Chapter 2

Towards Adaptive Design Strategies for Zero-Carbon Eco-Cities in Egypt

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Additional information is available at the end of the chapter

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Abstract

Eco-cities concepts are relatively new initiative launched by the World Bank, to help cities in developing countries realise ecological, social and economic sustainable future. Furthermore, with growing severe climatic events such as the rise in global temperature, flooding, wild land fires, and sea level rise, there is an urgent need to adopt sustainable and ecological design principles for the development of future cities. Egypt, one of the developing countries and third largest populated nation in Africa, is currently facing a series of threats. These include limited access to natural resources in relation to the population size and economic growth. In addition to the continuous challenging climate change implications. Despite that, till now there are no clear laws or legislation for eco-city design and construction. In this manuscript, we are trying to lay hands on hidden potentials and analysing successful private initiatives for existing eco-communities in Egypt. We adopted the analytical case study method tackling different aspects like renewable energy, permaculture, eco-sanitation, solid waste management, vernacular architecture, green transportation and green economy. The research contributes by critically analysing such attempts and concludes with design recommendations and strategies on how to reach an environmentally enriched, healthier, resilient and socially rewarding zero-carbon cities, running on their own locally available resources for the Egyptian cities.

Keywords: zero-carbon eco-cities, urban future, green urbanism

1. Introduction

Cities alone account for 78% of anthropogenic carbon emissions [1]. In the developing world, cities produce and consume at higher rates than rural areas per capita [2], and accordingly

account for an unbalanced share of greenhouse gas emissions. Let alone that the majority of urban south cities with coastal location with high concentration of economic activity and population [3] are the most vulnerable to the effects of climate change. In short, cities and consequences of human settlements are at the core of the problem, both in terms of carbon emissions at sources, and in terms of the effect of global warming. Low- and zero-carbon city design and planning can play a crucial role in reaching global targets in CO2 reduction, ensuring long-term energy security and reducing the impacts of climate change worldwide [3].

Egypt like many other several developing countries is facing a series of threats related to limited access to natural resources in relation to the population size and economic growth and energy poverty. All that had a strong influence on urban development and planning. Directing future development out of the narrow Nile valley and Delta becomes indisputable. The future urban development plans in Egypt for 2050 aim at spreading development over 40% of Egypt's area to exploit available natural resources and provide around 20 million job opportunities [4]. Other key concerns now in Egypt are climate change and moving towards a zero carbon era. This is a growing concern with Cairo being the most polluted capital in the Middle East, and according to the World Health Organisation [5], the second most polluted large city in the world in 2018. However, the majority of researchers and designers now throw around the terms eco-cities and eco-economy without clues on how to achieve them.

On a very limited scale in Egypt, few pilot settlements were early focusing on environmental sustainability, using renewables and eco-friendly building construction methods which have given such settlements a vital edge within national competitive sustainable communities. The majority however are private initiatives like Basata in Sinai, Tunis in Fayoum, El Basaysa in Sharkeya and New Basaysa in Ras Sedr. Only one so far is a governmental initiative named productive, low-cost and environmentally friendly village (PLEV) which is still in its study phase. When it comes to rating systems and assessment tools to achieve the objectives of the eco-cities, unfortunately the Egyptian rating system the Green Pyramid is still on hold, and even if it reached the action stage, it did not include any chapters for sustainable communities or eco-cities.

This study comes aligned with the new government decision for building a new capital city in new Cairo and another millennium city called New El Alamein. The proposed designs are targeting the wealthy minority and prioritise self-determination without looking at affordability, low-impact living and equality. Investing in green infrastructure especially when it comes to water conservation together with applying energy-efficient building design strategies was not of a concern. Hence, there is a great demand and need for a discrete code or guideline to help in designing and assessing new or existing cities. There is also a necessity for transdisciplinary eco-guidelines for our contemporary and future eco-city design and planning. But how can we design a community that is both liveable and sustainable is a key question that this study is trying to answer by filling in this gap in national codes and rating systems and showing broad lines for a pathway towards zero-carbon eco-city design in Egypt. It draws upon three case studies for private eco-communities in Egypt which are considered as pilot initiatives. Here we are analysing the three case studies and showing different design elements and drawing recommendation that can be used as a set of design framework for an eco-city model in Egypt like renewable energy, permaculture, eco-sanitation, solid waste management, vernacular architecture, traffic and green transportation, green economy and small/micro enterprises. Basata,

