ENVIRONMENTAL BEHAVIORS OF CURRENT MODULAR NEIGHBORHOODS THROUGH CURRENT REGULATIONS "ESTIDAMA", UAE

السلوكيات البيئية لوحدات الأحياء الحالية من خلال اللوائح الحالية "استدامة"- الإمارات العربية المتحدة

By

Oraib Khalaf Al Me'adat Al Abbadi

Student ID: 120073

Dissertation Supervisor: Dr. Hasim Altan

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Abstract

The efficiency of the environmental status management is of a crucial importance in big emerging cities, as these cities are not strangers to environmental setbacks despite their industrial rapid developments and advancements. Therefore, an adequate framework that sets basic implementation strategies of environmental methods and relevant legislations is essential for developing the sustainably environmental coefficient of cities and current industries.

According to Abu Dhabi 2030 vision statement established by Abu Dhabi's urban planning council, the urban context of a typical community in Abu Dhabi consists mainly of a neighborhood that is repetitive in its main functional components rather than its physical or structural perception known as "Al Fareej".

This paper, draws an attempt at capturing the importance essence of adopting environmental strategies within the development of current modular neighborhoods to produce “sustainably environmental communities”, through The Estidama community pearl rating system as the main sustainability guideline that is followed by Abu Dhabi, established to set and evaluate the mutual coexistence of communities with the environment from a sustainable point of view.

As Estidama is a new program established in 2010, it targets all relevantly new projects that are to be constructed or designed. The question of applicability remains unanswered to current neighborhoods as they are not addressed within the Estidama vision. This study’s importance lays in capturing the extent of influence that is to be anticipated when applying environmental green methods to existing neighborhoods, as these operating current neighborhoods are important elements to the city of Abu Dhabi and considered vital in defining the city's environmental status.

Through City Cad, and via Estidama credits, a direct reading of the environmental behavior change result in this study as direct numerical values to set a tangible results defined by scientific values.

The environmental setting in hand will be defined by Estidama after specifying the parameters that this program addresses.

As a result it is found that Estidama and current neighborhoods environmentally meet mainly in 4 environmental pillars tackling the CO2 and gas emissions, the water usage, waste generation and energy consumption. After running simulation on these parameters, it is noted that the neighborhood's post environmental behavior falls within the expected behavior of planned neighborhoods that are primarily targeted by Estidama, but do not hit the highest levels that are set by Estidama.

Indeed there is a link between the local rating program and current fully operating neighborhoods, and of course there is a noticeable influence on the environmental behavior by integrating Estidama environmental strategies, but it is not foreseen as an optimal setting as all

intervention methods are of an active nature rather than a passive one. Estidama within Abu Dhabi need to address the issue of current neighborhoods and work on including them within the sustainability movement of the capital due to their essential role in such initiative.

This study has come to a result of ultimately highlighting the ability of current operating neighborhoods to adapt to newly implemented concepts of sustainability, and highlight the ability of the implemented program of Estidama to adapt to the current setting of neighborhoods not only new ones. This also raises the awareness of the essentiality of sustainable communities and highlighting their role in achieving the balanced status between the environmental, economic and social developing aspects on both the local and national grounds.

Key words: *Environmental sustainability, Neighborhood, UAE, Abu Dhabi, Estidama*

الملخص

كفاءة إدارة الوضع البيئي هو من أهمية قصوى في المدن الكبيرة الناشئة، وهذه المدن ليست بغريبة للنكسات البيئية على الرغم من تطوراتها السريعة الصناعية والتقدم الملحوظ التي تسجلها. وبالتالي، تبرز الأهمية لإيجاد المدى المنتج لإطارا مناسبا يحدد استراتيجيات التنفيذ الأساسية لأساليب مستدامة والتشريعات ذات الصلة حيث أنه أمر ضروري لتطوير معامل المستدامة للبلدان والصناعات الحالية.
طبقا لبيان أبوظبي في رؤية ٢٠٣٠ التي أنشأها مجلس التخطيط العمراني في أبو ظبي، السياق الحضري للمجتمع في أبوظبي يتكون أساسا من الحي في تكراره للمكونات الرئيسية الوظيفية، بدلا من النظرة المادية أو الهيكلية و المعروف باسم "الفريج ".
هذه الدراسة، تتوجه لمحاولة لالتقاط جوهر أهمية اعتماد استراتيجيات بيئية في إطار تطوير الأحياء الحالية لإنتاج "المجتمعات البيئية على نحو مستدام"، من خلال تطبيق لنظام استدامة التقييمي للأحياء و المجتمعات يتبعه أبوظبي، التي أنشئت لتقييم التعايش المتبادل بين المجتمعات مع البيئة من وجهة نظر مستدامة.
نظام استدامة الذي أنشئ في عام ٢٠١٠، يستهدف جميع مشاريع الأحياء الجديدة ، في مراحل التصميم و البناء حيث أن الأحياء الحالية لم تعالج في إطار رؤية استدامة. أهمية هذه الدراسة تستفتي مدى التأثير المتوقع عند تطبيق الأساليب الخضراء البيئية للأحياء القائمة، وهذه الأحياء الحالية العاملة هي عناصر هامة في مدينة أبوظبي وتعتبر حيوية في تحديد الوضع البيئي في المدينة.
من خلال City Cad، وعبر اعتمادات استدامة، ستنشأ قراءة مباشرة كنتيجة تغيير السلوك البيئي في هذه الدراسة من خلال قيم رقمية مباشرة لضبط نتائج ملموسة تحددها القيم العلمية.
سيتم تحديد الوضع المطروح من قبل استدامة بعد تحديد الوجوه البيئية المحددة في استدامة.
وكنتيجة وجد أن استدامة والأحياء الحالية تتقابلان بيئيا بشكل رئيسي في ٤ دعائم بيئة و هي معالجة انبعاثات الغاز، واستخدام المياه، وتوليد النفايات واستهلاك الطاقة. بعد تشغيل المحاكاة على هذه المعايير، لوحظ وضع السلوك البيئي في الحي ضمن السلوك المتوقع من الأحياء المخططة التي تستهدفها استدامة، ولكن لا تصل إلى أعلى المستويات التي تم تعيينها من قبل استدامة.

في الواقع وجد أن هناك صلة بين التصنيف المحلي الأحياء الحالية و التي هي مأهولة و تعمل بشكل كامل، ولهذا تأثير ملحوظ على السلوك البيئي من خلال دمج استدامة، ولكن ليس من المتوقع انها الإعداد الأمثل حيث أن جميع طرق التدخل ذات طبيعة زائدة و ليست مفعلة من الأصل. استدامة في أبوظبي بحاجة إلى معالجة مسألة الأحياء الحالية والعمل على إدراجها ضمن الحركة المستدامة حبث يعتبر دورها مهما.

وقد أفادت هذه الدراسة إلى نتيجة تسليط الضوء في نهاية المطاف الى قدرة الأحياء الحالية للتكيف مع مفاهيم استدامة، وتسليط الضوء على قدرة البرنامج المنفذ لبرنامج استدامة للتكيف مع الوضع الحالي للأحياء وليس فقط الجديدة. هذا يثير أيضا ضرورة زيادة الوعي نحو المجتمعات المستدامة وإبراز دورها في تحقيق حالة متوازنة بين الجوانب النامية البيئية والاقتصادية والاجتماعية في كل النواحي المحلية منها والوطنية.

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Chapter 1

Introduction

The lack of integration between the natural and engineered systems is perceived as an environmental setback, highlighting misplaced priorities that address current environmental neglect in followed regulations and relevant legislations on the main governmental authorities that play the prime role in city and urban planning terms. This misplacement is unfortunately self-claimed as a common feature in the current cities development and growth progress.

Urban growth has been a feature of cities for as long as they have existed, human settlements have been increasing clustering into cities that form today's world image. Zooming back into this scene, the human settlements are foreseen as individual pixels that set up the final big picture, consisting of urban neighborhoods and their in-context communities.

Today's world is experiencing the largest boom of urban growth in history. This lays its burden on the environmental aspect of the urban growth behavior, as cities and towns hold the highest share in energy consumption rates and the greenhouse emissions. The urban sprawl is a persistent pressure on the world's natural resources, and is kept as it is sacred by all its forming neighborhoods and urban settlements.

There is an urgent need for dealing with the consequent environmental impact raised by the clustering of human settlements in neighborhood units that form a city. This is addressed by improving the current urban neighborhoods and pre-establishing planning new ones into adopting sustainably environmental methods and adjusting them into sustainable urban communities. Furthermore, drawing the importance of neighborhoods and adapting their operation to environmental standards as they are the core of current and future urban settlements, 2008 marked the first time when globally more than half of the population (about 3.3 billion people) lived in urban areas (Marique and Reiter, 2012);. Moreover, by 2030, an anticipated number of 5 billion will be distributed within urban areas of cities and towns as urban dwellers.

A governmental intervention through legislations and implementing policies is the most important step towards achieving a higher enhancement in the neighborhoods and their relevant community's environmental status quo.
This is indeed followed in Abu Dhabi the UAE, by the obligation of implementing the local green rating system "Estidama" on all future neighborhoods, through design and construction phases.

But the questions lays in specifying the fit role for all the current operating neighborhoods in the environmental sustainability vision of the capital, the neighborhoods of which exist before Estidama thus never implemented the concept of sustainability neither in design, construction nor in their operational ongoing phases.

To clearly enclose on such neighborhoods environmental setting within Estidama, a close up is to be done through this study to analyze Abu Dhabi's sustainability orientation and its link with current neighborhoods.

1.1 Background

In Abu Dhabi, the capital of the United Arab Emirates, the environmental sustainability movement issue was addressed by two initiatives, the Abu Dhabi 2030 vision and the establishment of the Estidama program, as presented below.

Abu Dhabi's urban planning council (UPC) has reflected the continuous efforts of developing a new sustainable city concept in Abu Dhabi's Plan 2030, of which sustainability is the milestone of any planned establishment and development vision of the future.

Furthermore, as a government initiative developed by the Abu Dhabi Urban Planning Authority Estidama was developed; a construction sustainability program and in which the pearl community rating system (PCRS) is implemented and followed as the rating system that is has to do with communities and futuristic neighborhoods taking place within the 2030 plan land use.

Estidama appears to have picked certain elements from the two systems of BREEAM and LEED amongst other sources of inspiration, but still developed a system that is quite progressive and distinctly local, adapting previous efforts and experiences to UAE's current and anticipated climatic conditions, social settings and industrial perception.

The combination of enforceability of parts of Pearls and the incorporation of Pearls within Estidama's larger development framework, together with Estidama's efforts to promote an Integrative Design Process and the efforts by the market-driven Emirates Green Building Council, all have the potential to hasten the market's adoption of green building practices at a faster rate than perhaps seen in the United States and the United Kingdom over the last 20 years.

This commitment is a reflection of the values and ideals of our nation. The tenet of sustainable living in the Middle East is the guiding force behind Estidama. More than just a sustainability program, Estidama is the symbol of an inspired vision for governance and community development (community pearl initiative)

Addressing the main issue of burdening the environmental aspect of these human settlements by increasing the development growth of neighborhoods and communities; many strategically environmental enhancement methods have been adopted by Estidama pearl community rating system and LEED (existing neighborhoods). These strategies are encouraged to be implemented and integrated for achieving the targeted rating level, pre-established for every projects unique settings and special requirements.

The environmental conductance of applying the many methods that Estidama draws within neighborhoods and communities will be attempted to be measured in this study and presented as tangible outcomes that tackle the range of successful green methods implementations in current communities and the extent of a positive influence that they can have on amending the environmental pattern of the neighborhoods.

1.2 Problem statement

While the tremendous growth of the emirates urban centers is quite remarkable, it raises important sustainability questions.

The sustainable framework implementation has been pursued by one of the most rapidly thriving cities of the world, Abu Dhabi, The United Arab Emirates. The capital's regulations and framework legislations have taken sustainability on a very direct implementation level.

The Estidama system is a very good one conceptually, but it has broken down at the implementation stage. As noted, the system is not applied or rather, has not begun being applied to existing buildings and neighborhoods. This is despite the fact that Abu Dhabi consumes well above the world average of electricity and water and also despite the importance of the role of current neighborhoods in lining the shape of Abu Dhabi's environmental sustainability statement.

Although pursuing such suggested sustainability enhancement methods for a tangibility sense of achievement throughout a "green" accreditation system is a positive well integrated goal for all communities intended for a sustainably environmental use, what is neglected within the construction market industry's run after budgets of money, time and personal professional achievement agendas is the environmental achievement of such sustainably planned communities and neighborhoods.

Since the neighborhood is already operating and had not been built on sustainably environmental foundation, thus the residents of such development are not expected to get involved highly within the adaptation to a sustainable setting.

This is mildly considered as it is considered as a post run, the behavior that occurs after construction completion, even after occupancy, moreover the lack of tangibility of this important aspect to most of the industry's professionals makes it even harder to prevail as an essential role, forgetting that it basically formed the foundation along with the social and economic majors, for all green systems to be established within current legislations and policies in the UAE.

Current existent neighborhoods are as important to Abu Dhabi as future planned ones. Even if Estidama is a new developed concept, it is possible for current neighborhoods to adapt to the requirements set out by Estidama, clearly for approaches that do not require major changes in neighborhood layout or design.

This setting is also of a great importance to current neighborhoods that comply with the 2030 Abu Dhabi's land use, and are planned to keep existing and operating in the future as well.

This study tries to find the link between Estidama and current neighborhood developments, a link that is not mentioned through this rating system program or its agenda.

1.3 Motivation of the study

This study humbly tries to capture the expected change in the environmental behavior of a current neighborhood numerically, in a tangible presentation, after adopting Estidama derived environmental approaches, thus presenting the most direct ways to influence a current neighborhood environmentally.

This is essential to narrow the gap between the current local green rating system "Estidama" that is made for the design and construction stages of neighborhoods, and current fully operating neighborhoods that are rich in content for the city's urban fabric.

This study is also motivated by the need to define where Estidama meets with current developments rather than planned ones and in what criteria these two meet, and what is the extent of adaptation between the two forces.

1.4 Significance of the study

This study's importance lies in raising the awareness of the essentiality of adapting current neighborhoods to sustainably environmental goals, reflecting their vital role in drawing the sustainable status quo of the capital. For such cause it is essential to study the extent of a positive influence that such adaptation, derived by local legislations, can have on environmental uses patterns and behaviors.

This study has been built on current and previous studies that address different corners of the same issue. It will also be based on approaches such as simulation, reporting and a real life caste study. This will definitely help the study to capture the tackling process for verifiable results that stand on a strong issue addressing foundation.

This study is also perceived as an initiative that fits perfectly in the rapid movement of Abu Dhabi's green achievements and ambition and thus foreseen have social and environmental features to comply with requirements of today's world in the UAE.

