



**Ain Shams University**  
Egypt



**University of Stuttgart**  
Germany

# **Towards Eco-houses**

The potential of applying eco architecture principles between technical  
and behavioral dimensions .The case El Gari village, Siwa.

**A Thesis submitted in the Partial Fulfillment for the Requirement of the Degree  
of Master of Science in Integrated Urbanism and Sustainable Design**

**by**

**Nojoud Ashour**

**Supervised by**

Prof. Dr. Mohamed Salheen  
Professor of Integrated Planning and  
Design  
Ain Shams University

Prof. Dr. Astrid Ley  
Professor of International Urbanism  
University of Stuttgart

Dr. Marwa Abdellatif  
Assistant Professor of Urban  
Design & Planning  
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Ain Shams University

Examiners Committee  
Title, Name & Affiliation

Signature

Prof. (external examiner)  
Professor of (...)  
University of (...)

Prof. (Title/Name)  
Professor of (...)  
University of (...)

Prof. (Title/Name)  
Professor of (...)  
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**Ain Shams University**  
Egypt

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**University of Stuttgart**  
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# Disclaimer

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Nojoud Ashour

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# Acknowledgements

As Maya Angelou said “when I go on stage I bring with me all the people that I love in my life”. It is the same feeling I had while writing my thesis, I bring all the people I love with me. The list is endless and I am grateful for the tremendous support that I got from the people I love during these two years. My special thanks goes to my Mom who pushed me to do my master’s thesis from the very beginning. She is always there to make sure that the atmosphere is comfortable for her daughter wherever she is. I’m grateful for my life coach, Nevin El Gendy, and her amazing tribe. I would never be able to finish the master’s thesis without her positive energy, her clever tools that I used to overcome challenges, her methods on dealing with negative thoughts and the systematic schedule that we created together to commit to the deadlines during the last two months. A huge thanks to my friends in Jordan and Egypt, they were always around whenever I need them, I’m so grateful for the support system that I had from them. A special thanks to Dr. Salheen who gave me the last-minute support of changing my topic with his amazing metaphor of the situation that I had with the first topic that I chose. I am thankful for the great support and push from Dr. Marwa; her constructive feedback and nudge to submit within the deadline is amazing. I will be forever grateful to her for the constructive feedback, last minute support and sweet messages that melt my heart every time I received them. I also want to thank Dr. Astrid for the constructive feedback during the research.

The empirical study would not have been done without the support of the amazing Al Domiaty

family in Siwa, the owners of Talist Eco Lodge. They became my family during my 18-day stay in Siwa; I am grateful for the fruitful knowledge that they have shared in several topics along with the thesis. Special thanks as well for architects Ramez Azmy and Emad Farid for their generosity of sharing knowledge about Adrere Amellal Eco Lodge and the fruitful tour inside the Eco Lodge. Finally I would thank my friends in the IUSD especially for the growing experience I had with them, and special thanks to Mennah for her greatest support.



# Abstract

This research aims to identify potential implementation of Eco Architecture solutions that are associated with both technical and behavioral dimensions in El Gari village-Siwa oasis to achieve a better well-being for both the ecosystem and human inhabitants. The research will have a deep understanding of Eco Architecture principles focusing on technical and behavioral dimensions. It will also identify the barriers associated with implementing Eco Architecture solutions specifically in El Gari village in Siwa Oasis-Egypt. The research follows a qualitative approach that is divided into two phases which meet the main aim. The first phase focuses on theoretical approach depending on literature reviews that form a deep understanding of Eco Architecture principles with the focus on technical and behavioral dimensions. The second phase depends on an empirical study that focuses on studying the solutions that are used in two Eco Lodges located near El Gari village. As these Eco Lodges brought new Eco Architecture solutions to the indigenous architecture in the area, the study will identify these solutions and identify the barriers of implementing such solutions in the local community in the village. The findings of the thesis are summarized in highlighting the strong relation between overcoming the barriers and environmental behavior tools. It adds, the limited integration between different potential stakeholders and influencers that could play fundamental role in achieving comprehensive change in El Gari village and Siwa and highlights the importance of creating channels between inhabitants, external investors, academics and governmental entities to provide a platform of knowledge sharing that will enhance to transform the new Eco Architecture technics in the village to create healthy and integrated community.



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# Arabic/ English Glossary

Karsheef :

raw salt blocks, not worked, used as stone for the masonry and tied up with a salty mud paste

feddan:

It equals 4200 square metres

## Acronyms

EQI

Environmental Quality International











*Siwa has everyting and it needs everything. Author*

# Chapter 1: Research Overview

‘The dialogue between architecture and nature is as old as architecture itself’ (Brebbia, 2006, p.19).

Eco Architecture is getting more attention recently for its fundamental impact on saving the earth. Eco Architecture is not only about technical skills but also how to make the community responsible. It is connected with the idea that the world is not random, but created under a set of rules that are intertwined. As humans who are part of this system, it is essential to act in harmony within the designed system (ORR, 2001).

## 1.1 Introduction

The current situation of the environment threatens both the Eco System and life on earth. The whole system is interconnected, any disorder in the system would affect the component either directly or indirectly. Buildings have been perceived as the most harmful source of pollution on earth as it consumes more half of the energy (ecobob, 2018). For this reason, a lot of movements concerning designing in harmony with nature had emerged recently. Eco Architecture is considered one of the approaches that represents the idea of designing with nature (Brebbia, 2006). As Rynska claimed, it appeared with vernacular architecture a long time ago. However, the concept of vernacular architecture terminated its efficiency after reinforced concrete, steel and glass emerged as better alternatives (Broadbent and Brebbia, 2008). This era did not only effect the technical part of the equation but also the way of thinking and daily routine of human beings. According to McDonough & Braungart (1998) as cited by ORR (2001), what has to be done in order to save the earth is ‘putting filters on our minds, not at the end of pipes’, and to reduce the use of toxic materials, and to develop the system of the closed loop that brings ‘products of service’ not products that are wasted in the air, water and land (p.26). The combination between develop-

ing technical solutions and changing the mindset is an important approach for efficient implementation of Eco Architecture that is adopted in this research.

The term Eco-, is defined by yourdictionary (2018) as ‘something that is environmentally friendly or sustainable’. Eco is also defined by dictionary (2018) ‘denoting ecology or ecological’ when it refers to the environment. Studying ecology provides us with better understanding of the world around us which effects our way of living on earth. It also directs us on how to use Earth’s resources sustainably. It is important to be aware that everything in the Eco System is essential; whereas a small Eco System in the forest may not seem so fundamental, yet it plays a great role in several things such as managing air, climate and other resources on earth. Ecology is always linked with the term Eco System that shapes ‘the interacting organisms and their physical environment’ (oxford-dictionaries,2018). Eco System and architecture are combined together under the umbrella of Eco-Architecture that includes technical solutions and behavioral dimensions. Although the term Eco Architecture holds technical dimension at the first insight, yet the behavioral dimension is an essential principle in its equation as well. Despite this fact, at times behavioral dimension is not taken into consideration seriously whilst implementing technical principles. For this reason, the study will focus on environmental behavioral as an essential dimension of Eco Architecture principles. Whereas there are more projects focusing on Eco Architecture, yet they cover a small percentage compared with what is actually constructed (Garofalo, 2018). The same applies on implementing Eco Architecture solutions in Egypt, although there are several old examples of building with natural materials and primitive Eco-friendly solutions, yet now there are limited examples which are mainly found in private projects or environmental initiatives.

Having this in mind, the focus of this research will be on identifying the potential of implementing Eco Architecture solutions in El Gari village in Siwa oasis where inhabitants used to build with natural building material and primitive Eco-friendly solutions but now they are using conventional materials to follow modernity stream. Although the village has limited implementations of Eco-friendly solutions yet it is surrounded by three Eco Lodges that execute different examples of Eco Architecture solutions. As this research aims to identify the potential of implementing Eco Architecture solutions in El Gari village, it will first have a deep understanding of Eco Architecture principles with the

focus on technical and behavioral dimensions, then it will have an overview on the barriers that are associated with implementing eco architecture solutions in El Gari. This requires, first a general overview of past and present use of natural resources in the area in order to understanding the context. Second it highlights Eco Architecture solutions that are implemented in the Eco Lodges beside the village and finally identifies the barriers that prevent local inhabitant in El Gari village to implement the examples that are used in the near Eco Lodges.

Whereas the main title is highlighting Eco houses, the focus of this research is on the technicality and the behavioral dimension that can be implemented in different buildings with different functions. The shift of focus is due to the limited examples of Eco houses that are in Egypt. On the other hand, different cases of Eco lodges and initiatives that implement Eco Architecture solutions which has directed the research to understand the technics that are used in Eco Lodges which might be implemented in houses as well.

## **1.2 Problem statement**

Buildings have been perceived as the most harmful source of pollution on earth, it consumes more half of the energy (ecobob, 2018). Buildings produces 50% of the CO<sub>2</sub> of all man-made emission (Roaf, 2013). The European Union currently imports more than 60% of its primary energy; the figure is continuously rising (Museum (U.S.), 2002). Furthermore, it has been recorded that the annual increase of energy cost has reached 25% between 2004 & 2008 (Roaf, 2013). This steadily increase of the price is pushing people to take energy saving measure into consideration (Bauer, Möslle and Schwarz, 2009). For instance, the increased use of air conditioning, heating and lighting systems dependent on fossil fuels is directing architects to design buildings that use clean and renewable energy (Museum (U.S.), 2002). On the other hand, it has been highlighted that building themselves could be seen as a potential to cover big part of the solution (nationalgeographic, 2017).

The problem statement in Egypt is not different from the global one. Kamel (2016) stated that the residential sector is responsible for 43% of the energy consumption in Egypt. Electricity demand in Egypt has drastically increased in recent years, due to socioeconomic changes, and is poised to import 16% of its energy demand by 2020 (Nadim et al., 2013). Egypt is considered as one of the countries that have rich ecosystems and 30 natural protectorates that cover 15%

of the total geographical area of Egypt (Halawa, 2016). Peasants in Egypt have been using the existing materials on earth as the main material to build their shelters for ages (Fathy, 2000). The rapid urbanization in Egypt responsible for the current threat to primary resources such as agricultural lands (Halawa, 2016).

In response to this, planners and architects are guiding urban development towards a healthy building environment by using techniques and strategies that reduce the use of non-renewable energy and other materials (Wong and Yuen, 201). Designing buildings that effectively utilize renewable natural resources such as solar energy, in a way that does the least damage to the major natural resources on earth is seen as the viable way forward (Brebbia, 2006). Whereas there are more projects focusing on this direction, they cover a small percentage compared with what is actually constructed (Garofalo, 2018). In fact, there is big interest in a sustainable field yet the frequency of application is limited due to several barriers such as affordability, time needed to source material and lack of adequate knowledge (Hankinson and Breytenbach, 2012). It is also important to highlight that people's behavior towards the environment has a huge impact on the earth as it is interconnected with human's decision on what, how or how much to consume. It has been stated that environmental behavior can increase or decrease the impact on global climate change (Brown, 2014).

Conclusively, the earth is facing a significant environmental threat which is mainly caused by using non-eco-friendly solutions for building construction and building usage by occupants. Despite the fact that there are several main-streams adopting sustainable solutions, the implementation of such approach is still limited. Whereas there is a need to develop Eco-friendly technical solutions, there is also the need to encourage people to adopt environmental behaviors that have been proven in past studies as to having a quantifiable impact in saving the planet. As is the case in Siwa Oasis, residents used to follow Eco Architecture principles in the past, but challenges, have led to the neglect of traditional ways of building. Therefore, the study will study Eco Architecture principles that covers both technical and behavioral dimension and also highlight the barriers that are associated with these solutions in order to have better implementation strategies in the future.

### 1.3 Research Aim and Objectives

This research aims to identify the potential of implementing Eco Architecture solutions that are associated with both technical and behavioral dimensions to achieve a better symbiosis between ecosystems and humans. To realize this aim, the research has to meet the following objectives:

- (a) To understand Eco Architecture principles focusing on technical and behavioral dimensions. As a prerequisite for realizing this objective, the research will have a deep understanding of the emergence of eco architecture and its relation to the Eco System.
- (b) To identify the barriers, that are associated with implementing Eco Architecture solutions for the local community in El Gari village. As a prerequisite for realizing this objective, the research will understand the natural resources management in Siwa and El Gari village. And will study new Eco Architecture solutions that are implemented in two Eco Lodges that are located near El Gari with the focus on the benefits and the challenges.

### 1.4 Significance of the Study

This research addresses Eco Architecture, a topic that is getting more attention recently for its fundamental impact on saving the earth. Preserving eco system is very important for our living on earth and it is crucial in several ways, by direct services (for example: food, clothing, housing, medicine etc.), indirect services (for example: the existence of mangrove swamps along the coastal margins protect the coast line from wave and erosion) and for value provided by bio diversity for future generations (for example: what humanity leaves for the future generation) (California Academy of Sciences, 2014). Any disorder with the Eco System will be crucial to human being living on earth (Teacher's Pet, 2015). Understanding the Eco System model or Ecology is essential since it can be applied on major issues in Ecological design. For example, understanding how Ecosystem uses local resources and recycle material can be a model that facilitates how to optimize the house's energy flow (Wenz, 2007).

The research brings to focus the behavioral dimension along with the technical details. This gives the research fundamental value and fills the gap within the limited improvement on behavioral level comparing with technical level. Adding to this, it identifies the barriers that are linked with implementing Eco Architecture solutions which can be considered in tackling the issues that are associated with Eco Architecture solutions in order to be solved in the future.



The situation in Siwa is considered as a show case for the huge focus on technical environmental work and less attention on the behavioral and mindset growth of the inhabitants. Although some of the investors invest in educating people some skills and engaging them in the local market, yet there is a need of shaking the awareness of the importance of saving the eco system in the area by using some systematic criteria to mark the change. To achieve this balance of developing, the study highlights the importance of brining several stakeholders under one umbrella to formulate common platform that shares comprehensive solutions from different knowledge backgrounds and experiences.

### **1.5 Target Audience**

The findings of this research target academics interested in Eco Architecture solutions with the focus of encouraging environmental behavior as an essential aspect to do change and save the Eco System. It also targets developers or investors who are planning to construct new buildings or houses in closer context and are aware of the importance of developing environmental behavior for the occupants of the building and neighbors. It is also significant for the policy agents who seek sustainable development in villages that highlights the area of technical development and guide them towards adopting a paradigm shift in environmental behavior.

### **1.6 Research Structure/Outline:**

This research is divided into five chapters. The first chapter includes the research overview, the introduction, problem statement followed by the aim and objectives of the study. Chapter two explains the methodology that was used and the data analysis. Chapter three provides the relevant literature reviews to study Eco Architecture principles; it covers a wide understanding of related terms such as Ecology, Eco System, Eco Architecture solutions and environmental behavior.

The fourth chapter identifies the potential of using Eco Architecture solutions in El Gari village. It first highlights the historical overview of the area in the perspective of natural resource management which followed by deep understanding of the Eco Architecture examples that are implemented in two Eco Loges near the village. It ends with a documentation of the barriers that are associated with implementing Eco Architecture solutions with local inhabitants at El Gari village. Finally, chapter five identifies the conclusion, the findings, limitations,

recommendation and further work.

# Chapter 2: Research Design

## 2.1 Methodology

The research follows a qualitative approach. It is divided into two phases; each phase meets the objectives listed in Chapter One. The first phase focuses on a theoretical approach in order to form a deep understanding of Eco Architecture solutions taking into consideration technical and environmental behavior dimensions. The second phase depends on an empirical study. It first studies the new Eco Architecture solutions that are brought by external investors which are implemented in the two Eco Lodges. Secondly, it identifies the barriers that are associated with implementing Eco Architecture solutions for the local community at El Gari village. The outcome of the first phase is a diagram that summarizes eco architecture principles highlighting both technical and behavioral dimensions. On the other hand, the outcome of the second phase is a summary of the barriers that are associated with implementing eco architecture solutions at the local community in El Gari village.

## 2.2 Data Gathering

Different tools are used to collect the needed data for each phase.

### 2.2.1 Data Gathering Tools

The first phase depends mainly on literature reviews of academic writing, articles, YouTube and books. The second phase depends on empirical study by using in-depth, informal interviews, observation, sketches and photos to have a deep understanding on the solutions that the Eco Loges use whilst highlighting the main challenges and benefits that are associated with them and the barriers that prevent local inhabitants from adopting such solutions.

### **2.2.2 Sampling**

The sampling of the target audience includes owners and architects of the Eco Loges, inhabitants from El Gari village, random people from the city center, active people who are interested in developing Siwa.

