritage International Congress (DigitalHeritage), 2013* (Vol. 1, p. 781). IEEE. https://doi.org/10.1109/DigitalHeritage.2013.6743847

Habtezion, S. (2016). *Gender and sustainable energy*. https://www.undp.org/publications/gender-and-sustainable-energy#modal-publication-download

Hamdan, H. A. M., Andersen, P. H., & de Boer, L. (2021). Stakeholder collaboration in sustainable neighborhood projects—A review and research agenda. *Sustainable Cities & Society*, *68*, N.PAG-N.PAG. https://login.ezproxy.uniroma1.it/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=edo&AN=149436470&site=eds-live&scope=site

Hartson, R., & Pyla, P. (2019). *Chapter 4 - Agile Lifecycle Processes and the Funnel Model of Agile UX* (R. Hartson & P. B. T.-T. U. X. B. (Second E. Pyla (Eds.); pp. 63–80). Morgan Kaufmann. https://doi.org/10.1016/B978-0-12-805342-3.00004-7

Hausladen, G., & Tucci, F. (2017). Technological Culture, the Environment and Energy: the outlook for research and experimentation. *TECHNE-Journal of Technology for Architecture and Environment*, 63–71.

Haya Karima. (2021). *About Haya Karima*. https://www.hayakarima.com/about_en.html (Accessed 24-09-2021)

Heck, B. van. (2003). *Participatory Development: Guidelines on Beneficiary Participation in Agricultural and Rural Development* ((2nd editi). Rural Institutions and Participation Service, Rural Development Division Food and Agriculture Organization of the United Nations. https://www.fao.org/3/ad817e/ad817e.pdf

Hettinga, S., Nijkamp, P., & Scholten, H. (2018). A multi-stakeholder decision support system for local neighbourhood energy planning. *Energy Policy*, *116*, 277–288.

Hicks, M., & Foster, J. S. (2010). *Adapting Scrum to Managing a Research Group*.

Highsmith, J., & Cockburn, A. (2001). Agile software development: The business of innovation. *Computer*, *34*(9), 120–127.

Hillier, B., & Iida, S. (2005). Network and psychological effects in urban movement. *International Conference on Spatial Information Theory*, 475–490.

Hoda, R., Salleh, N., Grundy, J., & Tee, H. M. (2017). Systematic literature reviews in agile software development: A tertiary study. *Information and Software Technology*, *85*, 60–70.

Hron, M., & Obwegeser, N. (2022). Why and how is Scrum being adapted in practice: A systematic review. *Journal of Systems and Software*, *183*, 111110. https://doi.org/10.1016/j.jss.2021.111110

Ibrahim, M., Shabib Aftab, M. A., Iqbal, A., Khan, B. S., Iqbal, M., Ihnaini, B. N. S., & Elmitwally, N. S. (2020). Presenting and Evaluating Scaled Extreme Programming Process Model. *(IJACSA) International Journal of Advanced Computer Science and Applications*, *11*(11). https://thesai.org/Downloads/Volume11No11/Paper_21-Presenting_and_Evaluating_Scaled_Extreme_Programming.pdf

IEA. (2019). *Multiple Benefits of Energy Efficiency,IEA, Paris. (Accessed 27-07-2021).* https://www.iea.org/reports/multiple-benefits-of-energy-efficiency/health-and-wellbeing

IEE PassREg. (2015a). *IEE PassREg PASSIVE HOUSE REGIONS WITH RENEWABLE ENERGY Collected Success Models of the Aspiring Regions (short versions) Selection and editing by EnEffect Based on the Success Models and Monitoring reports from PassREg's aspiring regions*. EnEffect. http://www.eneffect.bg/images/upload/Proekti/PassREg/SMs of ARs collected.pdf

IEE PassREg. (2015b). *IEE PassREg PASSIVE HOUSE REGIONS WITH RENEWABLE ENERGY Final Aggregated Monitoring and Evaluation Report Deliverable 2.5 Based on the Success Models and Monitoring reports from PassREg's frontrunner and aspiring regions*. http://www.eneffect.bg/images/upload/Proekti/PassREg/D2.5 Final Comparative Report.pdf

Inayat, I., Salim, S. S., Marczak, S., Daneva, M., & Shamshirband, S. (2015). A systematic literature review on agile requirements engineering practices and challenges. *Computers in Human Behavior*, *51*, 915–929.

Institute for Sustainability. (2009). *Institute for Sustainability - Home*. https://www.instituteforsustainability.co.uk/index.html (Accessed 18-12-2021)

Interreg Europe. (2019). *Policies to promote the internationalisation of SMEs for more competitive regional ecosystems in border areas of the EU - Project summary*. https://www.interregeurope.eu/interventures/ (Accessed 10-12-2021)

Jaansoo, A. (2019). *METHODOLOGY FOR STAKEHOLDER ENGAGEMENT within the project Inter Ventures*. European Regional Development Fund, Europian Union.

Jackson, S. E. (1991). Team composition in organizational settings: Issues in managing an increasingly diverse work force. *Symposium on Group Productivity and Process, 1989, Texas A & MU, College Station, TX, US*.

Jacquet, V. (2017). Explaining non-participation in deliberative mini-publics. *European Journal of Political Research*, *56*(3), 640–659.

Jehn, K. A. (1995). A Multimethod Examination of the Benefits and Detriments of Intragroup Conflict. *Administrative Science Quarterly*, *40*(2), 256–282. https://doi.org/10.2307/2393638

Jewell, S. T. (2018). *6 - Providing meaningful information: Part D—Current awareness* (A. P. B. T.-A. P. G. for I. DeRosa (Ed.); pp. 63–70). Chandos Publishing. https://doi.org/10.1016/B978-0-08-102017-3.00006-1

Jia, L., Qian, Q. K., Meijer, F., & Visscher, H. (2021). Exploring key risks of energy retrofit of residential buildings in China with transaction cost considerations. *Journal of Cleaner Production*, *293*, 126099.

Kadarova, J., & Demecko, M. (2016). New Approaches in Lean Management. *Procedia Economics and Finance*, *39*, 11–16. https://doi.org/10.1016/S2212-5671(16)30234-9

Kerr, N. J. (2018). *The rationale for retrofit : a multi-level, interdisciplinary perspective on the energy efficient retrofit of existing residential buildings*. https://login.ezproxy.uniroma1.it/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=ddu&AN=C2A0C092C96D805F&site=eds-live&scope=site

Khairi, M., Jaapar, A., & Yahya, Z. (2017). The application, benefits and challenges of retrofitting the existing buildings. *IOP Conference Series: Materials Science and Engineering*, *271*(1), 12030.

Kivimaa, P., Boon, W., Hyysalo, S., & Klerkx, L. (2019). Towards a typology of intermediaries in sustainability transitions: A systematic review and a research agenda. *Research Policy*, *48*(4), 1062–1075.

Klein, Julie T. (2008). Evaluation of interdisciplinary and transdisciplinary research: a literature review. *American Journal of Preventive Medicine*, *35*(2), S116–S123.

Klein, Julie Thompson. (1990). *Interdisciplinarity: History, theory, and practice*. Wayne state university press. https://books.google.com.eg/books?id=4uM8fjxhjqsC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

Kozlowski, S. W. J., & Ilgen, D. R. (2006). Enhancing the effectiveness of work groups and teams. *Psychological Science in the Public Interest*, *7*(3), 77–124.

Krarti, M., & Dubey, K. (2018). Benefits of energy efficiency programs for residential buildings in Bahrain. *Journal of Building Engineering*, *18*, 40–50.

Lang, M., Lane, R., Zhao, K., Tham, S., Woolfe, K., & Raven, R. (2021). Systematic review: Landlords' willingness to retrofit energy efficiency improvements. *Journal of Cleaner Production*, *303*. http://10.0.3.248/j.jclepro.2021.127041

Latin Dictionary. (2021). *Latin Dictionary | Dictionary Latin-English*. https://www.online-latin-dictionary.com/ (Accessed 03-08-2021)

Lawrence, R. J. (2010). Deciphering interdisciplinary and transdisciplinary contributions. *Transdisciplinary Journal of Engineering & Science*, *1*.

Lawrence, R. J., & Després, C. (2004). Futures of Transdisciplinarity. *Futures*, *36*(4), 397–405. https://doi.org/10.1016/j.futures.2003.10.005

Layton, M. C., & Morrow, D. (2018). *Scrum for Dummies* (2nd Edition (Ed.)). John Wiley & Sons.

Layton, M. C., Ostermiller, S. J., & Kynaston, D. J. (2020). *Agile project management for dummies* (Third Edit). John Wiley & Sons, Inc.

Leal Filho, W., & Brandli, L. (2016). *Engaging Stakeholders for Sustainable Development BT - Engaging Stakeholders in Education for Sustainable Development at University Level* (W. Leal Filho & L. Brandli (Eds.); pp. 335–342). Springer International Publishing. https://doi.org/10.1007/978-3-319-26734-0_21

Lee, K. L. (2008). An examination between the relationships of conflict management styles and employees' satisfaction. *International Journal of Business and Management*, *3*(9), 11–25.

Li, Y., Cheng, S., Li, Z., Song, H., Guo, M., Li, Z., Mang, H.-P., Xu, Y., Chen, C., & Basandorj, D. (2021). Using system dynamics to assess the complexity of rural toilet retrofitting: Case study in eastern China. *Journal of Environmental Management*, *280*, 111655.

Liang, X., Shen, G. Q., & Guo, L. (2015). Improving management of green retrofits from a stakeholder perspective: A case study in China. *International Journal of Environmental Research and Public Health*, *12*(11), 13823–13842.

Liu, G., Tan, Y., & Huang, Z. (2021). Knowledge Mapping of Homeowners' Retrofit Behaviors: An Integrative Exploration. *Buildings*, *11*(7), 273.

Liu, Y., Jin, X., & Dupre, K. (2022). Engaging stakeholders in contested urban heritage planning and management. *Cities*, *122*, 103521. https://doi.org/10.1016/j.cities.2021.103521

López-Alcarria, A., Olivares-Vicente, A., & Poza-Vilches, F. (2019). A systematic review of the use of agile methodologies in education to foster sustainability competencies. *Sustainability*, *11*(10), 2915.

Losasso, M. (2021). *Environmental Crisis and Climate Adaptation of the Urban Voids of Naples Historic Centre UNESCO Site BT - New Metropolitan Perspectives* (C. Bevilacqua, F. Calabrò, & L. Della Spina (Eds.); pp. 1972–1979). Springer International Publishing.

Lowe, P., Ray, C., Ward, N., Wood, D., & Woodward, R. (1998). *PARICIPATION IN RURAL DEVELOPMENT: A Review of European Experience*. Center of Rural Economy. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.553.5320&rep=rep1&type=pdf

Madalina, O. (2016). Conflict management, a new challenge. *Procedia Economics and Finance*, *39*, 807–814.

Maryna, Z., & Dmitriy, G. (2020). *Clear Acceptance Criteria for User Stories with Examples*. https://rubygarage.org/blog/clear-acceptance-criteria-and-why-its-important (Accessed 12-12-2021)

Mazzocchi, G., Cagliero, R., Tarangioli, S., Monteleone, A., & Angeli, S. (2021). *La prioritizzazione delle esigenze nel Piano Strategico Nazionale PAC 2023-2027 [The prioritization of needs in the CAP 2023-2027 National Strategic Plan]*. Rete Rurale Nazionale 2014- 2020, Mipaaf.

McKnight, W. (2014). *Chapter Sixteen - Agile Practices for Information Management* (W. B. T.-I. M. McKnight (Ed.); pp. 168–178). Morgan Kaufmann. https://doi.org/10.1016/B978-0-12-408056-0.00016-3

Meekels, S. (2017). *Product Owners in DevOps: What dominates your Backlog, Urgent or Important matters?* https://www.agitma.nl/product-owners-in-devops-what-dominates-your-backlog-urgent-or-important-matters/ (Accessed 20-11-2021)

Meijer, F., Visscher, H., Nieboer, N., & Kroese, R. (2012). Jobs creation through energy renovation of the housing stock. *Neujobs. Retrieved on July*, *7*, 2017.

Merriam-Webster. (2021). *Usage Notes "Intra-" and "Inter-": Getting Into It Usage advice within*. https://www.merriam-webster.com/words-at-play/intra-and-inter-usage (Accessed 03-08-2021)

Miah, J. H., Griffiths, A., McNeill, R., Poonaji, I., Martin, R., Morse, S., Yang, A., & Sadhukhan, J. (2015). A small-scale transdisciplinary process to maximising the energy efficiency of food factories: insights and recommendations from the development of a novel heat integration framework. *Sustainability Science*, *10*(4), 621–637.

Millhous, L. M. (1999). The experience of culture in multicultural groups: Case studies of Russian-American collaboration in business. *Small Group Research*, *30*(3), 280–308. https://doi.org/10.1177/104649649903000302

MiPAAF. (2021). *Comunicati stampa - Il Ministro Patuanelli in audizione congiunta alle Commissioni Agricoltura della Camera dei Deputati e del Senato [Press releases - Minister Patuanelli in joint hearing with the Agriculture Commissions of the Chamber of Deputies and th*. https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/17571 (Accessed 12-12-2021)

Mirzakhani, A., Turró, M., & Jalilisadrabad, S. (2021). Key stakeholders and operation processes in the regeneration of historical urban fabrics in Iran. *Cities*, *118*, 103362. https://doi.org/10.1016/j.cities.2021.103362

MISE. (2019). *INTEGRATED NATIONAL ENERGY AND CLIMATE PLAN*. Ministry of Economic

Development, Ministry of the Environment and Protection of Natural Resources and the Sea, and Ministry of Infrastructure and Transport. https://www.mise.gov.it/images/stories/documenti/it_final_necp_main_en.pdf

Mlecnik, E., Straub, A., & Haavik, T. (2019). Collaborative business model development for home energy renovations. *Energy Efficiency*, *12*(1), 123–138.

Morris, R. T., & Seeman, M. (1950). The problem of leadership: An interdisciplinary approach. *American Journal of Sociology*, *56*(2), 149–155.

Muldoon, N. (2013). *Why do high performing Scrum teams use story point estimation?* http://www.velocitycounts.com/2013/05/why-do-high-performing-scrum-teams-tend-to-use-story-point-estimation/ (Accessed 25-11-2021)

Mutani, G., Cornaglia, M., & Berto, M. (2018). Improving energy sustainability for public buildings in Italian mountain communities. *Heliyon*, *4*(5), e00628. https://doi.org/10.1016/j.heliyon.2018.e00628

Mycellium. (2021). *Mycelium A Biomaterial from nature to nature*. https://en.mycellium.co/ (Accessed 17/06/2021)

Nguyen, T. S., Mohamed, S., & Panuwatwanich, K. (2018). Stakeholder Management in Complex Project: Review of Contemporary Literature. *Journal of Engineering, Project & Production Management*, *8*(2).

Note, M. (2016). *Chapter 3 - Leading and Managing Teams* (M. B. T.-P. M. for I. P. Note (Ed.); pp. 41–71). Chandos Publishing. https://doi.org/10.1016/B978-0-08-100127-1.00003-6

Nunkoo, D. K., & Sungkur, R. K. (2021). Team conflict dynamics & conflict management: derivation of a model for software organisations to enhance team performance and software quality. *Global Transitions Proceedings*, *2*(2), 545–552. https://doi.org/10.1016/j.gltp.2021.08.007

Nygrén, N. A. (2019). Scenario workshops as a tool for participatory planning in a case of lake management. *Futures*, *107*, 29–44.

O'Brien, J. (2014). 8 - Decisions and arguments. In J. B. T.-S. K. O'Brien (Ed.), *Chandos Information Professional Series* (pp. 175–199). Chandos Publishing. https://doi.org/10.1533/9781780634326.175

OECD. (2020a). Addressing societal challenges using transdisciplinary research. *OECD Science, Technology and Industry Policy Papers*, *88*. https://doi.org/10.1787/0ca0ca45-en

OECD. (2020b). *OECD Future of Education and Skills 2030 Conceptual learning framework: KNOWLEDGE FOR 2030*. OECD Publishing. https://www.oecd.org/education/2030-project/teaching-and-learning/learning/knowledge/Knowledge_for_2030_concept_note.pdf

Oguntona, O. A., Maseko, B. M., Aigbavboa, C. O., & Thwala, W. D. (2019). Barriers to retrofitting buildings for energy efficiency in South Africa. *IOP Conference Series: Materials Science and Engineering*, *640*(1), 12015.

Okorafor, C., Chetty, R., & Haupt, T. (2021). A framework for Implementing Energy Retrofit Projects in Existing Building in South Africa. *IOP Conference Series: Materials Science and Engineering*, *1107*(1), 12001.

Omar, A. I., Khattab, N. M., & Aleem, S. H. E. A. (2022). Optimal strategy for transition into net-zero energy in educational buildings: A case study in El-Shorouk City, Egypt. *Sustainable Energy Technologies and Assessments*, *49*, 101701.

Ongpeng, J. M. C., Rabe, B. I. B., Razon, L. F., Aviso, K. B., & Tan, R. R. (2022). A multi-criterion decision analysis framework for sustainable energy retrofit in buildings. *Energy*, *239*, 122315. https://doi.org/10.1016/j.energy.2021.122315

Ortiz, J., Casquero-Modrego, N., & Salom, J. (2019). Health and related economic effects of residential energy retrofitting in Spain. *Energy Policy*, *130*, 375–388. http://10.0.3.248/j.enpol.2019.04.013

Ortiz, M., Itard, L., & Bluyssen, P. M. (2020). Indoor environmental quality related risk factors with energy - efficient retrofitting of housing: A literature review. In *ENERGY AND BUILDINGS* (Vol. 221). https://doi.org/10.1016/j.enbuild.2020.110102

Ottosson, S. (2003). Participation action research-: A key to improved knowledge of management. *Technovation*, *23*(2), 87–94.

Paez, A. (2017). Gray literature: An important resource in systematic reviews. *Journal of Evidence-Based Medicine*, *10*(3), 233–240.

Palazzo, A. L., & Benelli, F. (2020). *Energy Planning in Mediterranean Landscapes. Innovation Paths in Practices and Careers : QU3#20*. Quodlibet. https://doi.org/10.2307/j.ctv13xpr10

Palumbo Fernández, M., Bosch González, M., Fernández Renna, A. I., & Simó Solsona, M. (2021). Why it's so hard? Exploring social barriers for the deployment of thermal energy storage in spanish buildings. *Energy Research & Social Science*, *76*(June).

Parida, V., Rönnberg-Sjödin, D., Wincet, J., & Ylinenpää, H. (2013). Win-Win collaboration, functional product challenges and value-chain delivery: A case study approach. *Procedia CIRP*, *11*, 86–91.

Parrish, K. (2013). *A Path to Successful Energy Retrofits: Early Collaboration through Integrated Project Delivery Teams*.