It can be a part of future efforts to produce an implementation and operational rating system that can be adopted by current neighborhoods of the UAE, based on what is provided by Estidama community pearl rating system, which is to be presented within this study.

1.5 Aim and Objectives

Since Estidama is made for planned neighborhood developments, specifically for their design and construction phases, the aim of this research is to deliver an image of the extent of influence that Estidama regulations can have on the environmental uses patterns and behaviors of current neighborhoods; to find the size of the link between local green legislations and current neighborhoods that operate on anon-sustainable implementation plan.

This study also draws at simplifying and directing the possible methods that work on a current neighborhood through initiating an environmental bundle made of approaches and methods adopted through Estidama community pearl rating systems that can be implemented in current neighborhoods. Concluding the most direct implementation approaches that can be integrated within an operating neighborhood in which the pattern of the community environmental behavior can be enhanced.

Correspondingly, with the help of this particular study, a comprehensive idea can be acquired regarding how to create better sustainable communities in the changing global environment.

The objectives of such study consist of:

- Collection and evaluation of the recent and subjective views of various scholars regarding environmental trends, patterns and behaviors in sustainable communities through proper literature reviewing.
- Presentation of Abu Dhabi's 2030 plan and its relevant sustainability vision.
- Highlighting the Estidama community rating system role and statement.
- Presentation and analysis of the current strategies that have been adopted by the local Estidama pearl rating system for communities.
- Specifying the environmental approaches that can be adopted by a current fully operating neighborhood.
- Specifying a case study of an existent neighborhood for real data entry to the simulation program City Cad.
- Running a simulation model on the chosen case study to address the difference in behavior after applying the environmental amendments.
- Reporting the results of possible environmental enhancements.

- Highlighting the influence of integrating the environmental factors that affect current sustainable neighborhood developments on each environmental aspect.

Finally, results and findings will be reported then discussed within the final stages of this paper's presentation. This aspect thrives to form an environmental modular package that can be adopted in different community developments as a basis model as a concluding extensive statement.

Chapter 2

Literature Review

2.1 Overview

The main aim of the literature review is to evaluate and study various research papers which speak about in-depth information on defining sustainably environmental regeneration of neighborhoods and assessing neighborhoods through legislations frameworks of green rating systems. In this section, existing journals and papers are reviewed to present accessible knowledge to the subject of study.

2.2 Sustainable regeneration

The literature on the evolution of regeneration reveals that the process was primarily aimed at bringing deprived sections of urban centers to at par with the more developed locales. The evolutionary process ultimately led up to the current phase where policies developed are striving to establish sustainable places. Such development which is aimed at the establishment of sustainable places or communities can best be envisioned as sustainable regeneration. Sustainable regeneration projects are those which provide communities with lasting improvements through an integrated approach that addresses not only economic problems of deprivation, but also the social and environmental ones (Sustainable Development Commission, 2002). These aims of sustainable development are captured as the tenets upon which regenerative policies within the final phase are built on. They include: environmental strength, economic strength and social well-being (McDonald, Malys, & Maliene, 2009). Of key importance here is the role of environmental consideration. It would appear that the culmination of the evolution of the design of regeneration policy is the recognition of the role of the physical environment in alleviating deprivation.

Sustainability as a concept has featured prominently in many disciplines. It is one of the most emergent and most pertinent issues of the 21st century. While no concrete definition of the term has been developed, several proposals have been fronted. One such definition is that sustainability is process of efficient resource utilization in order to create capacity for re-use by future generations (Freedman, 2010). While the term has wide applicability, its use and reference almost always point back to the natural environment or elements therein. More emphasis has been placed on green energy and this allows adoption of environmentally clean fuel sources for example geothermal energy and solar energy. Green energy is credited for creation of pollution free environment thus protecting the environment from destruction.

Ecological significance and sensitiveness have grown tremendously, promoted in part by the realization of the depletion of resources (Roseland, 2000). This contributed to the need for sustainable approaches in development and urbanization but such recognition was mainly at the realms of policy development. Through subsequent stages of urban policy development, there arose environmental assessment tools, whose purpose was to assess the ecological impact of buildings. However, with time, such tools have now assumed an active role in guiding and

dictating the direction of building. They offer accreditation to buildings based on their score on the particular environmental assessment index. This has contributed to the awareness of sustainable regeneration and the need for sustainable development, as designers and constructors acquaint themselves with the precepts of sustainable buildings (Hoff, Ibrahim, & Resort, 2004). Therefore, sustainable regeneration is not just about the design of sustainable communities through affordability; rather, it is also about reducing the ecological impact of construction processes and buildings.

In order to better understand sustainable regeneration therefore, it would be profound to understand what exactly sustainable development refers to. Sustainable development has been defined as that "development which meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987). This definition captures the elements envisioned in the sustainability framework, whereby, resources are not utilized in such a manner as to threaten the ability of future generations to meet their needs. The key therefore for the current generation is to generate an environment whereby resources are safeguarded for utilization by future generations.

Sustainable regeneration introduces the concept of sustainability into the practice of urban regeneration, thereby creating places that are economically, environmentally and socially sustainable. According to (Winston, 2009), sustainable regeneration involves aspects of economic efficiency and environmental sustainability, while meeting social needs. The implication of this definition is that arising developments are expected to cater for needs of the population. Moreover, such developments would be arrived at through the most cost-sensitive route which is highly sensitive to the environment. The developments envisioned include facilities such as schools, hospitals, shops and infrastructural developments such as good transport and an environment that is clean and safe.

One of the more neglected areas when it comes to sustainable regeneration is housing. The inadequacy in the supply of affordable housing is vital (Raco, 2003). The problem features not only in times of economic dormancy, but also during economic growth. In the former period, market forces conspire to make impossible for the achievement of the goal of affordable housing. However, during the latter periods, the problem arises as a consequence of the utter reluctance of contracted developers to meet their obligation to supply the contracted amount of socially affordable housing (Raco, 2003). The effect of the problem of unavailability of affordable housing limits the sustainable regeneration goal of social as well as economic sustainability.

With regards to the economic sustainability goal, an emergent theme is the approach to be used, whether renovation or demolition. Renovation emerged as a substitute to demolition, which had been the dominant approach in the post-war era. This paradigm shift was necessitated by recognition of the value of the old, combined with an acknowledgement of the problems of replacing older settings with suburban ones (Winston, 2009). As would later emerge, this approach also had environmental benefits. Sustainable regeneration appears therefore to be

achieved when renovation is pursued rather than demolition. This is reflected in the value 'saved' when the old is not destroyed. After all, such value was a key driver of this paradigm shift towards renovation. Moreover, the environmental benefits related with the choice to renovate rather than to demolish support the notion that renovation is the approach of choice in order to achieve sustainable development.

Urban regeneration, even without the sustainable regeneration component, is perceived by some commentators (Evans & Jones, 2008) as a sustainable form of development. They contend that at the most fundamental level, derelict land reuse and the revival of neglected areas is sustainable. Indeed, even where the approach used is not necessary a sustainable one, the mere act of providing economic viability to an area that was previously impoverished can be considered sustainable. However, this mere act presents one of the problems associated with the interpretation of sustainable regeneration, its ambiguity. Evans & Jones indicate that one of the rather recurrent themes in the literature on sustainable regeneration is the prominence of the interpretation of sustainability purely along economic lines. They further argue that the ambiguity of the term (sustainability) is what primarily contributes to this dominance of the economic agenda. Indeed, even in the current example, it is evident that regeneration is perceived to be sustainable simply because it moves the area in consideration from a state of dereliction to one of economic viability. While social and ecological benefits may follow, they do not feature in the actual process, and are rather by-products of the process.

2.3 Sustainable neighborhood communities

Sustainable communities are the culmination of efforts to come up with sustainable urban places. They are "places planned and built to support sustainable living with focus on economic sustainability and environmental sustainability" (McDonald, Malys, & Maliene, 2009, p. 53). This definition reflects all three features of sustainable regeneration as captured by the Sustainable Development Commission, (2002): social, economic and environmental sustainability. Sustainable communities are therefore the end result of the sustainable regeneration process. Different communities face different combinations of activities that are environmentally sustainable and that the citizens are interested in and can afford (Roseland, 2003). In Rosland's view therefore, the sustainable community is a dynamic one, which constantly adjusts to satisfy social and economic needs of its current inhabitants, while yet preserving the environmental ability for support.

Some of the features of sustainable communities include the necessary facilities and infrastructures that will enable the members of that community to sustain their needs. In its most basic essence, a sustainable community is one where people wish to not only live, but also work, both in the present and in future. This is achieved through the provision of sustainable urban/municipal infrastructure (McDonald, Malys, & Maliene, 2009). Besides the refurbishment

of inefficient buildings, transport infrastructure should also be fixed. Moreover, there should be spaces that are open to the public. Additionally, such communities should facilitate the members with an avenue through which they can contribute towards the running of affairs in their neighborhood. Finally, such communities should have in place affordable, decent homes. These requirements of sustainable communities reflect the three key characteristics of sustainable communities. The social aspect is covered by the provision of forums for communication and the environmental aspect by the provision of green spaces. Finally, the other items address economic sustainability.

Other authors (Bridger & Luloff, 2001) define sustainable communities along five interrelated dimensions. The first is local economic diversity, a characteristic of standard economic development strategies (Bridger & Luloff, 2001). The second is self-reliance, in particular, economic self-reliance, whereby local markets are created; there is local production as well as processing of imported goods and the like. The third dimension is reduced energy consumption and careful waste management and recycling. Fourthly is the protection of biological and ecological diversity. This is coupled with an adept management of natural resources. The final dimension is a commitment to social justice whereby the shelter and work needs of all members are catered for. Above all, within sustainable communities, there is an effort to guarantee the empowerment of its citizenry such that they can effectively participate in decision-making (Bridger & Luloff, 2001). Once again, a breakdown of these five dimensions reveals that ecological, economic and social aspects are all addressed.

The above method has been conceptualized as a three-legged approach. This model has consequently been the object of criticism which contends environmental primacy over the other two aspects (Dale & Newman, 2010). Moreover, the social dimension is also commonly perceived as the weakest pillar. Nonetheless, the present evidence supports the importance of social systems in the sustenance of ecological systems (Onyx, Osburn, & Bullen, 2004). In practice, the model faces a more imminent threat: the dominance of economic goals over ecological and community goals of sustainability.

Sustainable communities have an important role to play in the regeneration processes. New sustainable communities can function as drivers of the urban regeneration process and such sustainable communities are an essential input of regeneration schemes.

One of the most profound analysis and evaluation of sustainable communities is provided by (Roseland, 2000). He not only describes sustainable communities, but also unsustainable ones. Unsustainable communities were those developed in the post-war era. Such communities were built under as presumption that there was an unlimited supply of energy and land. The consequence was inefficient growth of communities with long distribution chains. The outcome of urban design during this era was urban sprawl which had subsequent consequences such as air pollution and congestion (Roseland, 2000). Due to the realization that such resources as fossil fuels are not actually infinitely available; the move towards sustainable communities arose as

part of the larger shift towards sustainability. In light of this requirement, Roseland indicates that to achieve sustainable settlements, it is necessary to make urban centers more urbanized and rural settlements more rural.

Increasing the urbanity of an urban center is achievable through "re-urbanization" of city centers and sub-centers. Moreover, transport infrastructure should also be re-oriented from personal vehicles and subsidies on automobiles removed (Roseland, 2000). Additionally, the urban culture should be redesigned so that it is more public-oriented and traffic calming actions should be introduced. On the other end, country sides can be made more rural through the adoption and protection of sustainable agriculture and forests. Moreover, there should be a shift towards bioregionalism.

One of the hindrances to the attainment of sustainable communities is the obscuring effect of economic interests on the sustainability agenda. It has been noted that the journey towards sustainable regeneration often detours towards economic sustainability thereby leaving out the social and ecological aspects. This is according to commentators such as (Evans & Jones, 2008) who cite numerous examples of instances where economic interests hijack sustainability agendas.

An important factor to note is that sustainable communities do not just come about. Rather, they have to be developed. As such, sustainable community development arises as a variant of sustainable development. Sustainable community development is a development integrating social, ecological and economic decision-making (Dale & Newman, 2010). Roseland provides a framework through which sustainable community development can be achieved. This framework contains three essential elements, with a fourth whose purpose is to coordinate and balance the other three. The three core elements are minimized consumption of essential natural capital, multiplication of social capital and improved efficiency during utilization of urban space. The fourth pillar, which is meant to coordinate these activities, is the mobilization of citizens and governments towards the above ends.

The final component, mobilization of citizens, not only represents the coordinating arm in the strategic framework, it also represents a paradigm shift in the inclusion of the local populations in the development of sustainable communities (Roseland, 2000). Within the framework, mobilization of citizens purports to bring them on board not only at the execution stage, but rather, at the decision-making stage. The knowledge and efforts of local people are an essential consideration in order for sustainable community development to occur (Bridger & Luloff, 2001) contend that. This shared knowledge, together with understandings and interaction patterns which a group of people can bring onboard to any productive activity is referred to as social capital (Roseland, 2000). Such individuals are usually more aware of the needs of the community and the areas of shortcoming in terms of service provision.

The shift in approach towards inclusivity induces a democratic mode of governance which in turn necessitates the adoption of novel strategies that are capable of accommodating such approaches. These are bottom-up strategies, which are a replacement of the traditional top-down strategy (Bridger & Luloff, 2001). This view is shared by (Roseland, 2000) who further points out that strategies for sustainable development require redistribution, self-reliance, local focus and small scale projects as opposed to "trickle-down", dependency and regional/national/international focus. All these issues point towards a direct involvement of citizens in decision-making. This is validated by Dale & Newman, (2010) who assert that the traditional decision-making structures, that are hierarchical in nature, cannot adequately contend with the current community development requirements of high interdependence in today's global economy.

The push towards sustainable communities is a complex one that requires an integrated approach. There are multiple scales (micro, miso, and macro), multiple governmental levels involved (local, regional, national, and global) and a multiplicity of diverse societal actors (Dale & Newman, 2010). Dale and Newman further contend that the development of any solution within human and natural systems requires a combination of multiple expertise and multi-sectorial involvement (2010). In order for these stakeholders to coherently work together, it is necessary to create networks which facilitate the linkage of social capital. This is because social capital comprises ties, norms and trust (Roseland, 2000). It arises from the ability of individuals to trust one another thereby enabling them to make credible commitments.