#### **Architects and owners sampling**

The architecture sample includes four architects who designs the two Eco Loges. Ihab Al Domiaty and Sayyed Al Domiaty are the owners and architects of Talist Eco Lodge, Ramez Azmy and Emad Farid are the architects of Adrere Amellal Eco Loge. More than one interview was conducted with each architect; the first two architects were interviewed in Siwa at Talist Eco Loge. The first interview highlights the technical solutions that they used in the Eco Lodge, while the other interviews went into details to explain some technical details that were used in the building to overcome the challenges that inhabitants used to face in the indigenous architecture. The other two architects were interviewed in EQI office in Cairo and at Adrer Amellal Eco Loge in Siwa. Each interview lasted about 1-2 hours. The main focus was on the new Eco-friendly technics that are implemented in the Eco Lodge.

#### **Inhabitants in El Gari village:**

This sample includes six inhabitants, who worked in the construction of the mentioned Eco Lodges, who live in El Gari village. The main aim of the interview was to understand the situation of El Gari village in general, to identify any Eco Architecture solutions that are implemented in the area and to highlight the barriers that are associated with these solutions that limited its implementation in the village.

#### **Active people who are interested in developing Siwa:**

This sample includes three people. The main aim of the interview was to identify the barriers that prevent locals from implementing Eco Architecture solutions and examine how best to overcome those challenges.

### **2.3 Limitations**

Despite the research achieving its aims, it encountered a number of challenges. Firstly, the various opinions of Eco Architecture principles from different literature reviews make it challenging to summarize Eco Architecture principles in one diagram that combine several literature reviews. Secondly, identifying

the barriers depended on interviews with a sample of local inhabitant and not on market analysis or detailed investigations, this might not give a holistic view of the barriers but it gives an insight of the situation and the challenges that can be perceived as a base for further detailed investigation. Thirdly, the responses from the interviews with local people were difficult to capture perfectly due to the language barriers, although they speak Arabic yet their lingua franca is Amazigh language which was hard sometimes for them to understand my accent as a Jordanian. This affected the documentation of the barriers of eco architecture implementation as well. Fourthly, the wide scope of eco architecture principles make it challenging to go through detailed explanation of each solution in the empirical study. Fifthly, limited access to certain owners (not locals) either for Eco Loges or certain initiatives in Siwa affected the wider understanding of the nature of new developments that will be taking place in the future.

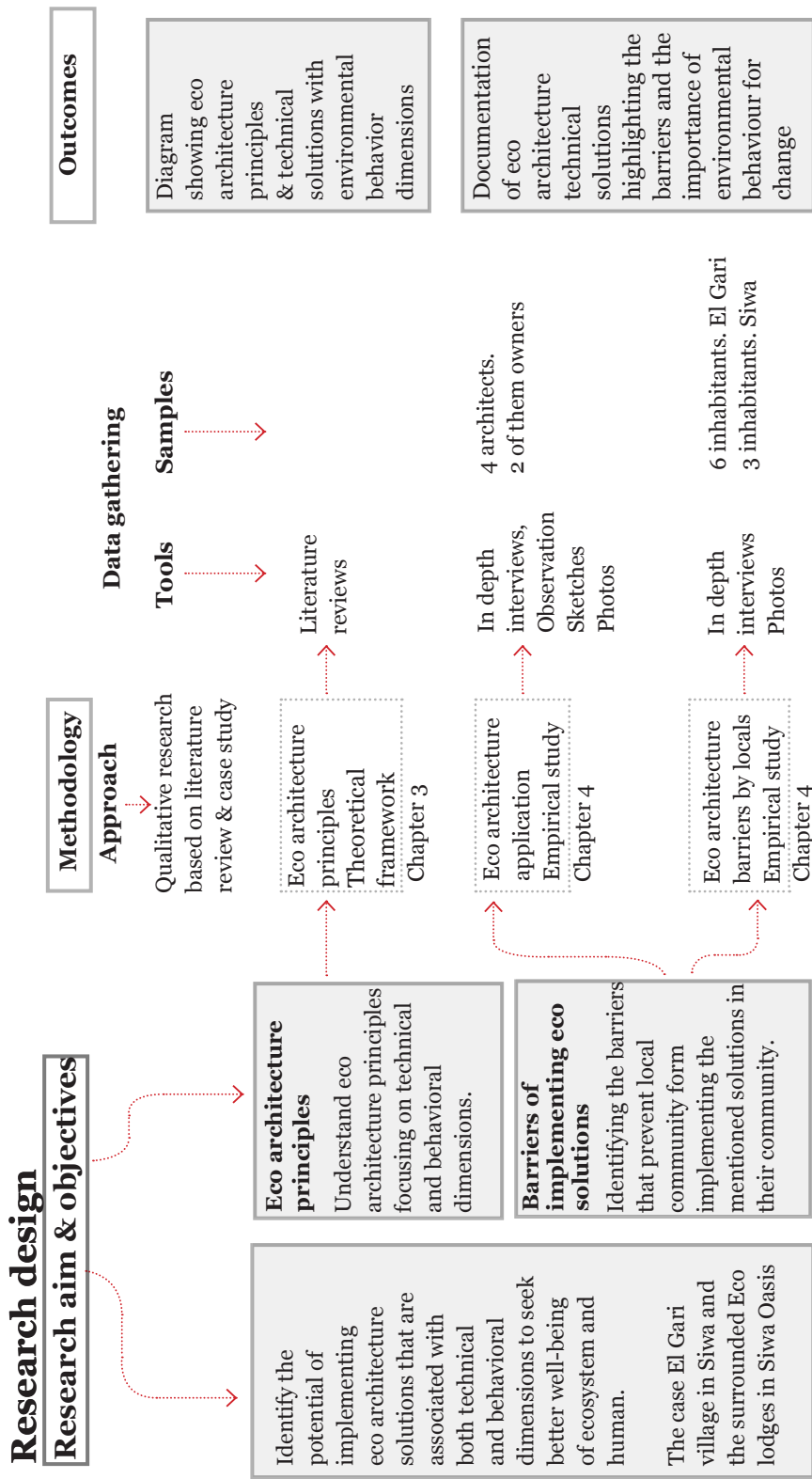


fig (1)Diagram showing the research design and the expected outcomes. Source: Author

# Chapter 3: Understanding Eco Architecture principles.

‘Eco-architecture is sustainable architecture that involves a combination of values: aesthetic, environmental, social, political, and moral’ (Hernández, Brebbia and Wilde, 2010).

This chapter is the initial phase of the study that responds to the first objective of the research that was mentioned in Chapter One introduces a brief understanding of Eco Architecture and a theoretical framework of Eco Architecture principles focusing on technical solutions and environmental behavior dimension through literature.

## **3.1 Understanding Eco Architecture.**

Since understanding Eco Architecture relates to bigger scale, this part traces the emergence of Ecology, Eco System, Eco Architecture and Eco House that will in turn lead to a focus in finer details in the technical solutions and environmental behavior in the next section. This section highlights definitions, brief historical overview and significance for each part.

### **3.1.1 The study of ecology and Eco System**

Ecology has no specific beginning but is thought to have developed from the ancient Greek history of nature by Aristotle and Theophrastus (Pimm and Smith, 2018). In the pre-18th Century, they studied several cases of plant-animal interactions (Thanos, 1994). Between 1860 and 1870, the science was named by German biologist Ernst Haeckel who then inspired others to develop the science. He defined ecology ‘as the study of the organic and inorganic conditions on which life depends’. He further titled inorganic as physical and chemical conditions on which life depends including climate, nutrients, and the nature

of water and soil. The organic conditions included ‘the entire relations of the organism to all other organisms with which it comes into contact, and of which most contribute either to its advantage or its harm’ (Merchant, 2005,p.159).

As stated by Schowalter (2016) ‘Tansley (1935) coined the term ecosystem to recognize the integration of the biotic community and its physical environment as a fundamental unit of ecology, within a hierarchy of physical systems that span the range from atom to universe’. In 1942, Lindeman introduced a modern understanding of the ecosystem through studying of energy flow in the aquatic system (Schowalter, 2016). The following diagram highlights the difference between Ecology and Ecosystem and provides further details about biotic and abiotic components, see fig (2).

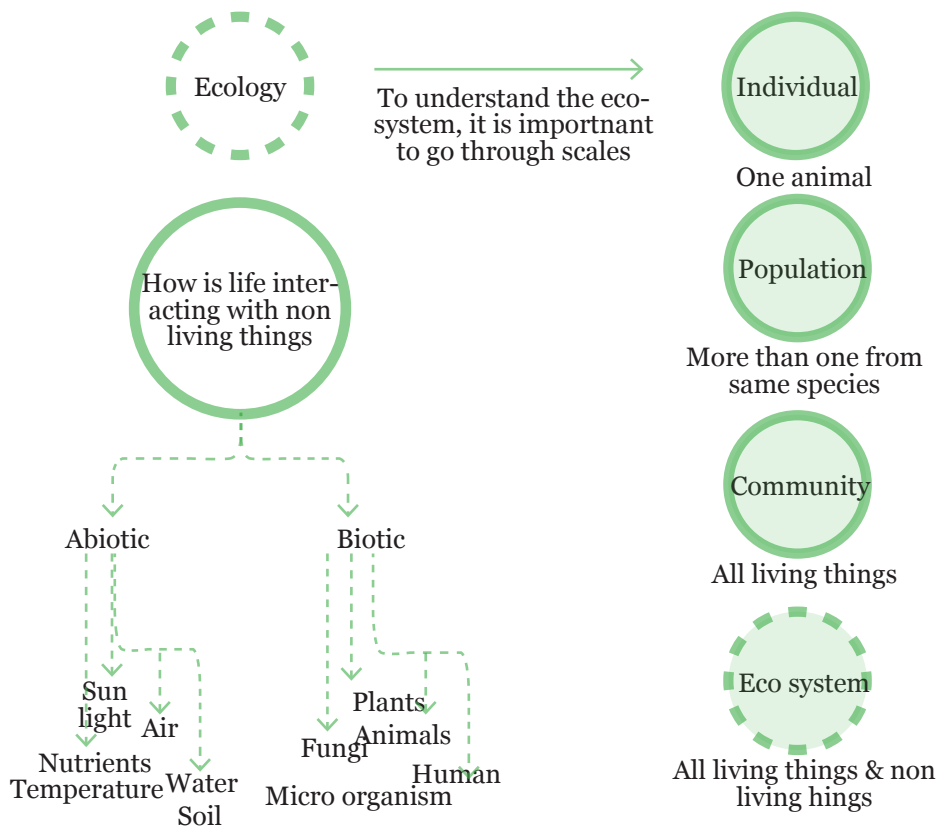


fig (2) Diagram showing an understanding of Ecology and Ecosystem and the differences between them. Source: Author based on Khan Academy, 2016



According to TEDx Talks done by Babbitt, it is essential to highlight how studying the ecosystem can inspire architecture. This can be highlighted in three main aspects or metaphors: first, thinking of how buildings can function like plants by converting solar energy and breath fresh air; second, thinking how building recycle the waste like the idea of the waste from one organism becomes the food of another; third, how to minimize competition over scars resources and maximize collaboration that it is reflected in human attitude (2015b).

### **3.1.2 The study of Eco Architecture**

There are several definitions for Eco Architecture, one definition stated that Eco Architecture 'is not only a matter of specific design choices that lead (most of the times) to specific high tech building products but the appropriate mentality that releases a specific attitude of dealing with building within nature' (Brebbia et al., 2006, p.22). As cited by Roaf (2013) 'Eco-architecture sees buildings as part of the larger ecology of the planet and the building as part of a living habitat' (p.26). Eco architecture is also defined as a field that 'entails passively and actively harnessing solar energy and using materials which, in their manufacture, application, and disposal, do the least possible damage to the so-called 'free resources': water, ground, and air' (Hernández, 2010, p.186).

The application of ecological architecture was founded in the 12th century AD as a primitive practice as it is found in the temple Angkor Wat. Complicated irrigation systems, using local natural materials, heating and cooling strategies was implemented in the temple (ansgrouplobal, 2018). Rynska argued that eco architecture had emerged with vernacular architecture a long time ago. However, the concept of vernacular architecture soon replaced by the use of reinforced concrete, steel and glass. Unfortunately, low energy consideration, use of local material and climate conditions became minor issues (Broadbent and Brebbia, 2008) comparing with conventional solutions.

Although the application of eco architecture was found in different civilizations a long time ago, the first eco-, passive and sustainable approaches appeared in the '70-ties (Broadbent and Brebbia, 2008). It developed as a sequence of energy crisis that occurred during the 1960s and 1970s as a response to this with the focus directed more towards the study of the relationship between the "form and materiality" of the building and their energy consumption (Brebbia, 2006). There is an emergence of a new approach that is shaped by areas of interest such as the introduction of new building technics, "bringing life to

new approaches towards existing old cities”, and revealing cultural values of the existing heritage that were developed differently depending on the policy that is applied in different countries (Broadbent and Brebbia, 2008).

### **3.1.3 The study of Eco house**

Pastakkaya (2015) defined eco house as:

*‘the house that derives much of its energy needs from renewable energy sources such as solar power, which can be converted into both thermal and electrical energy ... [Adding to this eco-house is defined] as a residence that has minimal impact on the environment, consumes minimal energy from design to demolition, and is built with eco-friendly materials and technologies – all without sacrificing the residents’ quality of life’.*

There is no single definition of eco house, but the literature emphasizes that all the definitions share the common base regarding the role of the built environment on being sensitive towards the natural environment in order to save the universe and maintain a healthy well-being for humanity. As stated by Philip, ‘an ecological house is modeled on the energy and material flows of natural ecosystems, and thus enhances rather than degrades the environment. Like an ecosystem, an ecological house conserves resources (energy, water, food and materials). It also produces resources, or at least gathers and stores more of them than it uses (Wenz, 2007).

The ideal eco house has no waste since the resources flow in circle. This is clearly found in the ecosystem in a scenario where ‘plants make animal food and animals make plant food’ where it is referred to by ecologist and ecological designers as the closing loops of nutrients. In order to mimic nature, some simple approaches can be implemented such as composting the food in order to use them to grow the garden. Another implementation is the gray water that can be used in growing plants (Wenz, 2007). Furthermore, successful eco house is identifies by the relationship between the people, the buildings they live in and the climates or the place (Roaf,2013). See fig (3).

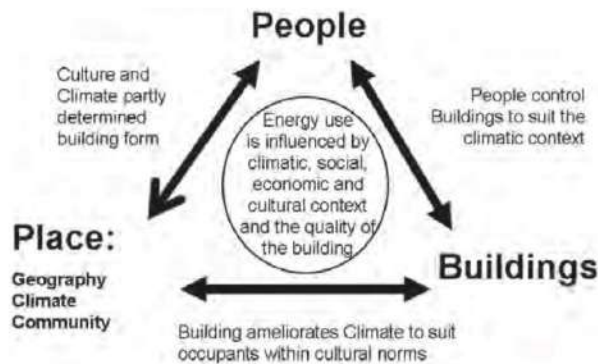


fig (3) Diagram showing the importance of people, buildings and place in Eco Architecture  
Source: Roaf, 2013.

There are various advantages of eco-friendly house that can be summarized under the following three main aspects; economic, social, and environmental. As for economic benefit, studies show that eco-friendly house costs less than traditional house (ecoviewhomes, 2015). Using recycled or secondhand materials saves a lot of money (kamran, 2013). It has been considered eco-house as inexpensive buildings by using passive heating and cooling techniques that can save 70 to 90 % of traditional energy use. The cost of infrastructure can also be lower in ecological design than other methods (Irrgang, 2005). Moreover, self-building using earth materials was implemented in several projects as an example on low cost housing (Abodeeb, 2014). Whereas using certain technologies might cost more as an initial cost is maintenance costs are less (kamran, 2013). In addition to the above, it is important to highlight that houses takes the biggest share of family's expenses, over food, clothes and transportation (Kotkin, 2016). According to Fathy (1969), it has been noticed that the structural steel is uneconomic and infeasible to build with as long as third of the work's population is living below the money economy.

As for social benefits, eco houses have a huge impact on health and social harmony (ecoviewhomes, 2015). Environmentally, it obviously has a positive impact on the environment in terms of lower carbon footprint, water conservation and waste reduction (ecoviewhomes, 2015). Furthermore, it reduces the negative impact on the climate change, the threat of species extinction, the loss of agricultural land and soil erosion (IUSD Lab-Cairo, 2014).