Habiba and El Gouna eco-communities were used as examples chosen as pilot projects, and they represent serious attempts in applying low-impact strategies and zero-carbon principles in sustainable building and community design. The three cases were also selected because they represent unique examples for an eco-community with an underlying philosophy of community behaviour and cultural understanding. They are designed, developed and managed in an environmentally sensitive manner. The main common philosophy was devised in response to the desire to preserve the nature with minimal carbon footprint. This analytical study contributes by drawing a vision of what a future sustainable zero-carbon eco-city in Egypt could look like.

2. Case study methodology

The study applied qualitative comparative analysis approach using case study methodology. The methodology comprises an in-depth literature search for previous work on eco- and zero-carbon cities to scan the field and understand where the Egyptian situation lays within the modern approaches in eco-cities notions. In this phase, we took a look at current policies of city development in Egypt, especially for the new capital and new El Alamein city. We also scanned for existing design and planning notions and looked at current examples to study. Three cases were then selected and analytically compared to each other to deduce lessons learned for possible recommendations for future city designs.

The three case studies represent private initiatives for pilot models for eco-communities in Sinai Peninsula in the northeast part of Egypt. They were chosen because they show a good mix of low-tech and high-tech building methods using available local materials. They also represent community-driven versus business-driven design approaches. During the case study investigation process, we carried out several site visits and interviews with the projects' owners and some of the workers and inhabitants/visitors. That was one main tool to collect the needed information and materials needed for the study. The projects managed to apply an array of low-impact and sustainable core principles for eco-communities but not necessarily that they have succeeded in all. As they are located in the same geographical zone, they also share the same climatic zone which is mild costal arid climate with harsh summer season. It was easy to compare the climate responsive solutions if any. We have picked the successful best practices and analysed them to drive key design applications that can be considered a start for a pathway towards eco-communities in Egypt. The aim is reach to a set of recommendation for principles that are low-cost, low-impact and can be community-driven and managed.

3. The four pillars of sustainability

As a known aim, sustainable development looks to improve the quality of life while preserving the Earth's natural resources [6]. There are three main pillars for sustainable development, which were first defined during the Development Congress in Johannesburg in 2002 and were later on further enhanced by scholars. These are the social, economic and environmental

pillars [7–9]. Economic sustainability calls for integrated approach that allows long-term growth while ensuring that no nation is left behind [6]. The utilisation of resources should not affect future income, allowing equity of resources for all generations, distributional equity and economic activity that are concerned with ecological aspects [9–11]. In terms of environmental sustainability, this refers to preserving natural resources for future generations and ensuring that natural resources are well managed and are being used with a suitable rate that would allow for regeneration of resources for the future [9, 11]. Social sustainability involves social cohesion [12], continuity of social values, identities and relationships and the sustainable presence of health, education, food, water, healthcare, and housing for all people [6, 9].

Moreover, recent literature indicates the importance of adding a fourth pillar for sustainable development, which is culture [13]. Cultural sustainability has seven main aspects that should be considered: heritage, vitality, economic viability, diversity, locality, eco-cultural resilience and eco-cultural civilisation [13]. Culture has previously been considered a part of social sustainability, including aspects such as equity, participation, awareness of sustainability, behaviour and preservation of sociocultural patterns, social capital, social infrastructure, social justice and equity [13]. However, culture is not yet included; thus, some scholars consider social and cultural aspects to be closely interconnected, as cultural values can influence social life. Furthermore, culture can actually be viewed as a necessary condition upon which all other aspects of social, economic and environmental sustainability can take place [13] (**Figure 1**).

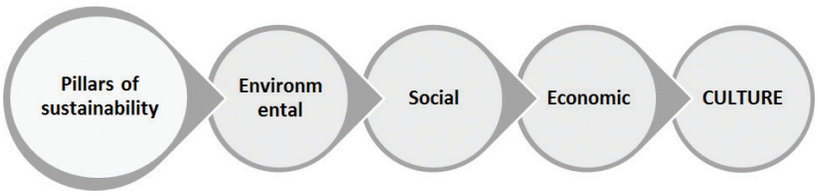

Figure 1. The four pillars of sustainability.

