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Sustainable Urbanism: Towards Edible Campuses in Qatar and the Gulf Region

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Abstract: As University Campuses worldwide are striving to become more sustainable and resource efficient, some are beginning to also develop the concept of the Edible Campus, which includes implementing spaces to grow food within the University Grounds. These initiatives are first and foremost to provide the users with healthy and sustainable food, but also to educate the University population about the production of food and the resources involved. Producing food on a campus not only reduces the food print, that is the energy that is required to bring the food from distant fields to the plate, but also allows more efficient resource use and recycling, for example the recycling of organic waste as compost and the use of grey water in irrigation. Dormant lands – green fields – can be used to produce crops, and decorative landscapes can be converted into productive landscapes with food and medicinal plants. Edible boulevards are constructed with fruit bearing trees, and can still have urban and climatic functions of providing shade. A permaculture approach to food production can also contribute to increasing biodiversity on the campus, with careful combinations of plants that repel harmful insects but attracts multiple species. So, How can the concept of Edible Campus be applied in Qatar and the Gulf Region, in a dry land climate? This research looks at the different practices and modes of producing food in dry lands and proposes an application at Qatar University campus. It builds on previous research on Food Urbanism in Doha, and on a prototype Edible Boulevard and Edible Rooftop Garden being implemented at the College of Engineering.

Keywords: Sustainable Urbanism; Food Urbanism; Edible Landscape; Edible Campus; Permaculture.

1. Introduction

Situated in arid and desert climates, the State of Qatar and most countries of the Arabian Gulf face limited land and water resources. Qatar, Bahrain, Kuwait, Oman, Saudi Arabia and the United Arab Emirates have food security issues that depend exclusively on international trade with a percentage that ranges from 80% to 90% of their economic activities (Bailey & Willoughby, 2013). That is why, food security assumes a particular political significance in the Gulf, and the countries are exposed to two major supply risks: availability and affordability of food imports, and price risk. In many cases, they import the majority of their food and produce water from desalination. In order to increase food and water security and also to maximize resource efficiency, it is important to find new approaches to design cities that integrate food production while balancing resource utilization. This can be achieved through educational institutions within cities, which act as powerhouses that gush forth innovative ideas and creative thinking by connecting the most intelligent, active researchers with a wide source of new knowledge.

Universities, being key institutions in processes of social change and development, play explicit role in spreading knowledge and producing highly skilled personnel to meet perceived economic needs (Brennan, King, and Lebeau, 2004). This role helps in encouraging and facilitating new social and cultural values supported by the students who assume the major change of their societies. That is why, the issue of food and water security can be addressed though universities, with the aim to encourage students to grow their food in campus. Corresponding design approaches (productive landscapes and edible campus gardens) are scrutinized by case study. The Edible Campus Project is proposed to be implemented in Qatar University campus – inspired by other projects such as the Edible Campus Project at the University of California, Santa Barbara (UCSB) - aiming to address local food insecurity by repurposing underutilized spaces for food production, turning waste into food, and engaging students as growers and producers. The project tin UCSB, co-led by the AS Department of Public Worms, AS Food Bank, and UCSB Sustainability Programs, the project has empowered the campus community, especially students, to be responsible stewards and leaders of our food system. Under the supervision of skilled professors, the project has trained students in practices that address social, economic, and environmental aspects of sustainability and help them to reclaim their personal connection to the land and their food. (http://www.sustainability.ucsb.edu/ediblecampus/).

On the larger scale of the country, Qatar National Food Security program was founded in 2008 with an aim to reduce Qatar's reliance on food imports through the realization of the principle of self-sufficiency. This program has developed a Master Plan for food security in Qatar. Part of this plan is The Sahara Desert pilot project that is currently being implemented to increase Food Security in Qatar (www.saharaforestprojct.com). It is an oasis of green technologies including concentrated solar power, saltwater greenhouses, outside vegetation and evaporative hedges, photovoltaic solar power, salt production, halophytes and algae production. This presents a unique research platform to demonstrate and optimize environmental technologies that will enable restorative growth in desert areas around the world and, thus, address major issues of food security within Qatar and the rest of Middle Eastern countries.

As architects and planners of urban landscapes, we hold a vital tool in the growth of a sustainable community. Food is both a local and global issue. The lack of productive urban land, food insecurity,

uncontrolled urban growth, and a general lack of societal knowledge of food growing and preparation are the main drivers to conduct this research and implement its prototype at Qatar University campus. The following sections will present the Edible Campus project that is initiated and implemented as part of this research.