From this reason, planners and architects are modifying the framework in cities and towns to become energy efficient, self-sufficient, less polluting and

more sustainable (IUSD Lab-Cairo, 2014). The tremendous impact that the eco house has on the environment is a strong drive to enhance the implementation of this system for all social levels worldwide. Eco house is considered as a way of building to achieve sustainability. However this is not the main reason why people build eco house. Thermal comfort is the main reason for people to build eco houses; for them, it is imperative that they adapt to the climate change that causes extreme changes in the weather. What drives people to do eco houses is the desire of human beings to live longer and stay healthy. Healthy homes have several features that include non-toxicity, thermal comfort, cheaper to keep warm or cool, more resilient to weather extremes and overall well-being that is encouraged by social, nature connection and aesthetic factors. The following table shows reasons why people care for having eco house (Day, 2016).

The previous sections highlight the definition and historical background of Eco Architecture and Eco houses from different literature reviews that reveal the importance of adopting Eco Architecture principles to achieve a better environment and well-being. It stresses on the importance of both technical and behavioral development that are considered as essential aspects for Eco Architecture understanding. The next part will focus more on the technical solutions and the behavioral dimension.

### **3.2 Theoretical framework on the study of eco architecture principles. Highlighting technical solutions and environmental behavior**

The following part focuses on the principles of Eco Architecture, highlighting its dimensions on technical solutions and the environmental behavior. To achieve this, different literature has been reviewed and concluded to come up with summarized framework of eco architecture principles, technical solutions and environmental behavior.

#### **3.2.1 Eco Architecture principles**

Certain things have to be highlighted in ecological design before we focus on the principles. First, what is unique about ecological design is that it does not only focus on “how to make things” but it focuses on “how to make things that fit gracefully over long periods of time in a particular ecological social and cultural context”. Secondly, Ecological design is seen as a means to make a community responsible. Thirdly, Politics and power play are an essential pillar in ecological design. Fourthly, it is not seen as “an individual art practiced by individual

designers as it is an ongoing negotiation between a community and the ecology of particular places” (Ibrahim, 2006).

McLaren (2009) has identified the main principles of eco design when it considers the following; (1) Appropriate location; to be connected with everyday facilities. (2) Building orientation for passive design. (3) Resource efficiency; taking into consideration energy saving. (4) Water wise; rainwater harvesting is advanced these days with different options for storage. (5) Small is beautiful; smaller buildings use less of everything. (6) Local; ‘Think global, act local’ remains valid. (7) Cyclic; toilet waste can be converted into compos (8) Adaptable; the best option is to renovate the building rather than replace it.

Looking at eco house perspectives, it is obvious that it has several aspects which are used as a guidance to eco houses. This guidance mainly considers the following main resources; energy, water, food and materials (Bassioni, El-Menchawy and Farouk, 2012). Eco houses looks at conserving these resources by implementing different methods and tools that will be explained in details:

#### **(a) Energy**

Eco houses must be energy sufficient; this is linked to space heating, hot water and electricity consumption (Pullen, 2016). There are several ways to achieve this; heating and cooling system can be implemented by establishing solar panels on the roof, storage batteries, and provide open access to sun’s rays. This method is usually implemented with other heating solutions such as window positions to allow sunlight in during the cooler months. Insulation is another factor in heating and cooling that is defined by walls and roofing materials especially when passive heating and cooling technics are taken into consideration. As for lighting; passive lighting is associated with the position of windows to catch as much daylight as possible during the day. Other alternatives that could be used include solar-powered LED lights, hydro LED lights, WIND-powered LED lights (Scott, 2017). As for electricity, solar photovoltaic (PV), solar power, wind power, or a hybrid of the two are valid options for electricity (Sheehan, 2015).

#### **(b) Material**

Building materials can be recycled, locally available, renewable, durable, and have negative carbon. One such example is Earthship whose main materials are scrap automobile tires, aluminum cans, and glass bottles encased in rammed earth. This method keeps the home warm in winter and cool in summer. Another

er example are cob homes that are made with soil and straw; it is not expensive yet fireproof and earthquake resistant and rammed earth (Sheehan, 2015).

Studies show that using natural materials has a positive impact on the house environment whilst non-natural materials that contain chemicals that can hurt the inhabitants (Pullen, 2016). It has been considered that rammed earth is considered as an affordable, energy efficient building, minimum carbon emission and has a low ecological footprint (Dabaieh and Sakr, 2014).

### **(c) Water**

The grey water can be used to irrigate the plants, which is rich in nitrogen (Sheehan, 2015). On the other hand black water can be used for outdoor irrigation for non-edible plants (Sheehan, 2015).

### **(d) Food**

Food production is another interesting aspect to consider in eco houses, as ecosystems keep its energy and reuses it. Ecosystems rely on this simple concept of “reduce, reuse, and recycle” such that there would be no waste making planting a good example for this. It can be implemented by composing the food waste and using it to grown plants and using solar energy to produce food thus making the loop closed (Wenz, 2007). In order for a house to be considered as an eco-house, it has to adhere to the aforementioned aspects as much as possible.

Getting back to the previous literature reviews the author has developed a diagram that shows the main resources; Eco Architecture principles that shows the relation with the Eco System that are followed by examples of technical solutions. The diagram consists of four parts; the first part (A) highlights the basic resources that the building needs. The second part (B) reflects the function of the resources. The third part (C) reflects Eco Architecture principles as a summary from the previous literature reviews. These principles are reducing waste, preserving nature, passively and actively harnessing renewable energy and the attitude of human being in dealing with building within nature. The fourth part (D) reflects the concept of mimicking the Eco System as it was mentioned previously in the literature reviews. The fifth part (E) represents the solutions that are used to meet Eco Architecture principles along with the Eco system. The sixth part (F) represents examples of detailed solutions that meet Eco Architecture principles, see fig (4).

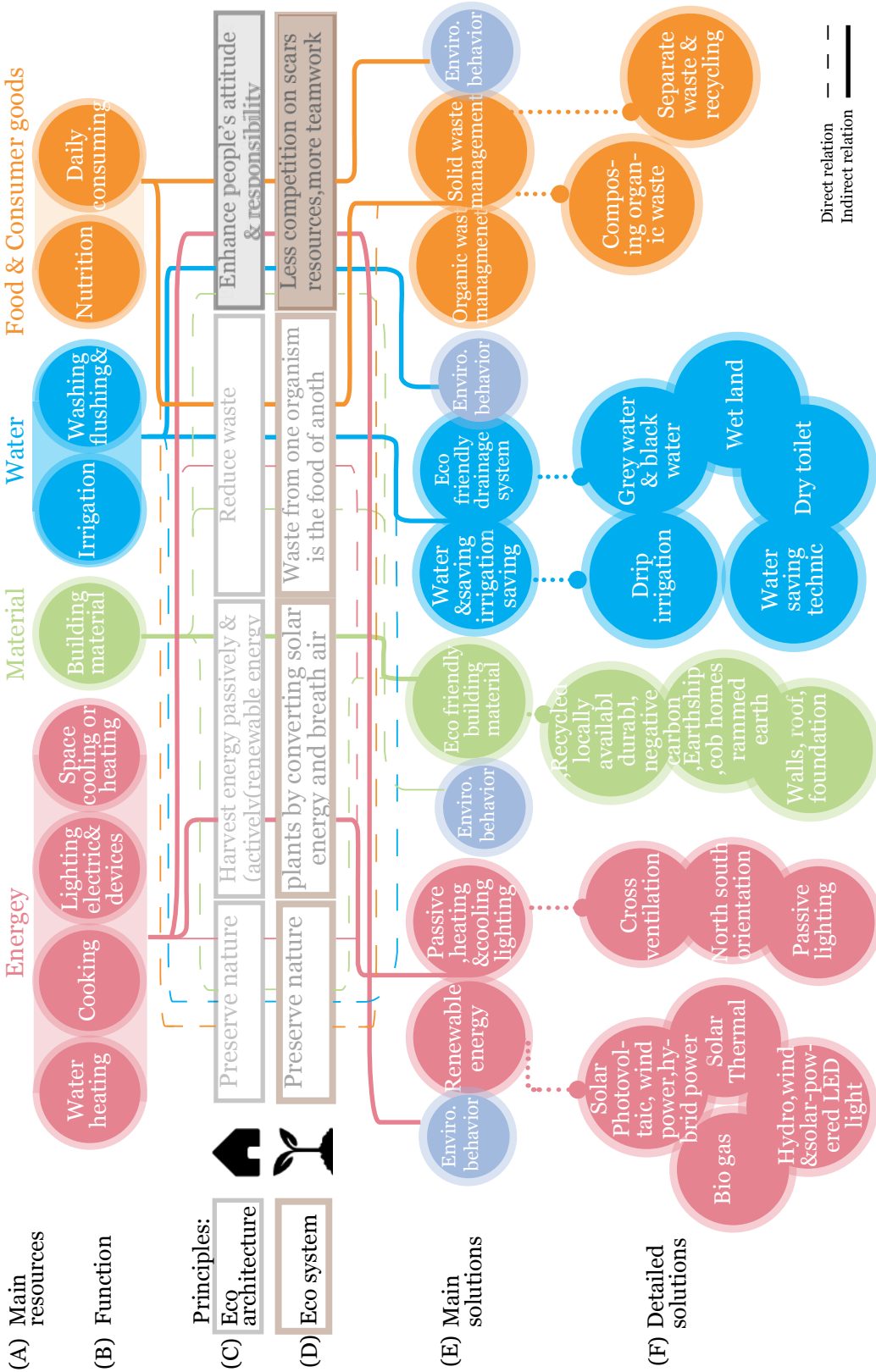


fig (4)Diagram summarizing Eco Architecture principles with a relation to the Eco System and how they are perceived as filters or guidance to select technical solutions and behaviors to save the Eco System. Source: Author, based on Brebbia et al., 2006, Hernández, 2010, Ibrahim, 2006, McLaren 2009, Pullen, 2016, Scott, 2017, Sheehan, 2015, Wenz, 2007, and El-Menchawy and Farouk, 2012



Focusing on the first objective, it has been noticed that despite behavioral aspects were mentioned repetitively in the literature reviews of Eco Architecture, yet the focus was delved more into technical dimension and less on behavioral dimension. For this reason, the research conducted a further research on environmental behavior to gain a deeper understanding of this aspect that can be applied practically. A study done by White and Habib (2018) highlights certain tools that guide the process of encouraging people to adopt environmental behavior in their community. For this reason, the next section will focus on environmental behavior in a detailed manner that can be implemented in projects with similar aims.

### **3.2.2 Environmental behavior**

*As stated by Brown ‘Human actions can and do shape the global climate’ (Brown, 2014).*

The consumption of goods and services by people is one of the main causes of greenhouse gases emission (Brown, 2014). It is important to highlight the importance of individual efforts on reducing the catastrophic impacts of buildings on the environment. The challenge the environment is facing is huge but if each person solves a small problem then the larger problem will disappear (Roaf, 2013). As Randal (2017) mentioned, the main challenge of environmental problem was the loss of biodiversity, the collapse of eco system and climate change. He however opined that the major environmental problems are selfishness, greed, and indifference. He believes that in order to deal with this, cultural transformation must take place. As stated by Damaskou (2016). ‘A switch to the Best Available Technology and Best Practice behaviour (BAT/BP) can lead to a 48% reduction in the consumption of electricity’.

It is obvious that behavioral research is getting more and more dominant since it reveals the huge influence on the ecology. Changing behavior can contribute in the decision making of several aspects such as using products that are more efficient, changing the “throw away” mentality (White and Habib, 2018). It is essential to highlight that although values, attitudes, believes and intentions hugely shape our behavior, it will be meaningless if it is not followed by actions (Brown, 2014). As stated by Wallace (2017) ‘Most people express approval of sustainable behaviors but still behave in unsustainable ways’. People tend to



disconnect with long-term benefits that results from taking sustainable actions and they refer to the benefit that it is happening now, that is why most of the people do not tend to spend money on energy efficiency even if they will save money in the long term (Wallace, 2017).

Although changing behavior is an essential approach to consider to save the earth, it is challenging because of the complexity of the psychological and sociological dimensions that are associated with changing behavior (Wallace, 2017). In order to encourage people to follow responsible environmental behavior, a set of principles are recommended to follow that are taken from a study done by White and Habib (2018) based on behavioral science studies. The main principles are reflected in the abbreviation SHIFT that is based on considering the main aspects that contribute in changing or maintaining sustainable behavior, that is, Social influence, Habit formation, Individual self, Feelings and cognition, and Tangibility (White and Habib, 2018). The following are they key factors of environmental behavior that includes the main tools that helps in encouraging environmental behavior in people:

#### **(a)Social influence**

Social influence is a powerful aspect on encouraging sustainable behavior, if one behavior is socially approved then it is more likely to be implemented. There are three tools by which social influence is achieved, social norms, social desirability and social group memberships (White and Habib, 2018). For this reason, the author concluded that in order for values, emotions and knowledge tools work, it has to be supported with social surroundings and eco-friendly built environment (Wallace, 2017). The following tools guide to achieve social influence in the community:

**Social norm:** It reflects what is common and socially appropriate in certain situation. For example, individuals are more likely to put solar panels if their neighbors have (White and Habib, 2018).

**Social desirability:** It means that individuals are most of the time moved when they reveal positive image to others. Individuals make sure they only exude positive image to others in public hoping that the others might appreciate their actions. Studies reveal that individuals are more likely to commit to an action if it was in public (White and Habib, 2018).

**Social group memberships:** Studies reveal that individuals tend to belong

to certain social group in order to have positive social image. People will be willing to follow behaviors that are in the group to feel that they fit in (White and Habib, 2018).

### **(b)Habit formation**

This section refers to motivating people to stop bad habits and adapt positive habits. A habit is usually formed by time by doing continuous action in specific context eventually becoming an automatic norm. Examples of these habits are turning off the light after leaving the room. The main key to adopt a habit is repetition and simplicity as stated by White and Habib (2018) where they opined that ‘Behavior that requires high levels of processing power such as complex analysis is unlikely to become a habit’. The following tools show how you can shape a habit by focusing on two major approaches; breaking bad habits and fostering good habits.

#### **Break bad habits:**

**Penalties:** In order to break certain habits, it is essential to impose punishment in order to discourage bad behavior. It can be fines, taxes or tariffs on unsustainable behavior. The challenge that is associated with breaking bad habits with penalties is that once the penalty is over people may easily go back to bad habits. As penalties might sometimes lead to negative results and defensive reaction, it is preferred to focus on fostering good habit (White and Habib, 2018). The only way to preserve the environment is to sue any firm or individual that hurts it (Brebba, 2006). In this respect, design transformation has to reconsider human intentions supported by political and economic bodies that transform intentions into actions (ORR, 2001).

#### **Foster good habits:**

**Making it easy:** If the action is easy then the chances that might become a habit increase. These actions can be such as providing low flow shower heads and sorting waste for recycling. Another idea is to make the product easy to access and visible to people (White and Habib, 2018).

**Prompts:** Cost-effective and easy tool to encourage people to adopt positive habit. Studies show that by placing clear sign above recycling bins and details of which items to be sorted in which bin increase the percentage of recycling from

15% to 54% (White and Habib, 2018).

**Incentives:** It includes rewards, discounts and gifts. It can be monetary incentives. Although there are benefits of incentive, it might be challenging as people tend to stop once the incentive is gone. It is important to make sure that the incentive is substantial as studies show that monetary incentives are not always effective. Therefore it is important to think of sustainable incentives (White and Habib, 2018).

**Feedback:** It means providing information about individual's performance or behavior. Studies shown its positive impact on performance and reaching goals (White and Habib, 2018).

### **(c)Individual self:**

It is essential to take into consideration individual self in encouraging people towards sustainable behavior. It includes several tools such as; personal norms, self-consistency, self-interests, self-efficacy and individual differences:

**Self-consistency:** Being consistent goes along with how individuals like to see themselves positively. Accordingly, Self-consistency is connected with encouraging sustainable behavior (White and Habib, 2018).

**Self-interest:** It is considered as essential aspect of encouraging sustainable behavior. It is related to self-benefit and can be achieved by tackling the barriers to the self-such as price, performance risks, aesthetic limitations or greenness of the product. Working on these barriers helps in increasing self-interest that contributes in sustainable behavior (White and Habib, 2018).

**Self-efficacy:** Making individuals aware about the impact of actions in making a difference will encourage sustainable behavior (White and Habib, 2018).

**Individual differences:** The recognition of the various individual differences. As it was mentioned before those who are pro-environmental and pro-social personality are more likely to be active in sustainable behavior. As for demographic differences, females tend to engage in environmental behavior (White and Habib, 2018).

### **(d)Feelings and Cognition:**

It is important to take into consideration feelings and cognitions that influence individuals to stick with sustainable behaviors (White and Habib, 2018).

### **Feelings:**

Guilt and pride are the main emotions that have been studied in relation with pro-environmental behavior. Guilt and pride share common concept as both reflect how seeing the self as being responsible for things. In fact, when people feel guilty about their reactions they are more likely to implement sustainable behavior. Moreover, it is important to promote a product or behavior through ethical attributes because sometimes clear guilt can back fire (White and Habib, 2018).