Passipedia. (2015). *Passipedia - The Passive House Resource » Scrum team*. https://passipedia.org/scrum_team (Accessed 12-12-2021)

PassReg. (2015). *PassREg FINAL REPORT*. https://www.passivhaustrust.org.uk/UserFiles/File/Technical Papers/PassREg final report.compressed.pdf

PassREg. (2015a). *Beacon project: Orduynenstraat Den Bosch*. https://passreg.eu/beaconProjectDetails.php?beacon_id=49&ref=beaconlist (Accessed 15-12-2021)

PassREg. (2015b). *Building for the energy revolution A Guide to Success*. PassReg. https://passreg.eu/download.php?cms=1&file=PassREg_Success_Guide_final.pdf

PassREg. (2015c). *PassREg Passive House Regions with Renewable Energies*. https://www.passreg.eu/index.php (Accessed 15-12-2021)

Peel, J., Ahmed, V., & Saboor, S. (2020). An investigation of barriers and enablers to energy efficiency retrofitting of social housing in London. *Construction Economics & Building*, *20*(2), 127–149. https://login.ezproxy.uniroma1.it/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=edo&AN=144305274&site=eds-live&scope=site

Pereira, L. D., Tavares, V., & Soares, N. (2021). Up-To-Date Challenges for the Conservation, Rehabilitation and Energy Retrofitting of Higher Education Cultural Heritage Buildings. *Sustainability*, *13*(2061), 2061. https://doi.org/10.3390/su13042061

Phillips, M. (2019). Challenges and policies to support rural environmental and energy transitions. *Paper at OECD and European Commission (DG REGIO) Workshop on Managing Environmental and Energy*

Transitions in Cities and Regions, *9*. https://www.oecd.org/cfe/regionaldevelopment/Phillips-2019-Challenges-policies-rural-environmental-energy-transitions.pdf

Pilemalm, S., & Timpka, T. (2008). Third generation participatory design in health informatics—making user participation applicable to large-scale information system projects. *Journal of Biomedical Informatics*, *41*(2), 327–339.

Pinterest. (2021). *Planning Poker (Scrum Poker Cards): An Agile Estimation and Planning Technique*. https://www.pinterest.com/pin/120400990022943246/ (20-11-2021)

Pitt, D., & Bassett, E. (2013). Collaborative planning for clean energy initiatives in small to mid-sized cities. *Journal of the American Planning Association*, *79*(4), 280–294.

Pittau, F., Habert, G., & Iannaccone, G. (2019). A life-cycle approach to building energy retrofitting: bio-based technologies for sustainable urban regeneration. *IOP Conference Series: Earth and Environmental Science*, *290*(1), 12057.

PMI. (2017a). *A guide to the project management body of knowledge (PMBOK guide) / Project Management Institute* (Sixth Edit). Project Management Institute.

PMI. (2017b). *Agile Practice Guide* (1st Editio). Project Management Institute.

Polo López, C. S., Lucchi, E., Leonardi, E., Durante, A., Schmidt, A., Curtis, R., & Torretta, V. (2021). Risk-Benefit Assessment Scheme for Renewable Solar Solutions in Traditional and Historic Buildings. *Sustainability (2071-1050)*, *13*(9), 5246. https://login.ezproxy.uniroma1.it/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=edb&AN=150372260&site=eds-live&scope=site

Poppendieck, M., & Poppendieck, T. (2003). *Lean software development: an agile toolkit*. Addison-Wesley.

Powell, D. J. (2018). Kanban for Lean Production in High Mix, Low Volume Environments. *IFAC-PapersOnLine*, *51*(11), 140–143. https://doi.org/10.1016/j.ifacol.2018.08.248

Prabatha, T., Hewage, K., Karunathilake, H., & Sadiq, R. (2020). To retrofit or not? Making energy retrofit decisions through life cycle thinking for Canadian residences. *Energy and Buildings*, *226*, 110393.

Prata, O. Di, & Ercoli, C. (2010). A key to understanding the challenges that face Italian project managers. *PMI® Global Congress 2010—EMEA, Milan, Italy*. https://www.pmi.org/learning/library/italian-project-managers-understand-challenges-6780

PresidencyEg. (2021). *Home / Share an Idea*. https://www.presidency.eg/EN/شارك-بفكرة/#step-one (Accessed 20-12-2021)

Prewett, R. (2011). *building opportunities for business managing low carbon retrofit projects LOW CARBON DOMESTIC RETROFIT*. https://www.retrofitacademy.org/wp-content/uploads/2020/05/5.-Managing-Retrofit-Projects-1.pdf

Prieto-Remón, T. C., Cobo-Benita, J. R., Ortiz-Marcos, I., & Uruburu, A. (2015). Conflict resolution to project performance. *Procedia-Social and Behavioral Sciences*, *194*, 155–164.

Rahim, M. A. (2017). *Managing conflict in organizations* (Fourth Edi). Routledge.

Rahman, N. A. A., Sharif, S. M., & Esa, M. M. (2013). Lean Manufacturing Case Study with Kanban System Implementation. *Procedia Economics and Finance*, *7*, 174–180. https://doi.org/10.1016/S2212-5671(13)00232-3

Ramadier, T. (2004). Transdisciplinarity and its challenges: The case of urban studies. *Futures*, *36*(4), 423–439. https://doi.org/10.1016/j.futures.2003.10.009

Rashid, N., & Khan, S. U. (2018). Agile practices for global software development vendors in the development of green and sustainable software. *Journal of Software: Evolution and Process*, *30*(10), e1964.

Reed, M. S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., Prell, C., Quinn, C. H., & Stringer, L. C. (2009). Who's in and why? A typology of stakeholder analysis methods for natural resource management. *Journal of Environmental Management*, *90*(5), 1933–1949.

Research Gate. (2020). *Project PRIN 2017-2020: TECH-START*. https://www.researchgate.net/project/PRIN-2017-2020-TECH-START-2

Reterurale. (2021). *Verso la STRATEGIA NAZIONALE PER UN SISTEMA AGRICOLO, ALIMENTARE FORESTALE SOSTENIBILE E INCLUSIVO [Towards the NATIONAL STRATEGY FOR A SUSTAINABLE AND INCLUSIVE AGRICULTURAL, FOREST FOOD SYSTEM]*. https://www.reterurale.it/PAC_2023_27/PianoStrategicoNazionale

Rhoads, J. (2010). *Low Carbon Retrofit Toolkit A roadmap to success*. Better Buildings Partnership. https://www.betterbuildingspartnership.co.uk/sites/default/files/media/attachment/bbp-low-carbon-retrofit-toolkit.pdf

Rodov, A., & Teixidó, J. (2016). Blending Agile and Waterfall The Keys to a Successful Implementation. *PMI® Global Congress 2016—EMEA, Barcelona, Spain*. https://www.pmi.org/learning/library/blending-agile-waterfall-successful-integration-10213

Rosenfield, P. L. (1992). The potential of transdisciplinary research for sustaining and extending linkages between the health and social sciences. *Social Science and Medicine*, *35*(11), 1343–1357. https://doi.org/10.1016/0277-9536(92)90038-R

Ruggeri, A. G., Gabrielli, L., & Scarpa, M. (2020). Energy Retrofit in European Building Portfolios: A Review of Five Key Aspects. *Sustainability*, *12*(18), 7465.

Sardaro, R., La Sala, P., De Pascale, G., & Faccilongo, N. (2021). The conservation of cultural heritage in rural areas: Stakeholder preferences regarding historical rural buildings in Apulia, southern Italy. *Land Use Policy*, *109*, 105662. https://doi.org/10.1016/j.landusepol.2021.105662

Schaltegger, S., Beckmann, M., & Hansen, E. G. (2013). Transdisciplinarity in Corporate Sustainability: Mapping the Field. *Business Strategy and the Environment*, *22*(4), 219–229. https://doi.org/10.1002/bse.1772

Schary, D. P., & Cardinal, B. J. (2015). Interdisciplinary and intradisciplinary research and teaching in kinesiology: Continuing the conversation. *Quest*, *67*(2), 173–184.

Schmeer, K. (2000). Stakeholder analysis guidelines. *Policy Toolkit for Strengthening Health Sector Reform*, *2*, 1–43.

Schmidt, S., & Weigt, H. (2015). Interdisciplinary energy research and energy consumption: What, why, and how? *Energy Research & Social Science*, *10*, 206–219.

Schönenberg, R., Schaldach, R., Lakes, T., Göpel, J., & Gollnow, F. (2017). Inter-and transdisciplinary scenario construction to explore future land-use options in southern Amazonia. *Ecology and Society*, *22*(3).

Schuurman, R. (2017). *Tips for Agile product roadmaps & product roadmap examples*. https://www.scrum.org/resources/blog/tips-agile-product-roadmaps-product-roadmap-examples

(Accessed 12-12-2021)

Schwaber, K., & Sutherland, J. (2020). *The Scrum Guide The Definitive Guide to Scrum: The Rules of the Game*. https://scrumguides.org/docs/scrumguide/v2020/2020-Scrum-Guide-US.pdf#zoom=100 (Accessed 15-11-2021)

Scrum. (2021). *WHAT IS SCRUM?* https://www.scrum.org/resources/what-is-scrum (Accessed 20-11-2021)

Scrum Guide. (2020). *The 2020 Scrum GuideTM*. https://scrumguides.org/scrum-guide.htm (Accessed 15-11-2021)

Segev, T., Harvey, A. P., Ajmani, A., Johnson, C., Longfellow, W., Vandiver, K. M., & Hemond, H. (2021). A case study in participatory science with mutual capacity building between university and tribal researchers to investigate drinking water quality in rural Maine. *Environmental Research*, *192*, 110460.

Serrador, P. (2009). Stakeholder management keeping your stakeholders thoroughly happy. *PMI® Global Congress 2009*. https://www.pmi.org/learning/library/stakeholder-management-keeping-stakeholders-happy-6697

Serrano-Jimenez, A., Barrios-Padura, A., & Molina-Huelva, M. (2017). Towards a feasible strategy in Mediterranean building renovation through a multidisciplinary approach. *Sustainable Cities and Society*, *32*, 532–546. https://doi.org/10.1016/j.scs.2017.05.002

Shaikh, P. H., Shaikh, F., Sahito, A. A., Uqaili, M. A., & Umrani, Z. (2017). *Chapter 9 - An Overview of the Challenges for Cost-Effective and Energy-Efficient Retrofits of the Existing Building Stock* (F. Pacheco-Torgal, C.-G. Granqvist, B. P. Jelle, G. P. Vanoli, N. Bianco, & J. B. T.-C.-E. E. E. B. R. Kurnitski (Eds.); pp. 257–278). Woodhead Publishing. https://doi.org/10.1016/B978-0-08-101128-7.00009-5

Sibilla, M., & Kurul, E. (2020). Transdisciplinarity in energy retrofit. A Conceptual Framework. *Journal of Cleaner Production*, *250*, 119461.

Silveira, K. K., & Prikladnicki, R. (2019). A systematic mapping study of diversity in software engineering: a perspective from the agile methodologies. *2019 IEEE/ACM 12th International Workshop on Cooperative and Human Aspects of Software Engineering (CHASE)*, 7–10.

SITdA. (2020). *PRIN2017_Conference.jpg*. http://www.sitda.net/12-in-evidenza/750-progetto-prin-2017-tech-start-1-year-closing-conference.html

Sliger, M. (2012). Agile estimation techniques. *PMI® Global Congress 2012—North America, Vancouver, British Columbia, Canada.* https://www.pmi.org/learning/library/agile-project-estimation-techniques-6110

Smith, L. (2000). Stakeholder analysis: a pivotal practice of successful projects. *Project Management Institute Annual Seminars & Symposium*.

Snedaker, S. (2005). *How to cheat at IT project management* (N. Hoeng (Ed.)). SyngressPublishing, Inc. https://books.google.com.eg/books?hl=en&lr=&id=Vz86qIE0KOEC&oi=fnd&pg=PR1&dq=How+to+Cheat+at+IT+Project+Management&ots=iQhsr8O6wQ&sig=baCWtZ0aO2y0LlLz7bYNBb2kOh4&redir_esc=y#v=onepage&q=How to Cheat at IT Project Management&f=false

Soares, N. (2017). A review on current advances in the energy and environmental performance of buildings towards a more sustainable built environment. In *Renewable and Sustainable Energy Reviews* (Vol. 77, pp. 845–860). https://doi.org/10.1016/j.rser.2017.04.027

SolutionsIQ. (n.d.). *INVEST (acronym)*. Retrieved December 12, 2021, from https://www.solutionsiq.com/agile-glossary/invest-acronym/ (Accessed 12-12-2021)

Staats, B. R., Brunner, D. J., & Upton, D. M. (2011). Lean principles, learning, and knowledge work: Evidence from a software services provider. *Journal of Operations Management*, *29*(5), 376–390. https://doi.org/10.1016/j.jom.2010.11.005

Starkey, K., & Madan, P. (2001). Bridging the relevance gap: Aligning stakeholders in the future of management research. *British Journal of Management*, *12*, S3–S26.

Stellingwerf, R., & Zandhuis, A. (2013). *ISO 21500 Guidance on project management–A Pocket Guide*. Van Haren.

Stober, D., Suškevičs, M., Eiter, S., Müller, S., Martinát, S., & Buchecker, M. (2021). What is the quality of participatory renewable energy planning in Europe? A comparative analysis of innovative practices in 25 projects. *Energy Research & Social Science*, *71*, 101804.

Streule, T., Miserini, N., Bartlomé, O., Klippel, M., & de Soto, B. G. (2016). Implementation of Scrum in the Construction Industry. *Procedia Engineering*, *164*, 269–276. https://doi.org/10.1016/j.proeng.2016.11.619

Strode, D. (2006). Agile methods: a comparative analysis. *Proceedings of the 19th Annual Conference of the National Advisory Committee on Computing Qualifications, NACCQ*, *6*, 257–264.

Suman, A. (2014). *4 - Developing conceptual frameworks: evolution and architecture* (A. B. T.-F. K. A. to M. Suman (Ed.); pp. 87–108). Chandos Publishing. https://doi.org/10.1533/9781780633695.87

Thamhain, H. J. (2016). Managing teams in complex project environments. *PMI® Research Conference: New Directions in Project Management, Montréal, Québec, Canada.* https://www.pmi.org/learning/library/managing-teams-complex-project-environments-8081

the Engage2020 Consortium. (2014). *Engage2020 Tools and instruments for a better societal engagement in "Horizon 2020" D3.2 Public Engagement Methods and Tools*. http://engage2020.eu/media/D3-2-Public-Engagement-Methods-and-Tools-3.pdf

Theocharis, G., Kuhrmann, M., Münch, J., & Diebold, P. (2015). *Is Water-Scrum-Fall Reality? On the Use of Agile and Traditional Development Practices BT - Product-Focused Software Process Improvement* (P. Abrahamsson, L. Corral, M. Oivo, & B. Russo (Eds.); pp. 149–166). Springer International Publishing.

Thesing, T., Feldmann, C., & Burchardt, M. (2021). Agile versus Waterfall Project Management: Decision Model for Selecting the Appropriate Approach to a Project. *Procedia Computer Science*, *181*, 746–756. https://doi.org/10.1016/J.PROCS.2021.01.227

Thompson, M. A., Owen, S., Lindsay, J. M., Leonard, G. S., & Cronin, S. J. (2017). Scientist and stakeholder perspectives of transdisciplinary research: Early attitudes, expectations, and tensions. *Environmental Science & Policy*, *74*, 30–39.

Toomey, A. H., Markusson, N., Adams, E., & Brockett, B. (2015). Inter-and trans-disciplinary research: A critical perspective. *GSDR 2015 Brief*.

Torabi Moghadam, S., & Lombardi, P. (2019). An interactive multi-criteria spatial decision support system for energy retrofitting of building stocks using CommuntiyVIZ to support urban energy planning. *Building and Environment*, *163*. http://10.0.3.248/j.buildenv.2019.106233

Tosi, H. L. (1994). *Managing organizational behavior / Henry L. Tosi, John R. Rizzo, Stephen J. Carroll* (S. J. Carroll 1930- & J. R. Rizzo (Eds.)). Blackwell.

Trombadore, A. (2017). Multidisciplinary Energy-Efficiency Think Tank for Supporting a Multilevel Governance Model in Energy Policies and Measures: MEETHINK Energy Project: Topic-6. In A. Sayigh (Ed.), *Mediterranean Green Buildings & Renewable Energy* (pp. 177–189). Springer.

Tucci, F., Santucci, D., Endres, E., & Hausladen, G. (2018). Smart urban districts: Dynamic energy systems for synergic interactions between building and city. *TECHNE-Journal of Technology for Architecture and Environment*, 92–102.

Usadolo, S. E., & Caldwel, M. (2016). A stakeholder approach to community participation in a rural development project. *Sage Open*, *6*(1), 2158244016638132.

Verma, V. K. (1998). Conflict management. *The Project Management Institute: Project Management Handbook*, 353–364.

Villax, C., & Anantatmula, V. S. (2010). Understanding and managing conflict in a project environment. *Defining the Future of Project Management, Washington, DC.* https://www.pmi.org/learning/library/understanding-managing-conflict-resolution-strategies-6484

Visual Paradigm. (n.d.). *What is Sprint Backlog in Scrum?* Retrieved December 13, 2021, from https://www.visual-paradigm.com/scrum/what-is-sprint-backlog-in-scrum/ (Accessed 13-21-2021)

Vogwell, D. (2003). Stakeholder management. *PMI® Global Congress 2003—EMEA, The Hague, South Holland, The Netherlands*. https://www.pmi.org/learning/library/stakeholder-management-task-project-success-7736

Volgger, M., & Pechlaner, H. (2014). Interdisciplinarity, transdisciplinarity and postdisciplinarity in tourism and hospitality education. In D. Dredge, D. Airey, & M. J. Gross (Eds.), *The Routledge handbook of tourism and hospitality education* (pp. 117–134). Routledge. https://www.taylorfrancis.com/books/edit/10.4324/9780203763308/routledge-handbook-tourism-hospitality-education-dianne-dredge-david-airey-michael-gross?refId=2a1c354e-2c7c-4eb8-96d9-0c7cba3a6524

Womack, J. P., Jones, D. T., & Roos, D. (2007). *The machine that changed the world: The story of lean production--Toyota's secret weapon in the global car wars that is now revolutionizing world industry*. Simon and Schuster.

World Bank. (2022). *Understanding Poverty Topics - Community-Driven Development*. https://www.worldbank.org/en/topic/communitydrivendevelopment#1 (Accessed 12-01-2022)

Xue, Y., Temeljotov-Salaj, A., & Lindkvist, C. M. (2022). Renovating the retrofit process: People-centered business models and co-created partnerships for low-energy buildings in Norway. *Energy Research & Social Science*, *85*, 102406. https://doi.org/10.1016/j.erss.2021.102406

Zedan, S., & Miller, W. (2018). Quantifying stakeholders' influence on energy efficiency of housing: development and application of a four-step methodology. *Construction Management and Economics*, *36*(7), 375–393.

Zein, O. (2016). *Culture and project management: Managing diversity in multicultural projects*. Routledge.

