Food, Energy and Water management innovation in Doha: a design-led nexus approach

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1. Introduction
Urban communities are vulnerable to food, energy and water demand since they are affected by population growth, urbanization and climate change. According to United Nations, the world’s population is expected to increase by 2 billion people in the next 30 years from 7.7 billion currently to 9.7 billion in 2050 and 68% of them are projected to live in urban areas by then. At the same time, 1/3 of the food produced in the world for human consumption every year gets lost or wasted and still, 795 million people worldwide are malnourished. A sustainable FEW Nexus is of critical need.

2. Aims and objectives
The Moveable Nexus Project is aiming to give a solution to the FEW Nexus through urban design methods and urban agriculture practices, together with stakeholders and the community’s participation. Its mission is to develop and practice the design method, evaluation effect and participation. The design method will be practiced through design charrettes and international workshops and the evaluation will be realized by a Food, Energy & Water consumption environmental footprint calculator. Finally, the participation phase will engage all interested members at the Doha Living Lab.

3. Qatar University Campus FEW Nexus facts

![Figure 1: Food, energy, water, waste components and carbon footprint for Qatar University. Source: (3),(4),(5),(6)](image)

4. Doha Living Lab Concept

5. Methods
A. Organic Waste Management
The food and agricultural waste generated in the Campus will be sustainably managed through on-site composting by using two different composting methods. The produced compost will be used to the Living Lab open field and net house trials.

B. Open field cultivation
Sustainable open field cultivation of aromatic plants and herbs. The produced compost will be used as a soil amendment, enhancing soil fertility and encouraging biodiversity.

C. Net house cultivation
The urban scale net house will be of simple construction with a shading system and no cooling system, thus with low energy consumption. Vegetables will be grown the local growing season between October and May, under the hydroponic system in growth bags using the produced compost. Microalgae will be cultivated with the use of a photobioreactor and an immobilized system inside the net house.

6. Evaluation tool
The environmental footprint of Food, Energy and Water (FEW) resources consumption and waste processing is calculated in an urban context in two scenarios: present situation and future predictions. Table 1 shows the food, energy, water consumption and waste generation data of recent years for the community of Doha, Qatar. Analyzing these data, the carbon footprint for each resource is calculated, with the electrical energy having the highest CO₂ footprint, followed by the food sector. The CO₂ footprint per capita is estimated up to 11672 kg (Table 2). Future predictions on the environmental footprint depend on the choices the community makes towards a more sustainable lifestyle.

Table 1: Food, energy, water and waste components for Doha, Qatar.

<table>
<thead>
<tr>
<th>Component</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>4.0 M</td>
</tr>
<tr>
<td>Energy</td>
<td>2.70 M</td>
</tr>
<tr>
<td>Water</td>
<td>1.48 M</td>
</tr>
<tr>
<td>Waste</td>
<td>1.8 M</td>
</tr>
</tbody>
</table>

Table 2: Present situation (2020) carbon footprint for Doha, Qatar.

<table>
<thead>
<tr>
<th>Component</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>1470 gram/day</td>
</tr>
<tr>
<td>Energy</td>
<td>4618043332 [unit/yr]</td>
</tr>
<tr>
<td>Water</td>
<td>75541641 [m³/yr]</td>
</tr>
<tr>
<td>Waste</td>
<td>657 [kg/cap/yr]</td>
</tr>
<tr>
<td>Total waste generated in community</td>
<td>226624.9 [ton/yr]</td>
</tr>
</tbody>
</table>

References
3) Qatar University Homepage, http://www.qau.edu.qa/, last accessed 2020/08/03

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