2.4 UAE and its Sustainability status

One of the characteristics of the global evolution of the urban regeneration paradigm is its lateral evolution. By lateral evolution, means of process began in certain urban centers around the globe, rapidly diffused geographically to have a far-reaching impact in the design and development of far-off cities (Smith, 2002). The key consideration during the design of any city is the development of urban places which are capable of attracting investors, visitors or new inhabitants (Milica & Milaković., 2011). Within the spectrum of sustainability, the solutions designed are aimed at satisfying the needs of the host cities. The effect is the development of sustainable places that are largely uniform and similar due to uniformity in the commonly accepted spatial solutions (Milica & Milaković., 2011). This is regardless of the physical location of the city/urban place in question.

The UAE plays host to two of the world's fastest-growing urban centers Abu Dhabi and Dubai. These cities are emblematic of urban-centered growth and according to (Bassens, 2012) the two cities continued to experience prosperity despite the 2009 debt crisis experienced in Dubai. Moreover, both cities experienced exponential growth in their populations spurred initially by the discovery of oil. Recent times however saw the sanctioning of development of cities with an

aim to shift away from oil-dependency. These cities are designed as business trade and servicing centers (Bassens, 2012). As part of the wider gulf region, the UAE plays an important role as a source of global capital.

In the study of urbanization in the UAE, it is of paramount pertinence to consider Abu Dhabi and Dubai. The two cities also serve as states and are part of the large unity of Arab Emirates. They are hallmark city-states of the emirates, with (Bassens, 2012) indicating that they possess a history of rivalry. Abu Dhabi serves as the federation's capital and also provides the president, a position secured owing to its oil wealth. Dubai on the other hand, was able to secure veto power in the supreme council.

The themes of urban regeneration are explicated in the design of urban centers in the emirates. Bassens, Indicates that the city-building projects operationalized in the emirates mirror those of successful urban economies oriented towards service. The role of the royal family in the development of these modernized urban centers has been a significant one. According to (Bassens, 2012), this has been through the facilitation of international investment from a supply-side perspective. Moreover, there has also been a relaxation of the fiscal and juridical environments with an aim of attracting regional as well as global investors. The endeavors of the royal family in creating a favorable environment for urban development is an exemplification of the role of government envisioned in the local strategic partnerships phase of the urban regeneration evolution process.

While the tremendous growth of the emirates urban centers is quite remarkable, it raises important sustainability questions. This is because according to (Bassens, 2012); Dubai was able to build its dream using large amounts of borrowed money. This is through the construal of Dubai as a prime destination for property development, tourism, real estate and other service related opportunities. However, the property bubble of 2008 led to a financial crisis in Dubai towards the end of 2009 due to the collapse of the property market and the emirates consequent inability to reclaim issued revenue. The Dubai debt crisis of 2009 highlights issues on economic sustainability of the emirates (Bassens 2012). In terms of figures, Dubai had an ambitiously laid out master plan designed to make it the economic hub of the world. Samarai & Qudah, indicate that part of Dubai's ambitious aims were to play host to 6 of the world's top ten tallest buildings (Samarai & Qudah, 2007). Moreover, it also aspired to play host to the world's largest airport. All this projects require heavy capital expenditure not only during construction, but also during maintenance. The economic sustainability problem is compounded by the current construction methods. According to Samarai & Qudah, the current methods lead to heavy energy consumption of the buildings not only during construction, but also during their day-to-day operations. The sheer magnitude and size of Dubai's constructions and projects therefore bring into focus the questions of energy consumption.

The energy consumption matter also brings into sharp focus questions on the ecological sustainability of the UAE. According to Bassens, (2012), the two cities cited in the examples

consume water and energy extravagantly. This is through ventures such as maintenance of evergreen golf course and expansive desalinization projects. Samarai & Qudah, contend that a stop in further future growth of energy consumption is necessary if sustainable habitats are to be obtained. The consequence of continual growth in energy consumption would be shortage of housing and food supply. UAE is said to be five times more unsustainable than any other country globally (Samarai & Qudah, 2007). This brings into stark focus the extent of the unsustainability of the UAE, which is rather expected going by the magnitude of its overly ambitious projects. Other factors that have coupled up to build up the magnanimity of the ecological unsustainability of the UAE are a fast growing population and immense financial resources (Samarai & Qudah, 2007). However, if harnessed in the right way, these factors could be turned around into potential resources to bring about sustainable communities.

Perhaps this is a plausible eventuality going by the UAE's mission to mitigate its global ecologic footprint. This is through a number of sustainable building projects such as the Bahrain World Trade Centre that harnesses wind power to harness 15% of its energy requirements (Samarai & Qudah, 2007). The Trump Tower in Palm Jumeirah is another such project. With mounted solar panels, it is able to harness energy. One of the more high profile examples is the visionary zero-carbon emission city of MASDAR in Abu Dhabi (Bassens, 2012). The city is a symbol of Abu Dhabi's sustainable development and ecologically sensitive social and economic growth endeavors (Hayek et al., 2010). The project aims to deliver sustainable neighborhoods to about 4000 inhabitants. However, while the said development addresses ecological concerns, it fails to meet the three-tier threshold for sustainable community since cost and legal barriers will put the place out of the reach of the majority and effectively reserve it for the better-off (Bassens, 2012). This marks the inability of the community to provide affordable housing thereby deeming it as economically unsustainable.

These are however not the only projects in the UAE. Samarai & Qudah, (2007) narrate the green community project, one that is designed to have 508 villas, 256 apartments and six recreation areas. This project was developed in less than two years from a desert area. As a sustainable project, it provided people with a space where they could live and interact with one another. Ultimately, such projects are targeted at meeting the self-reliance goal of sustainable communities (Bridger & Luloff, 2001). Individuals can live, work and play within such cities without having to cover great geographical distances. The multiplier effect is that the carbon footprint is reduced, thereby contributing to greater ecological sustainability of such places.

2.5 Abu Dhabi 2030

UPC has placed the Urban Structure Framework Plan Abu Dhabi 2030 to improve the status of the city through a 25 year urban development program.

In doing so, it is laying the foundations for a socially cohesive and economically sustainable society that maintains its unique cultural heritage in the emirate. Reflecting the dynamics and the essence of the concept of "Next Generation Planning ", the creation of Abu Dhabi Vision 2030 brand identity brings together all the elements of this innovative approach, allowing the UPC to communicate the full scope of the plan for communities UAE.

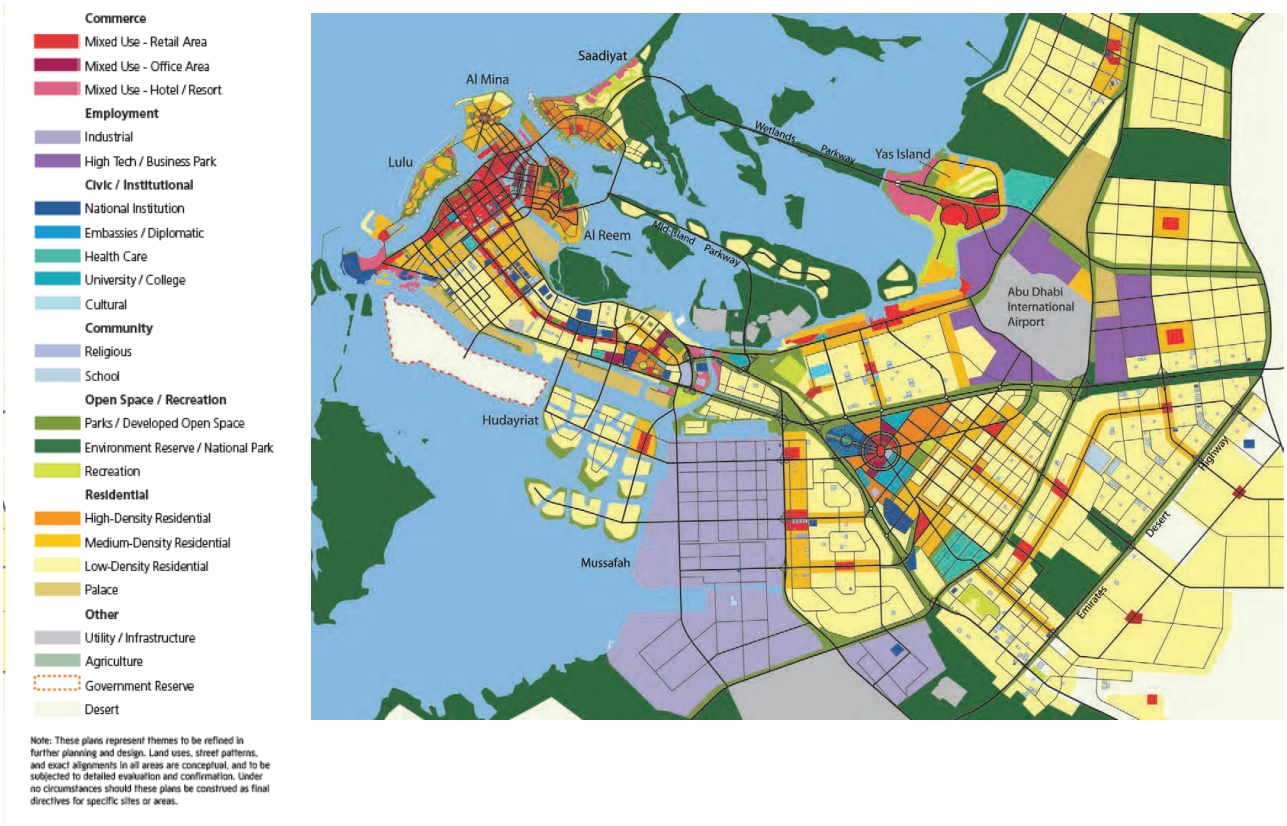

Figure 1: Abu Dhabi 2030 land use (Abu Dhabi urban planning vision 2030, 2007)

Very important aspects of neighbor hooding have been addressed within the futuristic vision of 2030.

These aspects are highlighted and analyzed for the use of specifying a case study that serves both the objectives of thesis study as well as the compliance features within Abu Dhabi 2030 (UPC, 2007).

- **Sustainability**

It is very difficult to reclaim damaged resources or natural environments or reinstate forgotten cultural legacies. Oil has brought considerable wealth to Abu Dhabi, but it is a finite resource that needs to be carefully utilized. Abu Dhabi's future lies in the

Ability to prudently use its existing wealth to actively explore renewable energy production, reduce the consumption of non-renewable resources and educate future generations. Resource efficiency is vital and the implementation of Estidama will support Abu Dhabi's move to become a truly sustainable Emirate.

- **Livability**

Livability is a crucial element in the overall success of Abu Dhabi Emirate. Plans, policies and developments need to relate back to the impact they will have on people's lives – how the Emirate's citizens and visitors will live, work and relax in the cities, towns and

Settlements and what facilities, infrastructure and open spaces will be required to provide secure and attractive surroundings. Explicit development policy, regulations and guidelines will be utilized to evaluate proposed projects to see how they fare against key livability elements, such as the public realm, transportation and community facilities. Living standards that are on a par with world-wide standards must be central to all development decisions.

Abu Dhabi has a rare opportunity to offer a special combination of features in its urban identity; an authentic and safe, yet also a progressive and open Arab city; a personality garnered from the desert and the sea; a traditional way of life but with the latest

21st century choices; and a place of business but also of Government and culture. The Emirate should be defined as much by the natural islands and dunes as the infrastructure, streets and homes to be developed.

Through the incorporation of these natural elements, livability will be tangibly increased.

- **Connectivity**

Abu Dhabi cannot solely rely on the car as the population of the Emirate's cities and towns grows over the next 20 years. The Emirate will need a multi-layered transportation network that meets the needs of Abu Dhabi's residents and visitors, reflects the size and demand of the local area and supports Abu Dhabi's move to a more sustainable and efficient transportation network.

The Abu Dhabi Department of Transport (DoT), in close conjunction with the UPC, has created a Surface Transportation Master Plan (STMP) to improve connectivity around the Abu Dhabi Metropolitan Area of Abu Dhabi. It aims to reduce the Emirate's reliance on the car by implementing a network of public transport to include high speed rail and rapid transit options, such as trams and buses, as well as supporting initiatives for walking and cycling. Furthermore, a system of new streets and redesigned streets will create safer streets, emphasize on high quality urban design and cater to all modes of transport.

- **Safe, shaded and walk able streets**

Safe, shaded and walkable streets are essential in the creation of attractive, user-friendly places to live, work and play in.

Improving safety when walking, through the introduction of clear, defined pedestrian walkways and pavements and visible and frequent pedestrian crossings, will make it safer and therefore more appealing for people, to walk short distances in comfort. Furthermore, temperatures in Abu Dhabi can reach well over 40 degrees Celsius during the daytime. Therefore creating well-connected streets that minimize unnecessary walking time, while providing cool, shaded pedestrian walkways, will make walking more comfortable and enjoyable all year round.

A commitment has been made to creating a system of 'shade ways' that interconnect sidewalks, pedestrian paths, trails, and multi-modal routes to ensure that residents and visitors experience a 'City of Shade'.

- **Emirati neighborhoods**

It is imperative that new housing projects across Abu Dhabi meet the needs of Emirati families. The traditional Emirati neighborhood system – known as 'fareej', brings together groups of homes that allow Emirati families to live in close proximity to each other to encourage social

cohesion, while ensuring family privacy and climate responsiveness through the integration of internal courtyards in the building design.

Weaving homes together with a mix of public amenities such as schools and clinics with shops and parks, through pedestrian-friendly streets that encourage walking and cycling, will create a dynamic, interactive and cohesive atmosphere.

Emirati neighborhoods that fuse traditional living arrangements with contemporary design will be implemented in a number of revitalization projects across the Emirate. This will showcase the benefits of merging the old with the new to create high-quality homes and attractive, safe and vibrant neighborhoods.

- **Community development**

Community development initiatives aim to create neighborhoods, which mix residences, shopping, services, recreation, and workplaces to create livable and convenient places that promote a variety of community values. Neighborhoods will incorporate a range of open spaces, an array of housing choices, improved air quality, as well as encouraging walking and public transit use through the provision of safe, shaded streets and flexible public transportation options. Community facilities such as mosques, hospitals, schools, recreational facilities, open spaces and parks, as well as privately provided facilities, such as shops and cafes, will respond to the needs of the Emirate's neighborhoods and provide a social space in which residents of the community can interact. Paramount to these functions is considerations for access and special needs, which meet accepted international standards.

This integration of employment, housing, retail, cultural, religious, recreational, and educational and community facilities in close proximity will add vibrancy and character throughout the settlements, towns and cities of Abu Dhabi Emirate.

- **Complete Sustainable Communities**

The UPC is focused on creating complete communities, both through the reinvigoration of existing communities and the creation of entirely new communities across the Abu Dhabi Metropolitan Area. From the provision of community amenities, such as schools, shops, mosques and parks, to the pedestrian-friendly shaded streets and pathways that connect these amenities to residents, the UPC aims to create communities that are convenient, attractive and self-supporting, all in a pleasant and socially cohesive environment.