Zorzetti, M., Signoretti, I., Salerno, L., Marczak, S., & Bastos, R. (2022). Improving Agile Software Development using User-Centered Design and Lean Startup. *Information and Software Technology*, *141*, 106718. https://doi.org/10.1016/j.infsof.2021.106718

Zscheischler, J. (2021). Transdisciplinary Research in Land Use Science—Developments, Criticism and Empirical Findings from Research Practice. In *Sustainable Land Management in a European Context* (pp. 127–143). Springer, Cham.

Zscheischler, J., & Rogga, S. (2015). Transdisciplinarity in land use science–a review of concepts, empirical findings and current practices. *Futures*, *65*, 28–44.

Zscheischler, J., Rogga, S., & Lange, A. (2018). The success of transdisciplinary research for sustainable land use: individual perceptions and assessments. *Sustainability Science*, *13*(4), 1061–1074.

Zuhaib, S., Manton, R., Hajdukiewicz, M., Keane, M. M., & Goggins, J. (2017). Attitudes and approaches of Irish retrofit industry professionals towards achieving nearly zero-energy buildings. *International Journal of Building Pathology and Adaptation*.

Annex (03.01) The systematic literature review

Focus	Study	Context	Discipline	Stakeholders
Culture Heritage	(Haas et al., 2013)	Case Studies in EU (3ENCULT, 2014)	Energy efficiency / Conservation	Academic bodies: lead the process that aims to provide recommendations for local decision-makers; Conservation and technical experts; Urban development experts; Industry partners; Implementation experts.
	(Polo López et al., 2021)	Historical Building	Renewable Energy	Research team: Lead the technical intervention;
	(Pereira et al., 2021)	Over EU	Mechanical Engineering; Emerging Technologies, Conservation	Research Team; Lead the technical intervention to support the decision-making
	(Galbiati et al., 2021)	Olivetti office building - Italy	Energy efficiency / Conservation	Research team Developed methodology architectural inquiry, technological analysis thermal diagnosis definition of different intervention scenarios multicriteria comparison
	(Guleroglu et al., 2020)	Administrative building Turkey	Energy and Structural Engineering	Research team: optimizing seismic and energy retrofitting.
	(Ceroni et al., 2015)	Historical Palace -Italy	Energy and Structural Engineering	Research team: multi-objective optimization (costs and execution time, and energy performance)
	(Carbonaro et al., 2016)		Building Physics and Industrial Sector	Research team: multi-criteria optimization Manufacturers: facilitate developing the materials
Building Retrofitting	(Ascionea et al., 2017)	Historical Palace -Italy	Energy and Structural Engineering	structural and energetic performance Research team
	(Assimakopoulos et al., 2020),	University dormitory in Greece	Structural Engineering, Energy, and Building Physics	Research team
		University	Civil Engineering	Research team: optimizing comfort levels in indoor spaces and verifying the economic and environmental effectiveness.
	(De Angelis et al., 2021)	public buildings (Auditorium) in Italy	Energy and Civil Engineering	Research team: Seismic and Energy retrofitting
	(Berardi, 2015)	Private research university's	Private research university	The research team + devel
	(Ferrante, 2014) (Serrano-Jimenez et al., 2017)	Residential Buildings (District scale) In Italy, Spain, and Greece	Architectural Engineering, Energy	Research team: Multiobjective (techno-socio-economic) optimization
Pre-retrofitting phase	(DellaValle et al., 2018)	Social Housing in Italy	Renewable Energy	Research team: pre-refurbishment phase to support the national retrofit program Locals: Interviewed

Annex (03-02) The engaged stakeholders in the Best practices

Project	Context	Engaged Stakeholders
Public Weigh House,	Bozen/ Bolzano (Italy)	a- Building Owner (Foundation); b- Local heritage office (I argue it represents the relative stakeholder, likewise in the agriculture societies, it might be the agriculture association) c- Business sector; d) Local Government.
D'Accursio Palace	Bologna (Italy)	a- Local Authority and local university (process leader involved); b- National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA), and National Research Council (CNR) (Provides expertise on monitoring); d- The Regional Agency for Monument Protection (communicating the results to the public); e) Local associations and the community (informed by the media).
Palazzina della Viola	Bologna (Italy)	a) The University of Bologna (scientific guidance and project owner)
The Material Court of the Fortress	Copenhagen (Denmark)	a) Building owner; b) Heritage authority (conservation viewpoint). c) Architects (shapes, appearance, functionality, and interior design condition); d) Structural engineer (risk assessment and the impact on existing construction); e) Services engineer (energy consumption).
Monumental School	Innsbruck (Austria)	a) Building owner and client (Promotes the work through disseminating results); b) technical experts (architects and structural engineers); c) Business sector (development of the prototypes, and to develop solutions); d) Cultural Heritage authority "the Austrian Authority" (providing feedback).
Industrial Engineering School	Béjar/ Salamanca (Spain)	a) The Owner "Salamanca University" (scientific and administrative contributions); b) Technical experts (related to the given topic knowledge); c) The client "School manager" (to collect feedback from students); d) Private business (to develop strategies for the installation of renewable); e) Industrial Partners solutions partner
Warehouse City	Potsdam (Germany)	a) The owners b) Academic body (University researched and conducted the retrofit), c) Technical experts (conservator, architects, and building engineers) d) Business partners developed ad hoc insulation materials to respond

Annex (03-03) The Scrum checklist proposal in the construction industry by the Agile Scrum Group, Netherland. The Author requested the file from (Agile Scrum Group, n.d.-b)

1	Sprint Planning • Goal: Determine the goal of the upcoming Sprint and make a plan to reach that goal; • Frequency: First day of the Sprint; • Attendees: Product Owner (PO), Scrum Master (SM), Development Team (DT) (required), and Experts (optional)
1.1	Preparation
	Product backlog is updated and insightful (PO)
	User stories for the next two sprints have been worked out in detail (so that ±5-10 User stories fit into a sprint, each User story contains acceptance criteria) (PO)
	Product backlog is prioritized (PO)
	Estimate if the right team members are in the development team for the upcoming Sprint (PO)
	Facilities for the Sprint planning (beamer, post-its, meeting room, etc.) (SM)
	Participants are invited (SM)
	An agenda for the meeting has been drawn up (SM)
	Definition of done has been updated if necessary (OT)
1.2	Activities
1.2.1	Sprint Planning Deel I: What do we do?
	Explain the purpose of the Sprint (PO)
	Determine capacity and commit to it (DT)
	Product backlog is explained, and everyone understands it (PO + DT)
	Commitment to selected user stories for upcoming Sprint (DT)
	Meeting does not exceed time box (SM)
1.2.2	Sprint Planning Part 2: How are we going to do it?
	Create a plan for each user story where tasks are broken down by
	A size of 1 day per task (DT)
	Commitment to the plan (DT + PO)
1.3	Result
	Commitment to selected user stories for upcoming Sprint (DT)
2	Daily Scrum • Goal: A standing meeting in which a plan is made for the next 24 hours in which activities of team members are coordinated. The meeting ensures rapid decision-making, coordination, and knowledge of the total project; • Frequency: Daily 15 minutes; • Attendees: DT (mandatory), SM (optional), PO (optional)
2.1	Preparation
	Tasks on the sprint backlog have been updated (DT) Team members have thought about the three daily Scrum questions (DT) *1) What did I do yesterday? 2) What am I going to do today? 3) What do I need help with / what hinders my progress?* Meeting can be held at sprint backlog (SM)
2.2	Activities
	Team members answer the three daily Scrum questions (DT)
	Team members offer each other help when possible (DT)
	Are there dependencies with other teams for which a Scrum or Scrums? should be invested?
	Scrum Master notes bigger obstacles (SM)
2.3	Result
	Meeting lasts no longer than 15 minutes (SM)
	Summarize follow up points (who, what, when) (SM)
	Sprint backlog has been updated (DT)
	Updated obstacle list (SM)
	Additional meetings are scheduled if necessary (DT)
	Items as needed for a Scrum of Scrums (DT)
3	Review Meeting • Goal: The development team presents the completed work to the Product Owner and stakeholders; • Frequency: Last day of each Sprint; • Attendees: DT, SM, PO, and Stakeholders.
3.1	Preparation

	The User Stories meet the definition of done (DT)
	The team does not exceed one hour to prepare the Sprint Review (OT)
	The Product Owner invites stakeholders for the review (PO)
	The Product Owner and the Development Team determine what will and will not be presented (PO + DT)
3.2	Activities
	Only User Stories that are completely ready will be presented to the Product Owner and Stakeholders (DT)
	The Product Owner accepts User Stories that are ready (PO)
	Reviewing the Product Backlog (PO)
	Stakeholders and Scrum team provide input for the Product Backlog (PO)
	The Velocity and Release planning are explained (PO)
3.3	Result
	Shared understanding of real progress
	User Stories from current Sprint are accepted by PO when ready
	Incomplete User Stories have been split or completely reverted to the Product Backlog
	Product Backlog is ready for the next Sprint
	Burndown Chart, Velocity, Release Planning, and possibly other metrics have been updated
4	Retrospective Meeting • Goal: Reflecting on the past Sprint in terms of people, relative, process, • and facilities/tools; • Frequency: Last day of the Sprint, after the review; • Attendees: DT, SM, and PO.
4.1	Preparation
	Have a plan for the retrospective (SM)
	List of obstacles is included (SM)
	Collect the agreed-upon actions (SM) from the previous retrospective
4.2	Activities
	Stay away from substantive discussions about the completed work (SM)
	Tell the goal and the agenda/working method (SM)
	Evaluate agreements made in previous retrospective (SM)
	Make sure everyone has their say (SM)
	Collect input for improvement (SM)
	Determine a maximum of 3 points for improvement for the coming Sprint and wise responsible to (SM)
4.3	Result
	Agreements on improvements in people, relationships, processes, and facilities.

IV. Assessing the Framework

Abstract

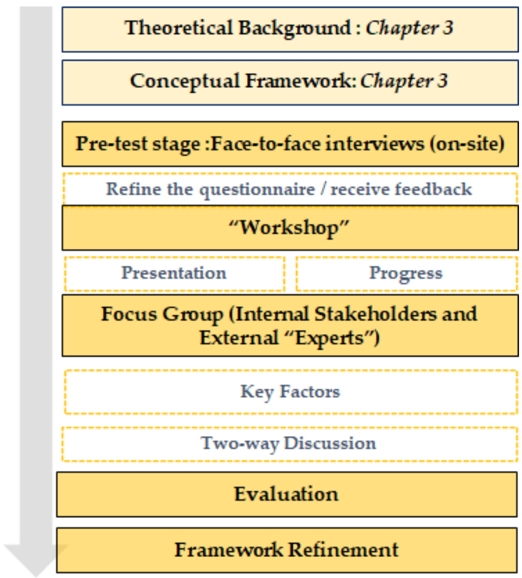
The chapter proposes a transdisciplinary collaborative framework related to energy retrofitting in the traditional settlement in Egypt and Italy.

To what extent can the scrum framework be adopted in transdisciplinary practices?
Wah the restrictions and benefits of adjusting agile methods in collaborative work?
What is the agreement level about the technical interventions?
What is the perception of the participants of the subject?
What are their concerns about the obstacles?
To what extent can we implement a pilot project?

The aim is to validate the provided conceptual framework using a qualitative focus group implemented in two traditional settlements in the Mediterranean region, Lasaifr Albalad in Egypt, and Pontinia, in Italy.

The framework enhanced the collaborative work, mitigated team conflict, and provided the first self-consumption building in Lasaifar Albalad.

Visual Summary



Keywords

Case Study, Energy Communities, Framework Validation, Qualitative Method

Highlights:

- The novel participatory approach enhances the collaboration between the stakeholders.
- The bottom-up framework increased the level of engagement (high-level participation, top-down) and enhanced the decision-making.
- Implementing the framework led to the funding of a pilot case study in Lasaifar Albalad – the first in the village- (off-grid solar system) is now in the implementation phase.
- The role of building cultural factors and social relations in energy retrofitting practices has been highlighted.

4.0 Introduction

The conceptual framework, or so-called analytical framework, is a graphic product that relates relevant theories from different concepts and concepts from multi disciplines to discover a particular phenomenon, assign the association among them, and structure the epistemology. The conceptual frameworks link ideas to experimental data and help resolve societal (real-world) challenges. (Maxwell, 2005; Rocco & Plakhotnik, 2009). It utilized mixed and qualitative methods (Ngulube et al., 2015). The conceptual framework can become the groundwork needed to deepen and develop such a topic (Barinda & Ayuningtyas, 2022). It can be built on the collected data from the literature search process (Abraham et al., 2019) in any domain such as business (Konopik et al., 2022), social science (Lakin & Kane, 2022), engineering (McComb & Jablokow, 2022), environmental science (Winkelmann et al., 2022), and in agricultural (Vialatte et al., 2022).

Adom et al. (Adom et al., 2018), in their literature review, have summarized some benefits of the conceptual framework, such as defining the concepts within the problem of the study, which protrudes the rationales of what the investigated topic is needed to be studied, it collects the different parties to discuss this framework, which can lead to theory development.

4.1 The Proposed Framework

The proposed framework is presented from multi-disciplinary theoretical concepts from three domains: energy retrofitting practice, project management, and software development, which produced an agile framework. This framework is original for three reasons. First, the first agile framework (relying on Scrum methodology) manages the collaboration to retrofit the built environment in the early decision-making stage to implement renewable energy communities (CER) in the traditional settlements in the Mediterranean region. Apart from the only indicated practice of the "DNA in de bouw" group in 2015 (PassReg, 2015), which aimed to achieve nearly zero-energy buildings (nZEB) at building scales in urban areas in Europe. Considering that they limited the Scrum participatory approach between the technical team and building owner in the early design stage, and by analyzing their schedule to implement the project, it was evident that they applied the traditional way, not the agile one (Section 3.6.3.1).

Second, the detailed procedures of exploring the participatory approaches boundaries have been discussed (Section 3.7), such as stakeholders, timeframe, intervention goals and level, the type of societal problems. Thanks to "the Engage2020 Consortium" (the Engage2020 Consortium, 2014), which analyzed 57 participatory approaches across Europe. Third, the complex nature of energy retrofitting practices and the complexity of the traditional (rural) landscape, both built environment and inhabitant culture, and the ambitious goal of engaging a versatile "right-stakeholder" in the process. Thus, the scrum framework could help organize the interlocking relation between the stakeholders in the complex nature of energy retrofitting practices towards energy efficiency. Figure (04-01) summarizes how the scrum framework can help the participatory approach.

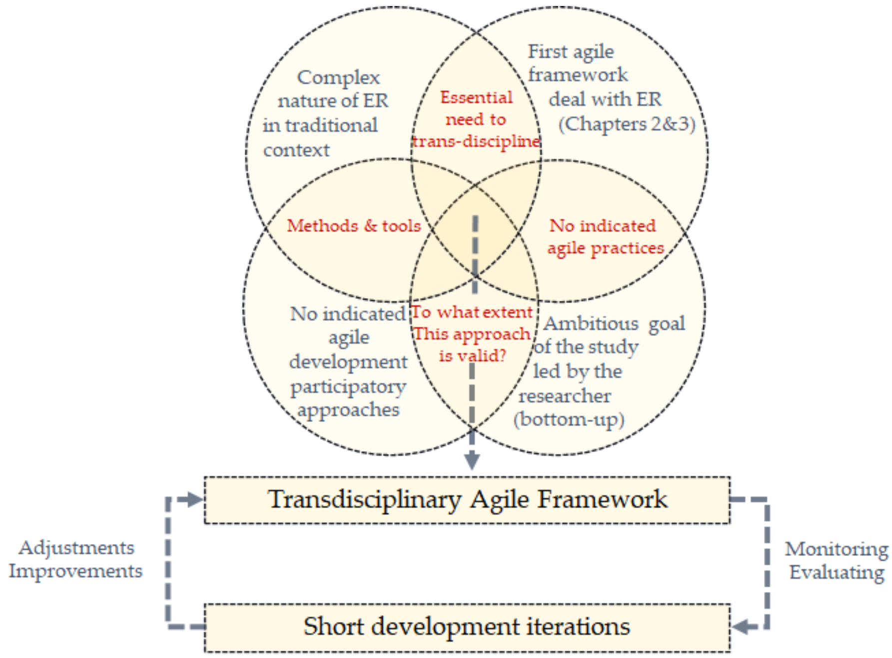


Table (04-01) Visual summary illustrates how the proposed agile framework can help fill some gaps in the collaborative work.

In this line, the participatory method enhances decision-making, and better understands the process boundaries. Moreover, the scrum method can also mitigate the uncertainty about different aspects such as rework, different fluctuations, and the conflict between the participants with the vital fact of the ambitious nature of the transdisciplinarity approach, in addition to the rapid adjustment of the work plan, which is developing a novel method of thinking based on the short iterations of so-called sprints. The scrum framework helps determine an effective work procedure that combines short iterative development and assessments, leading to holistic reviews and in-depth feedback. The validation process itself is the initial Sprint in the retrofitting process- Sprint Zero.

4.1.1 Why Focus Group

Jabareen (Jabareen, 2009) has emphasized that each framework should be validated. As he stated, "*Validating a theoretical framework is a process that starts with the researcher, who then seeks validation among "outsiders." Presenting an evolving theory at a conference, a seminar, or some other type of academic framework provides an excellent opportunity for researchers to discuss and receive feedback.*"

As a sequence, to identify stakeholders' preferences and evaluate the conceptual framework, the focus group technique can be considered one of the most efficient methods (EFSA-EU, 2021). Mainly, it can enhance the innovation of the different topics (Franz, 2011) by discovering experiences, emotions, services, ideas and collecting data from multiple individuals simultaneously, supporting the decision-making at the different stages. Simultaneously, according to the stakeholder analysis, the focus group method is a qualitative characteristic of the social science researchers between the selected participants (stakeholders). The method is frequently applied to generate or assess ideas and hypotheses. (Morgan & Krueger, 1998; Morgan, 2005; Onwuegbuzie et al., 2009; Krueger & Casey, 2014).

Focus groups are classified into three categories, full groups that involve 8-10 participants in a (90-120 minutes) session, mini-groups that involve 4-6 participants, and telephone groups that interview the individuals by telephone conference calls, and it usually takes (30-120 minutes). The common things are that the participants were selected based on their attitude, demographic, relevance to the subject, and moderator skills (trained) (Greenbaum, 1998). Despite that, the study engaged the participants (full-group) based on the stakeholder analysis of each context resulting from Chapter Three. Therefore, the focus group procedure has been revised based on references (Morgan & Krueger, 1998; Krueger & Casey, 2002; Krueger & Casey, 2014).

The study proposed an agile framework addressed in this paper is to study the phenomenon from a transdisciplinary approach and different perspectives to support retrofitting built environment traditional settlements in Egypt and Italy and to answer the following questions:

- To what extent can the scrum framework be adopted in transdisciplinary practices?
- Wah the restrictions and benefits of adjusting agile methods in collaborative work?
- What is the agreement level about the technical interventions?
- What is the perception of the subject participants and the participation itself?
- What are their concerns about the obstacles?
- To what extent can we implement a pilot project?