Adding to guilt and pride, fear and sadness effect individual's response towards the environment. These feelings can be provoked by showing the negative impact of our behavior on the plant. Hope is also related but has the least attention. Hope is connected by considering the future. This feeling is provoked by increasing climate activism and pro-environmental campaign. Provoking feelings in general will motivate people to adopt positive environmental habit (White and Habib, 2018). For example: Volkswagen Fun Theory Campaign believes that changing people's habit is easy once we make it fun (Abricot, 2017). To make it short, the solutions to environmental problems has to be designed in a way that touches a deep emotional level (ORR, 2001).

### **Cognition:**

It has been realized that lack of knowledge explains lack of adopting sustainable behaviors. One example can be informational labels that are informative and easy to understand. The most effective information that influenced decisions for individuals is to highlight the cost savings as an example. This is effective for people who have already positive attitudes for the environment. Information alone does not lead to sustainable and effective change. Information has to be studied carefully and has to be combined with other tools for effective change (White and Habib, 2018).

### **(e)Tangibility:**

As the consequence of sustainable actions are not realized quickly, it makes it harder for people to understand the need for adopting such behavior. For this reason, it is important to make ecological problems and solutions clear and tangible (White and Habib, 2018). It is important to implement examples of eco houses that can be preserved as a model to be duplicated. According to Vale and Vale (1975) as cited by Murphy (2012) 'Something that can be seen and touched and shown to work to some degree arouses curiosity, and curiosity in turn leads

to solutions' (p.94). As Wallace (2017) believes that engaging nature with the built environment is as essential way to consider that helps to create closer connection between human and nature that encourages the appreciation of nature, he adds that people protect and appreciate what they know.

**Future benefits:** It is essential to keep reminding people about the future benefit of implementing eco architecture solutions or adopting environmental behavior (White and Habib, 2018).

**Local impacts:** It is important to highlight the outcomes of sustainable behavior focusing on local and immediate impacts. Immediate impact can be reflected on the extreme weather events (White and Habib, 2018).

**Concrete communications:** It is important to make environmental problems and solutions more concrete, tangible and present (White and Habib, 2018).

This section has revealed the fact that despite changing behavior encounters several challenges, it is applicable if it is associated with structural plan and tools that are associated with continuous follow up since changing a habit needs a lot of effort and time. According to the literature reviews, social influence, habit formation, individual self, feelings and cognition and tangibility have been revealed as key factors of environmental behavior for encouraging environmental behavior changes. The following diagram conclude all the keys and the tools that were mentioned before, see fig (5).

### **3.3 Conclusion. Eco Architecture principles, technical solutions & environmental behavior**

To conclude, there are several perspectives and definitions to the meaning of Eco Architecture. However, as it has been observed previously, the common understanding for Eco Architecture and its principles are concluded under four main principles that include; preserving the nature, harvesting energy passively and actively, reducing waste and enhancing people's attitude and behavior toward the environment. As Eco Architecture has strong relation to the Eco System and focuses on how to design in harmony with nature, these principles are seen in the lifecycle of certain species in the Eco System and it is reflected and mimicked in the building to be considered as an essential element within

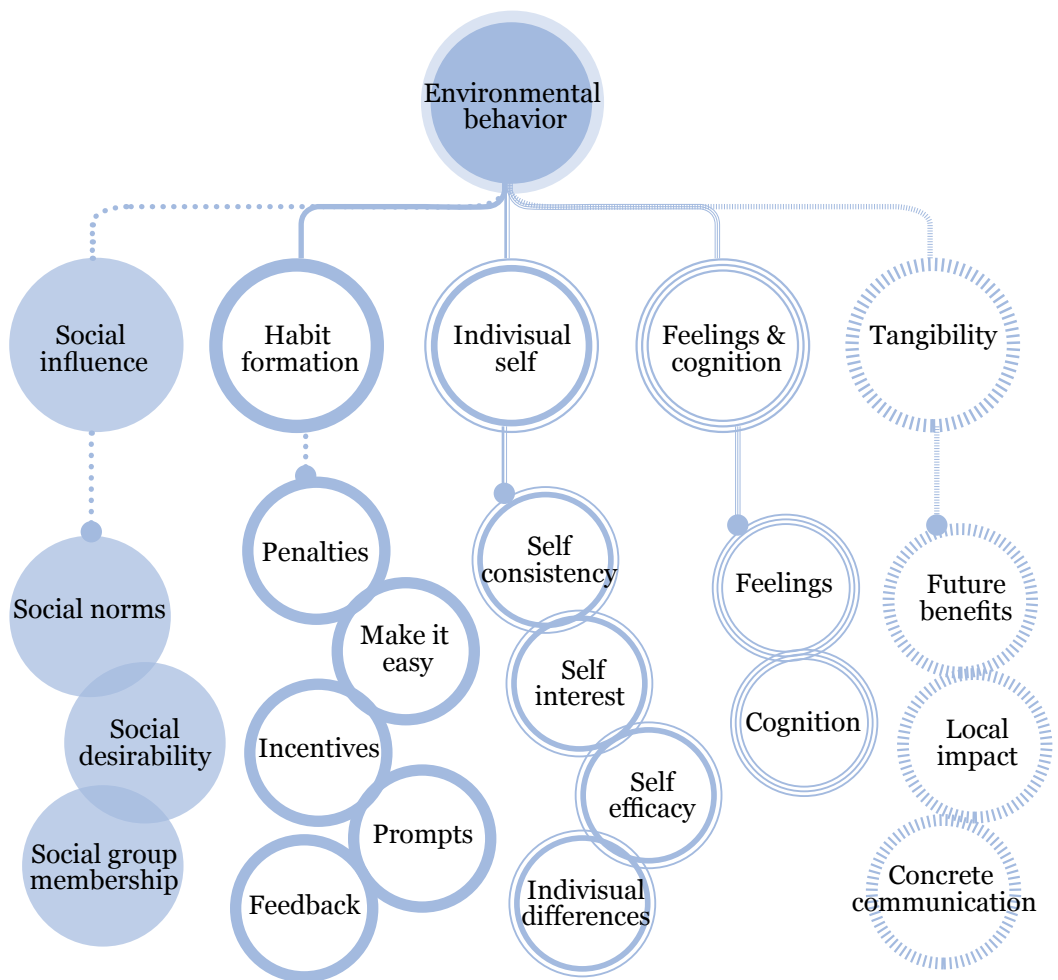


fig (5) Diagram showing key factors of environmental behavior and environmental behavior tools. Source: Author, based on White and Habib, 2018.

the Eco System. The reflection between Eco Architecture principles and the Eco System is perceived by the author as a filter that penetrates technical solutions and human behaviors. There are several technical solutions that meet the aim of the mentioned principles and it varies from high tech to low tech approaches.

As one of the repetitive aspects that was mentioned before, it is the importance of people's attitudes and mindset in preserving the nature. Nevertheless this was not highlighted widely in details in the literature of Eco Architecture. For this reason, further research has been conducted to look deeper into this aspect. As mentioned previously, the behavioral tools that are adopted in this research mainly depend on a research done by White and Habib (2018) and supported by other literature reviews that conclude the importance of adopting the follow-

ing key factors in order to encourage environmental behavior in a community; social influence, habit formation, individual self, feelings and cognition and tangibility.

The combination of technical details and behavioral tools are summarized in the following diagram, see fig (6) that represents a holistic approach which can be referred to while constructing or designing Eco-friendly structure that emphasis on the behavioral aspect as much as the technical aspects to create a space that represents human being and the physical structure as one united body that works in harmony between each other and the environment to create not only a healthy atmosphere but also a reliable community. Taking the research into the next level, the next part will go through practical examples for Eco Architecture solutions in Siwa oasis, focusing on using natural materials from the past and the present, low-tech and high tech solutions.

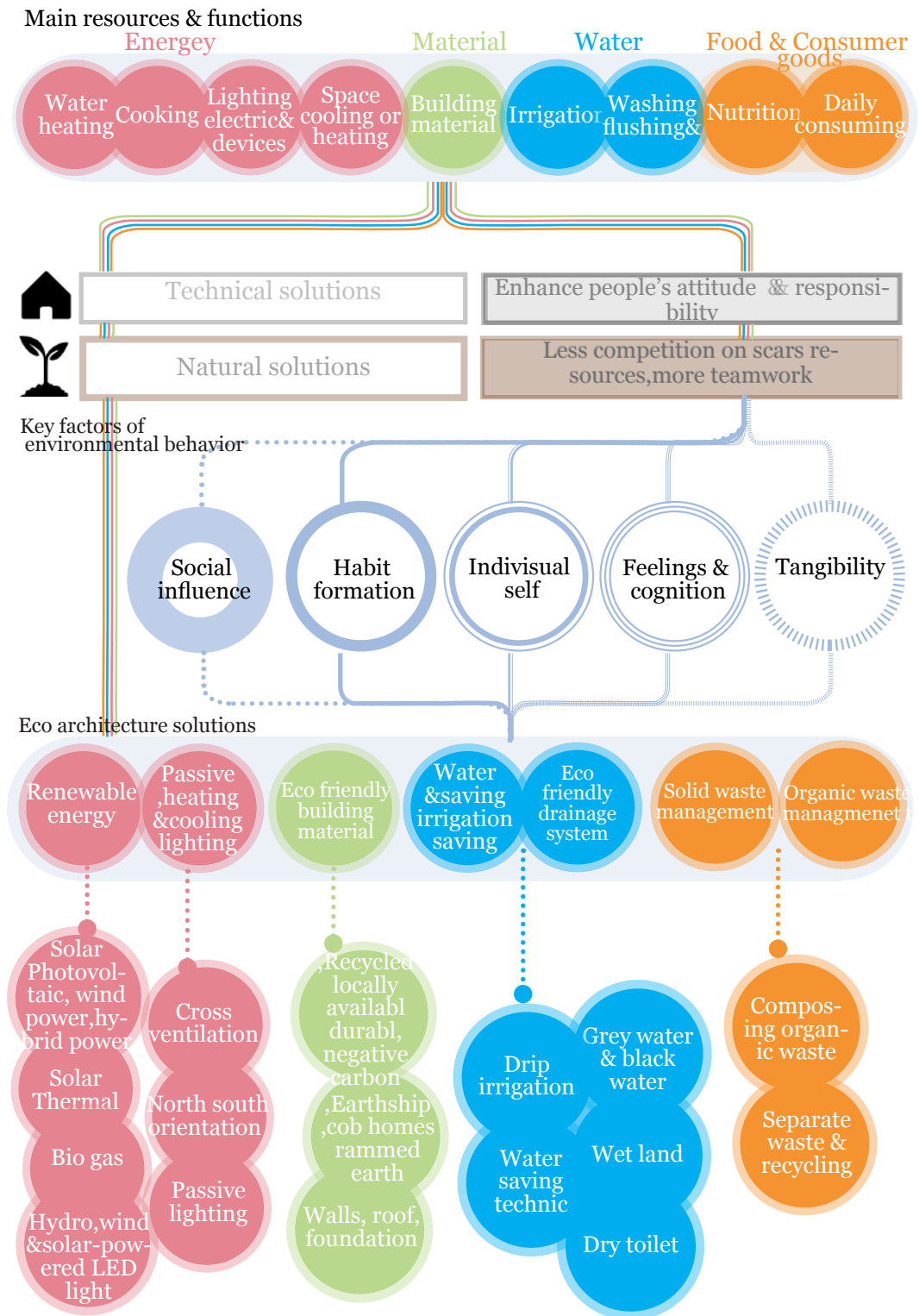


fig (6) Diagram combining both Eco Architecture principles and Environmental behavior key factors. Source: Author, based on Brebbia et al., 2006, Hernández, 2010, Ibrahim, 2006, McLaren 2009, Pullen, 2016, Scott, 2017, Sheehan, 2015, Wenz, 2007, El-Menchawy and Farouk, 2012 and White and Habib, 2018.



# Chapter 4: New Eco Architecture solutions and the barrier of implementation in El Gari village.Siwa

‘Build your architecture from what is beneath your feet’ (Fathy, no date).2010).

Egypt is considered as one of the countries that have rich Eco Systems and 30 natural protectorates that covers 15% of the total area of Egypt (Halawa, 2016). In the distant past, peasants in Egypt have been using the existing materials on earth as a main material to build their shelter (Fathy, 2000). The sections in this chapter will highlight the following; provide general historical overview and introduction about Siwa-El Gari village, highlight natural resources management in Siwa-El Gari village, focus on understanding new Eco Architecture solutions that are implemented in two Eco Lodges nearby El Gari, then followed by identifying the main barriers associated with Eco Architecture solutions in the local community and finally, it highlights the importance of the collaboration of different stakeholders and influencers to take the theoretical part into action.

## **4.1 Siwa background and historical overview – El Gari village**

This section will highlight geographical and historical overview of Siwa with the focus on the natural resources in the oasis and how it is managed in Siwa as a meso scale and El Gari village as a micro scale.

### **4.1.1 Geographical background**

Nature and environment has shaped species long time ago, it is only recent couple of hundred years when the species are shaping the environment that has negative impact on the ecosystem and on human beings (TEDx Talks, 2015a). Siwa is an example of how environment shaped the human being long time ago and how now humans are shaping the environment which results in a lot of deterioration of the environment and natural resources. Siwa is located only 50km from the Libyan borders and 300km from the Mediterranean Sea (Petrucchioli and Montalbano, 2011). It is in Egypt's remote western desert, with total area of 1088kilo meters (Ahmed, 2014). Western desert is part of Saharan desert and it is considered as the largest desert in the world that covers 5000km from east to west and 2000km north to south. The trade routes that have been created crossing Sahara in both direction emerged the need of a chain of settlements that are situated along the trade routes that offer protection and stopover for the caravans (Elsayed, 2016).

Siwa oasis is in a depression with the length of 75-80 km and width of 5-10 km, 18 meters below. It is well known for its rich landscape of olive, palm trees, several natural springs and salt lakes (Halawa, 2016). See fig (7).



fig (7) Image showing Siwa geographical location in Egypt. Source: Halawa,2016.

#### 4.1.2 Historical background

The first settlement of Siwa was in Aghurmi, that is situated east of the oasis. In 1203 A.D, some of the inhabitants of Aghurmi moved to build the new town Shali that is 2.5 kilometers west of Aghurmi settlement. Shali in Siwan language means “The Twon”. It was built on mountain called Siwa and it was built on the typology of a Berber Saharan Ksar as well. This type of construction was built on high levels for defense and for the optimum use of the fertile surface for cultivation. The typological feature of Ksar is high thick walls with small openings, usually the city would have just one entrance as the case of Aghurmi on the other hand Shali has three entrances. As the Siwan population grew and the need of more cultivated lands increased, removing the salty layer of the land was the main component of building material that is called Karsheef. This was an example represents agricultural development with urban expansion (Elsayed, 2016).

In 1926, the oasis experienced a heavy rain that lasted for three days along with an earthquake that forced the inhabitants to move from the fortified city and expand on the flat surroundings. In the thirties Shali was evacuated by the Egyptian authorities which increases the horizontal expansion of the city. This was followed by the construction of new mosque and police station that was authorized by the Egyptian king back then. This was followed by constructing the road between Siwa and Marsa Matruh. This phase is considered as a transitional point of urbanism in Siwa. It represents a mixture between imitation of the old and desire towards the new (Elsayed, 2016).

During the sixties and the seventies, a huge transformation occurred in the urban development in the oasis under the impact of political, economic and demographic changes. The forces of such transformation can be summarized in the following points; the provision of several services and infrastructure, establishment of public housing that was designed by the Ministry of Housing Development, the provision of public services that includes schools, mosques and health facilities, adding to this the change in labor market that results in arrival of foreign cheap labor to work in oasis’s plantations. This brought new urban pattern into the oasis that is shaped by the favoring of the painted concrete and fire bricks over the Karsheef houses (Elsayed, 2016).

As for social structure, the oasis contains eleven traditional tribes with a popu-

lation of 20,000 (Ahmed, 2014). Siwan people have their own traditional culture, customs and language. They speak Arabic and Amazigh language (Brebba, 2013). Siwa has strong tribal system that defines its cultural, political and social identity. The sheikhs of the tribes play an important role in the community (Khairy, Ragheb and Hendawy, 2016).

As for planning and institutional hierarchy, Siwa is considered as section of Matruh Governorate. Siwa consists of the city center and five villages. The villages are located in the eastern part and western part of Siwa, El Zeitoun and Abou Shrouf villages located in the eastern part of Siwa, while El Maraqui and Bahy El Din villages located Western eastern part of Siwa (Halawa, 2016).

