

A Design-led FEWW Nexus Approach For Qatar University

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1. Introduction

Demographic explosion, climate change, urbanization, change of life quality, and food demand have put extra concern on Food, Energy, Water, and Waste (FEWW) resources [1], therefore sustainable development in urban areas has become an urgent necessity. A special focus has been placed on university campuses as they are representative urban communities that can be considered as mini-cities since their need for food, energy, and water is substantial, and they generate a considerable amount of waste. Universities can be models for the community as they can apply and disseminate new ideas [2]. Furthermore, small-scale successful applications tested on campus can be later applied to a bigger scale.

2. Aims and objectives

The case study of the Qatar University campus as a Doha Living Lab generates ideas and gives solutions to the FEWW Nexus through urban agriculture practices adopted to the climatic conditions of Qatar. The main aim is to produce food sustainably by combining the nature-based systems and the technological systems of the Food-Water-Energy-Waste nexus design to increase food production on the campus while minimizing the use of energy and water, enhancing biodiversity and soil quality. To this end, the focus is on sustainable food waste management and food waste valorization, production systems using hydroponics to mitigate water and soil challenges, greenhouses with minimal energy consumption, and finally, the use of treated sewage effluent (TSE) for landscape irrigation purposes. The Doha Living Lab follows the M-NEX Design method [3], engaging stakeholders and the local community, as shown in Figure 1.



Figure 1. Steps of the M-NEX Design Process [3].

3. Doha Living Lab Design



Figure 2. Doha Living Lab design at the QU Campus Main Boulevard, at the edge of the Food Court (D04).

4. Doha Living Lab Areas



FEW Nexus area

Food: Urban-scale greenhouses and Microalgae raceway pond

Energy: PV panels, wind turbine

Water: Desalinated groundwater for food production



FEWW Nexus area

Food: Urban-scale net house, poultry farm, open field plots

Water: TSE for landscape irrigation purposes

Waste: Food, poultry and green waste composting



Community area

Meeting point: Green sheltered and shadowed recreational area

Community engagement: Enhanced awareness and participation

5. Evaluation

The Doha Living Lab, being an urban farm is assessed as a food system on its own. The FEWprint indicator [4] describes the DLL's performance by calculating the CO₂ footprint and explores the impact of local food production on the environment. Two scenarios are presented: the Business-as-usual for imported food and the New scenario if the same food is produced locally. The DLL's local food production (Table 1) is reducing the CO₂ emissions by 2% (Table 2).

Table 1: Doha Living Lab food production targets and achieved production.