Validation of the framework was carried out in two stages in order to assess its feasibility and suitability for the researcher and stakeholders. First, one-to-one interviews with the external stakeholders (experts and academics). Second, the on-ground implementation using the focus group method to identify the gaps advantages and receive instant feedback from stakeholders, and fulfill rudimental accordance on the framework in Lasaifar Albalad and Pontinia settlements. In order to improve the participatory approach and create dialogue and interchange among multiple stakeholders (researchers, national Institutions, society, non-profit organizations, and media), interdisciplinary experts have been involved in the qualitative study.

4.2 Framework Validation

The vision statement is to decide together and be on the same page to retrofit our built environment within the potential and the obstacles. The road map is to screen the gaps, potentials, and risks to retrofit the existing building in both villages using insulation materials and promote the energy communities. Particularly with the availability of the data in terms of the current electricity consumption in relation to the buildings (Chapter One) and the current situation, integrated with the current national initiatives and regulations.

Simultaneously, the author acts as the scrum master (servant leader) responsible for explaining the technicalities of the scrum principles. The development team was the selected stakeholders resulting from (Chapter Three). However, the team in this intervention is different from the team in software development (which is limited to the technical team) because it includes versatile participants (decision-makers, locals, cultural experts, local suppliers). Mainly the most significant differentiation between the team in the software.

After that, the initial Sprint planning was estimated at one week, and making a plan to reach the goal that the development team aims to fulfill within the Sprint, namely, what is the first feedback about the framework? What are their perceptions? What is the awareness level toward the retrofitting practices? Finally, what are the refined outcomes of completing the sprint backlog?

In the early stage of energy retrofitting practices in Lasaifar Albalad and Pontinia villages, the conceptual framework was evaluated using a qualitative method, started face-to-face to explore feedback, and refined the procedure. Second, create the transdisciplinary focus groups among selected participants (from those identified as stakeholders) representing different backgrounds, geographically from the villages, and the external stakeholders (certified project manger/s, professors). The digital platforms have facilitated the meetings. Table (04-01) shows the engaged stakeholders in both contexts. Table (04-02) Summarizes the scrum practices localization within both workshops.

Table (04-01) The Engaged Stakeholders

Stakeholders	Lasaifar Albalad Settlement, Egypt	Pontinia Settlement, Italy
Researcher	The author (moderator)	The author (moderator)
Academic body	Sapienza University	Sapienza University
Government	a- Agricultural association manager b- Former president of peasants syndicate	Pontinia Municipality
Locals	*a-* Farmers *b-* Employees	*a-* Farmers *b-* Employees
Media	National TV channel (Channel 6) a- A presenter at a daily program TV show (Good Morning Delta) b- Facebook groups.	Facebook groups
NGOs / Facilitator	Albakyat Alsalehat NGO	a- Pontinia Municipality b- Volunteer Translator
Expertise	a- Applied Science Architect / urban planner b- Social science c- Culture expert d- Agriculture Engineer	a- Architect b- Culture expert c- Agriculture Engineer
External Experts	a- A Certified Project Manager b- Expert researchers	An expert researcher
Too-related literature	(Abouaiana, 2016; Abouaiana, 2021; Abouaiana & Mendonça, 2022)	No study published discussed energy retrofitting practices in Pontinia

Table (04-02) Localizing the scrum practices within the workshop.

Team	Artifact	Event	Description
PO & SM	Product Backlog	Vision statement	Stating the vision (developing built environment together based on Chapter Two results); The necessary work to fulfill the product(project) objective orders these needs into a list; PO shows a requirement to the members, asks questions, and discusses possible challenges and strategies.
PO,SM& DT	Sprint Backlog	Sprint Planning (Direct goals)	*What can be accomplished and delivered as Increment*(How can we do it); What are the obstacles and benefits based on Chapter Two (approving the user stories); Localizing the concept of agile and scrum; What are their point of view directly about both framework and suggested interventions; How can we implement a real scenario case; The status of tasks progress has been handled by the moderator during the workshop (Chapter Three, Figure 03-30).
PO	Sprint Backlog	Sprint Planning (indirect)	Observing their facial expressions; Observing the communication levels and their preferences.

PO and Sponsors	Sprint Backlog	Daily Meetings	Preparing for the workshop activities (Short meetings with facilitator stakeholders) and inviting the stakeholders.
PO and External	Supportive item	Daily Meetings	Preparing for the workshop technically; Short face-to-face with volunteer external experts (researchers) to receive feedback about the framework.
DT	Increment	Sprint	The sum of all the elements that were accomplished during the Sprint, a completed (accomplished) task within the vision;
PO,SM& DT	Increment	Sprint Review	A summary of the accomplished tasks; Estimating the delivery dates and those targeted for the next Sprint.

4.2.1 Sprint Zero – Lasaifar Albalad

The author has implemented the exploratory step in (Chapter One) and previous studies that helped him contact the locals and express interest in participating in developing their village. As a result, the author has contacted an NGO in the village (it has societal activities, including a nursery), which has facilitated the event, namely, preparing the room, providing filming, providing a cold beverage and food. The author has called the other stakeholders one by one to arrange the date of the meeting. The session consists of 120 minutes.

Before the workshop, the author has welcomed each individual once they arrived to " break the ice" and try to add a friendly environment and help them get familiar with other participants. The questions have been prepared in a sequence term, with the intention to be easy to understand, to encourage the participant the speak. It was rapidly observed that the locals would like to ask what does the moderator want? Figure (04-02) shows preparation for the workshop.

(1) (2)

Figure (04-02) AlBakyat AlSalhat NGO, in which the workshop took place (taken by the author). Panel 1: shows the NGO from the outside. Panel 2: shows the room from the inside during the final arrangement.

The author has presented a 20-minute workshop to orient the attendees' focus towards the goals. In short, the workshop discussed many items. First, welcoming the attendees and stating the aim, followed by the introduction, shows the local environmental challenges of the rural settlements in the Delta region the direct impact on the locals (the electricity bills and the negative environmental impact). Figure (04-03) shows a well-known example in Lasaifar Albalad, the open sewage canal in the center of the village.

Figure (04-03) The open sewage canal of the village (it is existed for more than a decade, as the author observed) (taken by the author). The main aim of showing this example is to provoke the local attendees to raise their level of interaction as well as expectations. Primarily it has been proposed to cover this canal with photovoltaic. Noteworthy, the government (Decent Life Initiative) is regenerating the built environment in the rural settlements (including this sewage canal).

Second, previously implemented work by the author, either the publications or (Chapter One), namely the urban fabric, architectural style, the energy consumption patterns, and a summary of all the findings, Table (04-03).

Table (04-03) The related previous publications implemented by the author.

Reference By year	Retrofitting intervention	Context (traditional settlements)		Approach	Cross-disciplinarity level
		Egypt	Mediterranean		
(Abouaiana, 2016)	Technical	Delta Region	-	Bottom-Up	Mono-disciplinary
(Abouaiana, 2021)	Techno-socio-economic	Delta Region	-	Bottom-Up	Inter-disciplinary
(Abouaiana & Mendonça, 2022)	Techno-economic	Delta Region	Central Coastal Region, Portugal	Bottom-Up	Multi-disciplinary
This Research (ongoing)	*Techno-socio-cultural*	*Delta Region*	*Lazio Region, Italy*	*Mixed*	*Trans-disciplinary*

Finally, the workshop discussed the potential and risks of implementing any intervention and showed how the intervention is in line with governmental initiatives. Simultaneously, the purpose of the agile way has been discussed by highlighting the examples of the traditional way and showing how agile can help in mitigating uncertainty, Figure (04-04). The workshop is entitled "A Workshop on Developing a Participatory Framework to Improve Energy Efficiency for The Built Environment in The Delta region.". By the end of the presentation, it was apparent that the participants' feelings had been changed to be more comfortable. The irrelevant recommendations have been eliminated, such as new urban communities.

Figure (04-04) The moderator (scrum master) localized and simplified the scrum practices to the participants, showing the method, differences from the traditional way, and how it can be beneficial (taken by the NGO).

In the next step, external experts have been invited. The floor has divided into two groups. The first group consists of three volunteer professors and a certified project manager through the Google Meet platform. The second group physically consists of two experts in the villages (eco-material local supplier and solar energy manager in a community development large firm).

In general, the discussion has been divided into technical suggestions and recommendations and a critique of the idea. To clarify, the urban planner agreed on the interventions and showed the role of energy in the rural development equations. Besides, he provided a general recommendation to include the industrial buildings in retrofitting and reduce the energy consumption in the construction process. Overall, the reactions of the attendees were neutral about this intervention.

At the same time, he supported the participatory approach as potential to improve the Egyptian built environment as he stated a few days before the workshop, "*the ability to engage this number of people in Egypt is one of the challenges that I face during the similar intervention. However, I should be getting more details of your participatory approach.*"

The second expert was from the agriculture and water sciences domain. At the same time, she was involved in many academic activities in the Mediterranean region (Spain). In the beginning, she has referred to water efficiency in line with Egypt National Water Resources Management 2037. How it will support the environmental deterioration by canal lining national project and covering the open sewage canals (that has been explained in the workshop), so she highlighted the covering the canal by the photovoltaic may be ineffective. However, she showed the potential of this research to accelerate top-down interventions. Figure (04-05) illustrates an example of these interventions in the village.

(1) (2)

Figure (04-05) shows the Egyptian Government intervention (canals lining national project) in Lasaifar Albalad. To enhance the water system's capacity and mitigate climate change (taken by the author). Panel 1: Before (2021); Panel 2: and after (2022). The project is still ongoing. It is considered the first intervention of the recent presidential initiative Decent Life, reflecting the potential of implementing a pilot case study within the research.

She highlighted the green building and roof gardening, from the outcomes the extended family in one building can improve the collaborative approach in terms of high-level agreements, so the green roof can enhance the identity and improve the thermal, it can also boost the micro economy. She highlighted the eco-buildings and zero energy and cooling passive systems integrated retrofitting into the building envelope, with the potential of the building inside the agricultural mass. She also discussed the new national projects of national desalination projects and the impact on the agriculture process.

She referred to the possibility of establishing small desalination to reuse the greywater in septic tanks for the green roof or small plantations. The moderator asked an open question to align the intervention with the aim, to what extent this study can accelerate the green infrastructure (ongoing governmental intervention) in terms of the water-energy nexus. She highlighted the support by the government, improving the water resources, for example, the seawater into the Delta region, preventing some economics such as fish farms or rice that may increase soil salinity.

She pointed out the possibility of using the energy crops in the local economic activities (public ovens) to reduce natural gas. Although, planting these crops can affect the food security in the delta region in terms of the limited agricultural land. They could be in the green built and marginal areas. It was observed that the participants (the government) have interacted with her speech. It makes sense that farmers (the topic is too relative to their interest area) linked it with biogas from a technical perspective as well as the energy crops.

The third participant highlighted that the most critical barrier is how to find funds and investors. Otherwise, it will be a vague project. To implement on-ground development, what are the alternatives. When she recommended the interventions in the rural contexts (she spoke from a technical perspective in an academic classification), the locals have disagreed with this classification and pointed out that the village is urbanized from this point, the general mood has been changed. The conflict occurred because the rurality definition (not urbanized) has been precepted as (not civilized), which reflected the importance of simplifying the technical terms when talking in public.

The former peasants' president has described by examples that the scientists those are originated from the Egyptian rural in Lasaifr Albalad and the Delta region. He stated, " *you have confused the peasant mindset with the limits of the rural land on which he lives.*" the moderator resolves this conflict. However, it was observed that this issue had a negative impact on the locals for a while during the workshop.

Then she highlighted the role of building capacity first to the representative responsible for learning about the local community by classifying the rural into clusters or sectors by any classification such as by family or geographical. Here, a transformation in the meeting has taken place. The urban planner disagreed with her and has clarified that building capacity and raising awareness should be to use the technology, not the maintenance, as well as he agreed on the role of the selected local influencers.

The fourth participant was a certified project manager (originally from a rural settlement in southern Egypt) and an architect. From a managerial perspective, he has thoroughly critiqued the framework. He stated, "*to achieve an efficient project. I should determine four factors the clear scope of work, time frame, cost, and risks* " The general, what is to clarify the scope, to implement the which strategy among the numerous ones, what exactly and in detail what are the limitations.

The project is good, and the time is most important, he argued in the development project such as sewage (infrastructure) projects, although the benefits once the project, the problems of the implementation phase such as contractors problems, and the houses that are affected by digging process. Lead to resistance from people, so he recommended that as much as the time is short, it enhances the project's success.

The third aspect is the cost, who will implement the project, the owner or what? Who is the fund NGO, investors, individuals, and government? Each model should be implemented. If the individuals, what is the return of investment. He stated that the government has to plat
A local interaction by showing the role of the national banks can fund the project "Egyptian Arab Land Bank." and the investors, what is the benefit, which should have the opportunity so I can exclude them.

The fourth aspect is the risks. What are the possible risks once we implement the project? What is the probability of happening? Each one should be evaluated. What is its impact? How to face the risks. To accept or reject. The risks are the most important. He evaluated the Al-Gourna pilot project of the 1960s (by the architect Hassan Fathy) when the people rejected the project because no operation management plan was provided[1]. He argued that as a local inhabitant in the next village to Al-Gourna.

The risk level increases as much the intervention focuses on the micro context. For instance, during retrofitting dwellings, to what extent do they accept them from a cultural perspective, do the resident accept to leave their house, or what are the legislative problems.

In addition to many aspects, such as determining the target project, who will implement the technical intervention (local contractor or the sponsor), and the technical team's capability, which are all helpful in identifying the cost. Another expert suggested these workflows to select the pilot case study to implement the project (shortly) and rapidly consider the risks. For this reason, the moderator has stated, "*the technical intervention is in the early stage.*" So, agile can help. The short iterations helped in finetuning the plan, which has been suggested in line with the external senior software engineer (Chapter Three).

---

[1] Hassan Fathy himself referred to the people reject the project because the would lose their local illegal economies (Fathy, 2010).

The moderator asked the locals to what extent we could make a pilot project can we implement in the public building? For example, the health unit building. A local responded that the rice milling buildings much more electricity consumption. They agreed with the local who stated, "*who owns the rice milling building is an investor, so the project will be beneficial to him, and he can pay and renovate his building.*" Figure (04-06) shows the interaction of the local community.

Figure (04-06) Receiving feedback from the local community (taken by the NGO).

The bio-material material supplier Mycelium (Mycellium, 2021) has shown the benefits of eco-material (under-development) and how to collect the agro-waste from the village to be employed in the material. Some irrelevant issues have emerged, such as agro-tourism and educational tourism. Figure (04-07) shows another part of the discussion within the workshop.

Figure (04-07) The bio-material local supplier while describing the product. (taken by a member from the NGO). The highest debate occurred during this part of the workshop. For example, the experts criticized the product regarding validity and safety. It is worth mentioning that a similar nature-based material of this company has been evaluated as a retrofitting solution for rural dwellings in the Delta region in a previous study by the author (Abouaiana & Mendonça, 2022). It proved to have high environmental performance. Simultaneously, it was not profitable compared to the conventional insulation material.

4.2.2 Discussion of Results – Lasaifar Albalad

The workshop has been conducted, including versatile stakeholders from the local (from different cultural backgrounds), governmental bodies, representatives, experts. The discussion and the communication were two-way (Chapter Three, Figure 03-38), and new topics were raised.

In general, the participatory approach was accepted by all participants, represented in the acceptance to attend and welcoming as well. However, as observed, environmental sustainability issues are poorly addressed in the village, represented in the environmental deterioration (the sewage canal) and the lack of energy efficiency, such as the absence of photovoltaic and green technologies.

Simultaneously, the perception and the feedback of the participatory approach were positive and encouraging from all the stakeholders. The locals have appreciated the possibility of developing their village, despite the many critical issues and points of view that covered vast perspectives: technically, economically, socially, potential, and obstacles.

Technically, the workshop presentation has generally oriented the discussion toward renovating building envelopes and integrating photovoltaics into the built environment. The external experts (the researchers) have provided technical recommendations such as eco-buildings, green buildings, and water retrofitting impacts somehow energy efficiency.

In the same vein, from the project management perspective, it has been emphasized that a clear and defined scope is the foundation stone that determines the further aspects. Namely, what the intervention aims to do, in which way, and how. However, this Sprint aims to evaluate the initial process and collect feedback.

Economically, all the stakeholders have emphasized that it is the most critical barrier. In this line, four sources of the funds have been discussed (the government, banks, local funds from the village, and the investors). The majority has claimed the government is responsible (by the locals) and specific such as research funds (by the experts). Then the banks, as suggested by the influencer locals. Finally, the investors were excluded because it was unclear how they would be convinced to implement the intervention.

Noteworthy, the moderator has asked to what extent each inhabitant can donate by small fees. Although, the moderator should not contribute to the focus group (to avoid bias). He asked to what extent the village's own funding could support such intervention or to what extent each inhabitant could donate one EGP (0.06 EUR). He wanted to assess social acceptance and measure the locals' readiness to develop the built environment, especially when they emphasized "*we can not pay high initial cost*, *we can pay monthly installments,*" supporting the same finding of Abouaiana's study (Abouaiana, 2021). Because, from a local cultural perspective, belonging to development is the most critical to ensure the success of any intervention. It was evident that the recommendation had been rejected indirectly by the local participants, which might have also occurred because no clear vision was provided (i.e., who will benefit and what are the target case).

In terms of the time frame, the shortest schedule can lead to more efficient results for many reasons, the well-known rapid development rates by the Egyptian government, the social impact of reducing the working time that may disturb the locals, and finally, the nature of the suggested bottom-up intervention and the essential need to a "rapid" pilot project in the village. The possible risks should be monitored. Therefore, the scrum framework can improve the implementation of the development process and reduce uncertainty (predict the risks) because of its incremental and iterative nature, adjusting the barriers instantaneously and modifying the scope.

By the end of the question "to what extent we can provide a pilot project," one of the attendees has offered his dwelling to experiment (without any financial burden). The others suggested two buildings, the health unit public building and the private rice mills buildings (that are distributed outside the inhabitant center of the village) because it is the highest consumer building.

In terms of the participatory approach, a female participant pointed out that the number of participants is limited. There is a need to implement another workshop involving many locals and local administrative unit representatives. As she said, "*I could not understand what the aim of the workshop was in the beginning, but now I recommend engaging another influencer participant*." This requirement will be considered in the product backlog for the next sprints.

From the social interaction between locals and experts, the highest contribution took place in two scenes, first while discussing the irrigation and agriculture intervention and the economic barriers. In contrast, the debate between the experts has been raised while discussing the eco-material insulation panels as a retrofitting solution in terms of the technical validity, datasheets, environmental impact, and cost. This reflects the importance of innovative building materials that supports the findings of Hausladen & Tucci (Hausladen & Tucci, 2017).