El Gari village, is considered one of the villages that is located in El Maraqui area. It is located on the western part of the oasis and it was once separated from the oasis but now it is not. It was established by Bedouin where most of Siwan crafts are founded in this area. It was built by Karsheef but the heavy rain that was on 1982 has destroyed a lot of homes and since then people start to build with new bricks (Vivian, 2008). As stated by one of the local inhabitants that El Gari is located around 23 km far from the city center of Siwa, it is at the entrance of El Maraqui village (Díaz, 2013).

#### **4.1.3 Natural resources management in Siwa and El Gari village**

This section will highlight the use of natural resources in Siwa and El Gari village to give an overall understanding of the context of the area. Each resource covers insights about past practices, current practices, challenges. The structure of this section follows the main structure that was highlighted in figure (4) in Chapter Three, referring to line (A).

##### **(a)Energy**

Solar radiance in Siwa ranges between 86% in winter and 99% in summer. For this reason, Siwa is one of the greatest potential places to use solar energy. A study based on the The General Administration for Urban Planning shows that solar energy in Egypt can save 3.5 billion kw/h and save 2.2 million tons of fuel (Tawfik and Tolba, 2014). The climate in Siwa is extremely arid from April to November, very low rainfall from December to March with an average of 9.6mm per year. High evaporation rates from 17mm per day in July to 5.2mm per day in December. The temperature in summer is high that reaches maxi-

mum 37.7c in July and August. The climate in May, October and November is quote the same with a temperature average of 35 c and humidity of 64% (Masoud and Koike, 2006). This indicates the high potential of using solar energy for electricity. **Past practices:** The main source of light during the day is from small windows that have four wooden slits. The stair case tower was considered as lighting source where mirrors are located on walls to reflect the light from the sun inside the house (Ahmed, 2014). As for night light, according to one of the locals, Siwan used to depend on gas light. **Current practices and challenges:** Siwa is connected to the electricity grid of Egypt. It uses around 4-4.5 megawatt yearly. There is a future plan that Siwa will be the first city in Egypt that depends completely on PV cells power plant (IUSD Lab-Cairo, 2014). **El Gari situation:** Services in El Gari is the same as the city center of Siwa as mentioned above.

### **(b)Building material**

It has a huge system of salty lakes that is used as a raw material for the traditional construction of the oasis, that is called Karsheef (Petrucchioli and Montalbano, 2011). **Past practices:** The traditional urban example in Siwa that is built by Karsheef material, clustered in a dense shape, creating narrow and shady roads, that represents an excellent example of adaptation to the climate and the usage of local materials (Petrucchioli and Montalbano, 2011). It can be represented as a local knowledge that was built up through time and it is considered as 'Architecture without architect', 'hand-made' and 'low-tech'. As for the walls; the structure follows bearing wall system which Karsheef is the main material, the flexibility that the material provides in construction allows organic structures to be formed. The thickness of the wall might reach 1m that plays a huge role in controlling the temperature indoor and the balance in temperature. Dry palm tree wood is used as floor beams while dry palm tree leaves are spread as a second layer over the palm tree wood logs. Mud is used to cover the floor and roofs as finishing layers and is used for rendering walls. The span for inner spaces are between 3 to 3,5 meters restricted by the length of palm log. Now a day inhabitants perceive Karsheef as old-fashioned material for their houses (Elsayed, 2016). **Current practices and challenges:** Unfortunately, this type of construction is not common for Siwan people any more. As stated by Petrucchioli and Montalbano 'Now everything is dying out' (2011). Using conventional materials in buildings (reinforced concrete, or gypsum blocks) is the common way of building for locals now. The structure consists of multi-story concrete

structure with the maximum height of four stories with balconies that are typically repeated along the main elevation. Some of these buildings overlooking the street have shops on the ground floor (Elsayed, 2016). This type of building is aggressive for the environment, it weakens the link between place and history, environment and local resources, shape and structure. This leads to huge waste of energy that leads to collapse of the whole environmental system (Petrucchioli and Montalbano, 2011). **El Gari situation:** According to one of the inhabitant, El Gari consists of 136 houses that differs from each other by using different technics and material. As a result of observation and some interviews with residents, it has been realized that there are different typologies in the village. For example, there are six houses that have one or two rooms which are built with Karsheef beside the main house that is built with conventional materials as they use these rooms during severe weather. Another seventeen houses are built totally with Karsheef. There are four abandoned houses in the area that are built with Karsheef as well. The rest are built completely with conventional materials, see fig (8). Local inhabitants who build new rooms with Karsheef are aware of the difference in air quality between a room that is built by Karsheef and by conventional material, yet they avoid having a house build with Karsheef since it is not appealing anymore in the community and it is associated by poor community level.

### (c)Water

Siwa is formed from the natural land depres-



fig (8) Elevation of one side of one street in El Gari village. Source: Author.



sions which have high water table level. The abundance of water resources opens the chance for farming to be considered as main activity (Khairy, Ragheb and Hendawy, 2016). It has more than 300 fresh water streams and springs (Ahmed, 2014). Extra water resources formed several lakes in the oasis by time, which increased in size and salinity as a result of urban and agricultural growth (Khairy, Ragheb and Hendawy, 2016).

Hopes are focused on Siwa that shows potential possibilities in terms of expansion of cultivated land (Abdel□Shafy, El□Gamal and Abdel□Hamid, 1992). The two-main ground-water exist in a depth of 2km below the ground surface and 2m. The springs in Siwa create a network of oases named as the following from west to east; Maraqui, Siwa, Zaitun, and Massir, of which Siwa is the largest and most urbanized (Masoud and Koike, 2006). As stated by Al Domiaty during the interview, Siwa is well known by water richness and the availability of underground water it has natural pressure it does not need any pumping technics to be delivered to the surface, the main challenge is how to drain the extra water. Several industries get water from deep water and they bottle it for drinking water. According to Hegazi, the key term in solving Siwa environment problem highly depends on water management and urban zoning and distribution (Kenawy and Hegazi, 2017).

### **Water source**

**Past practices:** As past practices, Siwan people used to depend on springs as a main source of water. Men used to go to springs to bath. As for women, most of the time they take bath in their homes and they use little water on their body. On the other hand, they would seldom join their husband to wash their clothes in the spring and would take bath. Each house used to have a small sack to store water in the house for the daily use (Elsayed, 2016). **Current practices and challenges:** The main supply of municipal network for water is from the Dakrour well and it supplies the following areas; El Barein, El Maraqui and AbouShrouf. As mentioned before, the uncontrolled use of water is causing increasing of table water that leads to high level of salinity in the ground water. Digging wells without regulations is another challenge that the oasis is faces. As stated by Günsbauer (2015) there are regulations for digging wells yet it is not being implemented. Digging wells is fostered by paying 17-20 LE per month. It is clear that there is a gap between the regulations and the local activities, it is obvious that the regulations is not clear for the community. For this reason, it

is essential to bridge the gap between community and authorities and improve communication (Gänsbauer, 2015). **El Gari situation:** The source of water is from municipal water network. No wells are in the village. The residents claim that they don't face any challenges from getting water, Siwa has a lot of water. According to one of the residents in El Gari, installing water network was a collaboration from the government and from the families in the village. Pipes and materials were provided to the families, work was organized and implemented by the citizens.

### **Drainage system**

**Past practices:** As stated by one of El Gari residents, they used to put ashes to clean the toilet holes which eliminate the need for flushing water and avoid unpleasant odor. **Current practices and challenges:** There is no sewage network in Siwa, septic pit is the main way to get rid of waste water (Tawfik and Tolba, 2014). Wastewater is collected and is disposed without treatment outside the town. The waste water sinks through the ground where it mixes with underground water (Gänsbauer, 2015). Around 90000 m<sup>3</sup> and 165000 m<sup>3</sup> of drained water are annually added to the ground water table (Kenawy and Hegazi, 2017). Siwa has a problem in the sewage system, previously people used to drain all the sewage in the agricultural canals. In 2010, a project by Talaat Mostafa Company started a project that aims to connect whole Siwa to a sewage network, yet this project was not completed. Now Siwa has sewage infrastructure but it is not working. The municipality took a step in solving sewage problem by differentiating between agricultural drainage and the domestic sewage. As a result, people decided to make septic pits, yet it is not the best solution for the sewage especially that ground water is the main water resource in Siwa and it might be effected in the long run (IUSD Lab-Cairo, 2014). **El Gari situation:** According to one of the residence in El Gari Village, he said that the village depends on septic pits and they face huge problem regarding the sewage system, the septic pit needed to be emptied every month but most of the time the government doesn't come on time, which causes problems in the drainage.

### **Irrigation**

**Past practices:** Local people use flood irrigation system. For them it is the easiest way of irrigation that doesn't need a lot of effort. The basin irrigation system is the only irrigation method used in Siwa Oasis old farms. The irrigation basins are relatively small (4 × 4 or 5 × 5 m<sup>2</sup>) (Aly, 2014). **Current prac-**



**tices and challenges:** The majority of local inhabitant are still using flood irrigation but external investors use drip irrigation. Agriculture is one of the main industries in Siwa, it is well known by the production of dates and olives (Vivian, 2008). As stated by Fahmy (2017) that 700,000 palms tree are planted in Siwa that produce 84,000 tons of dates and 27,500 tons of olive each year. They also have some kind of vegetables like spinach, tomatoes, pumpkins and mint yet they get more vegetables and legumes from Mersa Matruh (Vivian, 2008). As stated by the owner of the locals, there are several farms in Siwa, owned by external investors, they use drip irrigation system and plant variety of vegetables and fruits but they export it outside Siwa. Using flood irrigation causes salinity of soil that effects agriculture by damaging the roots (El-Saied et al., 2017). **El Gari situation:** According to one of El Gari residents, no one in El Gari from the local community is using drip irrigation technic. All of them are following the old way of irrigation that is flooding. They claim that it is easier and they are used to it and drip irrigation is expensive for them.

#### **(d)Organic and solid waste management**

**Past practices:** Al Domiaty stated during the interview that the waste in Siwa was limited long time ago and all the organic waste was dumped in farms. **Current practices and challenges:** Siwa lacks an effective solid waste management, the garbage that is collected in Siwa is disposed in a landfill and are burnt (Tawfik and Tolba, 2014). **El Gari situation:** According to the one of the residence, people in El Gari village collect their garbage in any empty land near by their houses and they burn it.

Despite the fact that Siwa is rich in natural resources which enable the area to be self-sufficient yet it is obvious that natural resources are not used in a responsible manner that guaranteed the protection of the Eco System. It was obvious that past practices in Siwa respected natural resources more than current practices. Despite the shortage of Eco Architecture solutions in El Gari village yet there are some examples of new Eco Architecture solutions that are implemented in three Eco Lodges that are adjacent to the village. The following section will shed a light on the three Eco lodges, Adrere Amellal, Taziry and Talist, and will further focus on new Eco Architecture solutions that are executed in both Adrere Amellal and Talist Eco lodge. The chapter will be followed by highlighting the barriers that are preventing local community in El Gari village from applying them. The chapter will end with highlighting influencer s and

stakeholders that has the potential to move the theoretical approach into action through encouraging sharing knowledge and experiences with different bodies from inside and outside Siwa. The following map highlight the location of El Gari village and the three Eco Lodges in Siwa, see fig (9).

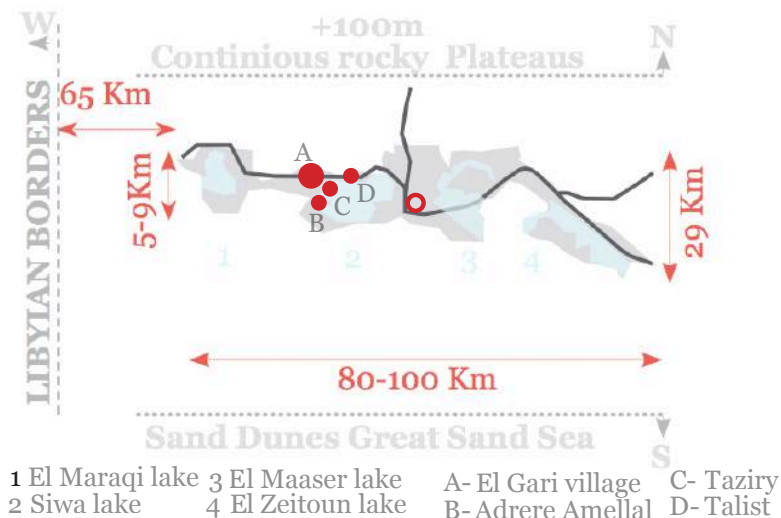


fig (9) Diagram showing the location of El Gari village and the three Eco Lodges in Siwa.  
Source: Halawa,2016 with small changes by the author.

## 4.2 New eco architecture solutions in Adrere Amellal and Talist Eco lodge

This section will focus on understanding new Eco Architecture technics that have been brought by external investors, Adrere, Taziry and Talist Eco Lodges, which encounter some of the challenges that are associated with the traditional building approaches in Siwa, such as the challenges that are related to building with Karsheef material. This chapter will first introduce the three Eco lodges shortly, followed by detailed understanding of Eco Architecture solutions that are implemented in Adrere and Talist. It will then highlight the barriers that are associated with the application of Eco Architecture solutions in El Gari village. The structure of the last two parts will follow the main flow that was highlighted in the fig (4) in Chapter Three, referring to line (A) & (F). The data that is mentioned in this chapter is a result of different interviews with the local inhabitants, architects and owners.

### 4.2.1 General overview Adrere, Taziry and Talist Eco lodges

Although there are three Eco Lodges, Adrere Amellal, Talist and Taziry, that are

close to El Gari village, yet the research will focus on Adrere Amellal and Talist for data accessibility reason.

### **Adrere Amellal**

Azmy and Farid stated during the interview that Adrere Amellal was built on Siwa Lake by the White Mountain. It consists of 42 rooms. Water: the Eco lodge depends on underground water to cover the hotel needs. Sewage is treated by wetland. Energy: the water is heated depending on the gas provided by the government. The Eco lodge is illuminated by torches and beeswax candles. Natural building material: as for building material, the eco lodge was built using natural material, using the same methods that it was used in the typical Siwan houses for the roof and walls. Garden: It has an organic farm that covers the need of the Eco lodge. Solid waste: there is no recycling system for the inorganic waste.

### **Taziry**

Taziry was built at the footstep of Red Mountain facing the White Mountain. It consists of 30 rooms. Water: the Eco lodge depends on underground water to cover the hotel needs. Sewage is treated by wetland. Energy: heating water depends on solar water heating panels and photovoltaic cells are used to serve the kitchen and reception to minimize the use of fossil fuel resources. Natural material: as for building material, the eco lodge was built using natural material, using the same methods that it was used in the typical Siwan houses for the roof and walls. Garden: It has an organic farm that covers the need of the Eco lodge. Solid waste: solid waste management is taking into consideration; the organic waste is used as compost and inorganic waste is segregated and sent for recycling (Taziry, 2018).

### **Talist**

Al Domiaty stated during the interview that Talist is located 10 km away from El Gari village. It consists of 10 rooms. Water: the Eco lodge depends on underground water to cover the hotel needs. Sewage: is treated by septic pit. Energy: the water is heated depending on the gas provided by the government. Photovoltaic cells are used to illuminate the rooms and kitchen facilities. Natural material: as for building material, the eco lodge was built using natural material with integration of conventional materials that helps to overcome certain challenges that are associated with building with Karsheef.

### 4.2.2 Study of new Eco architecture solutions in Adrere and Talist Eco lodge.

#### (a)Energy

##### **Solar thermal, photovoltaic and biogas**

**Brief explanation and challenges:** The two main technics that are used as a renewable energy in the eco lodges are Photovoltaic system, implemented in Talist & Taziry, and Solar thermal panels, implemented in Taziry. Another technic that is used is in Adrere's farm is the bio gas. One challenge is associated with Solar thermal panels as stated by as stated by Al Domiaty during one of the interviews, the smallest capacity that is available in the market feeds more than one bathroom, minimum three bathrooms. Adding to this, water might get cold when it is delivered by the pipes from the source to the rooms. **Benefits:** General benefits are associated with solar energy as stated by Maehlum (2018), renewable, abundant, environmentally friendly, low maintenance, silent, free electricity (photovoltaic). As for solar thermal system, the initial cost is less than photovoltaic, it takes less time to get the initial cost, the technology is less complex (Morley, 2014).

##### **Passive energy:**

**Brief explanation and challenges:** Some details of passive design are defined in cross ventilation, orientation, building form, glazing units, solar gains and shading and natural material ... etc (Damaskou, 2016). These elements have been implemented in eco lodges in order to save the heritage tradition of old building technics. The main challenge is the struggle between maintaining the view for rooms and direct the building in the right angle for cross ventilation. **Benefits:** It reduces the annual consumption level of energy, it has been stated that using passive technics reduces the average using of appliances and lighting by 27% (Damaskou, 2016).