4. Eco, zero-carbon and productive cities: history and development

Various academics have put together definitions and theories for an eco-city. The term 'eco-city' was first coined by Richard Register to describe a city where human beings can exist in harmony with nature therefore greatly reducing our ecological footprint [14]. It is also described as a combination of many innovative design and planning ideas, each of which complement each other to form a reliable, amalgamated public environmental and climate-responsive community [15]. In an eco-city, science and industry collaboratively work hand in hand to achieve technical innovations, quality development and strong, long-term employment of its inhabitants [16]. It is a comprehensive and transdisciplinary concept and an amalgamation between science and technology, municipal policy and responsible citizenship [15]. It had been discussed in discourse that management of the environment is a key factor in local economy of eco-cities concepts together with other decisive factors such as culture, climate, and landscape coupled with locals' lifestyle and their ambition for a better quality of life [17]. An eco-city is much more than a few buildings that are energy-efficient. It is a complete design package that examines every element of human interaction with nature and positions that interaction in a way that humans have much less impact on the activities of other life forms [18].

Over the last decade, both researchers and academic have been arguing around interdisciplinary concepts of eco and sustainable cities. There are many wicked and interconnected challenges like fuel poverty, climate change and ecosystem degradation intensively discussed in the discourse. Many have drawn concerns about low-impact design approaches and how to make low-carbon transition and reduce carbon footprint [19]. Others focus on eco-urbanism, while many others tackle the notions of zero-carbon and recently post-carbon together with finding ways to understand new forms of carbon on calculations through carbon value change [20]. Nevertheless, researchers had pinpointed that towards a road map for post-carbon cities, we should adopt multiple solutions than can work on different scales, starting from planning fundamentals till building a sense of community and calling for mainstream policies of urban development [21]; others highlighted the importance of community-led approaches towards low-carbon urban governance [22] and more chances for grassroots policies [23]. In the end, the idea is how to design a community that can become low- to no carbon starting from construction phases till operation. Furthermore, to be able to depend mainly on renewables in producing energy while taking into consideration other main key principles like transportation and land use and energy consumption. It is becoming evident now that societies with less dependence on fossil fuel resources decarbonise their energy, necessitate occupants' behaviour change and value perception. In addition, more effort is needed to adapt new technological innovation for energy saving [24]. That also should not be neglected towards defining a clear road map for zero-carbon societies.

The concept of productive cities introduces the idea that cities integrate several approaches that would allow them to generate their own energy and resources. This could include water, food and energy production. This is becoming quite important with the growing increase in food and water security problems all over the world, due to agricultural land being converted to residential and industrial areas [25]. Furthermore, after the industrial revolution, infrastructure systems increased, and many transportation systems improved, ultimately leading to greater urban growth. This allowed distances to be less restrictive, and cities no longer had to be situated next to their needed resources [26]. As a result, more cities have depended on importing their raw materials, food and energy, using them inefficiently and producing a great amount of waste. Moreover, there has been an increased dependence on fossil fuels for energy, which are being consumed in a rate that is much higher than their generation [26]. Thus, in order to ensure sustainability, it is imperative that future cities become places of production [25]. A sustainable urban planning approach is needed that would enable inhabitants to make use of available local renewable resources and be productive of their own food and energy [25, 26].

In terms of food production, there has been growing attention to the concepts of productive urban landscapes and urban agriculture [27, 28]. Productive urban landscapes are all open urban spaces that are planted in a way to be productive either environmentally or economically. This could include their use for food production from urban agriculture, removing pollutants from the atmosphere, maintaining biodiversity or simply improving the urban microclimate from trees [27]. Urban agriculture is mainly concerned with the growing of food and raising of animals for food in areas within or around the city [29]. Food growing can be on the ground, on roofs, in the building facades as vertical green walls or at fences and boundaries [27]. Recent research indicates that this can actually have several benefits for cities. This includes enhancing urban food security, providing job opportunities, urban greening of the city and giving an

opportunity to use urban organic waste as a resource [29]. Compost production, vermiculture and irrigation are all examples of using urban wastes into productive resources [29]. Mougeot [30] also asserts that it is a vital part of the urban economic, social and ecological system.