By the end of the workshop, the moderator, experts, and three locals had implemented a field trip has been implemented to discover the health unit buildings and the NGO. The private industrial building was not available to visit. Figure (04-08) shows the investigated buildings.

(1) (2)

Figure (04-08) The on-site visits after the workshop. (taken by the author). Panel 1: shows the rooftop of the NGO building, which can install photovoltaics. Panel 2: shows the health unit from the inside while discovering the equipment and loads.

To conclude, the scrum is a transparent process where the moderator (product owner) acts as the client who has the requirement (vision statement and goals) that evaluates the participatory transdisciplinary framework. The product owner initiated the sprint review process and reviewed him with the stakeholders from different perspectives. The first Sprint was implemented in six days (from contacting the stakeholders to the workshop day). Many problems and risks have been discussed. The feedback led to many modifications in the framework and provided information for the next Sprint.

4.2.3 Sprint Zero: Pontinia

The first step is to prepare the vision statement, to investigate the initial feedback to achieve an energy community in Pontinia in line with (Chapter Two). The exploratory step to determine the stakeholders consisted of three steps, first through social media platforms (Facebook groups) of Pontinia, with the aim to contact the locals. In this step, the author has succeeded in contacting a local supplier. Second, the on-site investigations that occurred in December 2021 led to an influencer (well-known) stakeholder in the village (the Youth Policy Advisor). Third, the author has direct contact with him on Facebook to describe the required interventions briefly. Finally, an online meeting took place in January 2022 for this purpose. The main aim and the suggested participatory approach have been described in this meeting. Figures (04-08) and (04-09) show the contact with the locals in Pontinia in the exploratory step.

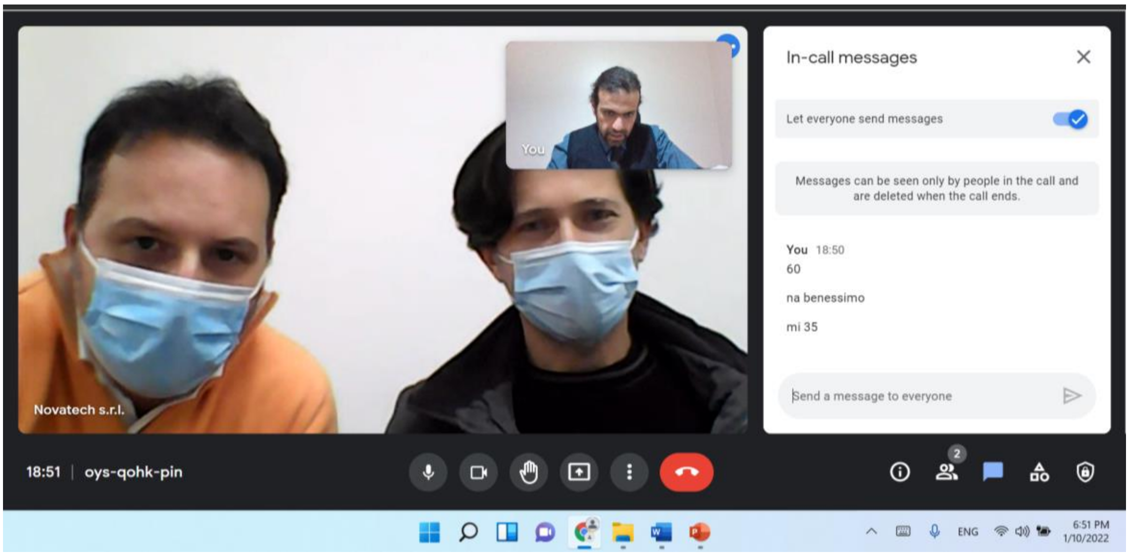


Figure (04-08) the first discussion with a local solar energy supplier (Novatech s.r.l.) in Pontinia (the screenshot has been taken after the participants' permission).

Figure (04-09) the first discussion with Simone Coco, the youth policy advisor in Pontinia Municipality. He played a notable role in facilitating the workshop, which is evident that engaging the "right" stakeholders is essential to ensure the success of any development (the screenshot was taken after the participant's permission).

The advisor played a significant role in informing the municipality representatives, such as the Mayor, the commissioner for public works, and the required stakeholders (as resulted in Chapter Three). In high-level coordination in two days. This Sprint was implemented eight days after the first online meeting. The workshop entitled "Develop a transdisciplinary participatory framework to improve the energy efficiency of the built environment in the Lazio region, towards an Energy Community in Pontinia. Figure (04-10) shows the workshop poster.

Figure (04-10) The workshop poster.

The participants were the author (the product owner), the youth advisor (as a scrum master), the development team consisting of the Municipality of Pontinia (the Mayor, the deputy, the commissioner for public works, culture consultant, managing director for public education). Private sector (photovoltaic and renewable energy). Experts and the local community, namely, the Manger of the CIA "Italian Farmers Confederation," Latina section, the representative of the Coldiretti "National Confederation of Direct Cultivators," an architect, and a farmer. A translator in order to facilitate the discussion where needed[2]. Figure (04-11) shows the involved stakeholders.

[2] Although, the author implement the workshop in the Italian language , the translator was essential to enhance the communication language where required.

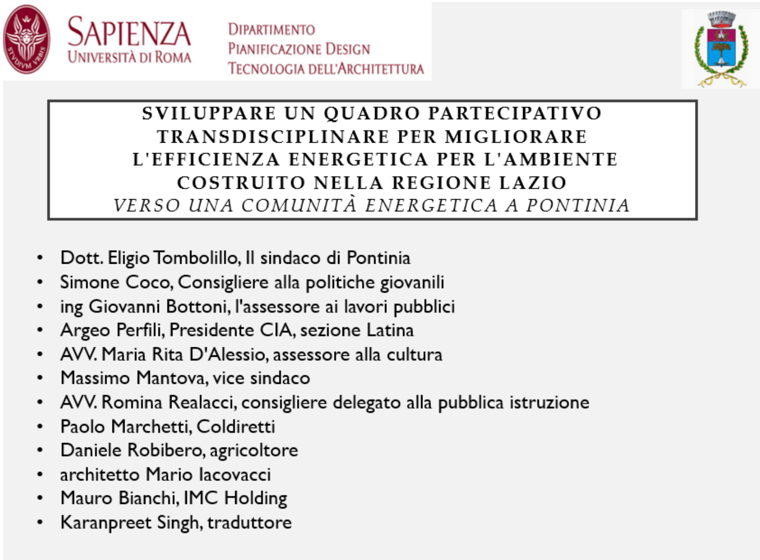


Figure (04-11) The engaged stakeholders in the workshop.

The workshop was implemented in 70 minutes (10 minutes of presentation and 60 minutes of discussion). The content of the presentation and approach in Pontinia was different from the Egyptian one. For many reasons, the first is the extensive attendance of municipal employees. Second, the technical intervention is focused on the energy communities because it is now a trend in Italy. The Lazio region pays considerable attention to energy communities, implemented in the first rural (touristic coastal) settlement in October 2021 in Ventotene (Regione Lazio, 2021). Finally, it was evident that Italy has preceded Egypt in renewable energy (Chapter One). Therefore, the Italian case study has promoted energy communities as a key concept.

Before the workshop, the author has discussed with the stakeholders in short discussions with small groups to "break the ice." A participant stated that "*it is appreciated to engage Sapienza university with us in a development proposal.*" Figure (04-12) shows a small group discussion pre the workshop.

Figure (04-12) A small group discussion with a local farmer and the CIA manager (taken by Simone Coco). The discussion was about the relationship between peasants' local economic activities and energy consumption.

After the facilitator introduced the moderator and the participants, the moderator has started describing the aim. First, he explained the efforts of the Italian government in supporting energy efficiency and sustainability issues, particularly in rural contexts such as Pontinia. The National Plan for Recovery and Resilience reflected this, which is divided into sixteen Components, grouped into six Missions. Namely, the green revolution and ecological transition mission with its two components of Energy Efficiency and building redevelopment and sustainable energy transition and mobility (NRRP, 2021). In line with the European Green Deal, the Integrated National Plan for Energy and Climate 2030 (PNIEC), and the sustainable development goals.

Therefore, the aim of the participatory approach can accelerate this transition in light of the lack of studies investigating these aspects at the micro-scale in Pontinia, integrated with previously implemented studies (Chapter One).

In order to ensure the clearness of the key concept, the moderator has defined the energy communities. Furthermore, he asked some open-ended questions, such as how we can accelerate the transition to an energy community how to overcome the anticipated obstacles, technically, economically, or socially accepted? What is the first pilot project that can be implemented? Finally, he stated that there are no right or wrong answers, but different points of view and sometimes negative comments are the most helpful. Figure (04-13) illustrates parts of the discussion.

Figure (04-13) At the beginning of the workshop (taken by Simone Coco).

After the presentation, the Mayor asked for clarification if it was for self-consumption or agricultural land. He emphasized the suitability of the buildings more than agricultural land, apart from the marginal areas (dead zones). The second expert discussed the Italian territory consisting of three typologies (plain, hill, mountains) areas and how the land in Pontinia is plain land "*pianura*" which is essential in achieving Italian food security. In other words, it is not accepted to cover this land with photovoltaics. He highlighted the potential of installing photovoltaics on the farm buildings, houses, sheds, and stalls. However, the technical obstacles of these structures in terms of the building envelope of the roof so-called "*eternit*" can prevent installing the photovoltaics on the farms. Figure (04-14) shows an example of these structures.

Figure (04-14) An example of the "*eternit*" roof in some structures in the industrial area in Pontinia. (taken by the Author). It is worth mentioning that the majority of the participants stated that "eternity" characterized the majority of the buildings (more than 90%) within the macro context of Pontinia. While the conclusion of the on-site investigation of the micro-context (limited to the inhabited center, 1 km^2 area) found another result, most buildings are constructed from conventional materials (reinforced concrete skeleton and brick).

The third expert appreciated the role of energy efficiency improvements in climate change, he stated he encouraged the idea he had in his farm and house for the self-consumption, but he stated the system's limitation that "*It barely covers my needs. I wouldn't be able to sell my neighbors.*" Also, he required clear guidelines by the government about the technicalities and the financial feasibility. He referred to doing "*a revolution*" to decrease and support these kinds of projects. The renewable energy expert has agreed on this point.

The fourth principle showed that energy communities and the discussed topic in the workshop should be invested to revitalize the local economy. However, considering that the most significant obstacles are the clear feasibility studies and the return on the investment. The policies that support the end-user has been discussed. In this part, the participants have forwarded the speech to the local supplier, who explained some numbers, which may indicate the essential role of the private sector in facilitating the process.

Female representation added another social perspective: the investment in renewable energy or retrofitting, representing an obstacle in terms of the family's financial priorities. The high prices of energy technologies are a significant obstacle compared to the current monthly salaries, which means that the situation of the existing dwellings is much better. The architect has emphasized that the project is promising. However, there are two difficulties: preparing a clear project statement and filling the gaps in the building's regulations.

One of the questions raised by the contributors was, who would lead the project? Overall, by the end of the discussion, the participants provided positive feedback about the workshop, in parallel with the uncertain issues related to the technical and economic feasibility. As a participant stated, "*when I have invited, I did not expect the topic will discuss these points, it is interesting, but only the high initial cost is the barrier.*"

4.2.4 Discussion of Results – Pontinia

The workshop has been provided, including 12 participants, one half from the Municipality of Pontinia and the other from experts, locals, and agriculture associations.

In general, the participatory approach was accepted by all participants, represented in the "rapid" acceptance to attend, host, and facilitate the event by the Municipality. The perception and the feedback of the participatory approach were positive and encouraging from all the stakeholders. The potential of developing Pontinia and implementing the second energy community in Lazio (after Ventotene) motivated the attendees. Despite some critical standpoints that covered vast domains: technically, economically, socially, and legalizations.

It was evident that the aim was to this there is a need to refine the goal by studying how to support the transition towards energy communities. Because the "energy community" definition drives the discussion in different directions (buildings, farm buildings, and open areas).

From a technical perspective, in line with the energy community concept, self-consumption is appropriate to the farms' structures, considering the readiness of the building in terms of their construction. The participants (from an agriculture perspective) have had photovoltaics on their farms (those are own or working for). Then, the self-consumption or collective self-consumption is the most encouraging solution integrated into buildings (residential – non-residential), considering that only one participant has installed photovoltaic cells on his house.

The economic aspect is the most critical obstacle in terms of the high initial cost and the unknown return of investment, or simply they have different priorities (socio-economic aspect). However, the support for individuals to finance the self-consumption of photovoltaic cells may reflect the uncertainty about benefiting from the energy efficiency, or it may reflect the lack of information. The aspect is linked somehow with the regulations, which should be considered to clarify: what is the juxtapositioning of retrofitting practices and energy communities in the Italian policies (for all stakeholders), how can the local community benefit from the economic incentives. The author intended to deepen the investigation of these points in further studies.

4.3 Refine the Framework

4.3.1 Sprint One: Lasaifar Albalad

Based on the outcomes of the initial Sprint, the framework has been adjusted at many levels, namely, the financial aspects, finding a pilot case study and a local representative, time frame, risks, and clear scope. The author has developed two scenarios in line with (Chapter Two) and the workshop outcomes.

Firstly, retrofit existing buildings using nature-based insulation materials, Figure (04-07). It has been evaluated in a previous study implemented by the author (Abouaiana & Mendonça, 2022). The local supplier accepted the offer to improve the material in situ using the agricultural waste and to train the locals (to boost the local economy). The recommended building was the NGO itself (the classroom where the workshop was conducted). This option has been excluded due to the high associated risk (the material is not approved yet).

Second, to promote solar energy for the self-consumption purpose (the initial step of the energy community). Which was accepted as one of the optimum approved user stories (Sprint Zero) in terms of micro-scale, solar availability, technicalities know-how, and short implementation period, considering resolving the associated uncertainties, which can be grouped as the following:

- The specific intervention (input 1): the vision statement, self-consumption buildings (zero energy building) serving the local community;
- Target case (input 2): the proposed building should be one of the public buildings, the health unit (which has been excluded), or one of the social buildings, the NGO private building. The aim is to implement the first (rapid) pilot study in the settlement (including the satellite villages);
- Socio-culture barrier (input 3): convincing the client to accept the intervention (although their enthusiasm, it took two days to accept);
- Economic barrier (input 4): the author convinced a communities development company, "Edara" (EDARA, 2021) (a representative was involved in the focus group), to support a pilot project as a societal role, in line with its internal policy, in addition to the predicted good reputation;
- Setting the project and communication plan (input 5): the team consists of the PO, Al-Bakyat Al-Salehat NGO (the client), SM, the author (coordinator), and DT, Edara Company for the solar energy domain (financial and technical support).

Then, sprint one was planned. It takes two weeks of planning the project, starting with the one-to-one meetings (online and by telephone) between the stakeholders, namely, the product owner (the client): Albakyat Alsalehat NGO, Mrs. Dalia Hamouda, the scrum master (the technical coordinator) (the author), and the development team (Edara company, Eng. Ahmed Khamis).

The meeting discussed the client requirements, which had two concerns: to what extent the supposed system is safe for the building structure and the possibility of removing and reinstalling the cells in case of any future extension. Noteworthy, the on-site survey was implemented on the workshop day (collecting the electricity bills). So the client received the answer, and the second requirement was considered.

After that, the team (the coordinator and technical Edara's team) implemented technical meetings (two daily scrums) within a week in order to discuss possible solutions (self-consumption, on-grid, or off-grid). After each meeting immediately, the coordinator has contacted the client online to show the results (in a simple way). No feedback was received, only clarifications.

The technical tasks have been divided between the coordinator (spatial and architectural analysis) and Edara's technical team (solar energy technicalities). After two days, a daily scrum was implemented (by phone) between the coordinator and technical team leader. Immediately, a call with the client took place to receive the feedback. Noteworthy that the scrum has not implemented the process totally (the team should be dedicated 100% to the task). Otherwise, a continuous follow-up by phone took place.

The technical and financial file was received on 23 January 2022. The offer was immediately discussed with the client and approved within two days. Then, Sprint two was started to install the photovoltaic. It is planned to implement in ten days (due to the capability of the donor), considering that they are usually working in Cairo, and they have their working methodology (not scrum). The aim was to implement a pilot project in the village relying on renewable energy and avoiding retrofitting the buildings. The summary of this Sprint was:

- Tasks: receiving the feedback from the client, preparing detailed technical analysis, and approving the financial support, in line with the vision statement and the included user stories in the product backlog (resulting from Sprint Zero);

- Sprint time: two weeks
- Increment: providing the technical offer, including possible scenarios (Annex 04-01), approving the funding; preparing the user stories for the upcoming Sprint;
- Refining the scope: selecting the proper technical solution after discussion.

4.3.2 Sprint Two: Lasiafar Albalad

Sprint two took six days to prepare for the implementation phase. In this step, the tasks are divided into the team, the architectural analysis, and communication (the author), solar panels technicalities by the development team (Edara's technical team). The approved funding was 48000 EGP (2693 EUR) to install the solar plant.

4.3.2.1 Real Case Study: Target Building

The target building is located in Lasaifar Albalad, between coordinates 31°10'55.9"N 30°43'06.1"E. It is a typical residential building with a different function: "Albakyat Alsalihat" non-governmental organization, it consists of one floor. Figure (04-15) shows the ultimate and intimate contexts of the target building.

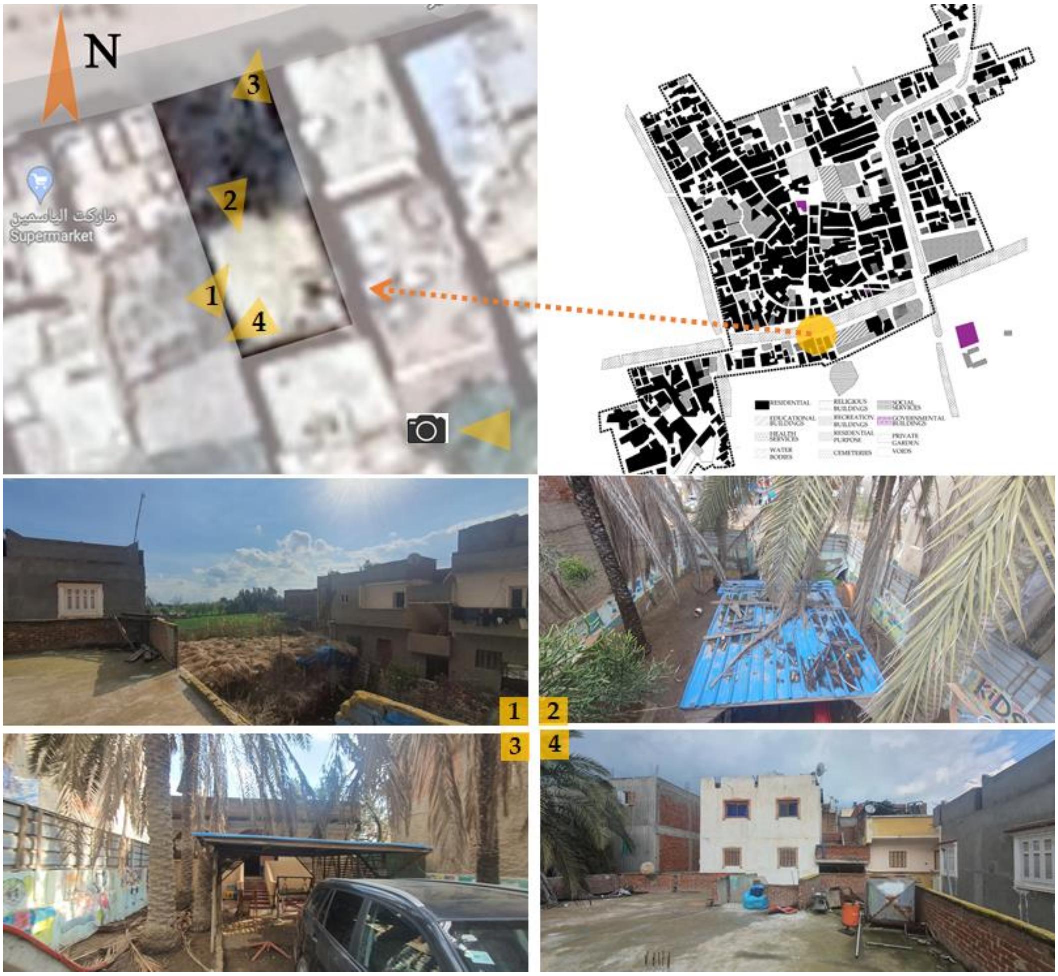


Figure (04-15) The ultimate and intimate contexts of the target building (taken by the author).