2. Literature Review

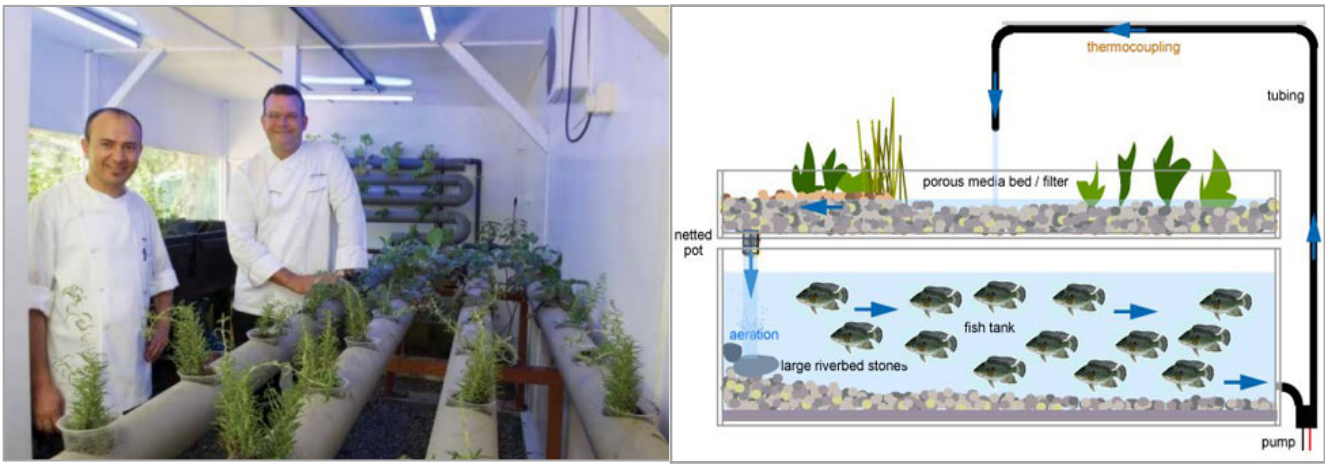
There is an accumulated evidence of the importance of growing edible landscapes and producing food in compact urban settings (Barale, 2009). A range of theories and approaches have been forwarded in order to investigate the idea of productive landscapes and edible gardens in Doha. In his paper Holdsworth (2005) has discussed how productive urban landscapes directly connect urban to rural surrounds. From this approach, sustainable cities grow where high-rise and dense buildings have increased in popularity since building facades have become gardens and all the foods necessary for the city come from nearby local farmers markets (Holdsworth, 2005). Likely, in his paper Grimm demonstrates that urban food systems have a potential of creating environmentally, socially and economically productive communities (Grimm, 2009). This reflects that continuous productive landscapes have the potential to become a tool to sustainable growth in urban communities. Therefore, urban food systems and design based on the theory *Food Urbanism* should be researched since food relates to the organization of a city and how it becomes infrastructure that transforms the urban experience.

Some projects in the Middle East are developed to promote for edible gardens in hot, dry climates. Aside from studying Edible Campus Case studies worldwide, it is important to also look at what is being conceptualized or implemented in the Gulf Region. A good example is Dubai's "Food City" which is a speculative plan developed by a Landscape Architecture firm (GLCA). This city includes artificial roof landscapes, renewable energy systems, aquatic farms, vertically stacked landscape surfaces, and thermal conditioning. The project conceives the city as a functioning metabolism rather than an industrial machine (Architecture Media, 2010). In Dubai, in 2007, and as a part of an ongoing effort to address environmental concerns, an onsite Bio-Garden has been developed at the Jebel Ali Golf Resort to produce a range of fresh fruits, herbs and vegetables for use in the restaurants dining outlets (www.jaresorthotels.com). The Bio-Garden was an area of un-used land. Currently there are 750m^2 of plant plots in the garden that will be extended by another 1,000m^2 to accommodate more fruit and vegetable varieties. A green house will be built to plant seedlings and nurture them until they are ready to be planted in the garden plots.

Natural design strategies such as edible landscaping have been shown to have positive biological impacts on the urban environment including improved urban biodiversity, habitat creation, resource conservation, increased productivity, storm water management and nutrient cycling (Barale, 2009). In particular, the use of native and adapted species in edible landscaping has been shown to reverse the ecological impacts of urbanization on native biodiversity and local habitats (Amirtahmasebi, 2008).

Also, the garden has an educational component where children and adults can learn about food sourcing and how to grow food in an arid climate. Hotel guests are encouraged to take an educational stroll around the garden and to learn about the natural health and beauty benefits from the plant descriptions. A watering pond in the middle of the garden creates an ecosystem and habitat that attracts a variety of bird species such as peacock, parrot, partridge and crows come to drink from the pond.