Furthermore, productive urban landscapes can be in the form of vertical landscapes as well [25, 27]. Vertical landscapes include the placing of vegetation vertically against the building façade. This can act as a second skin that may not only be used for food production but also can have environmental benefits as well [27]. This will be made easier in high-rise towers through the use of photovoltaic cells that would allow vertical farms to be self-sufficient and sustainable. This is because providing sufficient lighting to mimic the sunlight and water pumping for irrigation are usually the main energy concerns in vertical farming [25, 31]. In terms of energy, Leduc and Van Kann [26] proposed a sustainable urban energy planning approach to create productive urban regions. Leduc and Van Kann [26] concluded that urban harvesting should be used as a planning approach, to transform urban regions into more productive areas. This includes taking into consideration local materials and resources and harvesting them to minimise any imports, while waste is identified as a valuable asset. Furthermore, resource consumption patterns in cities are closely linked to urban functions. Therefore, description of urban functions is indicated as an important aspect that can help provide valuable information about local resource demand and availability [26].

5. Three case studies: description and analysis

We start here by introducing Basata, Habiba and El Gouna, the three cases studies chosen for this analytical part. Basata is an eco-lodge for tourists' activities with a main goal of supporting the Bedouin local community located in Nuweiba in South Sinai, Egypt. The eco-lodge includes main residential units and an educational centre that gave the chance to the local Bedouins to have access to basic education which is lacking in that remote part of Sinai. It attempts to create a special self-sustained eco-community around the main activity of tourists' units (huts and chalets) that has a relatively low impact on the surrounding environment and the native inhabitants (**Figure 2**).

Habiba is an agricultural-based community farm located in Nuweiba as well. The community is composed of a beach eco-lodge, an organic community farm and a learning centre that

Figure 2. The three case studies analyzed in this study.

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provides after-school education for local Bedouin children. The Habiba community advocates the idea of 'agritourism' and fosters the idea of international exchange in this aspect. It encourages having tourists and international specialists to come stay with them for a few months to share their experience in organic desert agriculture or to conduct research and experiments. Furthermore, the community also created the 'Sinai Palm Foundation', which is concerned with the expansion of palm date agriculture in the Nuweiba area. Moreover, the Habiba community partakes in different endeavours with partners, organisations and universities from all over the world to help in building their sustainable desert community in Nuweiba.

As for El Gouna, it is a small community spreads over 10 million m^2 of unspoiled terrain with 10 km of pristine beachfront located on the coast of the Red Sea, 25 km north of Hurghada. It contains residential area such as hotels, resorts and housing area together with public buildings such as universities, schools and libraries and finally the commercial and services area. On the other hand, El Gouna is to a great extent a gated community, with guarded entry gates surrounding the community. It is divided up to several parts; the island of El Kafr, the downtown area, the Marina area, and the workers' residential quarters. El Kafr mostly holds residential units. The downtown area is the main commercial zone, devised of several shops, restaurants, low profile residential areas. The Marina area holds two artificial bays with a waterfront walkway that has several small buildings (**Figures 3** and **4**).

Figure 3. The urban layout and the arrangements of huts and chalets in Basata showing the footprint and low density.

Figure 4. To the left sample of architecture style at EL Gouna and the right for the trials in using natural materials in Habiba.

5.1. Architecture, building materials and building technology

The main materials used in Basata's residential units are natural widespread biodegradable materials in Egypt like reeds, clay, straw and natural stones. The idea of using mainly using reeds, baby bamboo, straw and clay is to reduce the embodied carbon in the construction and also in lifetime energy usage. The applied indigenous construction methods reflected the local vernacular architecture of the region. The design was a response to cultural and social aspects as well. The main notion is emphasising the special character of the desert architecture and avoiding using any materials that can harm, pollute the environment or have high embodied energy together with eluding the use of any heavy construction equipment to avoid noise pollution during construction. For both El Gouna and Habiba, there are serious trials in using natural materials mainly stone, wood and clay, but the majority of the structures in both are manually using conventional materials like cement and fired bricks. In Habiba, they had examples of rammed earth construction, buildings with straw and buildings with recycled bottles. Many other building techniques were implemented as research work, as researchers can experiment and build their structures for testing and experimentation. In the three projects, stones and local materials are used in the hardscape like pathways and benches (**Figure 4**).