Building's area is 150 m². The building provides many social services, such as a nursery (serving around 75 kids between 3-5 years) and orphan care. The ground floor consists of one main hall, five classrooms, two toilets, a lobby including a kitchenette, an external store, and a stair led to the roof. All equipment has been calculated, with the electricity bills. This steep implementation in collaboration with (Edara's team) Figure (04-16) shows a typical classroom. Figure (04-17) shows an electricity bill.

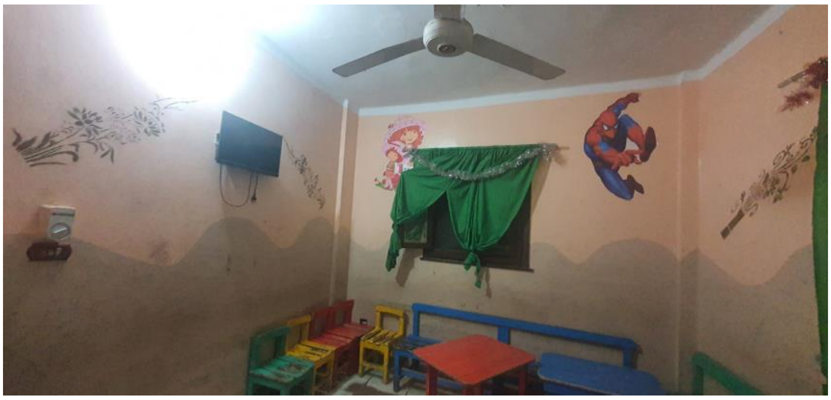


Figure (04-16) A typical classroom (taken by the author).

Figure (04-17) Typical monthly electricity bill of the target building. (taken by the client and edited by the author). 1) Client data. 2) consumption details (kWh). 3) code for online payment. 4)bill details 5) total amount in EGP. The average monthly consumption was 100 kWh, the annual is 1200 kWh approximately. Thus, the square meter consumes 8 kWh annually, which supports one of the thesis's findings: the square meter of the social activities buildings in Lasiafar Albalad consumes 6 kWh/annually (Chapter One, Figure 01-83).

In the second step, the electrical appliances were collected, building operation and occupant energy consumption behavior were discussed with the client. The maximum operation hours are between 7:00 am and 7:00 pm. The night load is for the fridge only. Table (04-04) summarizes the electrical loads.

Table (04-04) The daily electrical load loads of the target building.

S.n	Type	Quantity	Watt	Operation hours	Watt/day
01	Bulbs	7	9	4	252
02	Fans	7	70	4	1960
03	Television	5	45	3	675
04	Water pump	1	375	1	375
05	Water Kettel	1	1200	1	1200
06	Fridge	1	85	24	2040
Total (watt/day)					6502

From the table, loads capacity at the same time (instantaneous total) is 2438 watts/day. Equation 1 shows the inverter capacity.

The inverter[3] capacity = the instantaneous total x 1.2 (equation 1)

So the inverter equals 2925 watts/day (3 kW) approximately. The peak charge plant was designed as per location peak sun hours 5 hours/daily to charge the batteries and feed the mentioned load for 24 hours, as per the operation schedule. Sprint two activities can be grouped as follows:

- Tasks: implementing the first self-consumption building, using an off-grid solar plant (3 kW), in line with the vision statement and the included user stories in the product backlog (resulting from Sprint One);
- Sprint time: six days;
- Increment: first self-consumption building from 100% renewable energy;

4.3.2.2 Implementation and Associated Risks

Once the data was collected, the implementation day was determined as 29 January 2022. Although the date was determined after checking the weather forecast to find a sunny day (this time of year is rainy), an unestimated risk has emerged that the local internal road network (narrow two-way) suffers from heavy mud between districts and rural settlements, Figure (04-18), limiting the car speeds, as a sequence the car of equipment arrived three hours later, near to the sunset time. Therefore the installation was implemented at night. Figure (04-19) shows the implementation process.

Figure (04-18) Some internal roads post rainy days (taken by the author).

[3] The solar inverter is an electrical converter. Photovoltaic panels varying direct current (DC) output into a utility frequency alternating current (AC).

Figure (04-19) The technical team during implementation of the solar plant (taken by Eng. Ahmed Refaat).

It was observed that the unoccupied roof was neglected by the client, as seen in Figure (04-15). Another thing is the green molds on the brick parapet of the roof, Figure (04-20).

Figure (04-20) Green molds fungus indicates that the client ignores the roof, reflecting the maintenance behavior towards the solar plant. (taken by the author).

The expected risk was the lack of maintenance by the client post installing the plant. So, the team has emphasized weekly maintenance and operation instruction. The third risk emerged when the client expressed concern about "*what if the system dropped, how can we retrieve the conventional electricity source*" for this reason, although the technical guarantee of this off-grid system, the plan was modified immediately (agile way), and a switch has been added (two days later), instead of the direct connection from the solar plant to the internal electrical distribution panel, to enable switching. Figure (04-21) shows the working progress during the night. Figure (04-22) shows the solar plant after completion.

Figure (04-21) The working progress during the night (from left to right) (taken by the author).

Figure (04-22) The solar plant after installation resulted from implementing the Scrum framework.

4.3.2.3 A Nascent Experience and Promising Initial Results

The experiment is completed, and now the first self-consumption building in the village consumes the total produced energy. The experiment is still in a too-early stage, but encouraging preliminary results have been emerged in the first four days (between 30 January 2022 and 02 February 2022).

First, socially, a broad segment of the inhabitants expressed their interest (on the Facebook platform, by phone, and through direct contact with the client) to know more details, asking for visits to see this "new" system, and asked for its economics. A local said, "*really can I avoid paying 250 EGP of the monthly electricity bills?*". Some kids asked to see the experiment. Another expressed happiness about the uniform (they took many photos wearing the safety helmets). The client herself expressed her gratitude for the "new" experiment.

Secondly, to raise awareness, two additional findings were provided in a discussion between the lead researcher and the client. First, to include simple environmental aspects (i.e., this experiment) in the teaching activities in the nursery (teaching now is limited to religious subjects and readings skills). Second, a public playground (for the village's kids) was suggested in front of the nursery Figure (04-18). The project is now under study.

Thirdly from the media side, after two days, the author was invited to an interview in the official national program "Good Morning Egypt" to discuss the project results, Figure (04-23) once he published the experiment on social media platforms. This interest reflects two aspects: the importance of bottom-up practices and the role of the researchers and architects in developing the built environment, and the government's support for these kinds of interventions in line with (Goal 4, supporting innovation and scientific research) Egypt Vision 2030 to achieve sustainable development goals. Thanks to the agile mindset, which allows the ability to adjust the plan whenever.

Figure (04-23) The author was interviewed on the official national TV program (القناة الأولى المصرية, 2022). This may reflect the social impact of the experiment.

4.4 Conclusion

The study has developed an original participatory framework that integrates energy retrofitting with project management and software development, contemporaneously a transdisciplinary that involves the academic, locals, local associations, decision-makers, private sector, and external experts. The problem was how to achieve the ambitious goal to retrofit “our Mediterranean” built environment in the traditional settlement, in “too” early stages, motivated by bottom-up-enthusiasm, which is too important, as the author argues but not enough. Through all study stages, with the fonded results and the expected risks.

The framework was initiated from a bottom-up perspective, and it proved the success in integrating a top-down by including high-level decision-makers (the Municipality of Pontinia). The words are still stuck in the author's mind “*thank you for your effort in developing our village*.” On the other side, the framework led to the implementation of an actual case study (the first in the village and the neighbor ones) that was not planned in the preliminary stages of this research.

From a local cultural perspective, the author believes it will be a tendency among the other inhabitants. The originality is a Scrum framework and all the connected procedures and stages that can be obtained to deduce the sufficient level of feedback and preferences, actually to mental preparation them for the required intervention, and allocating the stakeholders “on the same page” using a restricted and methodological procedure that led to this step.

Social and cultural skills and life experience go hand in hand with technical skills. The author believes and advocates that studying the historical background of the place, music, architecture, and local language facilitated any intervention, to be precise, as a foreign researcher working in the Italian context and observed positive reaction from the Italians towards this, regardless of the techno-socio-economic obstacles.

Scrum proved a successful tool to implement the project, represented the rapid communications among the stakeholders, dedication 100%, adjustment work plan due to different inputs, it enhances the collaboration among the stakeholders, and finally, no conflict has been detected. ICT (mainly social media platforms) played a significant role in communications in the exploratory phase. Many surveys and two qualitative focus group workshops took place (applying the scrum method to validate the framework). The conversations with stakeholders and citizens are vital for creating work groundwork. It is inevitable to implement a field study after the theoretical preparation. It affected the process positively.

To conclude, the chapter has proposed a new direction of the investigation, which moves from a conceptual framework towards an agile practice to provide a new participatory approach that empowers knowledge exchanging and developing a cognitive model that can simplify transdisciplinarity interactions, involving all relevant stakeholders, enhancing the communications that enable possible retrofitting solutions of the Mediterranean built environment, on the one hand, and on the other, showing how could it improve the capacity of researchers and practitioners, who promote bottom-up rural development interventions.

Finally, although the promising future of the intervention, there is an essential need to evaluate the whole experience by validating the intervention on the ground, implementing the intervention, and finally monitoring it. Each part has its challenges, obstacles, known and uncertain risks. Likewise, the scrum filled a gap in the early stage it might succeed in the further steps.

Acknowledgment

The author acknowledges the support from Dalia Hamouda, Al Bakyat Alsalehat NGO, in facilitating and organizing the workshop in Lasaifar Albalad and taking charge of hosting the participants.

The author acknowledges the support of the Municipality of Pontinia, especially Mayor Dr.Eligio Tombolillo, for hosting the workshop. Furthermore, the ultimate support from Simone Coco, the youth policy advisor, took full responsibility for inviting all the required stakeholders and organizing the workshop.

Chapter Four References

Abouaiana, A. (2021). Retrofitting Rural Dwellings in Delta Region to Enhance Climate Change Mitigation in Egypt. *Environmental and Climate Technologies*, *25*(1), 136–150. https://doi.org/10.2478/rtuect-2021-0009

Abouaiana, A. A. A. (2016). *"Principles for Existing Rural House Sustainability in Delta Region (With Special Reference to Energy Efficiency)" (In Arabic)* [Cairo University, Giza]. https://doi.org/10.13140/RG.2.2.21412.71044

Abouaiana, A., & Mendonça, P. (2022). Retrofitting Dwellings in Traditional Coastal Settlements in Egypt and Portugal Using Nature-Based Solutions and Conventional Thermal Insulation Materials: Technical and Economic Assessment. *Journal of Architectural Engineering*, *28*(2), 05022005. https://doi.org/10.1061/(ASCE)AE.1943-5568.0000537

Abraham, R., Schneider, J., & Vom Brocke, J. (2019). Data governance: A conceptual framework, structured review, and research agenda. *International Journal of Information Management*, *49*, 424–438.

Adom, D., Hussein, E. K., & Agyem, J. A. (2018). Theoretical and conceptual framework: Mandatory ingredients of a quality research. *International Journal of Scientific Research*, *7*(1), 438–441.

Barinda, S., & Ayuningtyas, D. (2022). Assessing the food control system in Indonesia: A conceptual framework. *Food Control*, *134*, 108687.

EDARA. (2021). *Edara Property Management*. http://www.edara.com.eg/ (Accessed 01-2022)

EFSA-EU. (2021). *Engagement Toolkit Methods, tips and best practices to design effective participatory processes*.

European Food Safety Authority. https://www.efsa.europa.eu/sites/default/files/documents/engagement-toolkit.pdf

Fathy, H. (2010). *Architecture for the poor: an experiment in rural Egypt*. University of Chicago press.

Franz, N. K. (2011). The unfocused focus group: benefit or bane? *The Qualitative Report*, *16*(5), 1380.

Greenbaum, T. L. (1998). *The handbook for focus group research*. Sage.

Hausladen, G., & Tucci, F. (2017). Technological Culture, the Environment and Energy: the outlook for research and experimentation. *TECHNE-Journal of Technology for Architecture and Environment*, 63–71.

Jabareen, Y. (2009). Building a conceptual framework: philosophy, definitions, and procedure. *International Journal of Qualitative Methods*, *8*(4), 49–62.

Konopik, J., Jahn, C., Schuster, T., Hoßbach, N., & Pflaum, A. (2022). Mastering the digital transformation through organizational capabilities: A conceptual framework. *Digital Business*, *2*(2), 100019.

Krueger, R. A., & Casey, M. A. (2002). *Designing and conducting focus group interviews*. Citeseer.

Krueger, R. A., & Casey, M. A. (2014). *Focus groups: A practical guide for applied research* (5th ed.). SAGE Publications India Pvt. Ltd.

Lakin, K., & Kane, S. (2022). Peoples' expectations of healthcare: A conceptual review and proposed analytical framework. *Social Science & Medicine*, *292*, 114636.

Maxwell, J. A. (2005). Conceptual framework: What do you think is going on. *Qualitative Research Design: An Interactive Approach*, *41*, 33–63.

McComb, C., & Jablokow, K. (2022). A conceptual framework for multidisciplinary design research with example application to agent-based modeling. *Design Studies*, *78*, 101074.

Morgan, D. L. (2005). *Focus Groups* (K. B. T.-E. of S. M. Kempf-Leonard (ed.); pp. 51–57). Elsevier. https://doi.org/https://doi.org/10.1016/B0-12-369398-5/00039-6

Morgan, D. L., & Krueger, R. A. (1998). *The focus group guidebook*. Sage.

Mycellium. (2021). *Mycelium A Biomaterial from nature to nature*. https://en.mycellium.co/ (Accessed 17/06/2021)

Ngulube, P., Mathipa, E. R., & Gumbo, M. T. (2015). Theoretical and conceptual frameworks in the social and management sciences. *Addressing Research Challenges: Making Headway in Developing Researchers*, 43–66.

NRRP. (2021). *Piano Nazionale di Ripresa e Resilienza, NRRP [The National Recovery and Resilience Plan]*. Italian Governement. https://www.governo.it/sites/governo.it/files/PNRR.pdf

Onwuegbuzie, A. J., Dickinson, W. B., Leech, N. L., & Zoran, A. G. (2009). A qualitative framework for collecting and analyzing data in focus group research. *International Journal of Qualitative Methods*, *8*(3), 1–21.

PassReg. (2015). *PassREg FINAL REPORT*. https://www.passivhaustrust.org.uk/UserFiles/File/Technical Papers/PassREg final report.compressed.pdf

Regione Lazio. (2021). *Comunità energetica: a Ventotene piccola rivoluzione copernicana [Energy community: a small Copernican revolution in Ventotene]*. https://www.regione.lazio.it/noizie/Comunita-energetica-a-Ventotene-piccola-rivoluzione-copernicana (Accessed 11-01-2022)

Rocco, T. S., & Plakhotnik, M. S. (2009). Literature reviews, conceptual frameworks, and theoretical frameworks: Terms, functions, and distinctions. *Human Resource Development Review*, *8*(1), 120–130.

the Engage2020 Consortium. (2014). *Engage2020 Tools and instruments for a better societal engagement in "Horizon 2020" D3.2 Public Engagement Methods and Tools*. http://engage2020.eu/media/D3-2-Public-Engagement-Methods-and-Tools-3.pdf

Vialatte, A., Tibi, A., Alignier, A., Angeon, V., Bedoussac, L., Bohan, D. A., Bougherara, D., Carpentier, A., Castagneyrol, B., & Cordeau, S. (2022). Promoting crop pest control by plant diversification in agricultural landscapes: A conceptual framework for analysing feedback loops between agro-ecological and socio-economic effects. In *Advances in Ecological Research* (Vol. 65, pp. 133–165). Elsevier.

Winkelmann, R., Donges, J. F., Smith, E. K., Milkoreit, M., Eder, C., Heitzig, J., Katsanidou, A., Wiedermann, M., Wunderling, N., & Lenton, T. M. (2022). Social tipping processes towards climate action: a conceptual framework. *Ecological Economics*, *192*, 107242.