Figure 1. Plants and Herbs Grown using the Aquaponic Gardening Method at the Jebel Ali Resort and Hotel**.**



Alongside these governmental projects in the Gulf, there are examples of local community or residential food production by individuals. For example, here in Qatar, Indian expatriate workers, who hail from rural communities, develop extensive vegetable and fruit gardens. Also Qataris themselves have farms where they grow food. There are many opportunities to retrofit existing buildings and landscapes in the Gulf region and in Qatar, and to encourage communities to develop urban agriculture at the residential and community scale. Therefore, creating edible gardens in Doha can develop it as a sustainable city that is self-sufficient with food production. A healthy urban food system means a healthy and sustainably growing community that is economically, environmentally and most importantly a socially productive community.

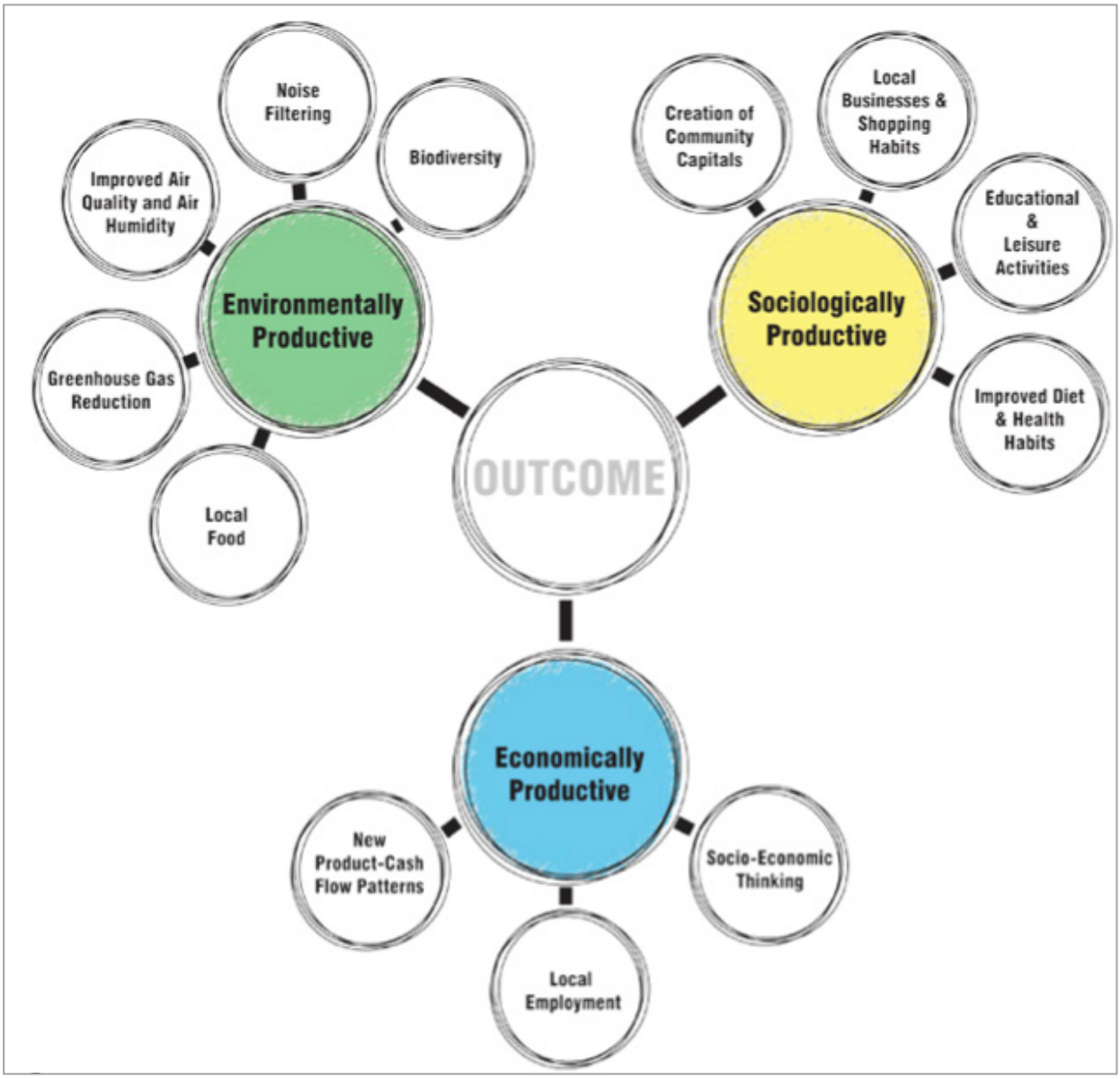
3. Food Urbanism in the Context of Qatar

Qatar is a small peninsula with an area of approximately 11,000 km2, bounded by the Arabian Gulf on all sides except in the south where it touches the eastern province of Saudi Arabia. The arid desert climate of Qatar is characterized by scanty rainfall with an annual average of about 80 mm (over the period 1972–2005) (www.fao.org). Therefore, rainfall is not considered reliable for supplementing irrigation and maintaining agriculture, yet it represents the main source of irrigation water in the form of recharge to groundwater. Other climatic characteristics are high temperatures during summer (> 40 °C), high evaporation rates with an annual average of 2,200 mm, very strong winds and high relative humidity (Abu Sukar et al, 2007).

