VERTICAL FOODCHAINS IN DOHA

RESEARCH PLAN

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STUDIO ARGUMENTATION

Although architecture is vast and impossible to master all of its qualities in a lifetime, architects still strive to be master builders not only for a building's aesthetic and spatial layout but also to engineer, invent, and innovate systems to heavily influence and reshape the way people live their life differently than what has been previously conceived. This studio is a chance to continue experimenting, innovating, and mastering my technical fascination while designing for the people in its respective context.

KEYWORDS

Climate Change, Self-Reliant, Vertical Farms, Healthy Foods, Urban Transformation, Cantilever Structures, Affordability, Harsh Environments, Bedouin

DEFINITIONS

Climate Change: Weather patterns undergo significant and long-lasting alterations primarily caused by human activities such as greenhouse gas emissions. Climate change has substantial effects on the environment and human health.

Self-Reliant: Capability to function independently without relying on external help for energy or resources, achieved through passive energy harvesting technologies and sustainable materials.

Vertical Farms: Agricultural facilities in urban areas that utilize vertical space to grow crops in a controlled environment, aiming to maximize food production and minimize environmental impact.

Urban Transformation: Process of change, redevelopment, and revitalization within urban areas, driven by population growth, technological advancements, and changing lifestyles. It aims to improve the quality of life and enhance the city's functionality.

Cantilever Structures: Architectural or engineering designs where a horizontal beam is supported at one end and projected outwards with no support on the other end, relying on the principle of leverage to distribute weight and provide stability.

Affordability: The ability of individuals or households to cover basic needs without experiencing financial hardship, including access to essential urban services.

Harsh Environments: Environments where survival is difficult or impossible due to conditions that present an unusual challenge to the fitness of every species and the stability of populations.

Bedouin: a nomadic tribe of Arabia

PROBLEM STATEMENT

Global food insecurity is not just a pressing issue, it's a ticking time bomb, especially for nations with challenging natural environments that heavily rely on imported produce. With the increasing unpredictability of climate change and the imposition of food export bans due to droughts in various countries, the urgency to achieve self-sufficiency in food production has become paramount (Flavelle, 2019). Food self-sufficiency is not just a goal, it's a necessity to mitigate the risk of hunger and famine and ensure the availability of accessible and affordable food, a challenge faced by approximately 800 million people worldwide. Establishing food sustainability within urban areas offers benefits such as reduced transportation time and helps to control urban expansion, as evidenced by the experiences of Doha, Qatar, in the early 2000s. Their aim is to achieve food self-sufficiency by 2030 (Ibrahim, 2022).

This research plan will delve into the two primary causes of global food insecurity and their impact on Doha, Qatar, a city that serves as a microcosm of the global food security challenge. The objective is to create a sustainable food supply within urban areas and explore how designed social spaces can foster constructive dialogue and openness toward other cultures within Arab and Islamic identity, thus making food accessible and affordable.

CAUSE 1 - GLOBAL CLIMATE CHANGE

The global climate is rapidly changing, increasing the risk of hunger and famine across countries. Frequent extreme weather events, such as hurricanes, typhoons, cyclones, prolonged droughts, and devastating floods, create food shortages that are a significant concern for many nations. Climate change has also led to the spread of new pests and diseases that affect crops and livestock, further impacting food production and availability (Gupta et al., 2015). By 2050, the global temperature will increase by 1.5 degrees Celsius, altering precipitation and the suitable climate for certain foods.

In recent years, we have witnessed the devastating impact of climate change through more frequent and intense wildfires in parts of Europe, North America, and Australia. These wildfires have destroyed vast land areas and disrupted ecosystems and agriculture, leading to significant food supply disruptions (Flavelle, 2019). Additionally, droughts in regions like India have halted rice production, leading the government to ban rice exports to ensure domestic food security. The warming of our oceans has caused the extinction of local marine species and forced others to migrate to more hospitable environments. Climate change has resulted in lower fish yields and higher prices for seafood, making it harder for the masses to afford nutritious food (Gupta et al., 2015).