القناة الأولى المصرية. (2022). *The first service building fully powered by clean energy inside the village of Kafr El-Sheikh. Arch.Ahmed Abouaiana reveals the details (in Arabic)*. Youtube. https://www.youtube.com/watch?v=CmfAKqkLVfE

Annex 1- the financial and technical offer prepared by Edara company, the offer, and the data sheets are available at: https://www.researchgate.net/project/Retrofitting-Built-Environment-in-Traditional-Settlements-in-Mediterranean-region-towards-Energy-Communities-Egypt


EDARA property management

العرض الفني والمالي

اطار عمل متعدد التخصصات لتحسين كفاءة الطاقة في البيئة المبنية للتجمعات الريفية باقليم حوض البحر الابيض المتوسط

توريد وتركيب محطة طاقة شمسية بجمعية الباقيات الصالحات قرية لاصيفر البلد مركز دسوق محافظة كفر الشيخ

عناية د/ احمد ابو عيانه

شركة ادارة لخدمات المدن والمنتجعات
اعداد المهندس/ أحمد خميس
المدير التنفيذي
التاريخ :2022/01/23


EDARA property management

❖ في اطار حرص شركة ادارة لخدمات المدن والمنتجعات على المشاركة المجتمعية , والتي كان من ضمن اعمالها المشاركة في الدراسة المقدمة من خلال الباحث الدكتور احمد ابو عيانة والتي هي بعنوان اطار عمل متعدد التخصصات لتحسين كفاءة الطاقة في البيئة المبنية للتجمعات الريفية باقليم حوض البحر الابيض المتوسط وكانت عينة الدراسة هي قرية لاصيفر البلد (مركز دسوق) محافظة كفر الشيخ مصر والتي تتضمن سبل استخدام الوسائل والانظمة الحديثة والمختلفة الخاصة بتوفير الطاقة الكهربائية والتخفيف من الاعباء المالية والاقتصادية على المواطنين بالريف المصري وكانت عينة الدراسة هي دراسة تركيب محطة طاقة شمسية كأحد التوجهات العالمية والدولية الحالية لتوفير الطاقة, تم اختيار مبنى جمعية الباقيات الصالحات (مبنى حضانة) كعينة اولية لتركيب محطة طاقة شمسية لتحقيق الاكتفاء الذاتي من استهلاك الكهرباء, وتمت الدراسة كالاتي:

✓ تم اجراء الدراسة في ثلاث اتجاهات بالانظمة المتاحة:

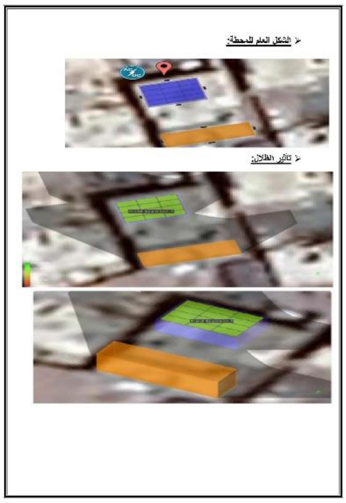
1 خطة الربط على الشبكة العمومية (بيع وشراء الطاقة لشركة التوزيع) (On Grid System):

➢ الاشتراطات :

1. ان يكون الحد الادنى للفاتورة الشهرية 1500 جنيه مصري.
2. توفر عداد ثلاث فاز .(مع العلم انه سيتم استبداله بعداد ذكي قابل للبرمجة).
3. الحد الادنى لقدرة المحطة 5 KW.

تصميم المنظومة:

انتاج المحطة المتوقع/سنة	قدرة المحطة بالالواح الشمسية	نوع التثبيت
8.9 MWh	5.6 KWp	برجولة معدنية



خطة الربط على الشبكة العمومية(بدون بيع اى طاقة لشركة الكهرباء& شراء فقط مساءا) (Self-Consumption):

الاشتراطات :

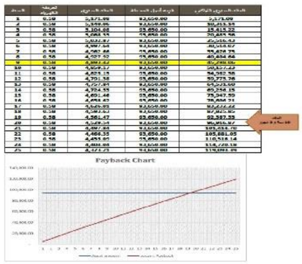
1. توفر عداد ثلاث فاز .
2. الحد الادني لقدرة المحطة (طبقا للاحمال الموجودة فعليا).
3. المدة الخاصة بعائد الاستثمار طويلة جدا (العميل ضمن الشريحة الاولي من المستهلكين , فاتورة شهرية في حدود الخمسين جنيها مصريا فقط لا غير).
4. لا نحتاج الي موافقة شركة الكهرباء التابعة لها الحاضنة. (مجرد اخطار)

اجمالي الطاقة المستهلكة	اجمالي الساعات	اجمالي القدرة الكهربائية	القدرة الكهربائية	نوع الحمل	عدد الوحدات
756 WH	12 H	63 WATT	9 W	LAMPS	7
1960 WH	7 H	280 WATT	40 W	CEILING FAN	7
1125 WH	3 H	375 WATT	375 W	WATER MOTOR	1
3600 WH	3 H	1200 WATT	1200 W	WATER HEATER	1
1440 WH	12 H	120 WATT	120 W	REFRIGERATOR	1
1280 WH	8 H	160 WATT	32 W	LCD TV	5

العرض المالى:

السعر الاجمالي	قدرة المحطة بالالواح الشمسية	الوحدة	الوصف	رقم
48581.1 شامل ضريبة القيمة المضافة	2.18 KWp	محطة	تصميم وتوريد وتركيب واختبار وتشغيل محطة طاقة شمسية مربوطة بالشبكة (بدون بيع اي طاقة للشبكة) للحضانة	1

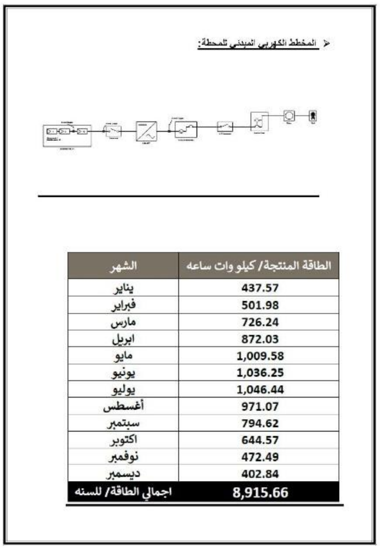
- العرض غير شامل اى اعمال خاصة بالبنية التحتية للمبنى والاعمال المدنية والانتقالات واى رسوم مقابل العداد الثلاثى او رسوم من طرف شركة التوزيع التابعة لها الحضانة.
- يرجى العلم ان المقترح غير مجدي اقتصاديا نظرا لاضافة تكلفة العداد الثلاثى بالإضافة الى التكلفة الاجمالية لتوريد وتركيب المنظومة.



العرض المالى:

السعر الاجمالى	قدرة المحطة بالالواح الشمسية	الوحدة	الوصف	رقم
106761 شامل ضريبة القيمة المضافة	5.6 KWp	محطة	تصميم وتوريد وتركيب واختبار وتشغيل محطة طاقة شمسية مربوطة بالشبكة للحضانة	1

- العرض غير شامل اي اعمال خاصة بالبنية التحتية للمبنى واى رسوم مقابل العداد التبادلي والاعمال المدنية والانتقالات او رسوم من طرف شركة التوزيع التابعة لها الحضانة.
- يرجى العلم ان المقترح سيتم رفضه من خلال شركة الكهرباء التابعة لها الحاضنة محل الدراسة , لانخفاض استهلاك الطاقة الخاصة بالحضانة.



المخطط الكهربي المبدئي للمحطة:

الطاقة المنتجة/ كيلو وات ساعه	الشهر
437.57	يناير
501.98	فبراير
726.24	مارس
872.03	ابريل
1,009.58	مايو
1,036.25	يونيو
1,046.44	يوليو
971.07	أغسطس
794.62	سبتمبر
644.57	اكتوبر
472.49	نوفمبر
402.84	ديسمبر
8,915.66	اجمالي الطاقة/ للسنه

خطة الاستغناء تماما عن كهرباء الشبكة واستخدام البطاريات للاحمال المسائية مساءا) (OFF Grid):

العرض المالي:

السعر الاجمالي	قدرة المحطة بالالواح الشمسية	الوحدة	الوصف	رقم
43000 شامل ضريبة القيمة المضافة	2.18 KWp	محطة	تصميم وتوريد وتركيب واختبار وتشغيل محطة طاقة شمسية للحضانة والاستغناء عن كهرباء الشبكة تماما	1

- تكلفة الاعمال المدنية والانتقالات 5000 جنيه مصريا فقط .
- يرجي العلم انه لا توجد اي اشتراطات (مجرد اخطار من المالك لشركة التوزيع التابع لها) , او تغيير العداد الخاص بالحاضنة.

(مقترحات اخرى)

نقترح كأحد اتجاهات المساهمة الاجتماعية أن يتم توفير أنظمة الري بالطاقة الشمسية لري اراضي المزارعين الصغار بدلاً من استخدام مولدات الديزل أو مصدر كهربائي لتشغيل مضخات المياه. هذا يقلل من تكلفة عملية الري بنسبة تصل إلى 100٪ ويقلل من انبعاثات ثاني أكسيد الكربون وهي خطوة نحو خطة الحكومة المصرية تجاه صفر انبعاثات كربونية.

عادة ، يستخدم صغار المزارعين أنظمة ضخ مياه من 5 إلى 10 أحصنة ، وبالتالي فإن عرض الميزانية لكل موقع يتراوح بين 90 و 150 ألف جنيه مصري. مع ملاحظة أنه في بعض الأحيان يتقاسم المزارعون أرضا واحدة ويعتمدون على مصدر واحد للري.

V. Recommendation and Conclusion

5.0 Summary

This thesis is divided into six chapters. The Introductory Chapter has provided an overview of the research: the research background, the definition of the primary keywords, limitations, general aim, and objectives, besides defining the method and tools used to answer the research questions. Then, the research structure showed how Chapters (1, 2,3, and 4) outcomes were integrated to achieve the main aim. Finally, Chapter Five provides an overview of the research findings.

5.1Contribution to Knowledge

5.1.0 Introductory Chapter

This chapter has introduced the research background and motivations to tackle the environmental challenges that obviously threaten our Mediterranean-built environment. The research problems can be concluded as follows:

- The climate change threats of the current built environment patterns in rural commons in the Mediterranean (one of the most sensitive regions) and the insufficient energy performance. Besides the decaying of the architectural identity;
- The complex nature of energy retrofitting practices in rural societies (that have particular cultural values in the entire landscape scene);
- Manging the interlocking relation between the different stakeholders and actors and the inevitable team conflict to support retrofitting decision-making and implementation.

By investigating rural villages in the Mediterranean region based on the literature, "traditions" notion and by analyzing the cases of Egypt and Italy, the study developed the concept of "traditional settlements," which are rural villages that combined the traditional landscape with the modern building typologies of the 1900s, and blended the small-dimension and primitive activities (agricultural, fisheries, and forests), with the modernized ones (excluding the tourism activities). They have distinct cultural values and social identities than those in historical settlements (culture heritage) and touristic destinations, supporting Abouaiana & Mendonça's findings (Abouaiana & Mendonça, 2022) who have emphasized a strong visual impact between these economical activities and the public spaces.

In parallel, in order to clarify the research context, this chapter has focused on Egypt and Italy as representatives of the Mediterranean region. It highlighted the main characteristics of these contexts, showing the different settlements patterns locally and the European contexts. In order to enable the comparison and replicable the finding, the analysis led to identifying two similar regions, the Delta region in Egypt and the Lazio region in Italy.

The study addressed transdisciplinarity as an approach to knowledge generation to tackle the complex retrofitting practices of the Mediterranean traditional built environments. Meanwhile, relying on a developed resilient and agile way to organize this collaboration. By applying and assessing the approach in two case studies. Finally, the thesis's scientific relevance, topicality, and findings have been highlighted.

5.1.1 Chapter One

Chapter One has achieved the first objective, "*to diagnose the built environment operation energy consumption to apprehend energy efficiency requirements in the Mediterranean region,*" using different methods.

First, the analytical method of the literature reviews integrated with the statistical data in the national censuses, Central Agency for Public Mobilization and Statistics (CAPMAS) in Egypt, and the Italian National Institute of Statistics (ISTAT) in Italy, supported by versatile official reports. The main finding was a better understanding of the built environment in the Delta and Lazio regions at a regional level: the physical aspects (buildings typologies and urban configurations) and the intangible aspects (demographic, socio-economic, infrastructure, and energy profile).

Second, this analysis identified two similar rural patterns (compared to each other and their regions), the Lasaifar Albalad settlement representing 339 main villages in the Delta region and Pontinia representing a typical pattern of the 1930s villages of the fascist rule. The main findings provided the first spatial analysis of these contexts. Moreover, two land uses maps (in AutoCad format) have been provided in an online repository.

Thirdly, a pilot experiment in the Egyptian case study has been implemented. The significant findings were: providing the annual electricity consumption average of different buildings per square meter, quantifying the correlation between the built environment (building and socio-economic factors) using statistical analysis, daily life has an observed correlation with electricity consumption.

Finally, the comparative analytical method between the two contexts found numerous points of contact and difference, particularly from a socio-cultural perspective, which is essential to be associated with any development proposal requiring field study. The utilized methodology in conducting the spatial analysis has succeeded in achieving the goal.

The methodology and data collection method utilized to quantify the correlation between socio-economic-cultural factors and electricity consumption was only successful in Egypt. Vice versa, in Pontinia, the respondents' sample was not significant. This study argues this might have occurred because of the following, but not limited to:

- Technical defects in the questionnaire design or difficulties in the technical terms;
- The differences between domestic electricity consumption in Egypt and Italy, as discussed in (Chapter Three, Section 3.5) may require different data collection approaches;
- The enclosed nature of the local societies, particularly with foreign researchers.

Therefore, the procedure of this part in Pontinia should be adjusted, altered, or avoided from subsequent studies, considering the proposed aspects and revising the questionnaire design.

5.1.2 Chapter Two

Chapter Two has achieved the second objective, "*to diagnose the retrofitting practices in traditional settlements in Mediterranean countries in a decade, considering the technicalities and beyond-technical aspects, to find the gaps and recent trends.*" By implementing three steps.

First, the theoretical approach discussed the top-down practices in Egypt and Italy at the national levels. The main finding was a better understanding of the existing energy efficiency situation, legalizations, directives, and initiatives. Which helped link the bottom-up interventions in line with them.

Second, a systematic literature review (SLR) of the SLR was implemented "to investigate whether the same topic has been reviewed previously." The finding emphasized the originality of the third step: "no SLR study investigated retrofitting the built environment in traditional settlements in the Mediterranean Region."

Third, for this reason, an SLR study was implemented using a restricted protocol to "identify the trend and fill the gap in retrofitting the built environment in the traditional rural settlements." The main findings identified the gaps and barriers that can affect the implementation of on-ground practices, in addition to highlighting the energy communities concept. It showed the potential of implementing the energy community, particularly with the low electricity consumption in the traditional settlements compared to the urban context of the pilot experiment concluded from (Chapter One), which was the second foundation pillar of the thesis.

Italy and Egypt are pivotal countries in their surrounded contexts in energy efficiency practices. Both are qualified to act as energy hup to the region. The national action plans offered numerous measures to enhance energy efficiency in the buildings (the central part of the built environment). The most different point between them is Italy is ahead of Egypt by almost a decade. At the same time, the electricity sector has been improved dramatically in Egypt since 2014.

5.1.3 Chapter Three

Chapter Three had the objective "*to provide a transdisciplinary framework to organize the collaboration work among stakeholders, which led to implementing efficient strategies to retrofit the built environment*." It has been achieved by developing a conceptual framework consisting of energy efficiency, project management, and software development domains. Each one has been analyzed concerning collaborative and participatory approaches, particularly regarding energy efficiency practices.

5.1.3.1 Chapter Three: Domain One

The sub-objective was to identify the domain characteristics, focusing on the management perspective. Therefore, a set of findings has been concluded. The complex nature of energy retrofitting practices, particularly in the traditional contexts that face many barriers that affect the process and increase uncertainty, requires ambitious transdisciplinary approaches that demand continual collaboration among the stakeholders all over the professional practice stages associated with the field's theories.

The chapter provided an intensive literature review, resulting in the obstacles into two mainstreams, the techno-socio-economic factors and process management, such as the stakeholders' selection and managing the interlocking relationship between them, which are considered the most critical uncertainties. Thus the study proposed in-depth analysis and systematic procedures to rationalize this ambition by integrating the second domain focused on these aspects, namely, project management.

There was an inverse relationship between settlements scale and locals' resistance to the on-site visits. The smaller the settlement size, the higher locals' resistance, supporting Pitt & Bassett's findings (Pitt & Bassett, 2013). Likewise, and vice versa, a positive correlation between the settlement size and the governmental support, by analogy with the case of the Pontinia case study.

5.1.3.2 Chapter Three: Domain Two

In the project management vein, intensive literature review contributed to determining and analyzing the leading keys to the success of any project and support the transdisciplinarity. Namely, stakeholder management, project management trends, collaborative work, and team conflict management, based on four key sources, Project Management Institute (PMI), The International Organization for Standardization ISO (ISO:21500), the literature review, eventually, the direct talks and interviews on-site with the locals.

First, the analysis helped engage the "right" stakeholders. Besides the well-known factors, this chapter provided that the enthusiast stakeholder, who has two observable personality traits, namely an entrepreneurial spirit (represented in his social and practical activities) and enthusiasm, which is easy to measure in the case of acceptance the invitation to talk or meeting an following up.

This result was confirmed by several personalities in the experimental studies in two countries, particularly in Italy: Simone Coco (followed up on the experiment, advocated and organized the workshop at a municipal level, and published its outcomes). In Egypt: Ahmed Khamis (CEO of Edara company, Cairo) decided to provide a fund (about 2800 EUR) to implement the solar plant. The study interviewed some stakeholders, and they did not show these traits, which support this finding.

Thanks to Information and Communication Technology (ICT), social media platforms played a significant role in contacting stakeholders, facilitating communications, and providing an overview of cultural preferences. Noteworthy mentioning is that the field trips are inescapable, even if the study is limited to theoretical aspects or it is investigating different cultures and countries.

Second, the chapter provided a collaborative problem-solving approach to mitigate the team's inevitable conflict and organize the relations. In parallel, the agile mindset was highlighted as a potential to facilitate these interventions. It was originated in the software development realm in 2001. It proved an efficient mindset to manage another process. So, from this point, it represented the third pillar of the conceptual framework.

Finally, post-graduate studies can provide successful real case scenarios. This supported the argument of reference (European University Association, 2017), and as discussed in (Chapter Three, Section 3.2.1). The self-consumption building in Lasaifar Albalad can be taken as an example (Chapter Four).

5.1.3.3 Chapter Three: Domain Three

In software development, many agile techniques and tools have been studied from a theoretical scene, resulting in the scrum framework being one of the most obtained frameworks in the practical scene. Scrum is too suitable for bottom-up practices. One of its benefits is rapid acclimatization. Each Sprint is a separate project to achieve a specific goal (final product) aligned with the project vision. It is characterized by the possibility of stopping at a certain point and building on it to complete the plan without going back again, where continuity (after delivering the sprint goal) is not essential as a process. The short period provides the ability to predict by checking and adjusting the work and limiting the cost of risk.

Localizing the Scrum techniques on the study purpose contributed to resolving the expected conflict between team members. It organized the responsibilities of the stakeholders, which could improve the collaboration between them. The short repeated iteration of the scrum helped develop the outcomes of the early stage of this research, which added other dimensions to the participatory approaches besides the technicalities, which have not been investigated before in retrofitting traditional built environments in the Mediterranean region.

5.1.4 Chapter Four

Chapter Four has achieved the objective "*to validate the provided conceptual framework of two traditional settlements in the Mediterranean region*." By discussing the developed conceptual framework's frontiers and validate it within two focus groups in two contexts to ensure ic can fulfill requirements within retrofitting practices in the rural built environment. In conclusion, it is disclosed that the developed framework has provided a bright vision of the nature of collaboration and communication from the early stages of any project in the rural commons.