As per the 2005 census data, the total cultivated area of Qatar is 6,322 ha, including 67 ha of greenhouses with an arable land of 2,651 ha, which includes 1,190 ha of vegetable crops and 1,461 ha of field crops (2005 data). The land suitable for irrigation is 52,128 ha and most of it is classified as having marginal suitability for irrigation (Awiplan Qatar & Jena-Geos, 2005). All cultivated areas are irrigated thus representing 12.1 percent of the land suitable for irrigation. Qatar imports over 90% of its food, and seawater desalination counts for 99% of water sourcing and which presents a very high factor of Food and Water “Insecurity” with a large dependence on technology and imports.

Urban agriculture contributes to food security and food safety in two ways: first, it increases the amount of food available to people in cities, and second, it allows fresh vegetables, fruits, and meat to be made available to urban consumers. (Solomon, 2008). Food production within the urban context occurs at a range of different scales and is performed by a variety of actors including private individuals, groups or associations, public administrations and professional farmers. It is not limited to a closed circle of professionals in the primary sector (www.foodurbanism.org). Whilst small-scale and localized food production has a long history, including individual allotments which have been popular in Europe since the late C18, it is the integration of such farming practices within the economic and ecological system of towns and cities that is a newer development. (Awan et al. 2010). This means that urban resources such as compost from food waste and wastewater from urban drainage is made use of, whilst urban problems such as the pressure on land and development also have to be negotiated (Henderson, 2009).

Figure 2. Urban Food System Outcomes.



4. Results and Discussion

The Edible Campus research project was suggested to identify ways of increasing campus sustainability by providing students access to fresh, local food through urban agriculture. Urban agriculture increases food security, nutrition, and urban biodiversity (van Veenhuizen, 2006). This research was completed to determine what is the desirability and what are the opportunities and constraints of implementing and maintaining edible plants, native or adapted to Doha, into Qatar University campus landscape.

The research is also intended to develop a better integration of "whole systems thinking" in designing projects, maximizing food production while minimizing energy, water and land use. The research methodology seeks to answer three basic questions:

- What are the practices of food production in residential architectures in Qatar?
- How can these practices be applied and replicated/adapted in architectural designs and the retrofitting of existing buildings?
- How can the knowledge gained through the research be applied in a prototype?

A blog / website was created for the project as a means to communicate the information to a larger public and to share it amongst the researchers. http://blogs.qu.edu.qa/foodurbanismdoha/. Through a literature review students learned about contemporary architecture and urban typologies for food production, as well as strategies for reintroducing urban agriculture to our cities (Gorgolewski et al. 2011; Viljoen et al, 2005; Wagner et al. 2009). The literature emphasizes how the production of food can lead to interesting solutions that create community and provide residents with immediate access to fresh, healthful ingredients. It also demonstrates how city planning and architecture that considers food production as a fundamental requirement of design results in more community gardens, greenhouses tucked under raised highways, edible landscapes in front yards in place of resource-devouring lawns, walls that bring greenery into dense city blocks, and productive green roofs on schools and large apartment blocks that can be tended and harvested by students and residents alike. Of the different typologies presented in the literature, the Edible Schoolyard is of particular interest in relation to the prototype garden being implemented by the research team at the College of Engineering campus. The concept of Edible Schoolyard emphasizes the role of education in creating healthier communities. Converting the schoolyards to farms that are grown and maintained by the students will help them explore themselves and strengthen their connection to the environment. This can also be applied to University campuses. (Grichting et al, 2014)