2.6 Estidama Pearl Community rating system

Estidama is an Arab word that is the Arab equivalent of sustainability. As such, the Estidama Pearl Community rating systems can also be translated to read the Sustainability Pearl community rating system. Launched in 2008, Estidama was an initiative of Abu Dhabi in its urban growth plan for Abu Dhabi 2030 aimed at promoting sustainable growth (Madden, 2010). In its vision, the government established that sustainability lay at the heart of any development in Abu Dhabi both in the short-run and in the long-run (Salmi, Kadi, & Leao, 2013). Consequently, the Pearl Rating System arose, as an initiative of the Estidama vision. The Pearl Rating System (PRS) combines the concepts of LEED and BREEAM and develops a localized rating system implementable in Abu Dhabi. Some of the key stakeholders involved in the Pearls rating system development include the Abu Dhabi Municipality, Urban Planning Council, Environmental Agency and Masdar city (Salmi, Kadi, & Leao, 2013). Once again, a look at the stakeholders involved in this push reveals the nature of the sustainable regeneration push, which is characterized by the involvement of strategic partnerships between players in the government and those in the corporate sector.

Essentially, Estidama targets to "create guidelines and regulations to ensure sustainable design operating and maintenance of all types of buildings and communities within the Emirate" (Salmi, Kadi, & Leao, 2013, p. 1105). It is built upon four pillars: environmental, economic, cultural and social. This differs from the traditional approach in that it invokes a cultural component. It is envisioned that upon full implementation, Estidama will impact on all facets of daily life such as school curriculums, investment options by the sovereign wealth fund, and the type of food (Madden, 2010). Within the Estidama framework, there is close cooperation between communities, businesses, organizations and policy makers. The purpose is to develop and encourage decision-making that is responsible. This is characteristic of the properties used to describe a sustainable community.

The Pearl rating system targets all types of buildings and communities. In line with this end, the rating system is tri-faceted. It has a community rating system, a building rating system and a villa rating system (Salmi, Kadi, & Leao, 2013). Each of these levels has its own criteria as well as its own rating system. There are three levels of certification: design, construction and operational. In the first, the proposed designs are evaluated to determine whether they are consisted with Estidama goals. Where this is the case, a design certificate is issued. In the next stage, a Pearls construction rating is carried out upon the completion of construction. The purpose is to ensure achievement of commitments made during design. The final stage, which has however, not yet been applied purports to evaluate performance of existing buildings. The proper implementation of the pearls rating system presents many potential benefits for the emirates. They include a reduction in its carbon footprint as well as financial savings due to the reduction in energy consumption (Madden, 2010).

The pearl system does not only address the assessment of buildings. Rather, it takes an integrated approach whereby it addresses sustainable design at the planning, design, construction and operation levels. Moreover, the system has seven key categories. Each of these categories addresses a particular performance or design metric, and has been referred to in other literature as sustainable development indicators (Singh, Murty, Gupta, & Dikshit, 2009). These categories are: natural ecosystems, livable communities, resourceful energy, precious water, stewarding materials, innovative practice and integrated development process.

While the Estidama system is a very good one conceptually, it has broken down at the implementation stage. As noted, the system is not applied or rather, has not begun being applied to existing buildings. This is despite the fact that Abu Dhabi consumes well above the world average of electricity and water. Another concern for Estidama is that after a mere 6 month of its application, the Pearls rating system was suspended (Salmi, Kadi, & Leao, 2013). This was for residential buildings and villas and resulted from difficulties in the application of the system. The implication is that while the Pearls rating system had the best intentions for sustainable development in Abu Dhabi, lack of proper planning led to a breakdown. A more tangible outcome of the failure of the Pearl rating system is the foregone opportunity costs. This is because Madden, (2010) indicates that the implementation of Pearls rating system could potentially have led to savings of roughly 11,000GWh in residential sector alone. Yet, this was one of the specific areas in which the implementation of the Pearls rating system failed.

The Pearls system was adapted from the LEED and BREEAM environmental assessment methods. This is the case for many environmental assessment schemes which are all usually based on BREEAM or LEED, but adapted to reflect particular national building requirements and standards (Yu & Kim, 2011). As a consequence of its adaptation from the LEED and BREEAM models, there are a number of similarities between the Pearls system and former two systems. For instance, in all systems, there is a mandatory minimum credit required in order for certification (Salmi, Kadi, & Leao, 2013). This is what contributes to what is one of the most progressive features of the Estidama, its incorporation into Abu Dhabi's master plan. However, owing to its unique adaptation in such a manner as to address the specific and local sustainability needs of the gulf community, the Pearl rating system has its own unique features. One such uniqueness is that the Pearls system places the greatest amount of stress on efficiency of water. This is in line with the fact that one of the greatest areas of ecological deprivation for the emirates is water resources.

The development of the Pearl rating system is a particularly good exemplification of the notion that a sustainable community is dynamic and adjusts in order to meet the needs of its inhabitants (Roseland, 2000). Thus, while the LEED and BREEAM systems provide guidelines upon which sustainable communities can be built, they remain flexible in their application such that they adapt to the needs of the community in which they are being applied. This is the case in the development of the Pearl system, which borrows from the ideals of the former two systems, but

integrates them into the needs of the local emirates community to develop applicable sustainable rating system.

2.7 Environmental assessment through current rating systems

Environmental concerns about the impact of urban regeneration on the physical environment are what prompted the commencement of sustainable regeneration. One of the emergent paradigms of sustainable regeneration is the advent of green buildings. Green approaches to construction emerged out of the realization of the need for building practices that are both sustainable and responsive to environmental issues (Poston, Emmanuel, & Thomson, 2010). In response to this requirement, there emerged the green building rating systems (GBRS), which were globally adopted. Examples of these rating systems include LEED, HK-BEAM, and CASBEE. However, with the shift from green buildings to sustainable ones, it has been said that environmental criteria have dominated over social and economic ones. Sustainable buildings are those encompassing the aspects of sustainability (environmental, social and economic), together with technical aspects (Berardi, 2011).

There are a variety of assessment methods available for use in the assessment of the sustainability of buildings. These methods are based on three frameworks: GBC, LEED and those developed from an analysis of other tools but with cultural adaptations of the assessment criteria. GBC refers to Green Building Council and was developed through collaborative research and contribution of over 20 countries. It led to the development of the Green Building tool, a framework used to rate tools. This framework was then adopted and developed by a number of countries. Though ended in 2005, the Sustainable Buildings tool has since been developed owing to continued contact between the iiSBE and its member countries (Poston, Emmanuel, & Thomson, 2010).

The second framework is LEED, which was launched in 1999. LEED refers to (Leadership in Energy and Environmental Design) and the framework was developed by the US Green Building council. The tool is one of the most recognized and applied building tools internationally. The other breed of building tools build on the tenets of the TBL (Triple Bottom Line). These tools emerged starting 2006. Examples are Pearl and Lider-A (Poston, Emmanuel, & Thomson, 2010).

Environmental assessment tools are usually meant to assess the environmental performance of a building. They are comprehensive tools that thoroughly evaluate a building's performance against a wide range of environmental criteria. The earliest such tool was the BREEAM, developed in 1990 (Ding, 2008). This tool/system was developed by the Building Research Establishment. This was in collaboration with private developers. BREEAM gained global prominence and informed many other countries in the development of their own environmental assessment methods for buildings. Together with LEED, this model is adopted and adapted in many countries, with suitable modifications to fit the regulations in that country, as well as

conditions such as climate (Yu & Kim, 2011). Such conditions usually precipitate unique sustainability challenges.

Assessment tools are important in guaranteeing the development of sustainable buildings. They set criteria and targets for building owners and designers to follow in order to achieve high standards environmentally. By enhancing environmental awareness of building practices, they provide the building industry with direction towards environmental protection and achievement of sustainability (Ding, 2008). Because of their structured nature, they provide environmental information in a manner that allows for the objective assessment of the performance of buildings thereby facilitating a means through which progress towards sustainability can be measured.

There are various ways in which current rating systems can be used and not just in the assessment stage. According to Ding (2008), the tools are most useful in the design stage. She argues that this is because at this stage, environmental considerations can be incorporated in the design allowing for minimal environmental impact. When the environment is considered at this stage, the concept of sustainable design arises, which is one whereby the practices incorporated in building result in environmental protection, efficiency and conservation of water, recycling practices and efficient utilization of energy (Samarai & Qudah, 2007). Moreover, such tools can go beyond design to feature earlier on. The earlier assessment tools are brought on, the greater the impact that can be derived from their incorporation.

Another way in which assessment tools can feature directly before the building process begins is during the selection of the most optimum project. Settling on the least environmentally detrimental option available is an important means of attaining sustainable goals (Ding, 2008). Moreover, consideration and incorporation of environmental issues at an earlier time helps to alleviate financial costs and frustrations that may arise from later alterations to project designs. One can envision this to be a consequence of the complexity of the endeavor to develop a green building. According to Yu & Kim, (2011), the holistic approach required in green building is to guarantee health of occupants in every aspect of the built project. This means not only the individual apartment, but rather, the entire building. As such, this would require an integration of thoughts by all concerned stakeholders in the construction of the building, including architects, owners and even local governments (Yu & Kim, 2011). This however also highlights a major problem with the current environmental assessment methods. Their design is usually such that they serve the purpose of indicating the environmental performance of a building. However, (Ding, 2008) asserts that by this stage, it may be already too late for the consideration of many environmental issues.

All in all, environmental sustainability assessment instruments were developed for and have been used to assess the sustainability of buildings. A case example is (Roderick, et al., 2009) who calculate the energy rating of a case study office in Dubai. They use the LEED, BREEAM and Green Star schemes. In the LEED system, the energy rating is calculated based on actual annual energy cost of running the building and the annual cost of running the baseline building. Under

the BREEAM assessment method, buildings achieve up to 15 credit points based on reduction in CO2 emissions. Thus, the energy performance of a building appears as an index of CO2. The score generated is compared to CO2 indexes on the energy performance index and an energy rating between A and G generated. Under these energy ratings, A is the most efficient while G is the least. In the final scheme, the Green Star scheme, the score achieved is compared to the score available for that category (Roderick & et al., 2009). A star system is used to certify a building, with the number of stars ranging from 1 to 6.

The method employed involved computer simulation. The case building was an eight-storey building that had open-plan offices. Moreover, the building had a three storey car pack area. It had a total floor area of 31291.8 m^2 with a lettable area of 9500 m^2. Simulation studies were then prepared for each of the schemes. This included 5 models for the LEED scheme, 2 for the BREEAM scheme and a baseline model for the Green star scheme. Some of the assumptions made to facilitate the study included: that there were no renewable technologies applied, no lighting controls like dimming systems, greenhouse Gas Coefficient of 0.434kg Co2/kWh; an average energy price of 8$/kWh; and heat rejection energy consumption of 0 (Roderick & et al., 2009).

Under the LEED system, the building scored 7.8% and did not meet the minimum threshold of 10.5% and as such failed LEED certification. Under the BREEAM scheme, the building achieved an energy performance asset rating of 49, a category B rating for energy efficiency. Thus, it scored 2 out of 15 BREEAM credits. Under the Green star scheme, the building achieved 11 out of 20 points (Roderick & et al., 2009). The implication of this research is that different rating methods yield different results.

2.8 Estidama and the environment

As this study aims to address the environmental behavior of current neighborhoods through estidama, it tackles the ability of current neighborhoods to be integrated with the Estidama environmentally oriented policies and credits.

As mentioned before, Estidama has broken down at the implementation stage of current neighborhoods; the system is not applied or rather, has not begun being applied to existing neighborhoods.

Thus this study is a tool capturing the ability of such community based neighborhoods to adapt to the Estidama intended policies and legislations.

As Estidama targets the four pillars of a community: Culture, Economy, Environment and society, this study will only address the environmental aspect of a possible application of Estidama on a current neighborhood.

The credits that are presented with an environmental value are as listed below:

LC-R1 Plan 2030

LC-R4 Outdoor Thermal Comfort Strategy

LC-7 Active Urban Environments

PW-3 Water Efficient Buildings

RE-R3 Energy Monitoring and Reporting

RE-3.3 Efficient Infrastructure: Smart Grid Technology 4

RE-4.1 Renewable Energy: Onsite

RE-5 Energy Efficient Buildings

SM-R3 Basic Operational Waste Management

SM-6 Improved Operational Waste Management

- NS-3 – INTENT: Demonstrate enhancement of the ecological value of the site by planting native or adaptive species. If 50% of the plants specified for planting are native and adaptive drought and/or saline tolerant species, including a minimum of 5 different types of species, a total of 1 point will be rewarded. This study will be aiming at the highest ceiling of all credits to put them to test, thus 70% of the planted plants will be of native and adaptive drought and/or saline tolerant species, 10 different plant species will be implemented into the proposal.

- LC-R1- INTENT: To ensure that all new development supports the vision for the Emirate of Abu Dhabi, as defined by the applicable Plan 2030, and/or Development Code, and/ or Area Plan.

This is achieved and previously demonstrated, the basis of specifying the study case at the fundamental study stage has been to comply with the futuristic orientation of Abu Dhabi 2030 vision.

- LC-R4- INTENT: Demonstrate an outdoor thermal comfort strategy has been employed to identify priority areas for shading and improve the outdoor microclimate for the community. The strategy is to consider the following as appropriate within the project's specific context: Orientation; Shading; Selection of high-albedo surfaces; Ventilation; Evaporative cooling; radioactive cooling; and Thermal mass.

Of all mentioned methods, this study will adopt the shading approach, as it is found to be the only solution that can be amended upon the case study without having a fundamental change, of which City Cad can assess and evaluate.

This will be implemented within the proposal by adjusting the shade percentage within city Cad to optimal levels, by using the shade option of buildings, shade elements and all the planted trees that are to be installed within the proposal.

- LC-7- INTENT: Demonstrate that outdoor spaces have been provided and programmed to encourage activity, including sport and recreation. The spaces must be specifically developed for any of, or any combination of, the following:

Landscaped areas for recreation; Playground areas; and/or Sports field areas.

The latter credit is highlighted as a crucial method to be adopted within the future sustainable communities, as it does not only affect the environmental behavior within the sustainable bundle, but it also directly tackles the social aspect of a sustainable community, a whole another important level of study that is to be discussed in upcoming papers, yet essential enough to be mentioned within this study, and this credit specifically.