5.2. Passive low-impact strategies

In Basata, several passive strategies were applied for energy-efficient cooling, heating, ventilation and natural daylight. The optimal use of natural wind patterns and night flush effect together with encouraging cross ventilation reduced the need for air-conditioning or any other forms of artificial cooling in summer especially inside the reeds and bamboo huts. While in the adobe/stone chalets, the high thermal mass of the walls and high-domed ceilings played a major role in reducing heat gains during summer and providing adequate indoor thermal comfort all year round. In winter, for example, the warm night sea breeze and thermal mass of the chalets stone walls help in providing warm indoor comfort with minimal need to night heating. In Habiba, the applications for passive systems were limited, but there were few trials in using passive heating systems like Trombe walls, and for cooling they depend mainly on cross ventilation strategies using windows and doors crossing each other. In El Gouna, they mainly depend on high thermal mass walls. In addition to some roof structures that are dome or vault shaped with high ceilings, which help in reducing cooling demands during the long summer season. Wind catchers and solar chimneys were used in some of the buildings for cooling and ventilation. The same for using passive cross ventilation which is crucial in the three projects because of the hot humid weather (**Figure 5**).

Figure 5. Example for using wind catches as passive cooling strategy in EL Gouna.

5.3. Waste and water management

Waste sorting has a strict policy in the three projects. In Basata and Habiba, organic food excess from cooking and from meals left over are used to feed animals grazed on site. Animal manure is used as an organic natural fertiliser for the plants, and it is also used in the clay soil mixture in building. For both Basata and Habiba, all solid recyclable materials are sorted and picked by a local NGO to the solid waste transfer station in Nuweiba, where they are further sorted and sent for recycling in main factories in Cairo. While in El Gouna, all waste is also recycled and sent to main waste stations in the nearby area. In the three projects, there is a water desalination plant onsite that produces fresh water and brine water (highly concentrated salt water). Also, they apply strict water conservation policy. Fresh water is used in kitchens only for cooking and rinsing the dishes, while in the bathrooms only for showering and handwashing. Brine water is used for the rest of purposes like washing the dishes, toilet flush and for construction work. In Basata and on some parts in El Gouna, toilets water saving taps are used and that helps in reducing water consumption. On average, each person uses from 70 to 100 l of water per day, compared to an average of 500 l per person per day in neighbouring tourism communities. As for wastewater, it is divided into grey water and black water. Grey water is used for irrigating nonedible crops, endemic palm trees and plants. The salty black water goes into sealed septic tanks and then is transferred to the main water treatment plant. In Habiba, the eco-lodge promotes the ideas of water management and conservation. A waste recycling system is also implemented in the eco-lodge but no waste water treatment system.

5.4. Energy resources

Basata and Habiba are located in an off-grid site so as an essential need; they had to start with diesel generator as renewable energy which was not feasible in terms of high cost. Now in Basata, they started gradually to replace the generators with solar panels for electricity and solar heaters for water heating. Energy saving light bulbs are used. In some building units, there are basic electric equipment, but no air-conditioners are installed, neither are TV sets, refrigerators nor electric entertainment facilities. In winter time, they tend to turn off the electricity generators for several hours during the day, since kitchen refrigerators are not in use as much. One of the strategies to reduce light pollution on site is to minimise the outdoor lighting features. For the Habiba community, it is concerned with energy and resource preservation. In the eco-lodge, there are no electric water heaters for energy conservation, and roof top coolers are used. However, the place does not integrate the idea of producing energy whether through solar cells or any other renewable means. At El Gouna, some of the buildings use solar water heaters located on the roof tops. Also, they have photovoltaic cells for electricity production in some buildings.

In both Basata and Habiba, food production and urban agriculture are, however largely implemented through the community organic farm. This provides inhabitants and locals with the locally produced organic food thus helping in creating a self-sustained community in terms of food production. In Habiba, the focus is more on the agriculture compared to the other two projects (**Figure 6**).