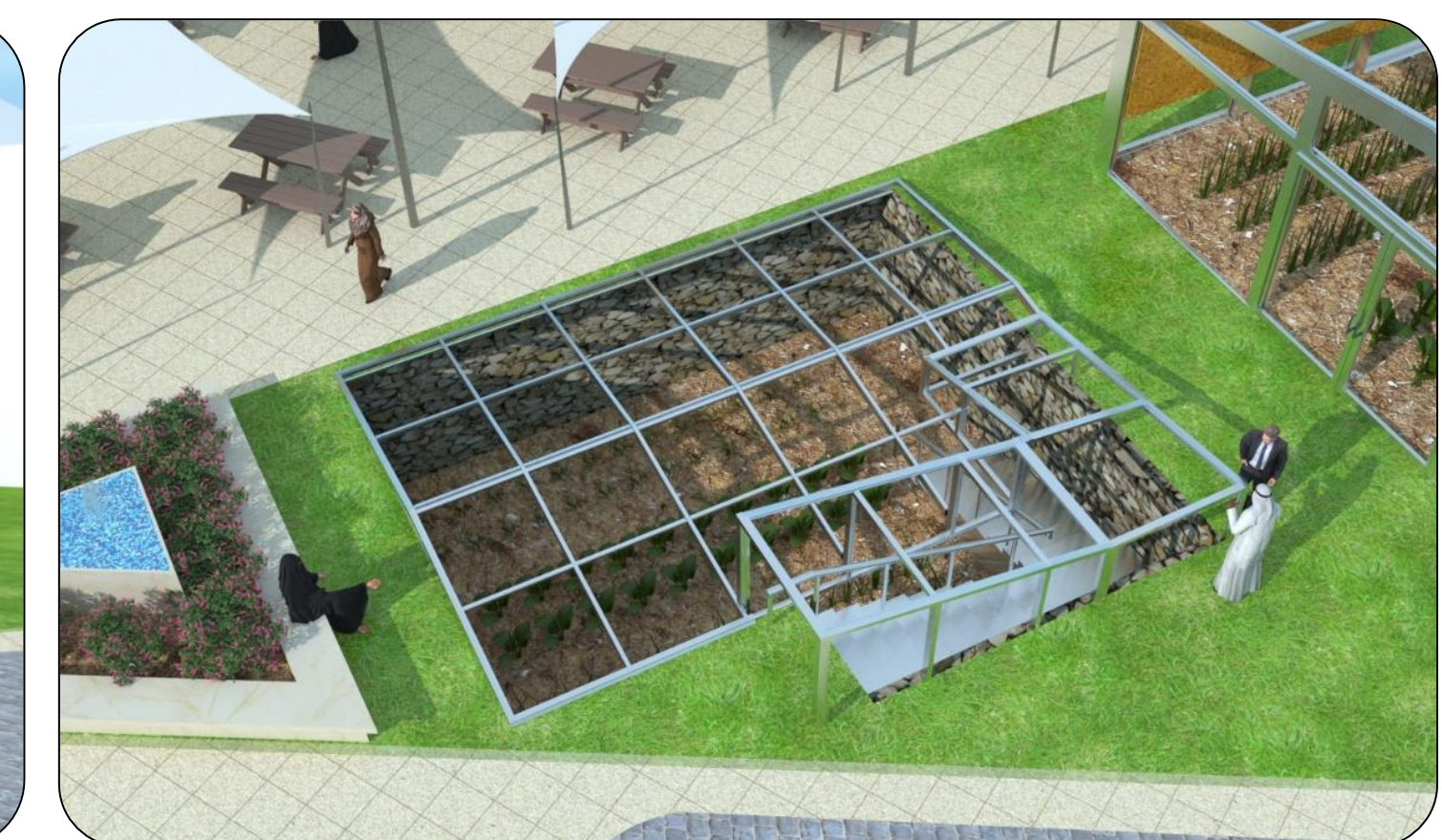
Target: Satisfy Qatar Dietary Requirements		
N° of people in community	100	
Consumption	3 days per week	
Duration	8 months per year	
Food provision (servings)	Doha Living Lab	Qatar Dietary Requirements [5]
Vegetables	3	3-5
Legumes	1	1
Fruits	2	2-4
Chicken meat	1	not specified
Eggs	1	not specified

Table 2: Doha Living Lab carbon footprint for BAU Scenario (imported food) and NEW scenario (locally produced food).

Food, Energy and Water carbon footprint		Doha Living Lab assumptions
BAU Carbon emissions (imported food)	12 ton/yr.	
NEW Carbon emissions (locally produced food)	11 ton/yr.	
Food	4 ton/yr.	
Energy	6 ton/yr.	
Water	1 ton/yr.	
Difference	-2 %	

6. Implementation

The Doha Living Lab moves from conceptualization to practice and implements the innovative greenhouse designs on the campus level validating the novel ideas and increasing the community's participation and awareness in the FEWW Nexus.



7. Conclusions and recommendations

The Doha Living Lab evaluation revealed the following results

- ✓ Energy is the greatest carbon emission contributor
- ✓ Food waste is a valuable resource for composting and animal feed
- ✓ To achieve a sustainable FEWW Nexus in terms of low carbon footprint
 - Use renewable sources of energy
 - Innovative solutions are needed, such as energy-saving technologies to reduce resource use in food production
 - Opt for a plant-based diet rather than a meat-based diet to reduce CO₂ emissions

References

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- 4) M-NEX Project WIKI Page. https://ecogislab.sfc.keio.ac.jp/wiki/index.php?title=Main_Page#Evaluation_Tools
- 5) Al Thani et al. (2018). Adherence to the Qatar dietary guidelines: A cross-sectional study of the gaps, determinants and association with cardiometabolic risk amongst adults. BMC Public Health. 18. 10.1186/s12889-018-5400-2.

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