- PW-3 - INTENT: Demonstrate that the average Water Reduction Target achieves the following improvement compared to the baseline building performance, from efficiency measures only:

1 Credit Point: Wbldg 16% improvement compared to the baseline building

2 Credit Points: Wbldg 22% improvement compared to the baseline building

3 Credit Points: Wbldg 28% improvement compared to the baseline building

4 Credit Points: Wbldg 34% improvement compared to the baseline building

5 Credit Points: Wbldg 40% improvement compared to the baseline building

Set targets for the average landscape irrigation demand, IBL, of all building plots within

The community as follows:

2 Credit Point: IBL < 4 liters/m2/day

2 Credit Point: IBL < 2 liters/m2/day

- RE-R3- INTENT: Demonstrate building guidelines have been developed based on analysis which identifies the most efficient measures for reducing the energy consumption of buildings within the community. The analysis should cover the following at a minimum:

Passive design strategies:

- Building orientation; Building glazing ratio; Building envelope parameters; and Shading strategies.

Mechanical and electrical systems:

- HVAC system design options; Lighting systems; Heat rejection options; and Metering strategies, integrated renewable energy generation options.

- RE-4.1- INTENT: Demonstrate that a percentage of the community's total energy consumption is supplied through renewable energy generated within the community site boundary. Renewable energy may be supplied by developer-funded and owned systems or through third-party onsite renewable energy hosting and purchase agreements (with a purchase agreement of at least 5 years).

Demonstrate that an onsite renewable energy feasibility study has been undertaken, and that one or more appropriate technologies have been selected from the study; and 1-8 Credit Points: Demonstrate that a percentage of the community's energy consumption is supplied through onsite renewable energy. Points are awarded as follows:

Table 1: Energy credit points (Estidama PCRS manual, 2012)

Points Achieved	Required Percentage
1	1%
2	3%
3	5%
4	7%
5	10%
6	15%
7	20%
8	25%

- RE-5- INTENT: Energy Efficient Buildings

Intent: To promote the reduction of energy consumption of buildings within the community to help decrease the carbon emissions associated with the development as well as limit the size and burden on the community infrastructure.

Credit Requirements

GENERAL - Buildings (except Villas)

Demonstrate that the average energy performance target (as defined within the Calculations and Methodology section), achieves the following:

1 Credit Points: Cbldg 15% improvement compared to the baseline building energy consumption.

2 Credit Points: Cbldg 20% improvement compared to the baseline building energy consumption.

3 Credit Points: Cbldg 25% improvement compared to the baseline building energy consumption.

4 Credit Points: Cbldg 30% improvement compared to the baseline building energy consumption.

The above mentioned Estidama extracted credits will be addressed throughout this study's proposal by adopting a renewable energy via City Cad.

The energy consumption specified values of the proposed modular sustainable community are to consist of a 30% cut off the main preliminary energy consumption of the original case study community.

- SM-R3/ SM 6 – INTENT: Demonstrate that Operational Waste Management has been addressed from the concept stage. As a minimum, the following must be addressed by the design and development team:

Annual estimates of Operational waste (in buildings and public realm); Summary review of existing and planned waste management infrastructure and programs available from the appropriate authority; Proposed options for diverting waste from landfills and incineration with a minimum targeted diversion rate of 40% by weight or volume of the total operational waste generated at full occupancy; Provision of adequately sized waste management facilities including:

o Collection and storage facilities for recyclables, general waste and hazardous waste, and

o Treatment facilities (e.g. composting, anaerobic digestion energy from

waste) where appropriate; and

o Adequate vehicular access for waste handling vehicles.

Develop and implement an Operational Waste Management Plan (OWMP) that includes measures for diverting waste from landfills and incineration to meet the following minimum targeted diversion rates:

1 Credit Point: 50% of the total operational waste generated at full occupancy (by weight or volume).

2 Credit Points: 60% of the total operational waste generated at full occupancy (by weight or volume).

These figures exclude all hazardous waste that must undergo specialized treatment.

The waste management related credits of SM-R1 and SM-6 are translated within the city Cad model through specifying the percentage of the recycling of the previously set up value of waste generation of the community unit.

A 60% recycling value will be targeted within the city cad produced proposal, the highest value achievable through Estidama established levels.

All above intents are directly extracted from the manual of Estidama Community Pearl Rating System, the concept of each credit is directly translated here in the same language as to get it across the reader exactly as it is in order to deliver the same message the manual gives without affecting it with the author's own understanding.

Going through the different credits and sustainable aspects of the Estidama program manual, it is concluded that the environmental face of Estidama addresses mainly four environmental parameters which are:

- Co2 and gas emissions.
- Waste generation.
- Water Consumption.
- Energy consumption.

These parameters are then to be addressed within the neighborhood modeling and reporting phases.

The necessity of integrating a sustainable green rating method within the operation ongoing phases of current neighborhoods was the highlight of all literature review materials of journals or articles, in which methods of assessing have been analyzed and defined.

There is no study that addressed the exact setting that this study addresses, this is mainly due to the variant of parameters that this study is based on and the unique setting of the issue in hand in the capital of Abu Dhabi.

Chapter 3

Methodology

3.1 Overview

The desired aim of this study can be accomplished through the selection of accurate procedures, which should be in line with the objectives of the research. Moreover, satisfying the ultimate objective and deriving the outcomes can be fulfilled through selecting the right methods for the study. This must be highly significant while undergoing the activities of the study.

This research has reviewed papers addressing all the various definitions, philosophies, methods; and the purpose of literature review was finally being able to reach a point to be able to select and rationalize the most accurate and compliant method and process, in order to absolute the research and analysis of a possible Estidama role in current neighborhoods in Abu Dhabi.

There are various methods used in the massive amount of papers assessed in the literature review section of the study. The main methods that have been used in order to evaluate a sustainably environmental neighborhood setting are:

- Computer Simulation
- Literature review/ Research study and Observational
- Survey
- Case study approach

This research will focus on how effective Estidama approaches can be on current neighborhoods. It has become a necessity to investigate the performance of the operating neighborhoods to establish an enhanced adaptive environmental pattern.

This paper aims at doing exactly that by using a simple questionnaire as a survey tool which has questions relating to the occupants' community main features.
Measurements will then be read from the simulation phase modeling a case study existing neighborhood in Abu Dhabi.
This research is a sequence of Literature review followed by a specified case study simulation method, from which results and discussion will be extracted.

The purpose of the research is to make an overall assessment, a direct adaptation as well as delivery of an environmental package that is designed to enhance the environmental behaviors of modular neighborhoods through evaluation of the current regulations and strategies established for the neighborhoods that are in UAE.

Thus, this dissertation chapter will provide an in-depth and comprehensive view regarding the ways in which the research will be undertaken in order to gather needful data and information to fulfill the ultimate objective of the research.

3.2 Scope of Study

This paper that is to be established, draws an attempt at capturing the influential extent essence of adopting environmental sustainable strategies within the existent development of communities to produce “sustainable communities”, through Estidama as the main sustainability guideline that is followed by Abu Dhabi.

A typical neighborhood in Abu Dhabi is to be chosen to undergo the simulation process. The case study main choice parameter is complying with the 2030 Abu Dhabi plan consisting mainly of a neighborhood of a repetitive nature. Modular neighborhood that contains unified features which are to be found the same in another neighborhood.

This study addresses residential neighborhoods, "home neighborhoods". This is clarified in the 2030 vision as it is planned to separate the urban area of work and leisure from the living urban areas that will not contain high rise buildings rather than user friendly neighborhoods.

The effect of adapting such concept is to be presented by capturing the difference within the environmental aspects readings before and after the application of the amendment.

3.3 Research Design structure

A proper research design is an important factor towards attaining the desired objectives. Thus, in any proposed research, research design serves as a blueprint, which ultimately helps and enables to prepare the research problem as well as make a plan to derive the outcome of the research. Moreover, the key importance of a research design in any study is to ensure that the evidences provide proper solution about the research question in a best possible manner. The research study comprised of a series of activities, which were necessary for conducting the entire study in an effective and proper manner. In this regard, research design selection will be highly dependent on the number of aspect that has been given key priority in the research process (Churchill & Iacobucci, 2009).

In regards to this study, research design is based on the following research structure summary;

- Introduction and literature review, presenting the first phase of the study's design, which is important to determine the brief theoretical understanding regarding the subject matter.

Regarding the literature review, the key reason behind reviewing the peers work is that it helps to obtain and propose the effective framework for the future development of the city, and use them as a ground reference to assure the study's output results validity and give it a proper sense of results comparison, oriented towards logic and anticipation of relevant results.

- Applicable case study' section; drawing the next phase of this research which is to develop a practical study emphasized towards the data collection procedure.

- The third phase focuses on the evaluation of the change in the neighborhood's environmental pattern. A comparison will be done to capture the difference before and after the environmental concept adoption. This is concerned by the two sections of the 'Proposed model results and discussion'.

3.4 Data Collection Techniques

Data collection is considered to be an essential element in research study, which helps to assist in obtaining the needful information in order to accomplish the desired aims and objectives of the research in a proficient manner. Moreover, the high quality data will be required to be collected in a systematic manner with the aim of obtaining an advanced knowledge for the evaluation of a particular research issue. Data collection approach aids in obtaining valuable data from primary as well as secondary sources.

The secondary data for any research are available and acquired through the previous published research work of various scholars through utilizing different sources including the books, journals, reports, articles, online sources and other relevant sources. Other method of data collection includes the primary research data collection that are gathered in the raw form, which includes the information, facts as well as the figures through the help of questionnaire, interview,

observation and survey methods. Moreover, there are wide ranges of sources through which data can be acquired. Thus, the decision regarding the selection of the method is highly dependent on the prior aims and objectives of the research and the availability of data from the reliable sources that are required for the particular research study.

In this research study, both primary as well as the secondary method of data collection have been applied. The primary data are collected through case study's observation and recording method before and after applying modifications.

3.4.1 Data collection- Questionnaire method

As for the data collection for statistical features of the neighborhood, site visits were conducted.

Through the site visits, buildings watchmen were asked by the author simple questions, concerning the statistical information that is essential in capturing the context of the neighborhood.

The collected data from the simple questionnaire are also of an essential importance to the City Cad modeling phase, and they will be presented on a later phase discussing the charactertics of the case study neighborhood.

The questionnaire was of a simple base as the overall data entry intake. The questionnaire that was asked to the watchmen included questions tackling the following fact aspects:

- Family's member's number.
- Number of used cars.
- Number of flats/ rooms.
- Facilities usages.
- Waste bins sizes, number and location.

The questions also addressed the social fabric of the community and its relevant sustainable behavior patterns (of inhabitants).

3.5 Research Mapping and methods

The overall main mapping of the research methodology consist of three parts, including the literature review, observation and reporting of the case study selection and the applications of simulation model through the use of city CAD software.

The review of the academic research aims to look at the concept of sustainable communities and neighborhoods planning, in addition to present the environmental approaches held by the local legislations framework and highlighting the origin of such approaches and policies.

The literature review will also highlight case studies of environmental sustainable communities, and project the results of previous efforts. Conducting the literature review of the research, journals, articles and researches are used and analyzed in order to frame the literal background of this research.

Observation and reporting is the second main method in mapping the layout of this study. A case study has been chosen, of features that do interdict the Abu Dhabi 2030 vision (meaning the neighborhood is to be existent now and in the future). The main characteristics of the neighborhood were noted, and features were reported into the neighborhood's model for simulation.

The simulation process lays the last layout of this research methodology mapping. City Cad software will be used to evaluate this neighborhoods environmental capacity in order to let the analysis read into produced values.

3.5.1 Literature Review Method

Reviewing literatures and various peer reviewed journals of previously published researchers is one of the important and integral aspects for a study. This section deals with the examination of the citations that are related to the subject matter of the research. Literature review helps in the development of the research problem and determines the dimensions and area of the study. Researchers usually structure their literature review from general to specific in order to identify the main areas of focus and discuss each area under separate subheadings. It critically provides the researchers with a solid foundation on which their research works are built and helps them to create a better understanding and insight related to previous research works and findings that have emerged (Anderson, 2004).

Thus, in this research study, literature review has been given the prior importance to provide a comprehensive understanding regarding the subject matter and provide insight regarding the consideration of critical issues in the underline research topic. Moreover, it has also assisted in providing numerous facts, opinions as well as information’s, which reflects the concept of sustainable policies and procedures in the global context.

Moreover, in the literature review section, the Estidama derived environmental approaches will be presented directly from the Estidama community pearl rating manual.

Also, Abu Dhabi 2030 vision of neighborhoods will also be highlighted as to adapt the 2030 visions into case study to ensure its existence and sustainability in the future adding a 3rd authentic dimension to the case.

3.5.2 Observation and Reporting

Prevailing the technicality aspect of such study, a case study has been chosen as to affiliate the observation modeling and reporting methodology. This is crucial to the type of the addressed issue of this paper as to portrait the tangible, technical side of the environmental behavioral setting of a community.

A neighborhood in Abu Dhabi has been chosen as the primary case study to undergo simulation process. Through site visits, primary observations are taken; number of buildings, number of floors, neighborhood layout facilities connectivity.

All results that contribute in addressing the environmental cast will then be reported, and compared to the anticipated results of the modified case study.

Modifications will include environmental changes, set out as approaches and technical add-ons by the Estidama Pearl Community Rating System.

The comparison between the initial and second results, are to be presented through direct numerical values backed up by graphical charts.

3.5.3 Case study approach

Choosing a case study is an important step and a main objective of this study towards capturing its aim.

The methodology approach behind choosing the case study has been established by using the real existing urban fabric of Abu Dhabi.

Referring to Abu Dhabi vision of 2030 the manual, it is clear that the country's vision towards neighborhoods of the future is a community of a houses/ villas or small building clustering into a neighborhood of a specific unity.

The vision states the high rise buildings as the industrial part of the city for mixed used functions of work and leisure. On the other hand, the emphasis has been on individual units of buildings, to be the destiny for living.

Also according to Estidama, the community pearl rating system is applied to short buildings of accommodation.

Therefore the case study neighborhood has chosen to be of a housing function, consisting of short buildings.

This among other factors (like connectivity, facilities nearby.etc), that will be presented in a later chapter derived from the vision of 2030, is the framework of the case study neighborhood choice. The main theme was to choose a neighborhood that does not contradict the futuristic vision the city, so that it integrates with Abu Dhabi's urban context and fabricates within.

The environmental parameters that are to be studied within the model are to be based on the Estidamas environmental targets.

To determine the environmental scenario of the chosen neighborhood, the main 4 aspects of an environmental setting have been specified and are to be analyzed within this study as to undergo the simulation modeling and reporting procedure methodologies.

3.5.4 Simulation Method via City Cad software

Simulation method of the research approach is becoming one of the most widely used mechanisms in most of the modern research. In the general context, most of the other research methods have to take various assumption regarding the possible cause and effect of the subject matter of that particular research. On the other hand, the simulation method allows the researchers to deal with the inherent complexity in the tradition research methods. Besides, it also allows the researchers to study the complex research system because it creates the observation on the basis of ‘moving forward’ in the future. Whereas, other research methods derive the research results on the basis of determining the history of the subject matter of the research topic. In this regard, the purpose behind the utilization of this research method in

various studies is that the researcher makes better prediction, discover various theories related to the subject matter, superior performance and provide proper justification (Dooley, 2002).