5.5. Green urban spaces and networks

In Basata, specifically, the approach for site planning aims for satisfying living needs and changing radically to a more efficient use of land. The site planning reduces the ecological

Figure 6. Using solar water heater and PV systems for electricity production in EL Gouna.

footprint with a minimal level of urban density. It is easy to cycle or walk and move around the place even when there is no specific cycling or walking lanes. One of the main environmental site concerns was but is not limited to preserving the abundant marine life, fauna and flora. There is no artificial planting or importing non-endemic flora. Grass is not used as ground cover because it requires huge amounts of freshwater and polluting fertilisers.

While in Habiba farms, the green urban spaces are mostly present in the form of the farmed desert land. The community organic farm has a variety of home-grown fresh vegetables and fruits aiming to green the desert. Furthermore, these fresh organic products are then sold in the area's local market. The idea of permaculture is also promoted, hoping to raise awareness on the benefits of organic food production for the local community and the surrounding Sinai region. As for El Gouna, the spaces are varying from public, semipublic, semiprivate and private according to the function of the buildings around. The green open public spaces are not well designed and not distributed enough around El Gouna, except for some soft scape around the hotels and the residential areas which act as buffer zone to decrease temperature. Generally, open public places such as squares lack shading devices and soft scape (**Figure 7**).

5.6. Mobility and urban transport

The main idea is to have Basata as a car-free community. The car parking spaces are only on the entrances of the project and not allowed further on. The car parking share is almost 0.3 for each dwelling. Walking and biking are the main mobility means. In Habiba, mobility and urban transport has not really been developed sustainably in the Habiba community. Reliance is mainly on transportation by car and automobiles to get to the area. Inside the eco-lodge area, walking is the main mode of transportation as the area is not very big and so there is no need for any other means. However, the farms and learning centre are a bit far from the eco-lodge, and transportation to them requires an automobile. It should be noted that

Figure 7. Urban farm in Habiba farm, and the urban spaces at EL Gouna.

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Figure 8. Bike rents and motorcycle.

the entire Nuweiba area is lacking in this particular aspect, as no means of public transport between the different eco-lodges is provided, and public transportation in the area is not quite developed. In the case of El Gouna, although it is considered a residential and touristic area, the main transportation there are bicycles, tuk-tuk and buses in addition to private cars. It is considered a walkable area; however in summer, it becomes so hard to walk or cycle during the day. The central area of El Gouna is just a pedestrian area and just a touristic place without even any economical place. Walking and biking are the main mobility means, and in El Gouna they used shared bus service to reduce car dependency. According to [32], there are several transport services that were launched in 2014 that combined a petrol engine with an electric motor for cars and shuttles. These allowed the ability for cars to run on electricity alone, all around El Gouna, and so reducing the carbon emissions (**Figure 8**).

5.7. Community involvement

The aim of Basata and Habiba is to create sustainable, environmentally friendly income for the local community. The integration of the local community is an integral part of the organisation and thus provides a lot of support to the local Bedouin community. The locals are provided with several job opportunities through their work in both the eco-lodges and specifically in Habiba in community farms and the Sinai Palm Foundation. In both aspects, they are educated and trained to work in the agriculture and farming work. Furthermore, the educational centre in Basata and the learning centre in Habiba provide after-school education for the local Bedouin children. The children also get involved in the farms as a learning experience to learn the value and importance or producing healthy food and farming. The Habiba community also supports the WOMAD project, a project that aims to empower the local Bedouin women and help them in raising funds for their children's education [33]. In addition to this, all surplus funds that come from the beach eco-lodge are directed towards the expansion and reach of such local projects [33]. In both Habiba and Basata, the local Bedouin women are also provided the opportunity to showcase and sell their handmade accessory products to the visiting tourists and eco-lodge guests. The organic farm's collaborations with NGOs, universities and organisations also expand the role of the place in providing a training hub for sustainable farming and development and an important model for the South Sinai region [33].