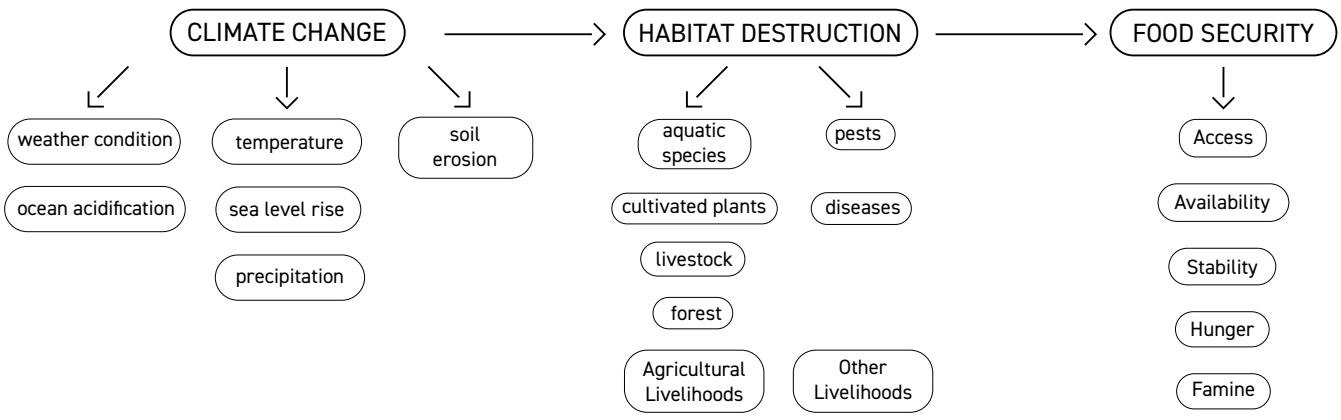

Figure 1: Climate change and its affects on global food security

Furthermore, severe climate changes have displaced millions, creating inhospitable environments that make survival even more challenging. As the world climate spirals out of control and limits our food sources, locally-grown food is the only way to survive in an increasingly inhospitable environment (Ibrahim, 2022). Relying solely on imported food is not sustainable in the long run. There is a growing need to prioritize locally grown food, even in harsh environments like deserts. Some nations are slowly evolving to self-sufficiency through vertical farmings within the urban landscape, providing much larger food yields in a small timeframe than traditional agricultural methods. Although vertical farming requires huge amounts of energy to produce food around the clock, some farms are self-sustainable through passive energy harvesting technologies and are even more productive in scorching heat countries like Qatar and the UAE (Brears, 2024).

CAUSE 2 - FOOD DEPENDENT

Qatar, a small, flat desert land country surrounded mostly by water in the Persian Sea, traditionally relied on neighboring countries for food and water in exchange for pearls and oysters harvested on its coastline and horses bred in the desert. Their long historical trade imports from hundreds of years ago provided them with food, now known as their natural dishes, from rice in India and Pakistan, spices in Iran, fruits in Oman, and freshwater from Saudi Arabia (National Museum of Qatar, N/A).

As Qatar began to flourish in the 1950s in terms of oil exports, it still imported 95% of its food. Unlike countries like Oman, Saudi Arabia, and UAE, which have mountainous regions and some fertile land to produce food locally, Qatar is a flat desert land with no possibilities for agriculture. Although they have become highly affluent due to the abundant oil deposits within their borders, they are still reliant on other countries for food. 20% of food imports come from Southeast Asia, the Americas, and Europe, and 80% of major food imports come from Middle Eastern countries, as shown in Figure 3.