Correspondingly, there are three approaches to simulation process, which includes discrete event, system dynamics and agent based. Discrete event approach of the simulation models has been utilized in various studies in which, variables and its corresponding states have significantly affected and changed the variables in a stochastic manner. Moreover, this approach is not suitable in those cases when the stated variables have a high level of interaction with others and changes in the continuous manner. On the other hand, system dynamics approach of the simulation models is applicable on those research studies, when the variables in the proposed question are numerous and changes on the continuous basis. Besides, agent-based approach of the simulation model are highly applicable were researcher interprets the scenario of the responses themselves (Dooley, 2002).

Thus, in this specific research study, system dynamics approach of the simulation models has been adopted in order to develop strategic framework for improved sustainable development in the city of Abu Dhabi and its neighborhood in order to strengthen the sustainable development of the city through taking the consideration of the opinion of the inhabitants. The research has been conducted through simulation method, which has been established using the City Computer Aided Design (City CAD) software.

This software has been utilized in order to provide significant aid to the simulation method. Thus, in this regard, system dynamics approach of simulation method has been exploited in this study because of the various parameters that have been involved, which are directly related to the environmental setting and have distinguished design properties as well as elements. City CAD software is implemented in order to provide significant importance and increase the reliability of the outcome through having the advantage of easy documentation of the database.

City Cad as a tool will be used to establish this research upon variable parameters among environmental settings and distinguished design properties and elements, by first choosing a case study of a current typical neighborhood in Abu-Dhabi to reflect the occurring status of local communities.

The simulation methodology will be set up accordingly, following the following steps:

- Establishing the case study neighborhood climatic model in Abu Dhabi
- Testing the case study neighborhoods current environmental setting as is.
- Reporting the results conducted from the simulation process.
- Adopting numerous design features and environmental approaches designated by Estidama and integrate them into the neighborhood model.
- Running the simulation on the updated amended model.
- Reporting the results of the second simulation

3.6 Data Analysis Procedure

The analysis of the research data is a most important aspect that needs the prior consideration in any research while conducting a particular research study. In this regard, the data analysis is regarded as the procedure through which the assessment and monitoring of both the primary as well as secondary sources has been done. Thus, the data analysis in the research method significantly aids in providing the validity and reliability to the research study. In this research study for determining further improved sustainable development policies for Abu Dhabi and neighborhood community, data had been obtained from primary as well as secondary sources analysis.

Correspondingly, in order to properly evaluate the extracted data, to establish the most efficient environmental strategy for the community of UAE, the search has also utilized effective instruments to identify the appropriate outcome of the research study. In this context, city CAD software program has been used for analyzing the data significantly. City CAD program is recognized as a software package, which is specifically used for conducting simulation process and reposting the result of the simulation process. Moreover, the software has also assisted in analyzing the case study community in the current sustainable policies from the environmental setting and provides wider range of data systematically.

The extracted data and environmental settings are then discussed using the comparison approach. The amended environmental setting is compared with the "as is" environmental setting. This

approach is crucial to be used as the search is addressing exact values and numerical readings, thus the use of comparison to form the whole picture of the environmental setting.

3.7 Reliability and Validity

In this research study, in order to maintain reliability and validity due consideration has been focused on the ethical issues. Additionally, in the research this factor is also taken into the prior concern while collecting the data from the reliable journals, articles with ensuring the higher reliability and validity in this research study. Thus, in this context in this research study, reliability and validity has been maintained for deriving proper conclusion to the research. It will be vital to mention in this similar context that proper maintenance of the factors reliability as well as validity has given higher scope to this research study for the future references.

3.8 Limitation of the Research

Mixed approach has been followed with the intention of accomplishing the determined objectives, which increased complexity issues owing to the alignment of these two methods. In this context, mixed approach has proved to be time consuming and expensive in this research method. Additionally, using qualitative or quantitative approach in this regard would have been time efficient and concise. However, application of any of the two methods would have reduced the criticality of the findings.

The key limitation of the research study has been in the variety of the parameters of such issue setting. Adding the concept of a community neighborhood environmental sustainability, to the specified parameter of the location i.e. Abu Dhabi, UAE, to the specified parameter of the current legislation of Estidama; all sums up a broad new customized study. Although this may mean that this is unique in nature for the paper quality type, it also means that a broad of references needed to be addressed while cross referencing different bits data information to finally use the extracted input portraying the foundation of this study's literate background.

Another point of view limits this study to its content presentation of a new concept due to its unique features. This study draws at finding out the adaptability of current neighborhoods to the environmental orientation of Estidama. According the primary research of this study this particular concept note has never been discussed in a paper before. This leaves the paper with a beneficial "new topic" feature, but also burdens the findings of a possible weak adaptability of current neighborhoods to Estidama, the link between the two maybe a weak one. This can narrow the research window for simulation and relevant research content. No matter what the link is findings and research will find out what the extent of such integration.

On the other hand, the research subject very much broader that requires the due consideration of various aspects of the communities, which can reduce the appropriateness of the findings. Nevertheless, in order to cope up with the limitations both primary as well as secondary method of data collection has been incorporated in the research (Neelankavil, 2007).

3.9 Ethical Consideration

The research study is required to be executed in an ethical way in order to ascertain the objective of the research in an appropriate manner. Additionally, thus the ethical considerations have been taken while conducting the research study. In this regard, in this research data of the case study neighborhood has been acquired through free consent of the residents or building watchmen. The data that has been gathered from the secondary sources were ensured to be obtained from the reliable sources (Halai, 2006).

Chapter 4

The Case-Study

4.1 overview

Referring to the above mentioned features of a defined neighborhood in Abu Dhabi 2030 vision, set up by the Emirate of Abu Dhabi, the case study that has been chosen for the purpose of evaluation of this study should meet the parameters of a modular neighborhood through connectivity, surrounding public facilities, containing undefined number of buildings forming a unit within their layout that allows residents to psychologically define their community boundaries of small neighborhoods where they get to know each other to strengthen the social dimension (Abu Dhabi 2030 statement, 2014).

Within the coordinates of 24º27’ North, within Al Bateen area in the emirate of Abu Dhabi, on a micro scale lays the specific neighborhood community chosen as a study object.

Figure 2: Ariel view of community case study (Google Earth, 2014)

4.2 complying statement

The neighborhood validates the Abu Dhabi 2030 vision of neighborhoods. It is of a modular nature; repetitive 6 short buildings. According to the 2030 vision, and as a current notice of the case study, the 6 buildings formation is equivalent to a unit, which is indeed repetitive with sometimes a slight difference in the orientation within the whole area of Al Bateen.

The community is formed in a cul-de-sac layout, the ultimate formation for a neighborhood to enhance the social interaction between neighbors, as the dead end that does not allow the formation of a car pathway add a user friendly feature for residents to use the area as a social recreation benefit.

The neighborhood does not contradict the futuristic land use vision of Abu Dhabi 2030 as its current location is within the residential land use area set out to be included within the urban context of 2030.

The neighborhood is also applicable to the connectivity parameter of the 2030 vision for Abu Dhabi neighborhoods; The neighborhood (1 in image), is close to three public schools within a diameter of 450m; shown in below image as Emirates National School (3), Al Bateen School(3) and Educ school (4). The study case neighborhood is 20 meters away from a mosque (2), laundry lot (2), a grocery shop (2) with a parking for the residents within, forming the centre area surrounded by the 6 buildings , as shown in the ariel photo taken from Google earth below.

Figure 3: Ariel view of community case study (Google Earth, 2014)

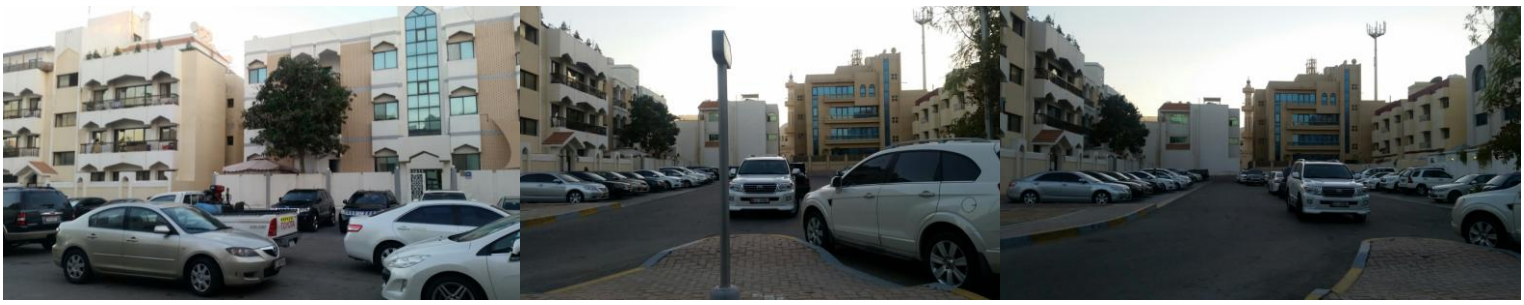

Figure 4: Images of neighborhood (by author, 2015)

4.3 Main characteristics

Through the site visits observation and the questionnaire the following features are considered as the main characteristics of the neighborhood, which are City Cad's data entry:

Type: residential

Urban form: Cul de Sac

Number of buildings: 6

Floors: 4 floors for each building

Flats: 2 flats for each floor, total of: 48 flats.

Number of residents: 190

Total Area: 5300 m2

Trees: 3, Main Street access

4.4 Environmental behavior record

Adapting the environmental scenario in city cad to this case study as is, with all above characteristics, has revolved in getting a clear idea of the environmental behavior of the whole setting. Moreover, the main addressed aspects of a proper environmental evaluation have been specifically reported through the following numerical measured values.

The environmental assessment of the given community basically revolved around four pillars; CO2 emissions (adding to the footprint of the community), landfill waste generation, water usage and energy consumption.

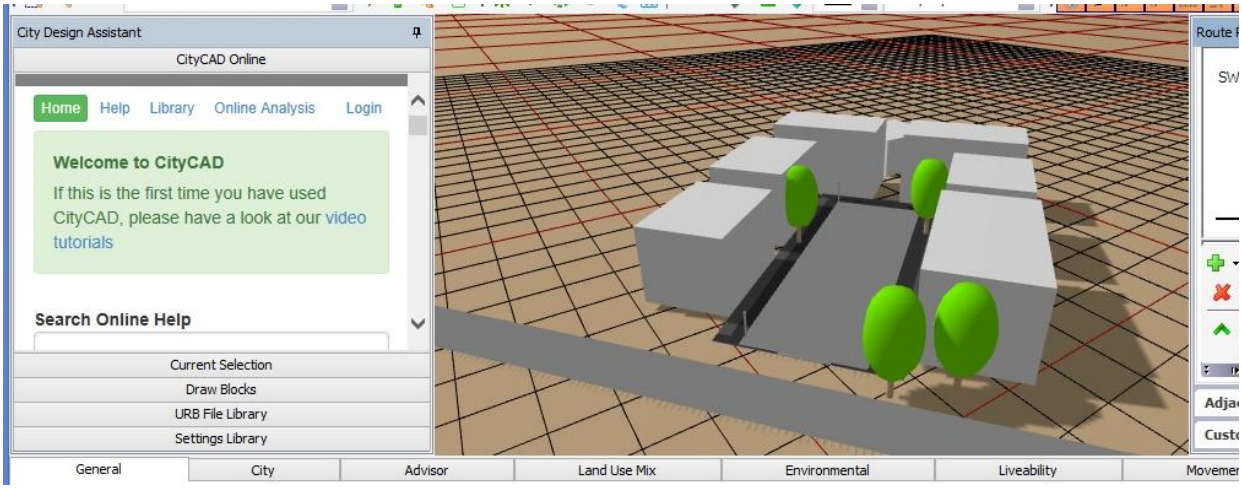

Figure 5: Extracted screenshot (City Cad, By author, 2015)

4.4.1 The annual Co2 emissions of a single household unit are equivalent to 10 tons of CO2, per year.

Entering all required data into City Cad, the reading of the CO2 emissions is ejected at 10 tons of emissions yearly.

Cross referencing the above reading to the US Environmental Protection Agency analysis, in 2013, the average household produced 12.4 tons of carbon dioxide. The above result of the study case neighborhood, extracted from the simulation process of City Cad, is found relevant to such report.

All carbon emissions ultimately can be traced back to the consumer behaviors, but the main source of such emissions goes back to the transportation and the cars involved.

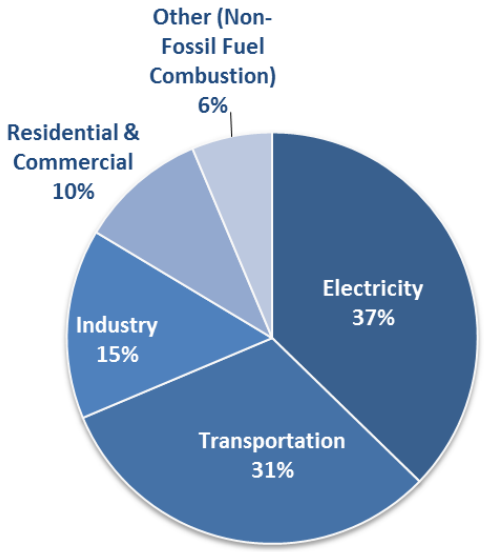

Figure 6: CO2 Emissions per household (US Environmental Protection Agency, 2013)

4.4.2 The waste generation meets the ceiling of 1000 Kg a year of each household.

The cross reference at this phase goes back to a seminar that was hosted at Al Ghurair University, which discussed the topic of "Best Practices on Waste Management", and organized by the Sustainability Network of Dubai Chamber, Abu Dhabi's average annual per capita household waste stands at 730 kgs and Dubai follows closely at 725 kgs (Khalifa , 2010).

The City Cad results prevailed the generation of 1000 Kg per household to be land filled a year, a value that emphasizes on the output of the seminar's given waste value.

Although a household represents organic waste that is deemed to landfill, but plastics and cardboards can form a big portion of the produced waste among other basic materials like glass and paper, all of which can be recycled and reduce significantly the land filled generated waste percentage of a household.

4.4.3 Water usage ranges around 160000 liters on a yearly basis.

According to time out Dubai, across the GCC, per-capita water usage ranges between 300 to 750 liters per day – far higher than the global average of 250 liters, highlighting the extensive usage of water within the UAE (Sands, 2013).