In El Gouna, the community part is somehow not considered except for few activities. The playground of the school is being used in summer or night for other community activities which increase the community relations. However, the buildings are not constructed by the residents themselves, which lack the community integration in this part. Thus, labours are hired from the surrounding areas to build this type of construction which they need to be trained before (**Figure 9**).

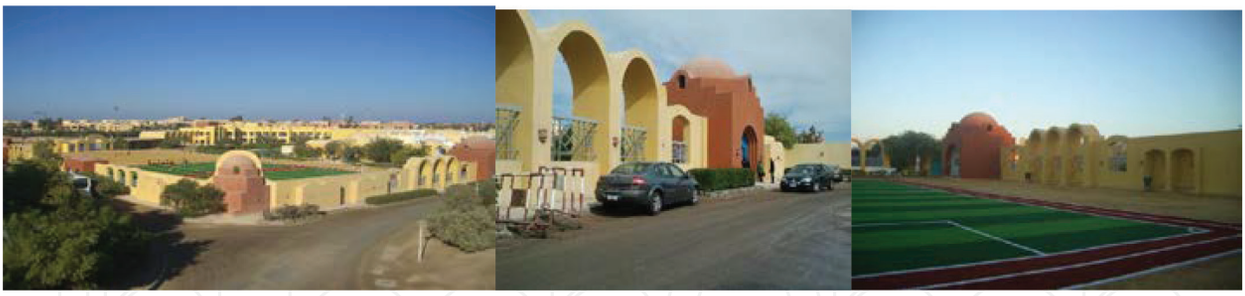

Figure 9. School's playground is turning into community activity in summer at EL Gouna.

6. Recommendation for planning zero-carbon eco-cities

The aim of eco-cities is to build a viable future for humanity with a healthy planet where the Earth, water and air will continue to support our complex renewable-powered ecosystems.