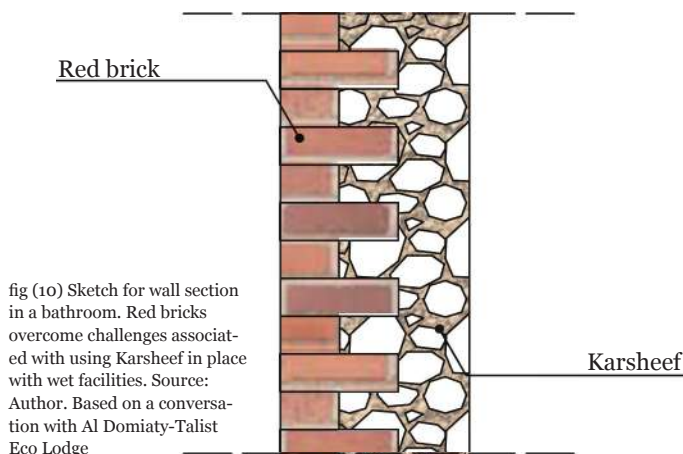
#### (b)Building material

##### **Karsheef**

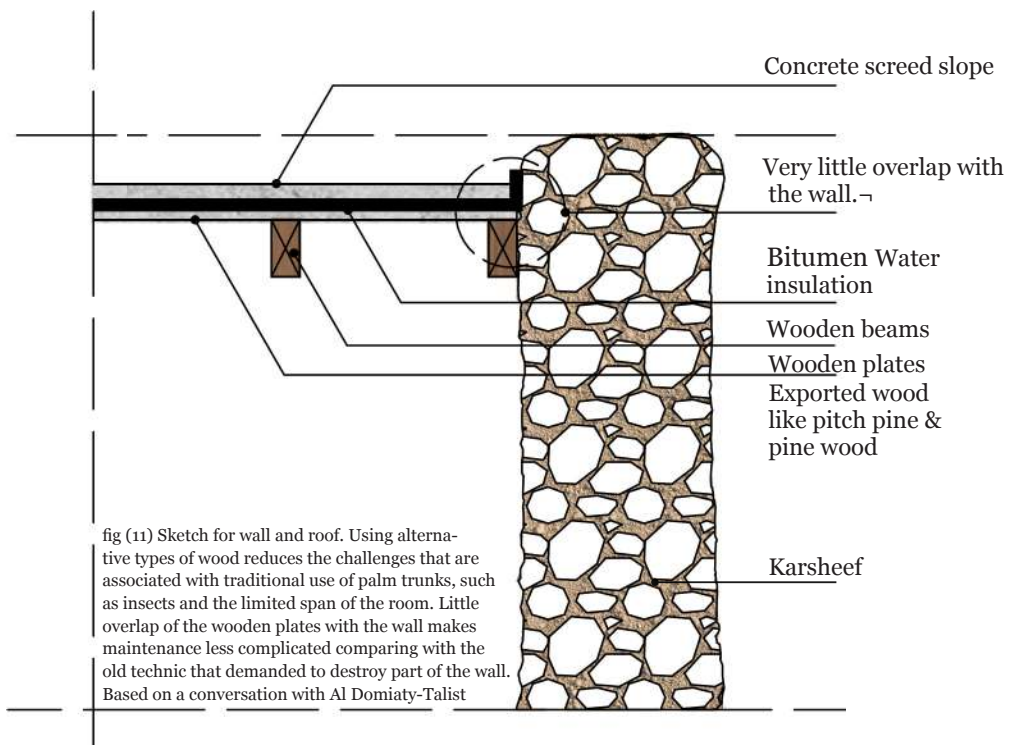
**Brief explanation and challenges:** Natural material uses simple technics that are easy to be taught which uses local available materials that are renewable and recycled (Ricci, 2011). Talist Eco lodge combined between traditional

building technics and conventional material that helped in overcoming certain challenges that are associated with old building technics. As it was mentioned previously with Karsheef material, old building technics face several challenges such as the continuous need of maintenance, the damages that is associated with rainfalls and the sensitivity to water while using modern wet facilities inside the house. Al Domiaty explained the technics that were used in walls, roof and foundation which reconsidered traditional methodology in order to overcome some challenges. He said that in spite the fact that they developed new technics, yet further research is needed to scale the implementation of natural building material. The following explains details about the technics that were used in Talist.

**Walls:** The construction in this system has air cavities produced from the irregular shapes from Karsheef and stones that increases its efficiency for insulation so it takes a lot of time to observe heat during the day and then it releases it during the night. They use the system of bearing wall, usually it has small openings, the wall is holding the load for this reason it is important to consider small openings in the wall. Once they decided to have wide openings they consider building one story building because the wall is weaker with wide openings. If there is an intention to build two floors then the dimensions of the voids has to be taken into consideration and it is better to do alignment of the windows, each window is underneath the lower or upper window. In order to deal with the sensitivity to water in using modern wet facilities, the architects combine Karsheef wall with red bricks, brick layer is the inside surface while Karsheef part is outside. The brick surface functions better with modern wet facilities. See fig (10).

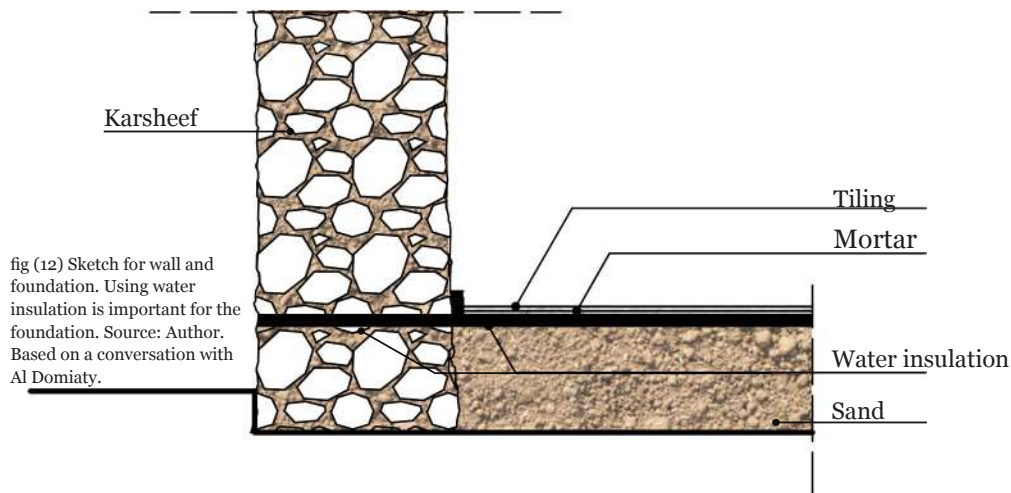


**Roof:** According to the owner of Talist, using palm trees is not useful anymore. It needs a long process to dry to be treated from insects. They soak it in salt water and then they wait for it to dry. Another reason is sand that falls down from the roof due to the weak joints between each palm beam. As a response to this, Al Domiaty used different kind of wood that act as palm beam with different dimensions. Several types of woods brought from Alexandria were delivered to Siwa for roofs and other uses. Although this type of wood is not local yet he claimed that more sustainable comparing with palm wood. He justified the use of imported wood due to fact that palm woods are used for buildings more than its capacity for the oasis. At the same time, he would recommend to think of other alternatives for roofs, as even this solution might limit the expansion of building with natural material hence it has the challenges associated with palm beams yet it is less frequency. In order to overcome the challenge of the rain-fall on the roof, Al Domiaty used concrete screed slope yet it was not successful since labors in Siwa are not expert in this specific detail, accordingly they are now thinking of other alternatives to solve such a problem. See fig (11).



**Foundation:** Foundation is another issue that has to rethink in traditional building materials. As it was claimed by Al Domiaty, the main aspect that

cause the building collapse is the absence of foundations or poor foundations. In order to guarantee strong foundation, Al Domiaty make sure to deepen the foundation if the soil is wet, he also add water insulation layer to protect the foundation. See fig (12).



**Benefits:** Building with natural material enhances the contacts with environment that has a positive impact on the health and well-being comparing with conventional materials (Bakker, 2017). Natural building materials don't cause pollution or mining, they have the least impact on the environment (Ricci, 2011). The combination of natural building material and conventional material is also useful, sometimes it reduces the challenges that are associated with using only natural material.

### (c)Water

#### Wetland

**Brief explanation and challenges:** Manmade wet land is a mimic of natural wetland that get rid of contamination, metals and sediments in water. It is divided into several steps, the first step consists of a septic tank where the water is collected and heavy particles settle, the second step goes to another tank where dissolved solids are filtered from the water is filtered through layers of gravel, the third step goes into another tank where pollutants in the water become less dissolvable forms and are absorbed by micro-organisms which live on the plants' roots (Gänsbauer, 2015). Wetland is used as drainage system in Adrere Amellal eco lodge by EQI since 2005, as mentioned before. The treatment is working successfully according to the architects. There is no specific challenge



that the eco lodge faces from the wet land and it is working successfully. See fig (13). **Benefits:** As stated by Gänsbauer (2015) there are several benefits of wetland, it is cost-efficient, feasible, robust and aesthetically pleasing way and it treats contaminated water, remove contamination, metals and sediments.



fig (13) Wetland picture and sketch in Adrere Amellal Eco Lodge. Source: Left, author. Right, architect Azmy

## Drip irrigation

**Brief explanation and challenges:** Drip irrigation is defined according to Dictionary (2018) 'a system of crop irrigation involving the controlled delivery of water directly to individual plants through a network of tubes or pipes'. Drip irrigation system is used in Talsit for irrigation. Just to give the plant the suitable amount of water. Drip irrigation is used to grow plants that doesn't need a lot of water. Lemon, potato, onion, pomegranate, olive, palm, Rocca, coriander, dill, olive trees and palm trees are planted in Talsit and are watered by drip irrigation. no specific challenges was mentioned. See fig (14). **Benefits:** As it is mentioned by Ihab, the water get into the soil before it evaporates and it provides what is needed for the plant not more not less. It is recommended to use drip irrigation as it is one of the solution that helps to reduce excess water in Siwa (Gänsbauer, 2015). It is stated by Netafim (2015) 50% of water is saved by using drip irrigation comparing with flood. 30% is more efficient than flooding. Combining drip irrigation with fertilization increases the productivity till 200%.

## (d)Organic and solid waste

### Organic and solid waste management

**Brief explanation and challenges:** Solid waste management means the



process of treating solid waste that considers environment and public health (Leblanc, 2017). Unfortunately the whole system is poor and the Eco lodges are not following any system accordingly, except for small experiments of reuse certain materials for decoration in Talist for example.

It has been recognized that the application of Eco Architecture solutions is exclusively implemented in the Eco lodges nearby El Gari village and very limited application of natural building material that is implemented by local inhabitant in the village. The following star diagram illustrate this, see fig (15). On the other hand, there are several challenges that are associated with the technical solutions that are used in the Eco Lodges, for this reason, there is a huge need to develop certain technical details that would improve the efficiency of the technic that encourages wider implementation for Eco Architecture solutions. This section also reveals the solutions that can be repeated easily and successfully in different projects and the solutions that need a lot of studies and development. For example, wetland, drip irrigation



fig (14) Drip irrigation in Talist Eco Lodge. Source: Author.

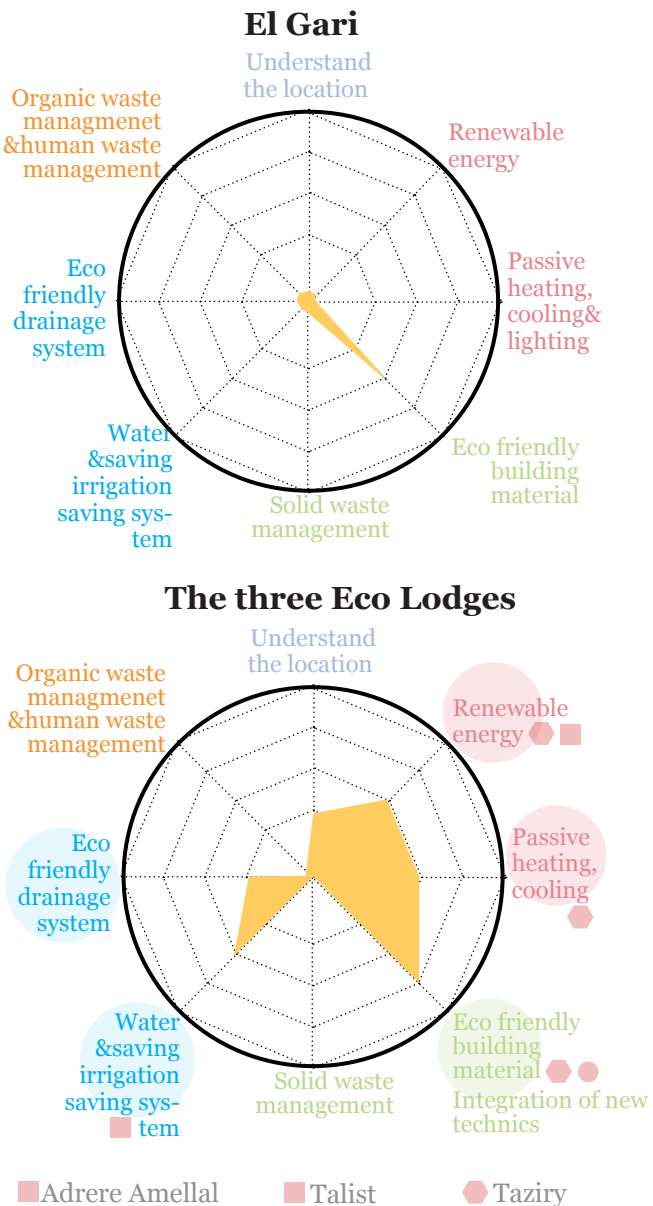


fig (15) Star diagram showing the availability of Eco Architecture solutions in El Gari village & the three Eco Lodges. Source: Author.

are the solutions that have the least challenges. On the other hand, Karsheef and waste management are the solutions that need to be developed the most. The following chapter will highlight the barriers that prevent local inhabitant in El Gari village from implementing the mentioned solutions.

### **4.3 Barriers associated with implementing Eco Architecture solutions in El Gari village**

#### **(a)Energy**

##### **Solar thermal, photovoltaic and biogas**

**Barriers:** First, affordability, since they need high initial cost. Second, lack of knowledge about the importance of using solar energy instead of fossil fuel, simply it is easier for them to use the electricity that it is provided from the government as long as it is cheaper in the short term and easier to implement. As for the bio gas, Dr. Moneer provided two houses in El Gari village with biogas units to support the community. Unfortunately, the biogas units are not used anymore. One of the residence mentioned that new generation does not accept the idea of moving animal waste for bio gas, for them it is connected to primitiveness.

##### **Passive energy:**

**Barriers:** The only barrier for the community is lack of knowledge and awareness of the importance of passive energy on preserve the environment.

#### **(b)Building material-Karsheef**

**Barriers:** There are several barriers; first because it needs more time and money to build this Karsheef. Second, this material gets a lot of dust, it needs regular maintenance. Third, as was calmed by the inhabitants, the traditional material is not sufficient to meet current demands, the community is driven by the modernization phenomenon (IUSD Lab-Cairo, 2014).

#### **(c)Water**

##### **Wetland**

**Barriers:** Although Dr. Moneer Nematallah, the owner of Adrere Amellal eco lodge, offered support to construct wetland in El Gari village, yet the families

didn't accept this idea because they were not familiar to external supports. People also mentioned that implementing wetland is expensive and it's not easy to get as it is not available in the market, on the other hand Azmy highlighted that constructing wetland is not expensive at all. As stated by Gänsbauer (2015) there are a lot of people who are not aware of the problem of water in Siwa.

### **Irrigation saving system**

**Barriers:** Lack of awareness. As for drip irrigation, local people don't use it locals are not aware of the negative impact that is associated with flood irrigation. Some of local inhabitants stated that it is expensive to use drip irrigation, on the other hand Al Domiaty mentioned that it is not expensive and it is available in Siwa market.

### **(d)Organic and solid waste**

**Barriers:** It is a big system that has to be organized, it is challenging for individuals to do recycling individually, unless it is organic recycling that needs further awareness for people.

Finally the barriers that were mentioned previously can be concluded under three main categories; practical, cognitive and financial barriers. It was clear how social influence and mindset have a huge impact on deciding whether to implement or not to implement Eco-friendly solutions by local inhabitants. As it was observed in the empirical studies that modernity illusion, which inhabitant adopt in their minds, have a negative impact on their decisions of implementing Eco-friendly solutions. Fig (16) concludes the barriers that are associated with each Eco Architecture solution in El Gari village.