City Cad presents the use of 160000 liters a year, equivalent to an approximate 450 liters per day falling right into the relevantly wide range of water usage that is set out in the number of community features in Time Out Dubai.

4.4.4 Estimated energy consumption is delivered through 3000 Kw/h, of each unit.

As for the above reading, it is emphasized by the 2006 statistical report of Abu Dhabi as stating that the average energy consumption of Abu Dhabi is about 3400 – 4000 kw/h of each household (ADWEC, 2006). Abu Dhabi rates among the highest cities of energy consumption. Among many reasons, the availability of a relevantly cheap substitute of electricity, feeding on non-renewable energy sources might prevail as the strongest reason.

Chapter 5

Proposed Model

Results and Discussion

5.1 overview

Estidama community rating system will be utilized to give a framework intervention method to the environmental layout of the case study neighborhood.

As previously mentioned, the main credits within Estidama CPRS that address the environmental impact on a sustainable status quo of a community are:

NS-3 Ecological Enhancement

LC-R1 Plan 2030

LC-R4 Outdoor Thermal Comfort Strategy

LC-7 Active Urban Environments

PW-3 Water Efficient Buildings

RE-R3 Energy Monitoring and Reporting

RE-3.3 Efficient Infrastructure: Smart Grid Technology 4

RE-4.1 Renewable Energy: Onsite

RE-5 Energy Efficient Buildings

SM-R3 Basic Operational Waste Management

SM-6 Improved Operational Waste Management

It has to be stated that only the credits that provide an environmental approach that can be adopted within an existent neighborhood are chosen rather than the other credits that benefit the assessment of a community. This is mainly due to the role of Estidama within this study, as previously mentioned it is adopted in reproducing a more environmentally sustainable version of the case study neighborhood, an aspect that is directly linked with applicable technical adjustments and post assessment sustainable solutions within the proposal. Derived approaches taken from above credits will be integrated within the model as presented below.

5.2 Implemented scenario - Technical aspect

Taking the environmental integrated credits and reflecting them into on-site simulated implementation within the amended model by adopting the following approaches from Estidama:

- The main area of the central car parking has been replaced by a green area, this is done through City Cad by changing the function of the middle area in the model.
- Increasing the percentage planting, this is done by adding trees to the neighborhood model unit. Trees were added mainly on the entrance of the neighborhood unit and on entrances of the buildings to also create shade for users upon entering.
- Increasing the shade percentage within the neighborhood model, this has been applied by adding shading devices on buildings openings, and increasing the whole shading percentage in the unit up to 30%.
- Adding a renewable energy source to the neighborhood unit, by adjusting the model's featuring in City Cad of the capability of a having a renewable energy on site.
- Decreasing the baseline building water usage, this is done by resetting the water usage to optimal levels, the optimal percentage is to be presented by City Cad upon all entries added. In real case scenarios, this can be implemented by adding low pressure flow devices to taps, shower heads and water based machines for domestic uses at the buildings.
- Decreasing the irrigation needs of the neighborhood model for the above suggested planting approach, through resetting the irrigation demands to 2 liters/m2/day, a value presented in Estidama. This can be easily achieved by using native and adaptive plants within the neighborhood landscaping planning.
- Decreasing the landfill waste to 40% (recycling to 60%). This is an entry option in City Cad where a percentage is entered, specifying the amount of recycling bins through the model.

After running the model after adopting the above approaches, a new environmental pattern will prevail. Each approach participated in influencing a certain environmental aspect of the whole trending. Thus, the layout of the following section will be based around the four environmental simulation pillars of CO2 and gas emissions, water usage, waste generation and energy consumption. Under each category, the participating approach will be mentioned as a categorization method, to clarify what approach helped with what environmental face.

5.3 Direct implementation and relevant results

This section delivers the results of integrating all above Estidama oriented methods to provide the status quo of the environmental sustainable behavior of the proposed community in direct values provided via City Cad.

The general result derived from this study so far is presented through defining the link between Estidama and the current neighborhoods environmental setting. It has been found that there is an environmental aspect, of course, that can be adapted and linked to current neighborhoods rather than the neighborhoods that are still in the design or construction phases as addressed by Estidama. Moreover, this environmental link includes four main pillars at a basic level, consisting of CO2 and gas emissions, Water Usage, Landfill waste generation and Energy Consumption, all of which are to define the below results.

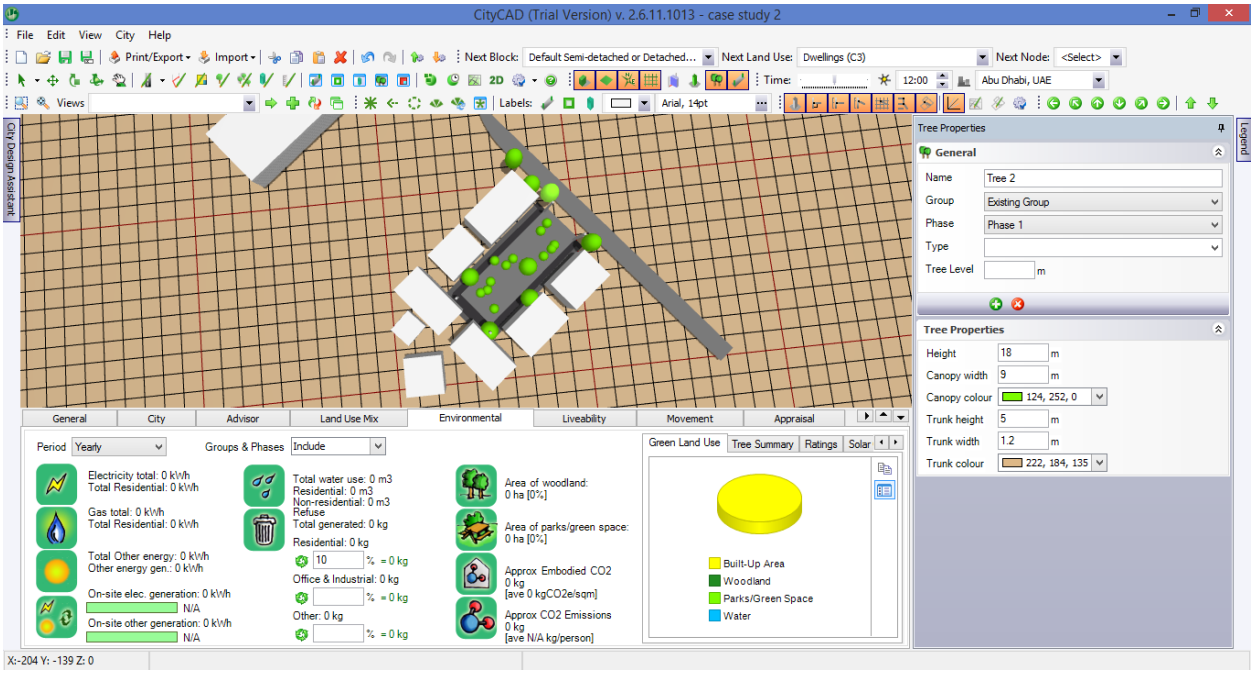

Figure 7: Screenshot of simulation model (City Cad, 2015)

5.3.1 Environmental Aspect 1: CO2 readings

Add-on Action: Replacing the central car parking in the model into a central green area, with 10 different species of planting.

What is noted at first glance is the reduction in the CO2 emissions value produced within the community units. From an annual amount of 10 tons of CO2, the unit registers a good reduction of 6.3% resulting in the production of 9.37 tons.

5.3.2 Environmental Aspect 2: Waste Generation

Add-on action: This is adopted through specifying a higher recycling target that reaches 60% of the waste produced. This action is considered as input in City Cad through sticking to the Estidama generated policy to add recycling bins for the waste different categories but not the organic waste that is deemed to landfill.

Applying the 60% recycling in the waste generation value, the proposed neighborhood will be left with only 400 Kg as an annual waste that is to be land filled. 600 Kg of waste is to be recycled; this is achieved by placing recycling collecting bins in the proposed neighborhood, backed up by applying a proper bin referenced segregation strategy within each building of the community. This is managed by Abu Dhabi municipality in providing the local community with the special recycling bins, and by integrating a proper design system for waste segregation to each building as foreseen by their individual designer teams.

5.3.3 Environmental aspect 3: Water Consumption

Add-on action: Using adaptive and native planting to reduce on irrigation needs. Adjusting the model in city Cad to a daily 2 liters/m2 and reducing the baseline building consumption to a 40% cut.

As to water consumptions, addressed by all mentioned PW credits, the simulation process of the proposed community reported the award of 3 credit points of Estidama. This is due to pre-specifying the irrigation needs of all planted trees to native and adaptive irrigation measures which is equivalent to IBL < 2 liters/m2/day as a set target, reducing the usage of water to 98000 liters annually, allowing a decrease of 40% in the overall primary water usage.

5.3.4 Environmental Aspect 4:Energy

Add-on Action: Adding shade devices within main pathways of building entrances and buildings openings. In City Cad increasing the input of the shade to 30%. Moreover, adopting a renewable energy source to cover up to 19.6% of the energy consumption of the neighborhood.

Finally, running the second simulation procedure throughout a renewable energy source within the production of the proposed community's energy system was implemented. Results revealed that the energy consumption of an electricity source was reduced by a percentage of 19.6 which does not achieve the highest ceiling of 25% set by Estidama (RE-4.1) but rewards the proposed community with a good score of 6 points for this credit, allowing the reduction of energy consumption to 2500 kw/h

Other passive strategies regarding RE-R3 did not participate in the above mentioned energy consumption reduction rate. This is mainly due to the extent of amendments this study is targeting towards the proposed community layout. The focus of this study is to apply changes upon the original case study within a proper logical framework and specified limits, as to offer the ability to utilize such measures within futuristic considerations rather than changing the fundamental basis of the case study like the orientation or implementing new construction materials which is impossible to apply in existing communities buildings without having to start from scratch.

Table 1: Simulation settings summary list (by author)

Environmental Aspect	First reading "as is"	Action	Relevant Estidama Credit	Post add-on reading
CO2 emissions	10 tons per household annually	Replacing the central car parking in the model into a central green area, with 10 different species of planting.	NS3 – Enhancing the ecological value of the site LC-7- INTENT: Demonstrate that outdoor spaces have been provided and programmed to encourage activity, including sport and recreation	9.37 tons per household annually
Waste Generation	1000 Kgs annually to landfill	This is adopted through specifying a higher recycling target that reaches 60% of the waste produced. This action is considered as input in City Cad through sticking to the Estidama generated policy to add recycling bins for the waste different categories but not the organic waste that is deemed to landfill.	SM-R3/ SM 6 – INTENT: Demonstrate that Operational Waste Management has been addressed from the concept stage. As a minimum, the following must be addressed by the design and development team:	400 Kgs annually to landfill
Energy Consumption	3000 Kw/h of each unit.	Adding shade devices within main pathways of building entrances and buildings openings.	LC-R4- INTENT: Demonstrate an outdoor thermal comfort strategy has been employed to identify priority areas for shading and improve the	2400 Kw/h

		In City Cad increasing the input of the shade to 30%. adopting a renewable energy source to cover up to 25% of the energy consumption of the neighborhood.	outdoor microclimate for the community. <u>RE-R3- INTENT:</u> Demonstrate building guidelines have been developed based on analysis which identifies the most efficient measures for reducing the energy <u>RE-4.1- INTENT:</u> Demonstrate that a percentage of the community's total energy consumption is supplied through renewable energy	
Water Consumption	160000 Liters annually	Using adaptive and native planting to reduce on irrigation needs. Adjusting the model in city Cad to a daily 2 liters/m2. Inputting a 40% reduction into baseline building model of water consumption.	<u>PW-3 - INTENT:</u> Demonstrate that the average Water Reduction Target achieves the following improvement compared to the baseline building performance	98000 Liters annually

5.4 Discussion

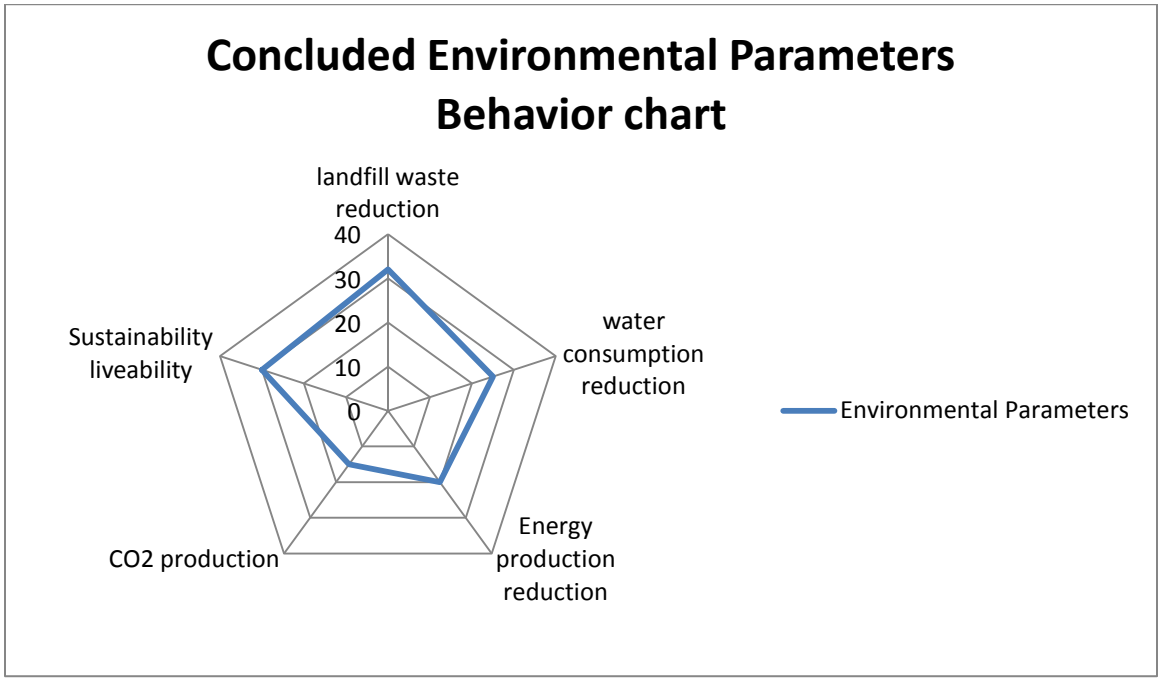

Figure 8: Environmental parameters behavior chart (by author)

The previous chart demonstrates the output of all found results; shown are the four environmental parameters that had been under study of this research's aim to figure the behavior of the environmental setting of the modified presented case study community.