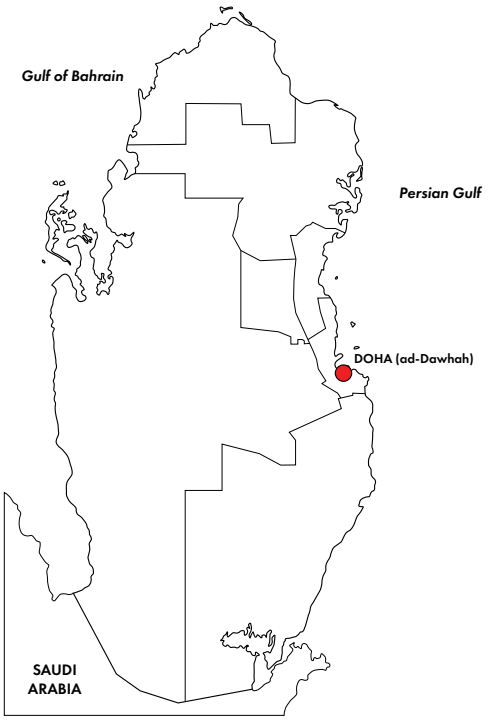

Figure 2: Map of Qatar

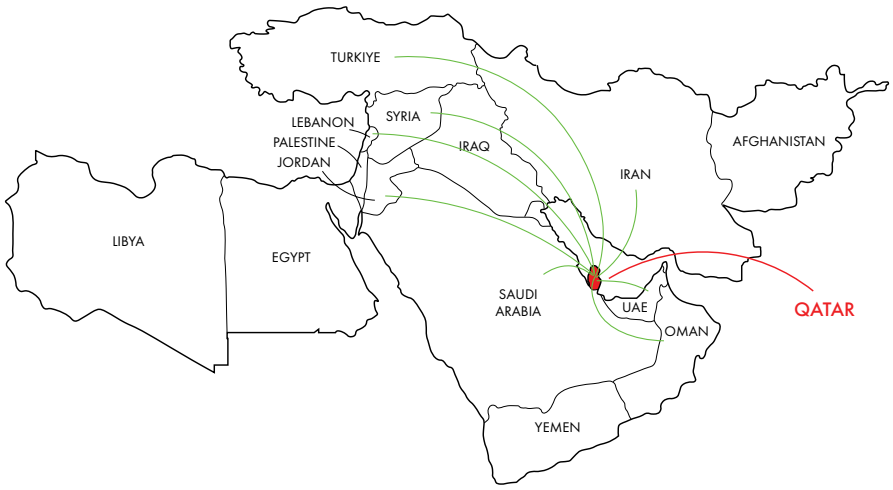

Figure 3: 80% of Qatar's food imports is in the MIddle East

OBJECTIVES

DESIGN OBJECTIVE

The design objective is to investigate the potential of community gatherings between the urban vertical farm and the city by envisioning them as hubs for communal activities, leisure, and green spaces. The goal is to enhance and modernize facilities and areas specifically designed for both Qataris and migrant populations in the city. The architecture, profoundly ingrained and representing Qatari culture and heritage, is a testament to their rich history and traditions. Doha, the capital city of Qatar and the proposed location for the urban project, faces challenges due to its dependence on food imports from other countries, and vertical farms need to engage with the city and its residents. The city has limited options for community gatherings and is mainly concentrated in Downtown and Waterfront areas, although Qatar is inherently prosperous and safe. By establishing public spaces to link the city and the urban vertical farms, there is an opportunity to improve access to affordable healthy food, social well-being, and public health while encouraging people to gather at these focal points for community activities.

Beyond touristy areas, the focus is on the vicinity of metro stations, which serve as gateways for many neighborhoods to access other parts of the city. As these metro stations are a mass transit system accessible and affordable for the masses, the metro station plazas surrounding each metro station become an attractive location to create a vertical farm and a social space to celebrate the locally grown food there. Rather than using the metro stations' plazas as vertical farms to be introduced and integrated within the urban landscape, there will be a social landscape between these two components, the city and the vertical farm, to connect them. The project aims to create a comprehensive plan that can be implemented in the areas surrounding the metro stations to develop a series of public spaces that promote improved social environments for the Doha community. By incorporating modern and contemporary design elements that reflect Qatari culture and heritage, the project seeks to challenge existing perceptions of urban vertical farming within the cityscape.