Sprint Zero, in both two case studies, has determined the roles and responsibilities of the stakeholders, prepared the goals within the general vision. The estimated time for the sprints was achieved within almost one week. The author (scrum master) has estimated the initial sprints frontiers, vision statement, sprint planning, sprint goal, and time frame. The outcomes proved a sufficient agreement level among the stakeholders about the framework. Meanwhile, the workshops discussed the same themes (technical, social, cultural, economic) and offered their own user stories (requirements) with respect to the surrounded context (i.e., energy communities in Pontinia and nature-based materials in Lasafar Albalad).

The product backlog has been re-arranged, and a further sprint has been planned in Lasaifar Albalad only to upgrade the conceptual framework. In Sprint One, the stakeholders, roles, and responsibilities were determined as a result of the initial sprint increment. The team has an estimated time frame, sprint goal, and planning. The increment led to social acceptance by the client of the intervention, approving financial, and providing possible technical solutions to a specific case study.

In Sprint Two, the intervention was achieved in a shorter time compared to the other sprints, considering that the development team (the donor) was not entirely dedicated to this project due to their own responsibilities. Otherwise, this may support that the more sprints, the less time to implementation.

The framework empowers information exchange, which in this study refers to a new way of interacting cooperative working, including simplifying the transdisciplinarity, involving all relevant stakeholders in the project development process, resulting in better collaboration and communication, and decision-making.

5.2 Research Aim, Objectives, and Questions

5.2.1 Achieved Research Aim

The research aimed to "*provide a framework to organize the relation between collaborators, increase their effectiveness as teamwork, avoid the expected conflicts, and retrofit the built environment in traditional settlements in the Mediterranean region*." The research succeeded in providing an agile scrum framework that combined energy retrofitting practices with project management and software development domains.

The study has developed an original participatory framework that integrates energy retrofitting with project management and software development, contemporaneously a transdisciplinary that involves the academic, locals, local associations, decision-makers, private sector, and external experts. The framework was initiated from a bottom-up perspective, and it proved the success in integrating a top-down by including high-level decision-makers (the Municipality of Pontinia). The words are still stuck in the author's mind "*thank you for your effort in developing our village.*" On the other side, the framework led to implementing an actual case study (the first in the settlement and the neighbor ones) which was not guaranteed in the preliminary stages.

Therefore, the research answered the main research question: "*What is the possibility of using agile methodology as a transdisciplinary retrofitting approach for the built environment of traditional settlements in the Mediterranean Region*?" Yes, it was possible.

5.2.1.1 Objective One

- Reduce energy consumption and Mitigate CO_2.

The study contributed to decreasing the energy consumption in the Egyptian case study, and it paved the way for further practices in the Delta and Lazio regions. In line with the national and European strategies of energy efficiency, carbon neutrality, and climate mitigation.

5.2.1.2 Objective Two

- Investigate the existing energy retrofitting practices in the past decade.

The study investigated the previous retrofitting practices between 2011 and 2021 in similar traditional settlements contexts, which has been led to identifying the gaps, and possible solutions, acting like inputs to the framework, with a view to retrofitting the built environment in Lasaifar Albalad and Pontinia.

5.2.1.3 Objective Three

- Provide criteria to select and form team works for each project.

The study provided a methodology to select and identify the stakeholders in the different stages of the interventions (early-design setting, brainstorming, planning, and implementation), considering the theoretical background, relevant practices, and socio-cultural aspects (for all team members) provided within this thesis.

5.2.1.4 Objective Four

- Enhance harvesting renewable energy using emerging technologies.

The study contributed to the practices by implementing the first zero energy building in Lasaifar Albalad. Renewable energy technologies have been employed. Moreover, the experiment raised the locals' awareness of renewable energy. Simultaneously, the study contributed to the theory by promoting the energy communities in the Lazio region, including the renewable energy communities. It paved the way to transfer the planning stage (technical intervention and stakeholder readiness) to the first real-case scenario in Pontinia.

5.2.1.5 Objective Five

- Preserve and enhance traditional settlements' identity and values.

The study contributed to valorizing the "cultural" identity, enhancing the societal values and belonging to the place. Once the framework increased their expectations and put them on the same page with the decision-maker. Their interaction in the retrofitting process increased, and their willingness to do "something" to their built environment emerged. Physically, harvesting solar energy (the photovoltaic panel) may add another dimension to the place's value. Finally, integrating local natural materials as retrofitting solutions is a future potential to enhance the traditional visual identity because this user story is included in the product backlog for further sprints.

Finally, the study answered the latest research sub-question, "What are the differences between each context outcome?" Although Lasaifar Albalad and Pontnina have the same general characteristics, compared to their regions, the outcomes varied notably. So this study fostered a novel approach between Egyptian and Italian rural built environments to compare both contexts at many levels, such as the settlements' origin and growth, urban fabric, architectural style, cultural perception to the interventions for both locals and decision-makers. The study provided social and cultural aspects that affected the participatory approach.

5.3 Conclusion

The research focuses on a field rarely discussed in the literature: the possibility of quantifying the correlation between socio-economic aspects and electricity consumption in a typical rural settlement representing influence and the energy, and diagnosing the current buildings typologies in two traditional settlements.

The energy retrofitting strategies include developing an agile participatory approach in the early stage, including planning, decision-making, and preparing a participatory framework. This study provided a significant contribution to knowledge in the agile transdisciplinary retrofitting approach, based on the contribution of three domains. Each has been analyzed in detail.

The scrum framework promoted a better understanding of how to implement efficient retrofitting strategies that provided a rapid adjustment of the work plan and rapid feedback from the engaged stakeholders equally. That proved a success in mitigating the uncertainty in energy retrofitting practices. In addition, the short iterations helped adjust the project path at any time, only under a mainstream aim and precise inputs. It also helped in engaging the stakeholders and increasing their expectations. In addition, it upgraded the bottom-up way to a mixed one (with the top-down one). As proved in Lasaifar Albalad and Pontinia. Figure (05-01) shows the hierarchy of implementing this research.

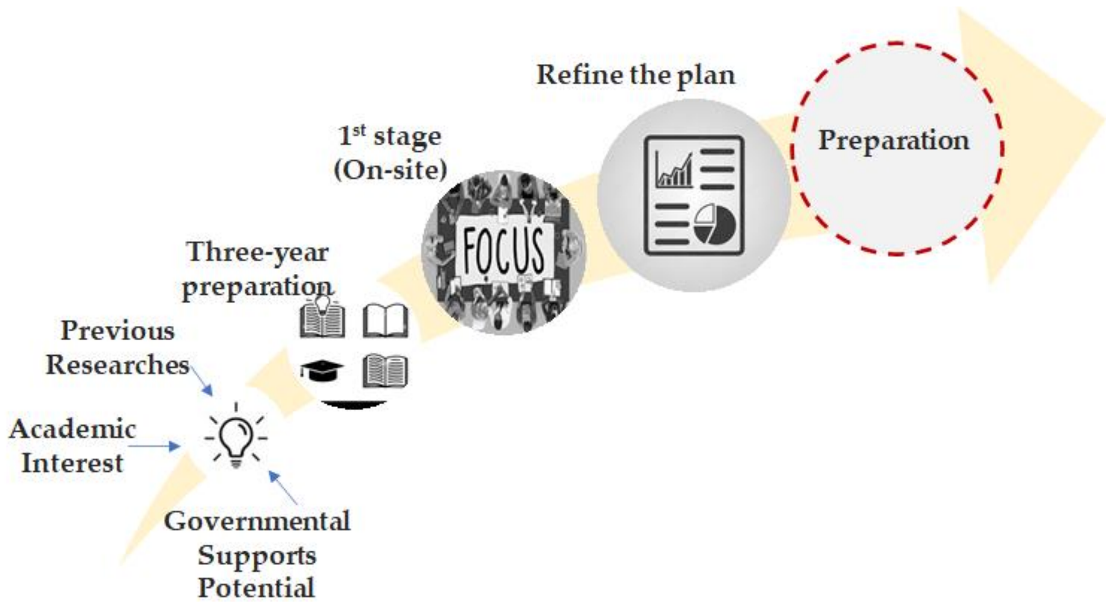


Figure (05-01) The hierarchy of developing this research. How the idea emerged and developed along the Ph.D. cycle timeline. The aim is to highlight the importance of this exploratory focus group as the first on-ground intervention, in line with the study aims.

5.4 Research Limitation

Although the study focused on Egypt and Italy as representatives of the entire region, investigating different Mediterranean countries may lead to different results. The study was limited to the traditional farming-based settlements and the plain areas (morphologically). The research implementations did not apply to the historical and cultural heritage settlements.

The end-use electricity consumption of different building types has been collected only in the Egyptian case study. As a sequence, the correlation between socioeconomic factors and end-use electricity has been done in Lasaifar Albalad.

The validated scrum framework and its capability to mitigate energy retrofitting practices' uncertainties and team conflict and enhance communication have only been implemented in a real base case in the Egyptian case study. In Pontinia, it was limited to the planning phase. Figure (05-02) shows this limitation.

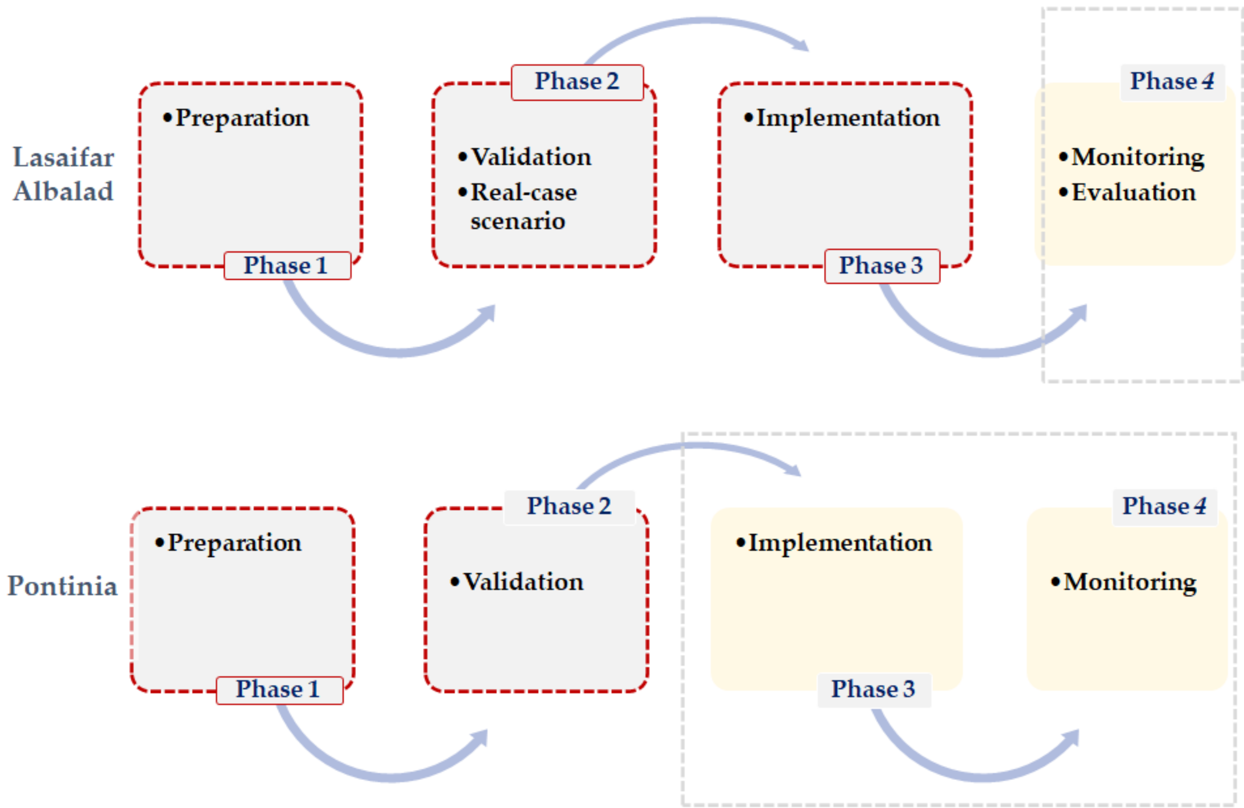


Figure (05-02) shows the progress of validating the framework

5.5 Recommendation and Further Work

Architects and researchers play a notable role in leading energy efficiency practices. The author argues that architects are responsible for integrating sustainable practices in their designs by convincing the clients and having sufficient knowledge, either by him/herself or from external experts. The author was told by some architects(experienced and fresh graduates) in a previous study (Abouaiana & Mohamadin, 2018): it is a matter of legislation and clients' preferences. Therefore, the author believes it is a myth, in one case only: Has the architect considered energy efficiency practices? Has he evaluated the feasibility of any practice, i.e., how much insulating the envelope costs? This is inevitable: the architect nowadays is a "maestro."

In Lasiafar Albalad, monitoring the case study will be implemented at many levels to evaluate the experiment. It can be grouped into the following points. First, the energy consumption will be evaluated to investigate to what extent the intervention achieved the electricity's self-sufficiency. Second is the economic evaluation, such as the maintenance fees and investment return. Third, the social impact on the client, and residents, to investigate to what extent the experiment was replicated. Fourth is the post-occupancy behavior, namely maintenance.

From the fact of the proven low energy consumption of the residential buildings, compared to high ones or the urban context. Harvesting renewable energy can also achieve zero-energy buildings and energy communities, particularly in Lasaifar Albalad, supporting Abouaiana's findings (Abouaiana, 2021), "*harvesting renewable energy that would drastically reduce energy consumption and CO2 emission.*"

Eventually, this study can provide guidelines to support the decision-making in the recent initiative Decent Life. As well as, the author intends to contact the initiative's representatives in the Delta region to discuss these findings besides the concluded findings in the previous studies (Abouaiana, 2016; Abouaiana, 2021; Abouaiana & Mendonça, 2022).

In Pontinia, there is an essential need to implement a real-case scenario by retrofitting existing buildings employing the energy communities principles. In line with the notable efforts of the Lazio region towards the transition to energy communities. The involved stakeholders are willing to "do something to develop the village," a strong foundation point. Therefore, the lead researcher intends to accelerate the implementation of an energy community project in the region, like implemented in the Ventotene settlement.

The current end-use energy consumption will be collected using a different method (than the one used in this research), which is critical to providing efficient retrofitting strategies. In the same vein, the RECON tool, based on "*Art. 42 bis of Legislative Decree no. 162/2019 converted into Law nr. 8/2020*" (RECON, 2021), will facilitate the transition towards energy communities in Pontinia.

The author intends to implement further studies to deepen these thesis findings and build upon what has already been discussed in the workshops. That will promote energy communities and agriculture-based energy efficiency practices, such as agrivoltaics, which is a trend now in Italy. To clarify, in 2021, ENEA (the National Agency for New Technologies, Energy and Sustainable Economic Development) has coordinated a national initiative to generate a national network to promote knowledge and methodologies for developing and spreading agrivoltaic systems "*AgriVoltaico*." That plans to offer business opportunities to energy communities and strengthen rural policy (Agrivoltaico Sostenibilie, n.d.).

Therefore the next sprint is planned by preparing another mini-group in Pontinia to receive feedback and adjust the work plan (resulting from Sprint Zero). The tasks of the next sprint can be grouped as follows:

- Selecting the target case and identifying the stakeholders (socio-cultural barrier);
- Preparing the technical analysis (i.e., consumption and possible retrofitting solution) (technical barrier);
- Preparing the budget planning according to the Italian market (economic barrier);
- Providing the estimated time frame and discussing the associated risks (technical barrier);
- In parallel, investigate the juxtapositioning of energy communities and agrivoltaics key concepts with the Italian rural and agriculture policies and the National Recovery and Resilience Plan (NRRP, 2021) as a way to resolve the economic barrier (legalization and economic barriers).

Lastly, though the study focused on specific contexts, the agile framework can establish many foundation pillars to provide a replicable methodology for different Mediterranean countries, utilizing different key concepts and engaging other actors and stakeholders. All can contribute to retrofitting and valorizing our rural Mediterranean built environment.

Chapter Five References

Abouaiana, A. (2021). Retrofitting Rural Dwellings in Delta Region to Enhance Climate Change Mitigation in Egypt. *Environmental and Climate Technologies*, *25*(1), 136–150. https://doi.org/10.2478/rtuect-2021-0009

Abouaiana, A. A. A. (2016). *"Principles for Existing Rural House Sustainability in Delta Region (With Special Reference to Energy Efficiency)" (In Arabic)* [Cairo University, Giza]. https://doi.org/10.13140/RG.2.2.21412.71044

Abouaiana, A., & Mendonça, P. (2022). Retrofitting Dwellings in Traditional Coastal Settlements in Egypt and Portugal Using Nature-Based Solutions and Conventional Thermal Insulation Materials: Technical and Economic Assessment. *Journal of Architectural Engineering*, *28*(2), 05022005. https://doi.org/10.1061/(ASCE)AE.1943-5568.0000537

Abouaiana, A., & Mohamadin, M. (2018). *The Role of Egyptian Residential Buildings Energy Code in Enhancing Sustainable Development in Egypt : Evaluation of Nine Years of Practice* (H. Elshaarkawy, S. Zahiri, & J. Clough (eds.); Issue September 2018, pp. 517–526). Proceedings of SDBE2018: International Conference for Sustainble Design of the Built Environment. https://doi.org/10.5281/zenodo.4025302

Agrivoltaico Sostenibilie. (n.d.). *https://www.agrivoltaicosostenibile.com/en/*. Retrieved February 25, 2022, from https://www.agrivoltaicosostenibile.com/en/

European University Association. (2017). Energy transition and the future of energy research, innovation and education: an action agenda for European universities. *Int. J. Prod. Res*, *53*, 59. https://eua.eu/downloads/publications/energy-transition.pdf

NRRP. (2021). *Piano Nazionale di Ripresa e Resilienza, NRRP [The National Recovery and Resilience Plan]*. Italian Governement. https://www.governo.it/sites/governo.it/files/PNRR.pdf

Pitt, D., & Bassett, E. (2013). Collaborative planning for clean energy initiatives in small to mid-sized cities. *Journal of the American Planning Association*, *79*(4), 280–294.

RECON. (2021). *RECON: Strumento per la valutazione economica delle Comunità di Energia Rinnovabile [RECON: Tool for the economic evaluation of Renewable Energy Communities]*. https://recon.smartenergycommunity.enea.it/# (Accessed 05-01-2022)

Acknowledgment

My heartfelt gratitude and thanks to my esteemed tutor *Prof.Alessandra Battisti* for her valuable advice, wise academic guidance, endless support to improve my academic career, and inspiration during the Ph.D. journey, which would not be complete without it.

Also, many thanks to the Department of Planning, Design, and Technology of Architecture (PDTA), La Sapienza Universit, represented by *Prof.Fabrizio Tucci.* For supporting us constantly, providing us with the methods and tools in scientific research that helped us in our Ph.D. journey over the past three years.

Dedication

A special dedication to the soul of my dear father, the owner of the most influential and positive words in my life. To my lovely mother, thank you.

To my lovely kids Malek and Dana. To my lovely wife, Dina, thank you for taking a huge part of my responsibilities towards our family during writing the thesis.

To all my big lovely family, thank you for the outstanding support.