Using a renewable energy is the most direct way to integrate a sustainable concept within any community. The impact of such approach can achieve more than the recorded 21 scored scale enhancement in the energy consumption levels. The above score refers basically to the inability, within this study's specified setting, to modify the elements of neither the studied buildings envelopes nor their orientation. Modifying these two parameters can significantly increase the impact of the energy consumption reduction, while adding a renewable/ green source of energy that can provide for the consumption at optimal sustainable levels.

On the other hand, the integration of a direct active approach of renewable energy activation within site has taken the share of 19% of the total energy consumption that is produced by a non renewable source of energy. Within the Estidama regulations, those are initially made for newly planned or still constructed neighborhoods, the ceiling of the renewable energy share of the neighborhoods total energy consumption is set up on 25%. For an existent neighborhood, like the

presented case study, the ability to involve a 19% share of energy is seen as a good value share and a proportional beneficial step into achieving a more environmentally sustainable level.

Redefining the central open area to a green area, and transferring it from the previous function as a central car parking participated in recording a significant reduction in the CO2 and gas emissions production levels, recording a 15 scaled score, grounded according the 4 environmental aspects behaviors as a whole. This is mainly due to the reduction in carbon monoxide gas from cars, otherwise other sources of CO2 emissions of individual household activities are of a constant production pattern, as previously discussed within this paper research.

The reduction of 6.3% in the CO2 and gas emissions, influenced by the application of the Estidama approach is found to be of a relevant rounded percentage, as compared to the percentage provided by (Mckenzie, 2010) of 7.4% as the estimated reduction in CO2 emission within programs targeting residential sustainable energy use within the residential communities.

Therefore, and according to what has been stated above, the influence of Estidama on the case study existent neighborhood is up to an acceptable extent and is foreseen to emphasize on the ability of a standard remarkable change in the environmental pattern.

It is concluded that the effect of applying the environmental oriented credits of Estidama was most influential on the landfill waste generation aspect. A great increase in recycling on terms of waste management is to be achieved by integrating the waste management methods highlighted within the Estidma manual and mentioned early within this study.

This probably a virtual result based on the optimal setting of the whole modeling process, on real grounds this is anticipated to be based upon the behavior of end users and individuals who have the individual choice of waste segregation. Although that this is the case, but is anticipated optimistically as the awareness of such environmental importance for such process is seen to be increased among users by integrating the environmental sustainability concept and implementing its approaches through the whole neighborhood operation.

In the above chart, on a scale from 0 to 40, referring to the fundamental results of the integration of all four analyzed environmental parameters grounded at zero, and after the 31 score rewarded value of the landfill waste generation reduction, water consumption achieves a value of 26. It is important to note that indoor water methods have not been recorded throughout this paper's measurements, as it is assumed to be of individual house hold decisions, and are not included in the overall community environmental framework that is foreseen as a general package for the whole community without referring or jeopardizing the individual freedom of choice, which will hopefully be oriented towards more sustainable levels after applying the mentioned methods due to increasing the awareness of the importance of a sustainable community concept, this is

obtained by controlling the whole water usage of buildings in setting the baseline needs of each and decreasing it to optimal levels.

The decrease from 160000 liters to 98000 liters as an annual water usage brings the attention on the ability of adaptation of such neighborhoods to newly added environmental measures, and emphasizes on the importance of such adaptations given the shown results of enhancement.

As the intervention approach addressed a current neighborhood, then all adopted methods came as active strategies rather than passive ones. Estidama's established methods have come to a result after integrating them within the operation of a current neighborhood, but the integration also showed the small window that consisted of a direct interface of the 4 environmental pillars that was foreseen as the possible link of application between Estidama and current neighborhoods. Abu Dhabi and the UPC should not overlook the environmental vital importance of the current neighborhoods in establishing the sustainability vision stated in Estidama an Abu Dhabi's 2030 vision.

A very important issue that has to be stated within this study's scope, is the fact that City Cad cannot measure the additional enhancement status of a sustainable environmental improvement within the community that can be achieved by the individual residents efforts in increasing all appropriate behavior that maintain the optimal level of a sustained environmental setting. The change of behavior is foreseen to take place due to the implementation of all above mentioned sustainable methods, which increase the sustainable awareness among all residents

This intangible effect cannot by any chance be assessed in proper direct values by any software, not only city Cad, as it obviously addresses the nature of the individual and their welling to participate towards an environmental sustainable community. The social dimension within this study's results had to be highlighted, a dimension that is not complying with all technical assessments but is complying with this study's anticipated results in direct technical implementation of sustainably environmental communities in real life as an operational effect rather than a construction or design phases effect.

As this study's main subject has been dealing with a community, the awareness of the sustainable environmental status of the neighborhood and having ways to enhance should be a main target for any future community developments. The human is at centre of any sustainable

development and increasing the sustainable awareness leads to a noticeable progress in people's behavior and consumption patterns within a community of a responsible reference.

5.5 The environmental modular package

This section bundles up the most direct methodologies that encountered a recognizable change in the sustainable environmental behavior of the analyzed case study community. The approaches that are to be clarified below are extracted from the mentioned process, connecting all dots of this study.

It is important to re-emphasize on the fact that this study's virtual technical implementation process has been done by an existing framework under the current regulations of Estidama, moreover this was applied on a case study community that is formed by futuristic parameters and onwards vision specification for the upcoming Abu Dhabi 2030. This draws a true authentic dimension towards the feasibility of future efforts to adopt this study's results and its produced sustainable environmental bundle to be applied on existing communities in order to behave their most archival optimal sustainable level, of Corse opposed to minimal amendments possible as not to jeopardize the current form, design and layout of any community outside the logical and realistic measures.

This study also puts in consideration, in establishing the sustainable environmental package, the ability to be implemented within any communal development of the futuristic vision of Abu Dhabi 2030.

Although the provided solutions are extracted from one specific neighborhood case study and by using one specific environmental evaluation software, that should not mean that the to be established modular solution bundle cannot be implemented in any community forming projects.

The solutions are designed and formed in an independent way as to serve onward environmental goals.

A very important approach is to increase the planted trees among the neighborhood. A good way to do this is to establish a central open green area that can also host some social exercises, strengthening the social aspect of a sustainable community as well as its environmental face.

Building on the above approach, through the specification of native and adaptive trees, develops into the second methodology approach of this study's sustainable environmental package.

The use of native and adaptive trees is linked directly with the irrigation needs by not burdening the water consumption with the suggested increase in plantation. The study actually showed that the watering needs of planting 20 trees can still be maintained by a value of less than 2 liters/m2/day which is Estidama's highest set target.

Installing domestically water controlling equipment, such as basin taps, BD flushes, shower heads that runs on a minimized flow is guaranteed to reduce furthermore the water consumption levels to up to 40%, a percentage that is targeted within Estidama for building rating system.

Setting ways and equipment for waste management such as segregation waste containers, waste management brochures and proper waste segregation related signage, forms an important approach drawn by this study's aim of achieving a modular sustainable package. Establishing a proper waste management plan for the community assures high values in operational recycling, thus improving the environmental level and the social responsibility towards a better community quality.

As for the final basic methodology, a renewable energy source of production has to adopted in upcoming design considerations, in the UAE solar energy, by adapting a PV panel system, is highlighted among numerous existing projects and is prevailed as the best relevantly easily applicable approach as to reduce the burden on producing energy in traditional ways, that depend on non-renewable resources.

Adapting the above sustainable environmental package can positively affect the behavior of any given community in terms of achieving a proper environmental quality and an ambitious sustainable output.

Chapter 6

Conclusion

It is essential to emphasize within this section on the importance of integrating a sustainable environmental interface to the many phases a neighborhood goes through during all design, construction and operational stages.

Neighborhoods have become strongly integrated as a prevailing urban factor to the city's fabric context. This highly contributes to the necessity of implementing their vision of implementation within a sustainable application by maintaining an environmental approach.

Abu Dhabi as the capital of the United Arab Emirates has been well aware of such important issue, aiming to achieve a better tomorrow and a sustainable future that can maintain all resources without jeopardizing them for future generations. To achieve such goals Abu Dhabi adopted the Estidama project, a sustainable green rating system for communities among other two versions for villas and buildings, and has made it mandatory for all governmental projects and Abu Dhabi 2030 community developments to undergo Estidama regulations and to fit within its designed framework.

After specifying an existence neighborhood as the study object of this paper, the environmental status was defined by assessing the inputs of the neighborhood into City Cad. The assessment of the specified neighborhood led to direct valued results that drew the setting of the environmental status by evaluating the main environmental parameters which are the CO2 emissions, waste generation, water needs and usages and energy consumption.

The neighborhood's buildings usages and all surrounding and central areas have been set to their exact type and function; moreover all characteristics of the neighborhood, along with its exact location have been preset into the City Cad model; requirements of the software to achieve realistic results.

All extracted results did not contradict the results of previous research efforts and utilized references that assured the validity of the valued outputs of all mentioned parameters; the results that were excluded by the first simulation process, assessing the "as is" original neighborhood, were in the same range of statistical readings given out by previous researches and references.

Estidama separate environmental credits were used to conclude all implementation methods that can enhance an environmental setting of the proposed neighborhood. Applying such measures enhanced the sustainable environmental behavior of the community as anticipated.

Results showed the after readings, readings of which declared a change in the environmental output of the neighborhood after implementing the Estidama derived approaches.

As presented results showed variable influence extents on the environmental pattern of the neighborhood. Each result derived from a design, function or input data amendment through City Cad.

As discussed, the change in the environmental pattern produced after the amendments fit right in the expected environmental behaviors of neighborhoods basically planned on sustainable approaches. Although the resulted change in the environmental behavior did not hit optimal levels of the previously established ranges through Estidama, but the results fell right into the range of the expected environmental influence values.

This is seen and presented as a good enhancement level for a fully operating neighborhood highlighting its ability to catch up with the sustainability vision of Abu Dhabi, even if not planned on environmentally sustainable fundamentals.

The study mainly addressed an existent neighborhood, adopting direct environmental "add-ons", through implementing environmental sustainable approaches. These add-ons form a bundle of environmental strategies and approaches, and this bundle can be easily adopted by developers and market stake holders on current neighborhoods across Abu Dhabi.

It is never too late for a neighborhood to be more environment friendly and to behave more sustainably even if it is already established and operating in full function, but this possibility should be highlighted by Abu Dhabi's urban planning council through a direct translation to legislations and policies that solve to enhance the environmental sustainability of current neighborhoods, rather than only addressing new neighborhoods that are to be yet built.

The current neighborhoods play an important role in establishing the sustainability vision of Abu Dhabi 2030 and Estidama, and they are nowhere to be gone as these current neighborhoods comply with all the neighborhoods parameters of Abu Dhabi's urban planning vision of 2030 minus the sustainability factor.

This whole study was based on results founded by the City Cad software. This program has been found as a very useful tool in analyzing the sustainable behavior of a community through providing direct numerical values. Such results present their importance in getting across the environmental behavior to different stakeholders, designers or authorities of which may not have a fundamental knowledge of the sustainable vocabulary, thus a numerical value will definitely be in essential use as it is basically understood and may easily be transferred to tables or charts in order to get the final picture of the neighborhood's environmental setting.

Therefore, the tool of City Cad is highly recommended to be used within futuristic design projects or planning initiatives.

It is ought to be stated that all above results are to be similarly achieved in all neighborhood types; the results are not strictly recorded for the case study’s neighborhood type or geographical location. The study case had been only specified across the Abu Dhabi 2030 plan as to increase the validity of this study’s outcome.

Through the application of direct and basic modifying approaches, a community within a neighborhood can behave more sustainably. The study has showed the enhancement of the environmental setting of the chosen community, and by addressing such methodologies and methods through the overall design and planning framework by current policies and generations, any community can achieve the goal of a sustainable foundation behavior of which the importance is essential in highlighting Abu Dhabi as a sustainable city that consists of a sustainable growing urban growth.

The sustainability livability is an overall average value of the whole environmental approaches that went under this study's analysis, of which the livability of the sustainability is maintained within the community. In between integrating all the studied environmental approaches within a sustainable community project, the sustainability livability can be enhanced by a 30% increase value.

This development, if applied on current neighborhoods, not only enhance the environmental status quo of Abu Dhabi neighborhoods, thus the city's environment, but also creates numerous job opportunities and increase the neighborhood and the city's awareness levels towards the environment. Nevertheless, the sustainability as a whole will be addressed as discussed, the sustainability as a concept will be implemented and founded in the setting of a city that consists of environmental friendly neighborhoods and aware communities.

6.1 Future recommendations for future research

This study has been established upon previous researchers' efforts, and is considered as a humble step and another brick in the wall of the ongoing researching movement towards achieving a comprehensive approach in implementing the environmental sustainability concept in current and upcoming developments.

Going through the process of setting up this paper, many points and aspects have been taken in consideration as to fill in the gap of this study's question of research, which allows the paper to serve as an orientation guide to future efforts to pick it up from where it has been left by the researcher.

Emphasizing on the importance of a successful research towards frame working the importance of the environmental sustainability in today's urban and industrial world, the following points are to be perceived as recommendations for future researches:

- The first point of recommendation is to address the social part of the environmental sustainability implementation within a community; a community is based on people and made for people and their intangible effect on the sustainability implementation within their space of living has to be analyzed in a comprehensive approach.

- The second recommendation is to elaborate on the ability of integrating more design oriented environmental approaches and more passive techniques, in a way, for current existing neighborhoods.

- To build on new ways to enhance the environmental behavior of an operating neighborhood by introducing new sustainably environmental approaches, not mentioned within Estidama, but can be awarded under Estidama's IP target for innovative practices.

- Emphasizing on the role of the current urban fabric of Abu Dhabi in the future sustainability orientation.

- Studying the governmental point of view in future studies addressing the governmental role in settings of current neighborhoods through legislations.

- Including urban experts' solutions and suggested approaches to enhance current neighborhoods environmental statuses.

- Moreover, new software tools have to be explored; today's technological world is rapidly blooming by the second thus future researches should utilize more advanced versions of current or future smart software tools to measure the environmental sustainability of a community or a man made development.

- Fostering inclusiveness and cohesiveness; this is by delivering a divers and inclusive study base that not only presents the direct status of the role of current green policies and guidelines, but also states the role of engagement of stakeholders in the evolution of their communities, from policy to ongoing revitalization, evaluation and adaptive management.

- An important future recommendation is to emphasize on the economical influence of the above reported results; as to analyze the reduction effect on the economical aspect when energy is cut down from 3000kw/h to 2400kw/h per a household.

- Emphasizing on the economical beneficial aspect of applying such solutions that can help reduce design costs, avoid misunderstandings and leave more time to work on design quality, and analyzing the economical dimension of such issue into direct results and numerical data as to ease the delivery of the concept to readers.

- Finally, utilizing a case study approach as an important methodology as it proceeds with an authentic feature to the study's issue of analysis and delivery.

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