5. Experimental Section

5.1. Detailed Investigation into the Case Study: Al-Waab Oasis Permaculture Garden in Doha

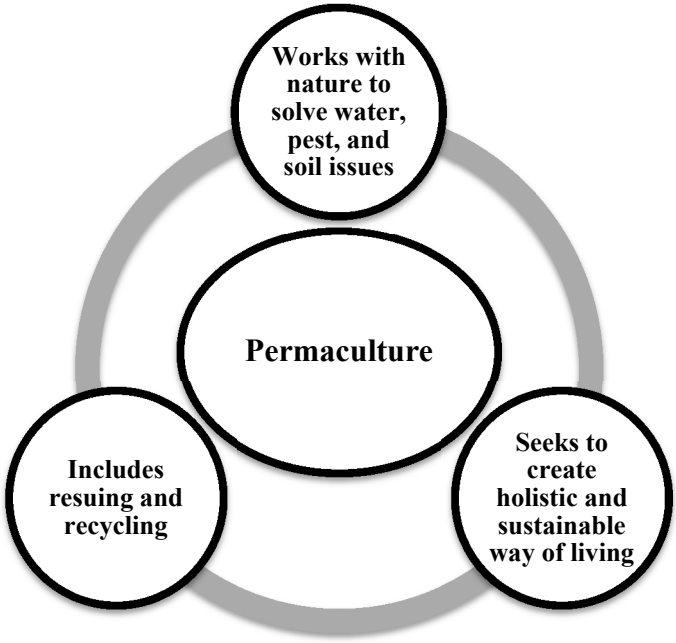
This case study presents a comprehensive implementation of the Permaculture concept that supports food urbanism in terms of offering long-lasting agriculture and healthy environment. This case is implemented by a Canadian master gardener and Permaculture expert who lives in Doha. After receiving her Permaculture certification in Jordan in September 2011, Paige was excited to begin implementing the Permaculture techniques. She decided to learn how to tackle the challenging growing conditions in

Doha, Qatar, and began with a site in Al-Waab Oasis Compound in Doha after receiving approval from the compound manager to begin the project.

5.1.1. The Concept of Permaculture

Permaculture means Permanent Agriculture, and Permanent Culture. Practitioners of Permaculture aim to create a self-sustaining, natural system by creating a surplus within the system by building healthy soil, recycling water, etc. Permaculture is a practice that works with nature to produce a sustainable garden design, and its techniques can be used in all applications including, but not limited to farms, private gardens, and buildings.

Figure 3. The Concept of Permaculture.



5.1.2. Permaculture Implementation

Paige Tantillo has implemented this concept while believing in Permaculture as an effective way of planting edible landscapes regardless of the climatic conditions. The harsh weather of Qatar was a good driver to try the types of food that can be grown in this environment. The implementation process was based on the idea of test beds that are distributed in the house's backyard and on the top roof. The objectives of the test beds are to:

- Gather empirical data about what grows well in Qatar and demonstrate the wide variety of food that can be grown, even with the harsh growing conditions.
- Demonstrate how Permaculture techniques can help increase food security
- Provide a tangible demonstration of how implementation of Permaculture practices helps to increase and benefit soil structure by use of compost, manure, straw, diversity of plants
- Demonstrate that natural pest management practices can be used instead of harsh chemicals

- Increase bio- diversity with a mix of vegetables, herbs, fruit trees, and beneficial plants to increase biodiversity and decrease pests and bring beneficial insects to site

The Permaculture Gardens consists of planting spaces in 3 areas:

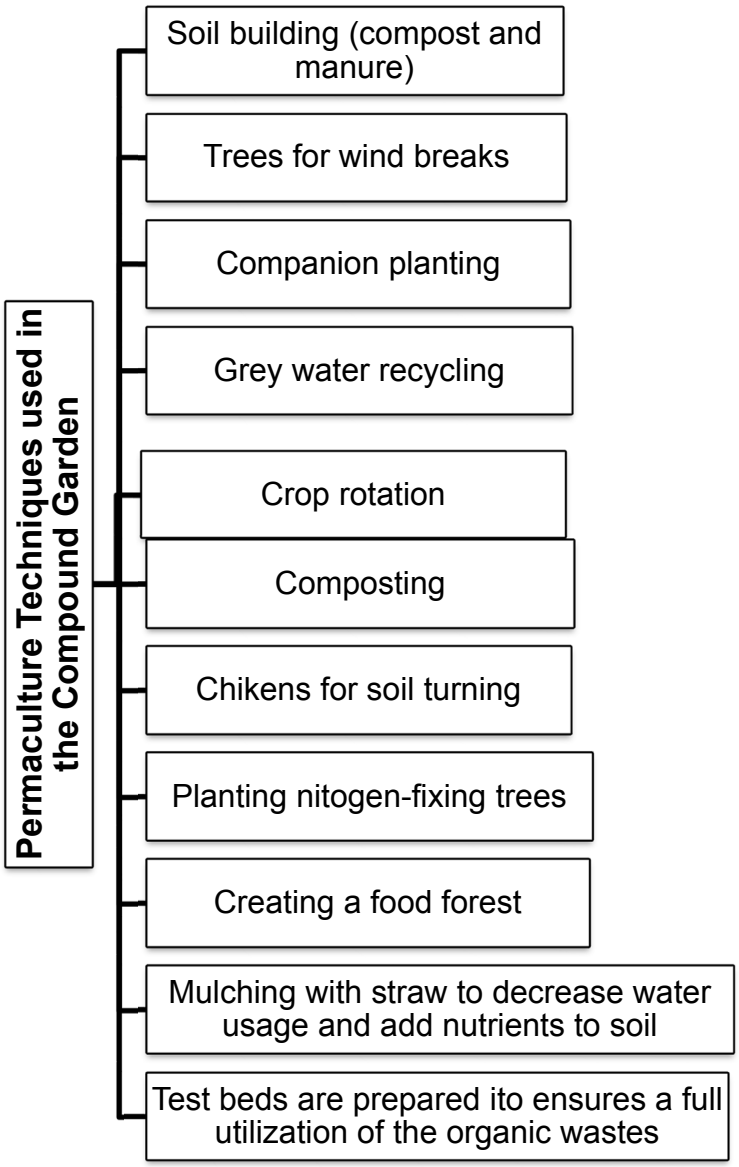
- Location 1:Paige's Back-yard garden (Fig. 4)
- Location 2: Paige's Rooftop container garden (Fig.5)
- Location 3: Rooftop container – grey-water area
- Location 4: The Compound garden, as shown in (Fig.6)