The schedule reveals that the dominant barrier is cognitive barrier, which stresses on some quotations that were documented from random Siwans. As one young man said that "what is really needed here in Siwa is development of the society, working on this dimension will support taking decisions for better environment". On the other hand, some people in Siwa and in El Gari village are aware of the importance of implementing Of Eco Architecture solutions but they do not know to implement it how and they do not have enough money. The following quote from this young man emphasis the previous notion. "I want to build a house from Karsheef deep within my heart, but in reality, I can't afford it". The last two sections emphasizes the importance of encouraging environ-

mental behavior that can be achieved by following the suggested key factors in Chapter Three, that is, social influence, habit formation, individual self, feelings and cognitions and tangibility, along with developing technical solutions by doing further researches in order to come up of efficient solutions as well.

		Barriers		
		<b>Practical</b> <ul style="list-style-type: none"> <li>• Technical challenge</li> <li>• Limited accessibility, market/system</li> </ul>	<b>Cognitive</b> <ul style="list-style-type: none"> <li>• Lack of awareness</li> <li>• Modernity illusion</li> </ul>	<b>Financial</b> <ul style="list-style-type: none"> <li>• Not affordable</li> </ul>
Eco architecture solutions	Photovoltaic & Solar thermal		Lack of awareness	
	Biogas		Both	
	Cross ventilation, N.S orientation		Lack of awareness	
	Natural building material	Both	Modernity illusion	
	Constructed wetland	Limited accessibility, market/system	Lack of awareness	
	Drip irrigation		Lack of awareness	
	Solid & organic waste recycling	Limited accessibility, market/system	Lack of awareness	
	Solid & organic waste management	Limited accessibility, market/system	Lack of awareness	
		Has barrier	Doesn't have barrier	Contradiction in opinions

fig (16) Schedule showing the results of empirical study that shows the barriers associated with each Eco Architecture solutions. Source: Author

At the end, it is important to highlight that someone has to initiate these changes and take certain decisions into actions. For this reason, next section will shed a light on potential influencers and stakeholders who can be involved in the research phase and sharing knowledge and experience as the initial phase of the development in order to take it to the next level of implementations.

#### 4.4 From theory to practice

Although there are a lot of efforts that aim to develop the built environment, yet

these efforts did not manage to develop the community on the other hand each one reinvents the wheel (ecumene-studio, no date). As it was highlighted previously in section 4.2, there is a need to develop certain technics and materials in order to overcome the challenges that is associated with natural building material, adding to this it was highlighted in section 4.3 the importance of considering encouraging environmental behavior for change. Accordingly, a strategic plan has to be identified and different stakeholders have to come together to share their knowledge and experiences in order to take the researches into next level. The idea of combining academic and practical field is supported by Kundoo who believes in the combination between practice and academia, she mentioned in one of her interviews that she follows “research-oriented practice and a practice-oriented teaching approach”. She believes that this approach put the project into a context and helps to match one’s aim into practice, it allows to reflect about new concepts in reality with other professions and students (construmat, 2017). See fig (17).

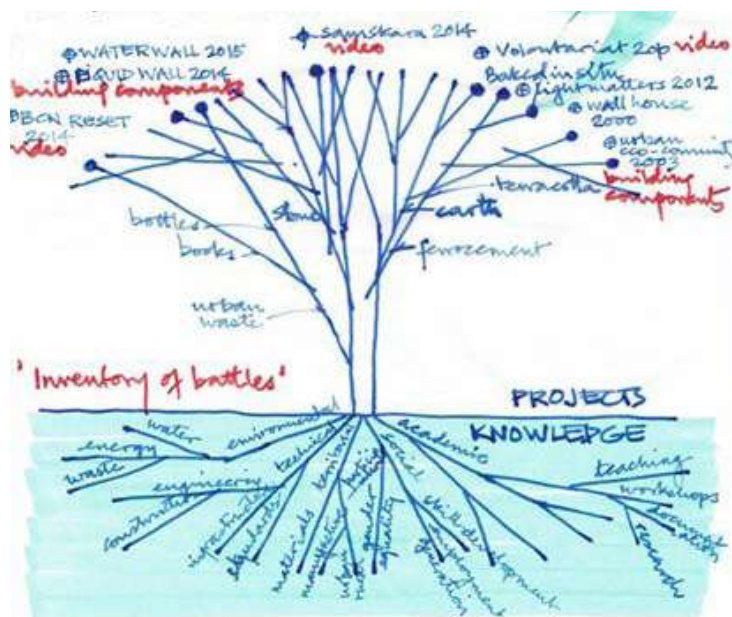


fig (17) Drawing by Anupama Kundoo to explain metaphorically that the roots are the knowledge and the fruits are the outcome projects. Source: Author. Sánchez, 2016.

As mentioned by White and Habib (2018). If the key players in certain countries are not aware to the importance of sustainable strategies and slow in actions then it is fundamental to consider educators to move faster in the process through future professionals who are more aware and sensitive towards sus-

tainability (SAMAD, 2007). However, in the long term the concentrated efforts by all the key players, such as developers, government agencies, NGOs', other professionals especially planners, civil, mechanical and electrical engineers, the respective professional bodies, and the public, are fundamental in future actions (SAMAD, 2007). The following is listing of potential stakeholders; Siwa local community, Siwa Community Development and Environmental Conservation Association, City council, Siwi initiative, Adrere Amellal, Taziry and Talist Eco Lodges and researchers. It is essential not only to highlight upon bodies inside Siwa but it is also essential to include people who are working in similar vision of using Eco Architecture solutions and develop the community such as the projects in Saina that includes Basata Eco Lodge, Karm eco lodge, Handover and Habiba Farm. See Annex if need further information. See appendix 2.

# Chapter 5: Conclusion and discussion

## 5.1 Summery

The study initially highlights the threat that the planet is facing from the accelerated percentage of pollution that is mostly coming from buildings thus raising the notion that despite buildings being the most harmful agent of ecological degradation, it can be also the solution for healthy environment by implementing eco architecture principles. The research went through several phases in order to realize the main aim, which focuses on identifying the potency of implementing eco architecture solutions that are associated with both technical and behavioral dimensions in a village context.

The main objectives that directed the research to reach the aim are; developing a deep understanding of Eco Architecture principles focusing on technical and behavioral dimensions and identifying the barriers that are associated with implementing Eco Architecture solutions for local community, which are represented in El Gari village. Focusing on the first objective, it has been noticed that despite behavioral aspects were mentioned repetitively in Eco Architecture literature reviews, yet the focus was delved more into technical dimension and less on behavioral dimension. For this reason, the research conducted a further research on environmental behavior to gain a deeper understanding of this aspect that can be applied practically. A study done by White and Habib (2018) highlights certain tools that guide the process of encouraging people to adopt environmental behavior in their community.



As an outcome consequence of this chapter, a diagram was developed in fig (4) in order to have a deep understanding of Eco Architecture. It highlights the following; the main resources that buildings need, the principles that act as a filter to identify Eco Architecture solutions and environmental behavior tools. This diagram perceives Eco Architecture principles as a filter that penetrates technical solutions and human behaviors. The purpose of the filter is to eliminate Eco-unfriendly solutions and behaviors that threaten the environment and allows Ecofriendly solutions and behavior that seek to achieve healthy living for people and the Eco System.

Whereas several studies show a huge positive impact of implementing Eco-friendly solutions and encouraging environmental behavior on saving the earth, the implementation of both dimensions are limited compared to the conventional solutions and human consumerism these days. Focusing on El Gari village, it has been realized that there is limited implementation of Eco Architecture solutions by local inhabitants and various implementation in the surrounded Eco Lodges by external investors which has directed the study to determine the barriers that are associated with implementing Eco Architecture solutions by local inhabitant in the village. This dimension has been covered in Chapter Four through empirical study in El Gari village and selected Eco Lodges nearby.

For the purposes of identifying the barriers, the research first documents several applications of technical solutions that are executed in two Eco Lodges located near El Gari village. It highlights the benefits and challenges of Eco Architecture solutions that are implemented in the aforementioned Eco Lodges. This gave an insight about the following; what can be repeated successfully in different projects in Siwa and similar contexts and what needs further development and study. Secondly, it highlights the main barriers by conducting several interviews with locals living in El Gari that result in practical, cognitive and financial barriers. Chapter Four supports the discussion that took place in Chapter Three as the study reveals how social influence and negative habits have a huge impact on implementing Eco-friendly solutions by locals. As it was observed in the empirical studies that modernity illusion, which inhabitant adopt in their minds, have a negative impact on their decisions of implementing Eco-friendly solutions. This stresses on the importance of encouraging environmental behavior that can be achieved by following the suggested key factors that



were mentioned in the third chapter, that is, social influence, habit formation, individual self, feelings and cognitions and tangibility, along with developing technical solutions. Accordingly, the objective was met in the research through literature reviews that took place in the third chapter. And the second objective through empirical study in chapter four.

## 5.2 Findings

This section presents the main findings of the theoretical and empirical work of this research. The theoretical part (Chapter Three)- that was based on the literature review- highlighted the importance of Eco Architecture principles in both technical and behavioral dimensions. The empirical study (Chapter Four) - that was based on the field visit- identified the barriers that limited local people from using such solutions in the village. Upon compiling the analyses of both parts, two main findings could be deduced:

- **Strong relation between overcoming the barriers and environmental behavior tools**

It has been realized that the main barriers that prevent local inhabitants from implementing Eco Architecture solutions are concluded in the following three aspects; practical (technical challenges and/or limited accessibility in market or system), cognitive (lack of awareness and/or modernity illusion) and financial (not affordable). It has been recognized during the interviews that the three barriers are essential, that means working on one aspect of these barriers is not enough to encourage local inhabitant to implement Eco Architecture solutions. For example, working on financial barrier alone is not efficient as it is not sustainable. Once the financial support ends, the commitment of taking eco-friendly decision will stop as well.

The findings from the previous part and literature reviews reveal the strong relation between overcoming the mentioned barriers and encouraging environmental behavior. Changing from conventional solutions to Eco-friendly solutions requires an investment in human behavior and mindset along with other tools that direct individuals to take better actions towards preserving the earth. Revising the tools that were developed by White and Habib (2018) shows that it deals with these barriers in certain aspects.

Fig (18) illustrates the relation between the barriers and environmental behavior tools that were mentioned previously in Chapter Three. For example, if

financial barrier is one of the barriers of solar photovoltaic then following habit formation key factor depending on incentive tool can support the financial barrier. At the end, both technical and behavioral improvement works in parallel with each other in order to achieve efficient change. See fig (6).

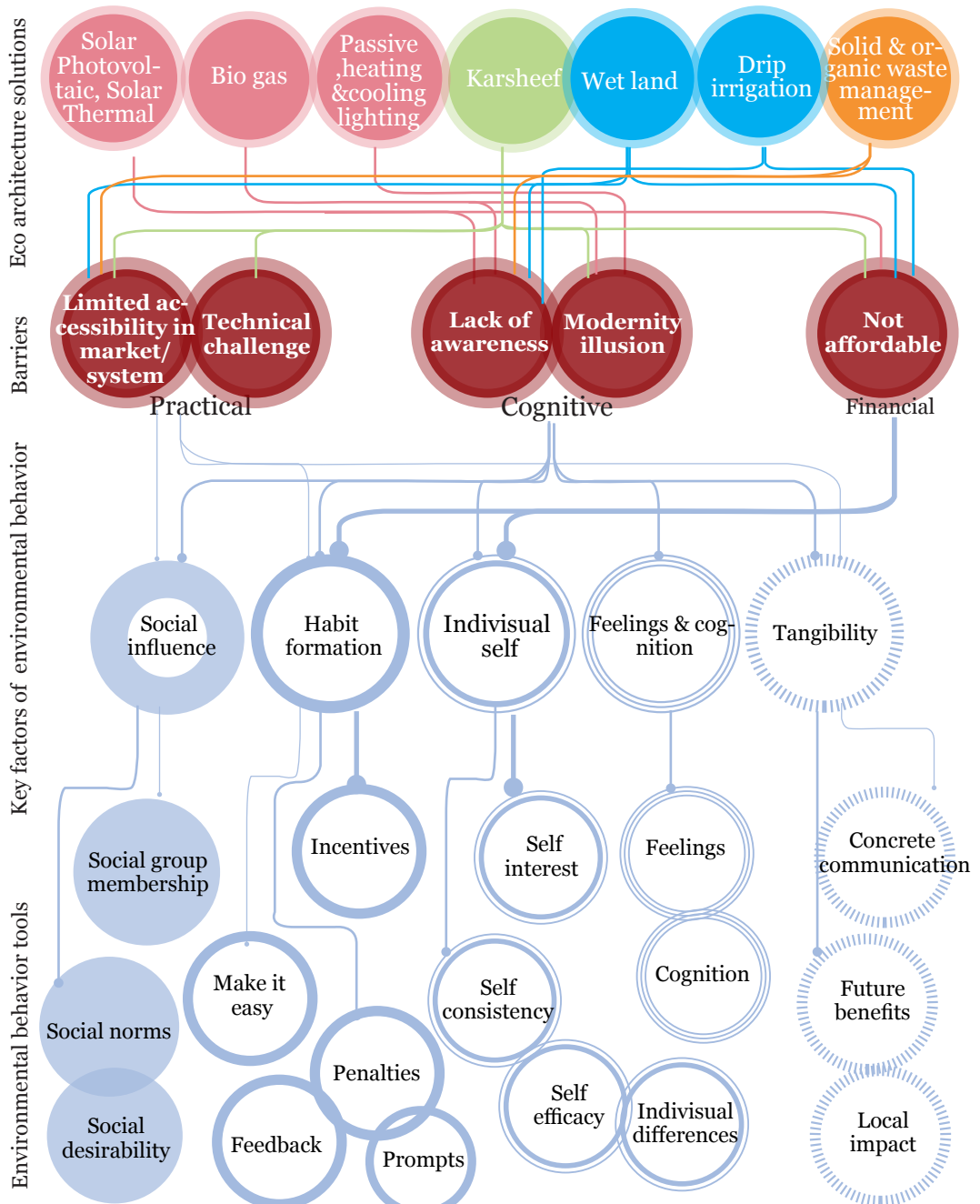


fig (18) Diagram showing the relation between Eco Architecture solutions, the barriers associated with the solution and how it can be tackled by using Environmental behavior tools. Source: Author, based on study by White and Habib, 2018 and Bassioni, El-Menchawy and Farouk, 2012

- **Limited integration between different potential stakeholders that could play fundamental role in achieving comprehensive change in El Gari village and Siwa.**

Field work observation revealed the limited integration or collaboration between external investors local inhabitant, in terms of knowledge sharing and community development. The mutual benefit is currently limited on opening job opportunities, and less through vocational training and support with the bio gas that was initiated by EQI. Unfortunately, it did not have an impact neither on the inhabitant's decision to be environmentally friendly nor their behaviors, this limited the sustainability for the change. According to the star analysis that was mentioned in Chapter Four fig (15), it is obvious that the implementation of Eco Architecture solutions is limited to Eco Lodges for tourism purposes and financial benefits and it is important to scale this implementation to reach local inhabitant. Improving technical details and encouraging environmental behavior can be achieved by gathering different stakeholders from different backgrounds, and combining academic and practical approaches in order to achieve effective results for change. Influencers and stakeholders have the potential to move the theoretical approach into action through encouraging sharing knowledge and experiences with different bodies from inside and outside Siwa.

### **5.3 Discussion**

The findings that were identified in the previous section are brought into context in this part. Highlighting the three main barriers and the strong relation with environmental behavior will be discussed here followed by the limited integration between different stakeholders. Practical (technical challenges and/or limited accessibility in market or system), cognitive (lack of awareness and/or modernity illusion) and financial (not affordable) aspects are the main barriers that prevent local people from using eco architecture solutions. As it was mentioned previously, there is a great potential to use environmental behavior tools to overcome these barriers. Regarding practical barrier, using the tool “making the product easy” is an important way to develop certain solutions for building material for example as it was revealed that building with Karsheef is getting harder and more expensive thus thinking about other alternatives is critical in ensuring the use of natural building materials. This requires combination of intensive research and experiments in order to come up with suitable building

material that is available and affordable. Another aspect that makes the product easy to get is by making it accessible in the market. This can be implemented for example by having a contractor for building with natural material. For instance, in dealing with solid waste management, the existing of an organized system is essential to make it easy for people to separate their waste; it would be hard for individuals to do the recycling by themselves.