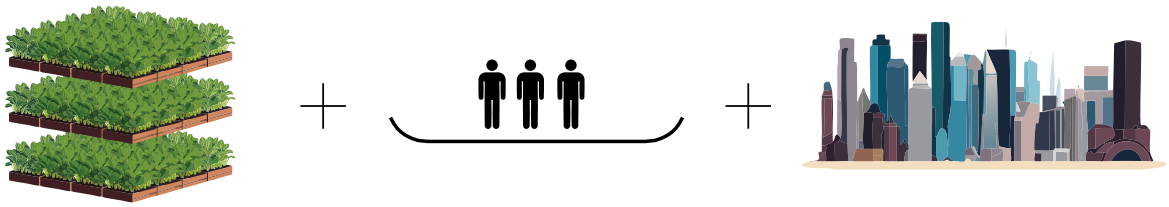

Figure 5: Three components system

TECHNICAL OBJECTIVE

Setting up a vertical farm is very expensive and requires enormous energy to maintain. It has proven challenging to build vertical farms in Europe due to its high energy input but very efficient in desert countries with large amounts of underutilized land and natural resources, such as wind and solar energy, to properly maintain vertical farms all year round without relying on energy infrastructures. The technical objective is to approach vertical farms in a pre-fabricated modular construction system with passive energy harvesting technologies implemented into the construction and design. Rataher than creating one modular system, the goal is to construct small modular systems composed of an aquaponic farm component and sustainable technology capable of transportation and assembly without heavy equipment. It will be built off-site in a controlled facility to mass produce the same small modular parts, cutting material cost, labor, and time. It is then on-site that it could be assembled and, if required at a later time, disassembled and reused elsewhere. This construction approach eliminates the high-start up cost, long labor time, and technical knowledge often required in the early stages of construction and design.

HYPOTHESIS

Contemporary urban vertical farming typically involves situating a factory in an industrial zone without respect for its context and connection to city occupants. However, this thesis proposal aims to expand the connection and greater need for the city by envisioning designs that not only consider the social aspects of the local community but also create cost and build efficiency through the use of pre-fabricated modular systems implemented with passive energy harvesting technologies and components required for an aquaponics farm.

Building on these ideas, the thesis proposal delves into contemporary designs and cultural identity, covering both the design and technical aspects. Its overarching goals are to stabilize Qatar's food security, ensure its future growth, and establish a direct connection with the people. This emphasis on food security not only underscores the proposal's relevance but also instills confidence in its potential long-term growth in ease of use through transportation and demountable experiences, making it a significant contribution to the architecture and engineering fields.

OVERALL DESIGN QUESTION

How can urban vertical farms be seamlessly integrated into the city landscape to ensure easy access to affordable food and contribute to improved public health?

THEMATIC RESEARCH QUESTION

How can sustainability technologies integrated into pre-fabricated modular systems be used to impact its users positively?

SUB QUESTIONS

1. How can our understanding of energy harvesting technology create sustainable vertical farms in an arid region?

2. How can architecture and construction collaborate to integrate all energy harvesting technological and aquaponics components systems cohesively for sustainability and cost-effectiveness?

RESEARCH METHODS & EXPECTED RESULTS

1. Case Study Analysis - Qualitative

This research method answers sub-question 1.

I plan to analyze two case studies in sustainability and urban vertical farms to understand how passive energy technology systems work, how they work together to create a sustainable environment, and how to achieve small-scale vertical farms that could be expanded or contracted over time.

The first case study is the Dubai Expo 2020 Sustainability Pavilion, designed by Grimshaw Architects. Their design uses passive energy technologies aligned with the UN Sustainable Development Goals. It has demonstrated that it could produce affordable and clean energy for the desert region while influencing thousands of visitors to understand the vast environment's impacts, both positive and negative, on our daily lives.

The second case study is the Tampines Blk 146 vertical farm in Singapore, created by a local firm, Netatech. In a small-scale, stacked-unit raft system, they could fit the vertical farm on a small plot of land next to an apartment building. Primarily created to grow rice, vegetables, and fruits, a fish tank for biofilters could be added on the ground floor, allowing a variety of food to be grown other than its primary objective.

2. Research By Design

This research method answers sub-question 2.