Figure 4. Plan View of Paige's Back yard Garden Permaculture Test beds.

Figure 5. The Permaculture Test Beds in the Compound Garden, near Paige's house.

Figure 6. Paige Tantillo with her roof-top garden Permaculture Test Beds.

Figure 8. Permaculture Techniques used in the Compound Garden, Al-Waab, Doha, Qatar.



This foundational research, by Paige, into the feasibility of growing food in Qatar using Permaculture techniques has shown that success is possible. A Ph.D student- Luzita Ball, with the active support and supervision of an Assistant Professor of Architectural Design- Dr.Anna Grichting Solder, and Associate Professor of Architecture Dr.Yasser Mahgoub, have decided to now do some more detailed research into the benefits of Permaculture for the context of Qatar, and its possible applications to Qatar's architectural design and urban planning. This they are doing by applying Permaculture principles and techniques to an existing Food garden at the Department of Architecture and Urban Planning at Qatar University.

5.1.3. Permaculture Edible Garden at Qatar University

Due to Dr. Anna's active interest in 'Systems Thinking', and 'Sustainable Food Urbanism', the first stages of an Edible garden associated with the new Women's Engineering Building at Qatar University have already been implemented.

The task involved a design stage where plans and drawings were generated in the form of design proposals. Together with expert permaculturalists, corrections and guidance intended to reach out for a final design scheme. A part of the garden was planted with seeds and young plants, including tomatoes, eggplant, cabbage, broccoli, squash, and corn. Al-Sulaiteen Agricultural complex assisted with the planting of the first prototype beds using both seeds and plantings. Following this, Building Operations Services expressed their interest in developing the project as part of their landscaping strategy. This now needs to be followed up on and also to discuss the issues of the project, plantings, maintenance, etc. and how it can be fully implemented. Also, it needs to be adjusted to comply with the principles of permaculture.