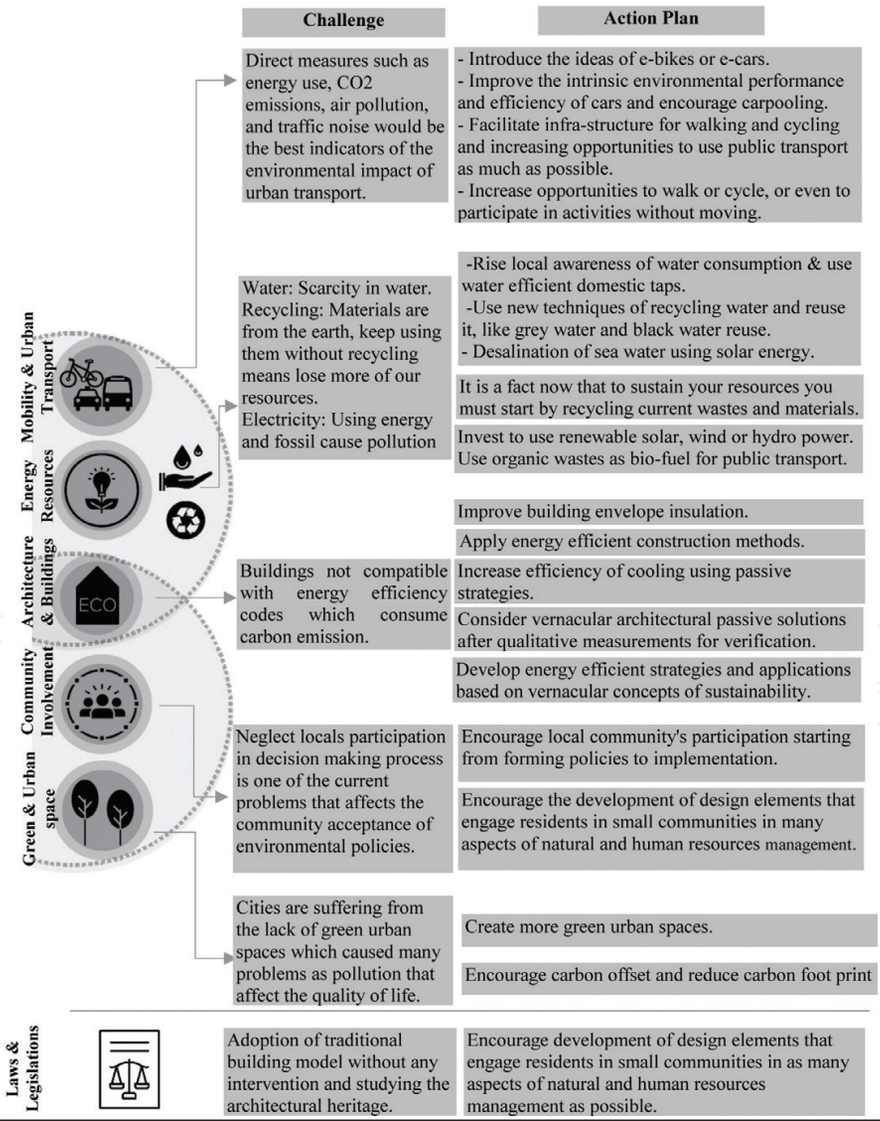

Table 1. Recommendations and proposed solutions for current challenges to be used as future for guidelines in designing eco-cities in Egypt.

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In this chapter, it is clear that the concept of eco-community can be achieved apart from the government. So, it is even easier if there is an obligatory design guideline and strict laws and legislations. Here in this section, we are recommending a group of ideas that can be used as guidelines for designing eco-cities based on the analysis of the three case studies. We tried to form the recommendations as current challenges and proposed solution for guidelines. **Table 1** illustrated some essential points that are advised to be taken into consideration while planning an eco-city.

7. Conclusion

The twenty-first century is shaping up to be a traditional era for the humanity who dwells on this Earth. The pressure we are placing on the planet's resources has become increasingly unsustainable. The resulting problems we face, such as water and resource scarcity, increased energy demands and costs, shrinking fossil fuel reserves and a changing climate, have sounded a wake-up call heard round the world. Those who are heading the call and embracing the need for change are finding the necessary solutions and opportunities not only to address this global set of problems but also to advance and improve humanity's relationship with the living world and improve our quality of life. Much of the stress we impose on the Earth is manifested in the way we design, construct and use our built environment; that means buildings and cities must play a vital role in shaping our sustainable future. They are as much representatives of a global approach to our built environment as they are exemplary buildings.

This chapter introduces a brief understanding of eco-community's definitions and is discussing three of the Egyptian pilot projects as an analytical model for a prospect of a zero-carbon city design and planning in Egypt. The dream of the eco-city in Egypt is a city that is a desirable place to live. It is becoming a necessity to develop an integrated model for an eco-city lead by a multidiscipline group of experts including but not limited to renewable energy, agriculture, eco-sanitation, solid waste management, vernacular architecture, traffic and green transportation, economy, social and cultural studies, services, governance and small and micro enterprises. Renewable energy and energy efficiency are a core sector with close implications on other sectors such as agriculture, transportation, housing and services. If these conditions are fulfilled, the community will be able to perform the required actions to produce all needed services and products resulting in an improvement in the overall economic conditions without degrading the surrounding environment. In Egypt, we need a city that is designed around the individual and the family creating a fully integrated neighbourhood orientated around public spaces and civic amenities and a city that encourages the growth of communities and relationships. Sustainability, a vibrant economy, future viability, scientific excellence and a decent life attitude all melt in the same pot towards the same goal of a post-carbon eco-city model for its inhabitants.

We can conclude from the case studies that the concept of low-carbon and low-impact communities can be transformed from an idea to reality and practice. They are not only a product but also a process for sustainable lifestyle. In Egypt unfortunately, we tend to apply replicable outcome-based approaches. It is high time to look for strategies that prioritise participation. We need to deal with complex challenges in our city design approaches. A holistic approach in dealing with low-carbon economic growth should consider the social, economic and ecological reciprocity. More grassroots and community-driven approaches are needed for equity

towards low-carbon urban governance. A formal policy support on a national level is important together with national guidance on sustainable communities and community asset transferee. Designing eco-cities is not anymore about only attempting to reduce GHG emissions and energy consumption. We should tackle it from a more holistic view and consider economic justice, behaviour change and wellbeing in addition to community self-management. Some of the recommendations sound like basic aspects in sustainable city planning in modern cities, but Egypt still lacks such basic concepts of sustainable city design.

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