I plan to understand these systems in this order before designing the pre-fabricated modular systems:

1. Understand each of the sustainable technologies systems to create a sustainable aquaponics farm,
    i. Air-to-Water technology
    ii. Solar Energy technology
    iii. Wind Catcher technology
2. Understand the 13 components of the aquaponics system,
3. How could the sustainable technologies system work together as one system,
4. How could all of the 13 components of the aquaponics system work together with the sustainable technologies system,
5. Determine the minimum size, how many people a specific farm size feeds daily, and every possible parameter to help design the pre-fabricated modular system.

THEMATIC RESEARCH STRUCTURE

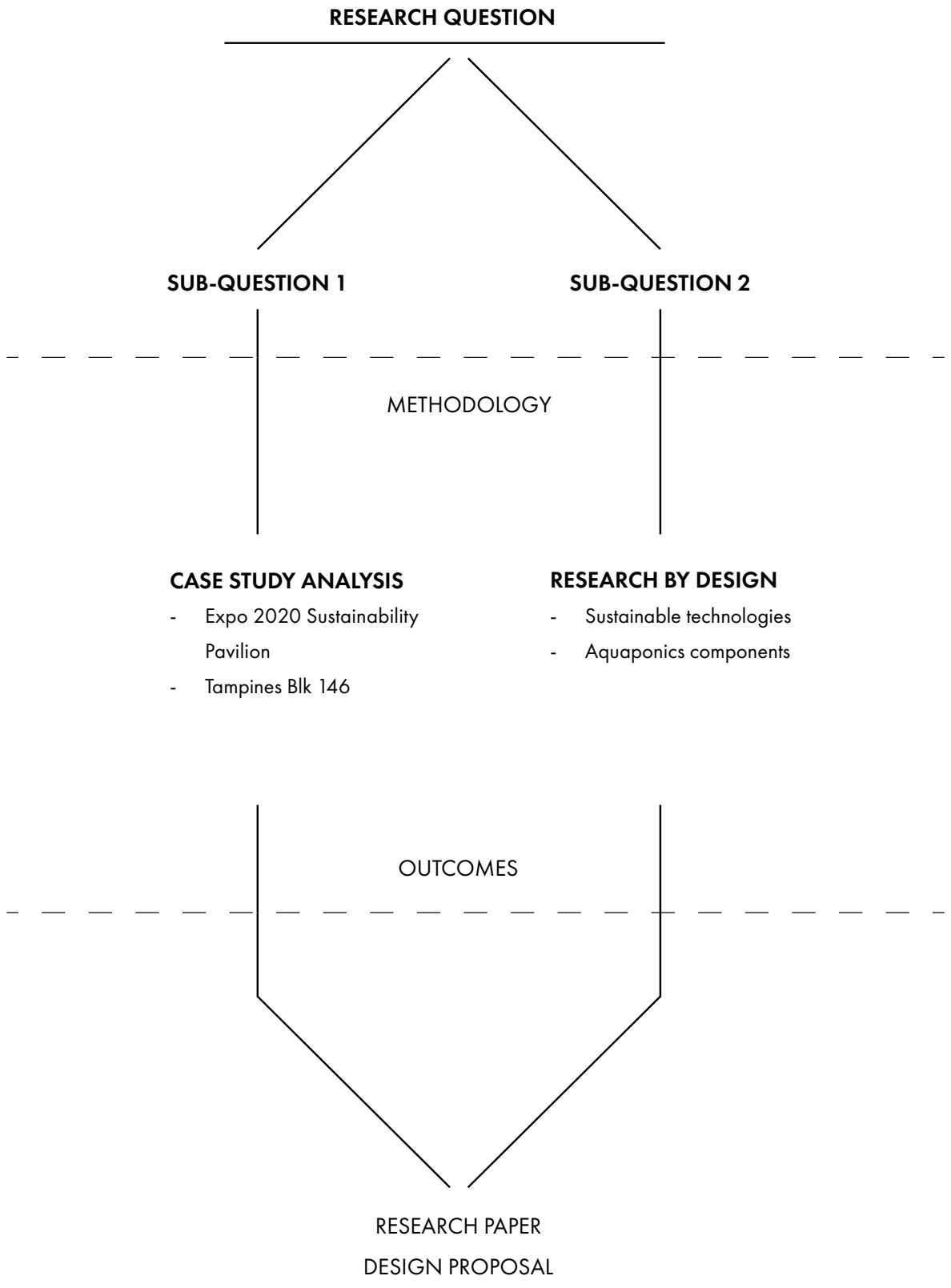

Figure 6: Thematic Research Structure

RESEARCH PLAN DIAGRAM

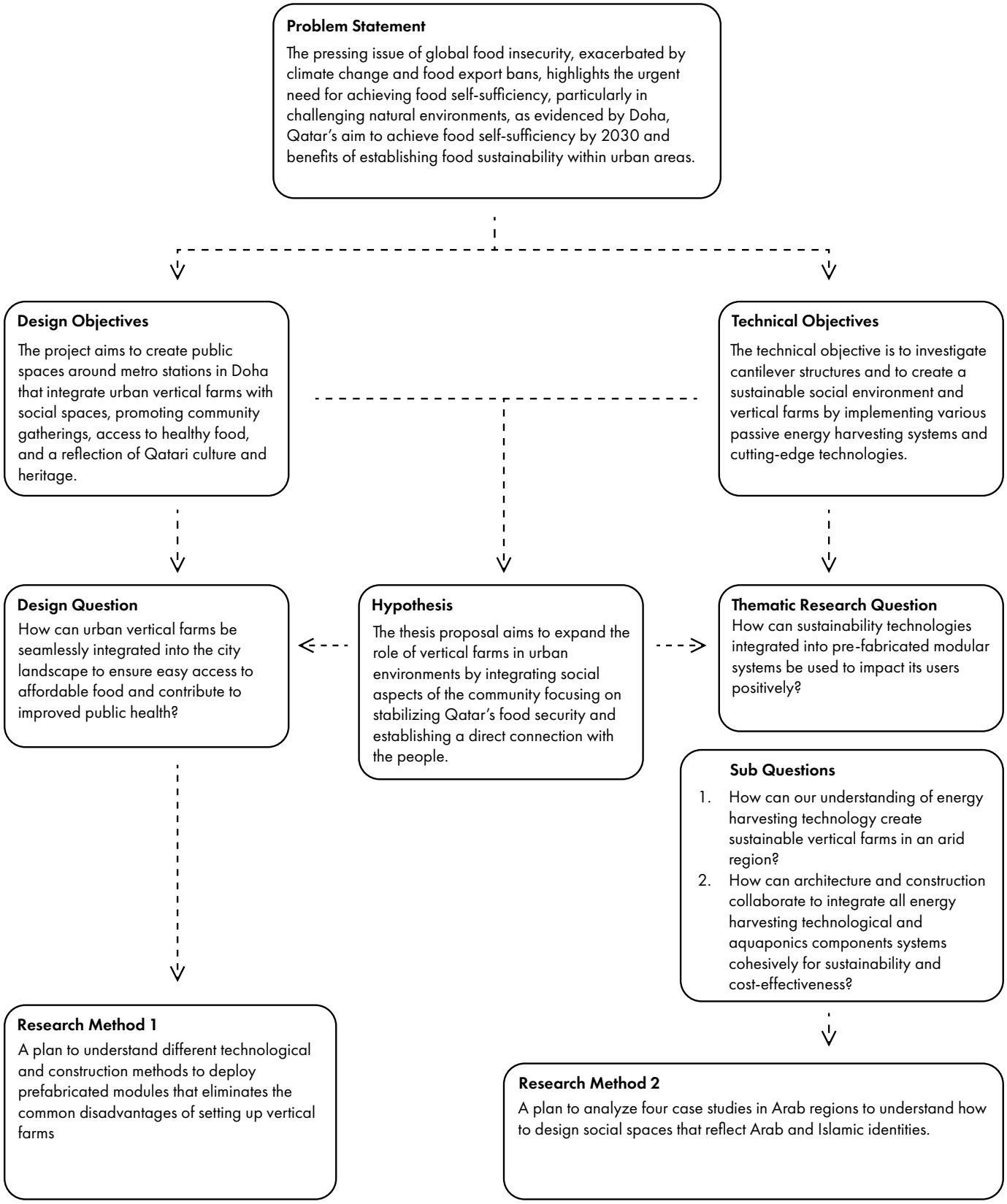

Figure 7: Research Plan Diagram

VISUAL PLANNING

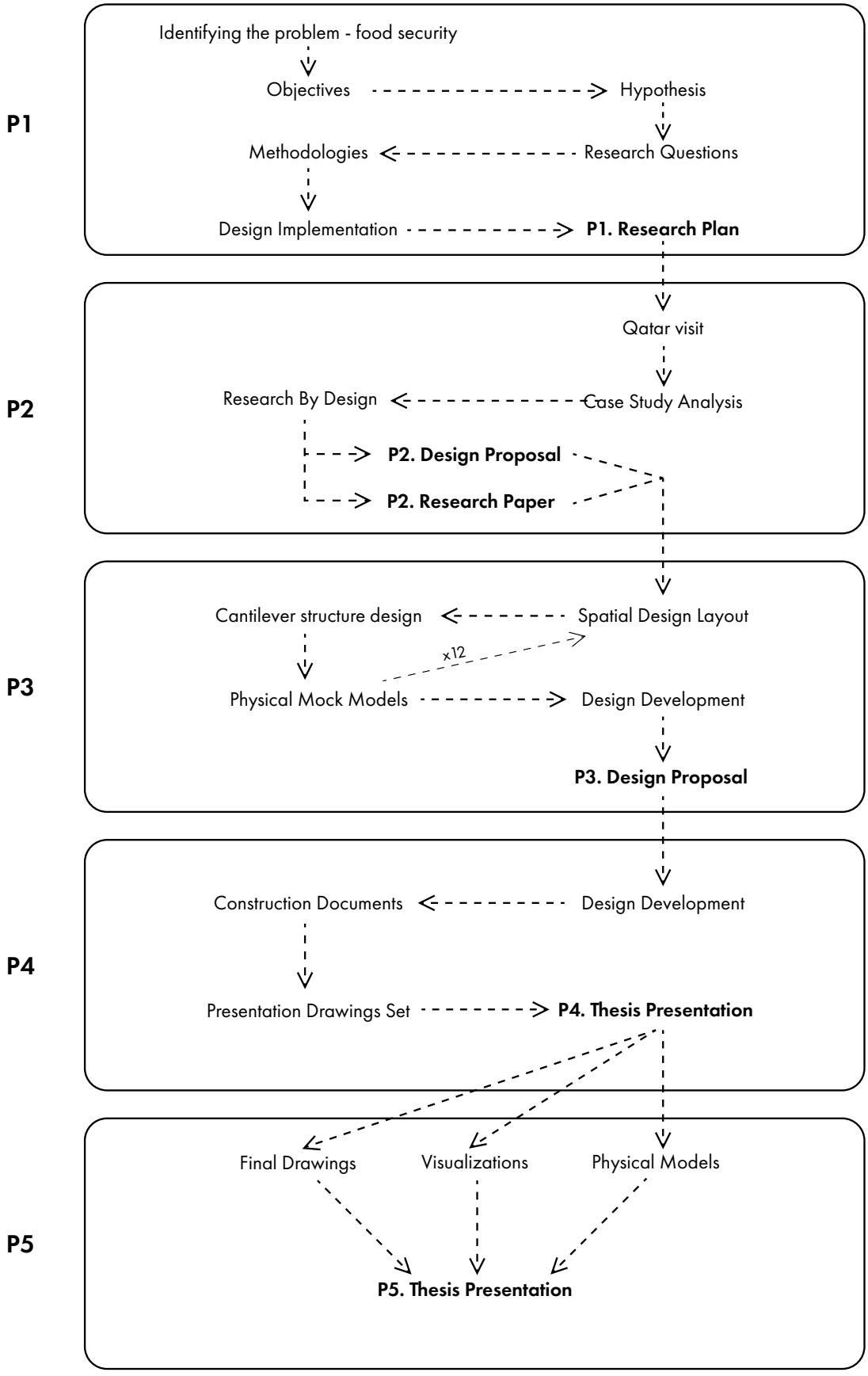

Figure 8: Visual Planning

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ILLUSTRATIONS LIST