As for cognitive barriers, using tools such as social norms, cognition and positivity of self-concept are an essential ways to overcome cognitive limitation. Moreover, penalties will also push people to be responsible in using natural resources and preserving nature. It will motivate them to implement eco architecture solutions. On financial barriers, incentive tools can solve part of this barrier. As the initial cost of photovoltaic, thermal solar panel are expensive, certain incentives are essential to ease their acquisition. The integration of other environmental behavior tools, as were mentioned previously, is also important as it formulates an efficient way to encourage people. Such decisions cannot be implemented through one party, it has to be a collaborative effort of the local community, researchers, government, owners and architects of eco lodges, social scientist, NGOs, external investors. This brings us to the second finding that is limited integration between external investors and locals and limited collaboration with several bodies in order to achieve comprehensive change in El Gari village and Siwa.

Owners and architects of Eco Lodges from Siwa and Saini can share knowledge and experiences to shape lessons learned for future development. For example, Habiba farm adopts community development and integration in organic farming, his experience is essential in this field. Karm eco loge is owned by one of the local community, which makes it not limited on external investors. This might bring Eco Architecture solutions closer to the community but the risk would be if it became limited to tourism which is bring us to rethink approaches and lessons learned. Connecting the implementation of Eco Architecture solution with business is not the key element for change because it can be limited to certain people and will disappear once the business is over. For this reason, it is important to invest in encouraging environmental behavior for change that includes financial incentives as well as technical development. Social scientist can support by encouraging environmental behavior for locals whereas the NGOs can support the projects financially. Local communities collaborate with all stake-

holders as they are the main beneficiaries and if the strategy does not meet their needs then the chances of success would be low.

#### **5.4 Recommendations**

Accordingly, the following recommendations are highlighted in the following points:

1. Implementing environmental behavior tools are important as it makes the change more sustainable and authentic, especially that it adopts changing behavior and mindset of individuals.
2. It is essential to create integration between external and local inhabitants that helps to dissolve the image that Eco Architecture solutions are inclusively related to tourism and provide a platform of sharing knowledge of the new techniques and experiences from inside and outside Siwa that will bring researches into practical level.

#### **5.5 Further work**

This research can be taken further by considering the outcomes of the research and investigate the potency of using these outcomes to scale the implementation of Eco Architecture solutions in Siwa. This can be done by having detailed study on the three barriers and inviting potential stakeholders to conduct focus group discussions on the possibility of implementing these tools for future change in Siwa. For example, as the main barriers for locals are practical, cognitive and financial dimensions, a further research is needed to conduct a detailed study on financial limitation for example. As Siwan people claimed that wet land and drip irrigation is expensive, a notion differed by the architects who designed Adrere and Talist who posited that it is not expensive. Detailed financial studies are needed to reveal the exact expenses on eco architecture solutions that will help to proceed in implementing the tools that were developed by White and Habib (2018). In order to implement these tools, the study highlighted certain steps that can be used to put it into practice. These steps can be considered with the tools in a selected case study in order to test its applicability either in Siwa or another similar area. Appendix 3.



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## **APPENDIX**

### **Appendix 1**

List of owner's and architect's interviews  
List of inhabitants interviews

### **Appendix 2**

Examples of initiatives and Eco Lodges who have successful implementation of technical and social dimensions that can be useful to share their experiences with the new development projects that will be conducted in Siwa or similar context.

### **Appendix 3**

List of owner's and architect's interviews  
List of inhabitants interviews

List of owner's and architect's interviews

Interviewees:

- Ihab Al Domiaty (owner & architect of Talist Eco Lodge)
- El Sayed Al Domiaty (owner & architect of Talist Eco Lodge)
- Ramez Azmy (architect of Adrere Amellal Eco Loge)
- Emad Farid (architect of Adrere Amellal Eco Loge)

Interview's questions:

- Where is the Eco Lodge located?
- How many rooms does it have?
- What are the Eco Architecture solutions that are implemented in the Eco Lodge in terms of the following; energy, building material, water and waste management?
- Could you please give a brief description about each solution, could you please provide further illustration by sketch.
- What are the challenges and benefits that are associated with each solution?

List of inhabitants interviews

- 
- What are the solutions that you use in terms of energy, building material, water and waste management in the Village?
- What are the challenges that you face in each facility?
- What are the Eco Architecture solutions that are implemented in the Eco Lodge in terms of the following; energy, building material, water and waste management?
- If yes, could you please give a brief description about each solution, could you please provide further illustration by sketch.
- If no, what are the barriers that prevents you from implementing such solutions?
- Would you rather use new Eco Architecture solutions (like the ones that are implemented in the Eco Lodges nearby)?
- If no, why?
- If yes, is it useful? ⇐⇐



Examples of initiatives and Eco Lodges who have successful implementation of technical and social dimensions that can be useful to share their experiences with the new development projects that will be conducted in Siwa or similar context.

### **Basata Eco Lodge**

Basata is the first eco lodge built in Egypt in 1986. It is located in South Saina between Taba and Nuweibeh. Basata means simplicity in Arabic and it reflects the main concept of the eco lodge. The main concept is to create a form of tourism that has low impact on the environment and the native inhabitants, the Bedouins. In order to achieve these aims, the eco lodge focusses on architecture waste, recycling and responsible tourism (Basata, no date).

As for architecture, local building material are used in the eco lodge such as bamboo, clay and natural stones. Cooling the area depends on passive design. As for water cycle, small scale desalination plant is used to produce both fresh and salt water. Every day they have capacity of 15m<sup>3</sup> for fresh water and 60m<sup>3</sup> for salt water. Fresh water is used in the kitchen (for cooking and rinsing the dishes) whilst in the bathroom for showering and washing. On the other hand, brine water is used for washing dishes, flush toilets and construction work (Basata, no date).

Waste water is divided into grey water and black water. Grey water is used to irrigate non-edible plants. The black water goes into sealed septic pit that is delivered to Nuweibeh's water treatment plant. As for solid waste management; organic waste is fed to animals in the farm. Waste from animals is used as fertilizer for the plants. All non-organic waste is delivered to Hemaya NGO, which is founded by the same owner of Basat, for sorting and then sent for recycling in Cairo. As for energy saving; the eco lodge depend on electricity generators for basic use and solar panels for heating water (Basata, no date).

### **Karm eco lodge**

It is an eco-lodge that is based on sustainable eco-tourism; it focuses on caring for the natural environment and well-being of its inhabitants. It is owned by Bedouin and was built by the EU funding under the supervision of St. Catherine Protectorate. The eco-lodge is located in a unique natural area that is surrounded by Wadi Gharaba near Sheikh Awaad and Nagb Hawa, the traditional route to the Monastery of St. Katherine. Their main concept is simplicity and having minimal impact on the environment. There is no electricity and as such, there are solar panels for water heating and sanitary compost toilets. Such projects

support tourism and promote the protection to the environment (Sheikhsina, 2018).

The El Karm eco lodge is situated close to the town of St. Catherine in the mountains of Sinai owned by and managed by a Bedouin from the local community near by the eco lodge. It was an abandoned building and was renovated by using on local and eco-friendly materials, local buildings technics, low technology solutions in order to minimize environmental impact and save water and energy, solid waste management technics, and waste water management and reuse (El-Borombaly, Yehia and Khalil, 2014)

### **Handover**

Considering the visit in St. Kathreine, as part of a class in the program, it was highlighted by visiting the construction site of the Cultural Visiting center of Al Tarfa community. It is built of rammed earth, using simple techniques to meet the principles of eco buildings that would have the minimum impact on the natural environment in the area. The main materials that were used in the construction are stones, white clay, brown clay, sand, red sand, lime, metal, gravel and wood. As for the water circulation, this building is adopting the dry toilet technique that is divided into solid waste and liquid waste. Solid waste is turns into fertilizer after 9 months by using a tank a chimney for ventilation, while the liquid waste is turning into grey water to water the plants.

Hand Over enterprise would be an interesting example to highlight. The three main pillars that they adopt in their projects are; sustainability, human centered design and education. Sustainability directs them to use sustainable design techniques, using local materials, implementing passive design techniques. As for human centered design, it is focused on the users and the importance to meet their needs, for this reason, users are involved during the process of the design. As for education, knowledge sharing is the main concern, this achieved by workshops and different sessions (Hand Over, 2018).

### **Habiba Farm**

It is located in Nuweiba, South Sinai. Habiba farm is considered as an organization that includes beach lodge, communal organic farm and learning center. The main aim is to create sustainable income and healthy environment for the local community. The main strategy of Habiba farm depends on engaging universities, partners and organizations from different countries to support in creating a model of sustainable community in the desert. Although the main lodge was built using conventional materials, what is special about Habiba farm is the engagement of the community and supporting local Bedouins. Habiba Organic

Farm trains and educate volunteers; it is considered as a successful model for the local community to adopt the idea and an experimental lab for different type of vegetation in the desert and practical education for Bedouins. As for the learning center, it supports projects to empower local Bedouin women and raise funds for further educational opportunities for the children. Before 2000, it was almost impossible to find the community participating in the planning process (Basha, 2017).

In 2003 the bottom up planning approach was associated with the development process to stress on the importance of the involvement of the local actors. As for smaller projects, most of the investors start their projects depending on their own interest rather than the actual need of the community (Basha, 2017). On the other hand, it was noticed during the meetings with different investors that the community is considered as an essential actor in their projects. Although their role might not be obvious in the decision making stage but it is mainly highlighted in providing several services to the community such as opening more job opportunities, increasing the level of education in the area and encouraging different types of investments. Eventually, the integration of the community is a win win situation especially since the Bedouin have a strong control on the area which gives them the opportunity to perform as a strong actors in the success of the project.

As it has been observed during the previous visit as part of a required class, Habeeba Farm went through several stages to work with the community to encourage them to adopt a new idea of economic development. These stages will be explained as the following; the first stage aims at building trust with the community by introducing the idea and act as an effective example in a continuous base. This is followed by the second stage that aims at building human capacity and establishing a solid knowledge for the community by conducting lectures run by experts and specialist. After this, it would be essential to move to the next level and enhance the community to implement what they learnt and establishing a direct connection between them and the experts to achieve bigger benefit of the learning process.



## STEP

**1****Clarify the context**

Identify the specific behaviour you wish to influence. Be specific about what sustainable consumer behaviour you wish to influence. Rather than saying "I want my customers to be sustainable", you might say "I want my customers to purchase our new technology", "I want my customers to use this product more effectively" or "I want my customers to bring back the packaging, so it can be repurposed". Be clear about what your objectives are. In addition, consider the context in which the behaviour will take place. Is it public or private? Do you want to encourage short-term changes or long-term changes?

## STEP

**2****Identify the target segment**

Identify the specific group of consumers you wish to influence. It is worth considering the characteristics of your selected consumer segment. What are they particularly motivated by? What specific needs and wants do they have? Are there specific types of messages that would best resonate with them? Specific research might be done to better understand your target segment and their needs, as well as what they see as key barriers and benefits (see Step 3).

## STEP

**3****Determine the details**

Given what has been uncovered in steps 1 and 2, the practitioner should consider the specific barriers to behaviour change (as well as potential benefits of behaviour change). Why wouldn't consumers want to engage in the identified sustainable behaviour? What are the possible barriers to adoption of the product, service or behaviour? The best way to answer this question is to first look at existing research – does it have anything to say about barriers in your specific domain? The second step is to ask your current or desired customers. Different techniques such as observation, surveys, interviews, focus groups, etc. could be used for this purpose.

## STEP

**4****Select and apply the tools**

Select tools that make sense given the behaviour and the context, the target and the specific barriers and benefits associated with behaviour change. One way to do so considers the primary and secondary barriers that have been identified with regards to the target consumer segment engaging in the desired behaviour.

## STEP

**5****Test your strategy**

You can conduct a small-scale test of the effectiveness of your chosen behaviour change tools. If the test is unsuccessful, you can use the data collected to try to uncover why and go back to one of the previous steps as necessary.

## STEP

**6****Implement and evaluate outcomes**

Once you have a strategy that tests well, this can be implemented on a larger scale and the overall outcomes can be evaluated. Monitor and measure your outcomes. Consider using alternative tools if your objectives have not been met.



# نبذة عن الرسالة

يهدف هذا البحث إلى تحديد التنفيذ المحتمل لحلول الهندسة المعمارية البيئية المرتبطة بالأبعاد التقنية والسلوكية ، في سياق القرية التي تستخدم المواد الطبيعية والحلول ذات التقنية المنخفضة والتكنولوجيا الفائقة ، لتحقيق رفاهية أفضل لكل من النظام البيئي والسكان البشر. سيكون لدى البحث فهم عميق لمبادئ العمارة البيئية التي تركز على الأبعاد الفنية والسلوكية. كما سيحدد العوائق المرتبطة بتنفيذ حلول الهندسة البيئية. يتبع البحث مقاربة نوعية تنقسم إلى مرحلتين تحقق الهدف الرئيسي. تركز المرحلة الأولى على النهج النظري اعتمادًا على مراجعات الأدبيات التي تشكل فهمًا عميقًا لمبادئ العمارة البيئية مع التركيز على الأبعاد الفنية والسلوكية. تعتمد المرحلة الثانية على دراسة تجريبية تركز على دراسة الحلول المستخدمة في كبريتين صديق للبيئة بالقرب من قرية الغاري بواحة سيوة. ولما كانت هذه الأكواخ البيئية قد جلبت حلول هندسة معمارية جديدة للهندسة المعمارية المحلية في المنطقة ، فإن الدراسة ستحدد هذه الحلول وتتعرف على الحواجز التي تعترض تنفيذ هذه الحلول في المجتمع المحلي. سيصوغ هذا ملخصًا لمعنى العمارة البيئية مع التركيز على البعد التقني والسلوكي ونظرة عامة على الحواجز التي ترتبط بتنفيذ حلول الهندسة البيئية وتوصيات التنمية المستقبلية في سيوة أو سياق مماثل.

تم تلخيص نتائج الأطروحة في إبراز العلاقة القوية بين التغلب على الحواجز وأدوات السلوك البيئي. وعلاوة على ذلك ، فإن التكامل المحدود بين مختلف أصحاب المصلحة المحتملين يمكن أن يلعب دورًا أساسيًا في تحقيق تغيير شامل في قرية القاري وسيوة. ويضيف أهمية إنشاء قنوات بين السكان والمستثمرين الخارجيين والأكاديميين والهيئات الحكومية لتوفير منصة لتبادل المعرفة التي ستعزز لتحويل تقنيات العمارة البيئية الجديدة في القرية لخلق مجتمع صحي ومتكامل كما تم تسليط الضوء عليه.



# إقرار

هذه الرسالة مقدمة في جامعة عين شمس وجامعة شوتجارت للحصول على درجة العمران المتكامل والتصميم المستدام. إن العمل الذي تحويه هذه الرسالة قد تم إنجازه بمعرفة الباحث سنة ...

هذا ويقر الباحث أن العمل المقدم هو خلاصة بحثه الشخصي وأنه قد اتبع الأسلوب العلمي السليم في الإشارة إلى المواد المؤخذه من المراجع العلمية كل في مكانه في مختلف أجزاء الرسالة..

وهذا إقرار مني بذلك،،،

التوقيع:

الباحث: نجود عاشور

التاريخ: ٢٠١٨/٧/٢٩



# نحو البيوت الصديقة للبيئة

## إمكانية تطبيق مبادئ العمارة البيئية بين الأبعاد الفنية والسلوكية - حالة قرية الغاري ، سيوة

مقدمة للحصول على درجة الماجستير في العمران المتكامل والتصميم المستدام

أعداد: نجود عاشور

لجنة أشراف

أ.د. محمد صالحين

أستاذ التخطيط والتصميم العمراني  
المتكامل جامعة عين شمس

أ.د. أسترديد لاي

أستاذ العمران الدولي جامعة  
شتوتجارت أ.د.  
أسجامة

د. مروة عبد اللطيف  
التصميم والتخطيط العمراني  
جامعة عين شمس

التوقيع

لجنة الحكم

أ.د. ....  
الممتحن الخارجي  
أستاذ .....  
جامعة .....

أ.د. ....

أستاذ .....  
جامعة .....

أ.د. ....

أستاذ .....  
جامعة .....

تاريخ المناقشة: .....

الدراسات العليا

ختم الإجازة

موافقة مجلس الكلية .../.../...

أجيزت الرسالة بتاريخ: .....

موافقة مجلس الجامعة .../.../...

جامعة عين شمس



جامعة شتوتجارت





# نحو البيوت الصديقة للبيئة

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سيوة

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إعداد

نجد عاشور

المشرفون

د. مروة عبد اللطيف مدرس التصميم  
والتخطيط العمراني جامعة عين شمس

أ.د. أسترید لای أستاذ العمران الدولي

أستاذ التخطيط والتصميم العمراني المتكامل جامعة شتوتجارت

أ.د. محمد صالحين

جامعة عين شمس