Figure 9. Conventional Urban Food System Flow Diagram

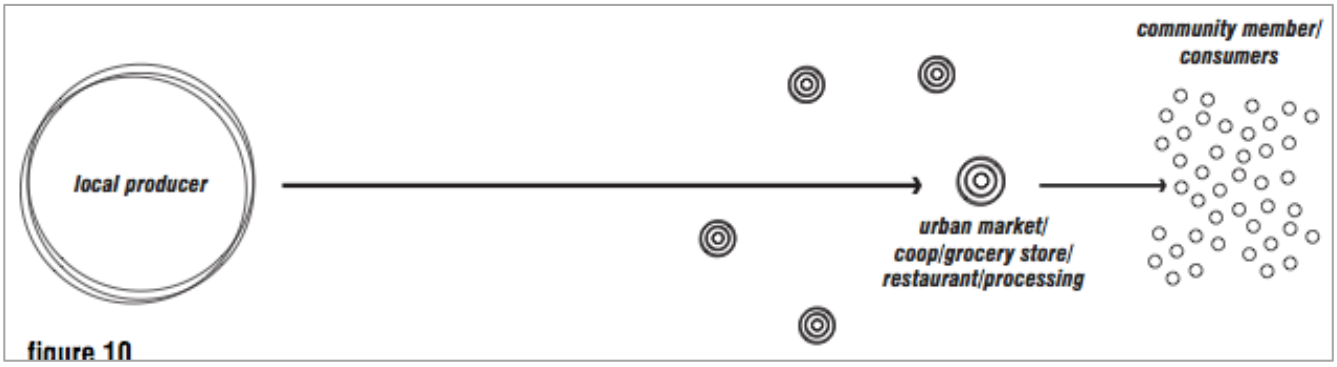
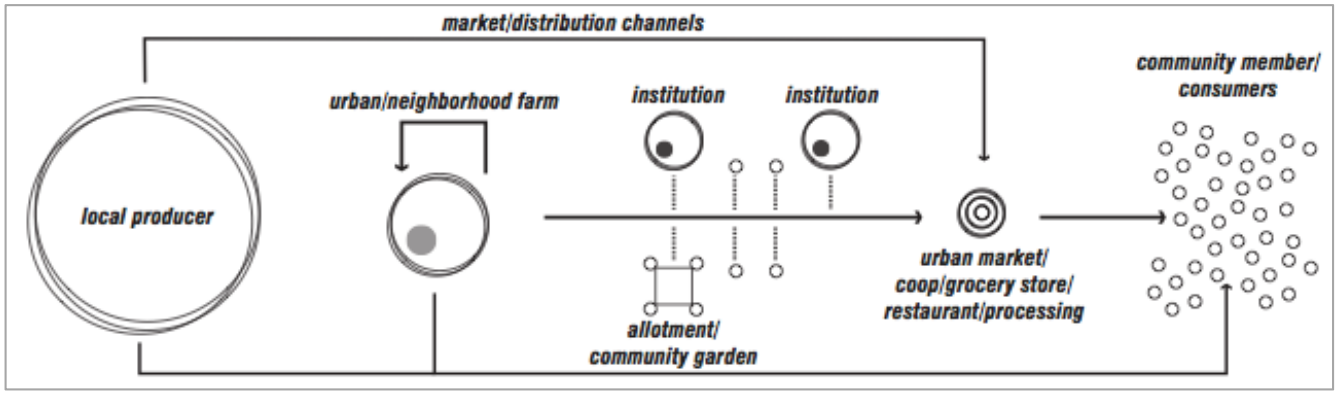


Figure 10. Proposed Urban Food System Flow Diagram



The launch of the Prototype Edible Garden at CENG took place on 20th May 2014, as part of the Department of Architecture & Urban Planning 5th Architecture Day. The event, a Juicing Festival and Competition, co-organized with the Student Association, aspired to spread the importance of such healthy habits as juicing and detoxing, as well as bringing the attention to food security, food urbanism and the design of productive landscapes in Qatar. During the event, the students presented and conducted visits of the Edible Garden.

The Edible Boulevard community garden is now being developed, with the help of Luzita Ball, Paige Tantillo under the supervision of Dr.Anna Grichting, and it is being conducted as a more systematic research project into the benefits of Permaculture Design Principles and Techniques in Qatar and Drylands, using Qatar University Campus as a case study and laboratory. The concept of Permaculture is defining the theoretical framework of the edible garden and green roof prototypes. The Edible Boulevard Garden and roof are now intended to become small Permaculture prototypes and

demonstration areas that can involve students from other colleges and departments in cross-disciplinary experiments into food and plant medicine production, and the benefits of Permaculture Techniques for the Qatari context in particular.

6. Limitations of the Study

There were a number of limitations in our research project. Due to the timeframe of the project, it was necessary to narrow the scope; consequently the project looked specifically at edible landscaping in the College of Engineering in Qatar University campus. This delimitation was chosen because the College of Engineering campus has the most potential for edible landscaping and a good density of students, and was also easily accessible to the researchers. Previous projects have been conducted on the campus, thus providing information to inform the research. Additionally, our group was the most familiar with the College of Engineering campus landscape, making it easier to navigate.

7. Conclusions

Systems Thinking and Food Urbanism needs to become a part of the design curriculum in Architecture Schools so that students will think about Resource and Waste systems, about Food Flows and Productive Landscapes, in order to develop more symbiotic designs and urban plans. Practical knowledge can be gained by developing prototypes such as the Villa and Compound garden, and the Permaculture Edible Boulevard and Green roof of the Department of Architecture and Urban Planning, at the College of Engineering in Qatar University, Doha, Qatar. A prototype such as that which was, and continues to be developed at Qatar University to increase the production of food on the campus, is proposed as a catalyst to extend the productive and edible landscapes to the whole campus, and to investigate and identify all the potential spaces for growing food on site, to provide both students and the workers with easily accessible and healthy food, and to reduce the "foodprint" of bringing food to the plate. There is great potential to recycle the organic waste on the campus and to implement strategies to make better use of water and energy resources through the systems thinking that will be applied to the University Campus.

The University is an opportunity to share knowledge, skills, experiences, and ideas, and to spawn further multi and inter-disciplinary research and community initiatives. It also has the potential to influence many future architects and urban planners of the region, and experts in other fields as well. The benefits of Permaculture are being investigated, and the principles and techniques may find interest in Doha and elsewhere in Qatar, the Gulf, and other Arab countries, as the results of the research project are obtained and presented. There is a spirit of optimism and excitement amongst the designers and researchers, who see that there may be many opportunities to implement Food Urbanism and Permaculture Design principles and techniques in various locations in urban, arid areas, to the predicted benefit of residents, the environment, and the food security of dry countries like Qatar.

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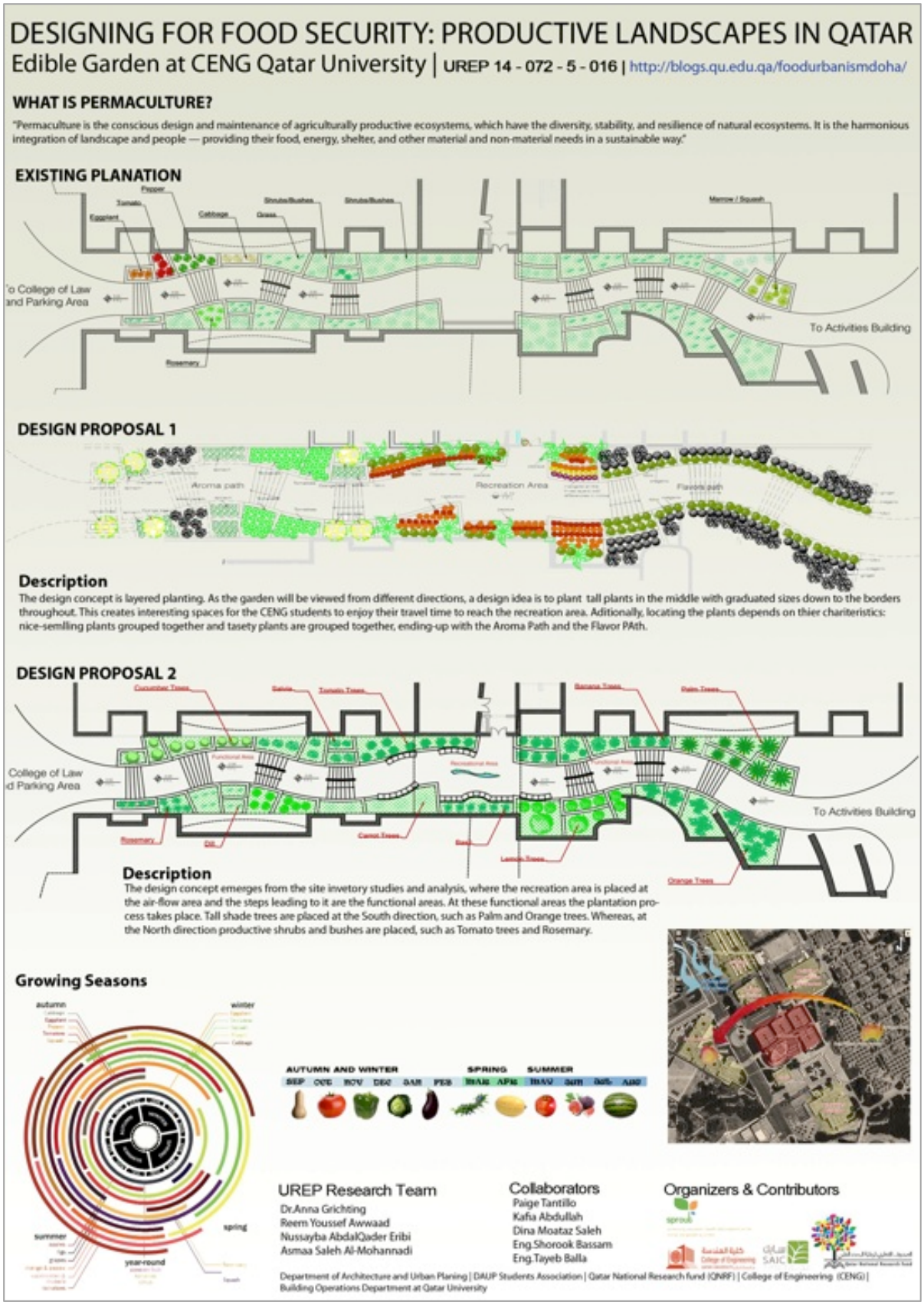
Figure 11. The Project for the Edible Boulevard Garden at the Female College of Engineering – Plan views of the designs – Designed by students for the Edible Garden Launch**.**



Conflict of Interest

The authors declare no conflict of interest.

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