ABUNDANCE WITHIN SCARCITY
Food Security in the Favelas of Brazil

Menglin Ding
Master in Landscape Architecture,
Rhode Island School of Design, 2023
Abundance within Scarcity:
Food Security in the Favelas of Brazil

Menglin Ding
MLA Landscape Architecture, RISD
INTRODUCTION
Abstract
Introduction

RETHINKING FOOD CRISIS
Global Context
Lexicon
Food Crisis
Case studies

FAVELA IN BRAZIL
Site Analysis
Timeline
Favelas in Rio de Janeiro

ABUNDANCE WITHIN SCARCITY
Scarcity of Favela
Abundance of Favela

SCARCITY TO ABUNDANCE: THE VERTICULTURE AGRICULTURE IN FAVELA
Design Principles
Concept Model
Community Partition
Model Plan
Strategies
Conclusion

APPENDIX
Literature review
Reflection
Bibliography
Rapid urbanization has been accompanied by the expansion of unplanned, underserved neighborhoods with large concentrations of poor people, known as “informal settlements.” Obtaining stable, fresh, and healthy food sources often requires people to spend more money, which can be a challenge for residents of informal settlements who may struggle to afford it. To create greater food security and decentralized food production, Abundance within Scarcity, Food Security in the Favelas of Brazil explores how urban agriculture can be strategically reintroduced into limited-open-space informal settlements and tap into the abundant potential of this seemingly “barren” region. Finally, this project will build a more sustainable and resilient urban food loop system.

This research zooms into Favelas, Brazil. The strategies focus on how to integrate urban agriculture with building gaps and rooftops to provide social, economic, and environmental benefits to informal communities by using pipelines to connect fragmented systems, working with gravity to transport resources, and using residual spaces.

**Key Word:**
Informal settlements, Urban agriculture, Food insecurity

**Abstract**
Rapid urbanization has been accompanied by the expansion of unplanned, underserved neighborhoods with large concentrations of poor people, known as “informal settlements.” Obtaining stable, fresh, and healthy food sources often requires people to spend more money, which can be a challenge for residents of informal settlements who may struggle to afford it. To create greater food security and decentralized food production, Abundance within Scarcity, Food Security in the Favelas of Brazil explores how urban agriculture can be strategically reintroduced into limited-open-space informal settlements and tap into the abundant potential of this seemingly “barren” region. Finally, this project will build a more sustainable and resilient urban food loop system.

This research zooms into Favelas, Brazil. The strategies focus on how to integrate urban agriculture with building gaps and rooftops to provide social, economic, and environmental benefits to informal communities by using pipelines to connect fragmented systems, working with gravity to transport resources, and using residual spaces.

**Key Word:**
Informal settlements, Urban agriculture, Food insecurity

**Introduction**
As the global population approaches 8 billion, the world faces a serious food insecurity crisis. Since 2019, the number of individuals facing considerable food insecurity has surged from 135 million to 345 million, as reported by the WFP.1 The process of urbanization has brought about significant shifts in regional functions and population movements between urban and rural areas, leading to the gradual displacement of agriculture from cities. Consequently, food production, transportation, and distribution processes are separated. Events such as the 2007-2008 food crisis, the COVID-19 pandemic, and the ongoing conflict in Ukraine have revealed the fragility of existing urban food systems and supply chains.

Brazil is the third largest agricultural country, yet it still suffers from a severe food crisis. Currently, 33.1 million Brazilians endure hunger and 30% of families are at risk of food shortages.2 The globalized economy has led to a greater dependence of Brazilian agriculture on external conditions, and food prices can rise once important products are restricted. This leads to unaffordability for many Brazilian families. Despite the fact that some public interest organizations have become involved, the situation is not promising.

---

When you talk about food, you're talking about agriculture – you're also talking about security. Whether it's food security or national security. You're also talking about poverty. You're also talking about health. You're also talking about racism and power. That's the intersection of food and agriculture.76

— Pakou Hang

Human survival is closely dependent on food, which provides us with the necessary energy to survive, it is also an essential bridge connecting us to the natural world. With the acceleration of the globalized economy and urbanization, large-scale, intensive agricultural activities have been implemented in rural areas, and while this model of agriculture has indeed increased crop yields, it has not entirely solved the problem of food security. Cities, especially those “gray spaces” that are often overlooked continue to face food supply uncertainty for their residents.
Global Context

CHAPTER 01

Rethinking Food Crisis

Food Insecurity Map


Abundance within Scarcity
Food Security in the Favelas of Brazil
Lexicon

Food Sovereignty

Food sovereignty is the human right to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and the right to define one’s own food and agriculture systems. It puts those who produce, distribute and consume food at the heart of food systems and policies rather than the demands of markets and corporations. It defends the interests and inclusion of the next generation.

Due to the often marginalized and vulnerable position of informal settlement residents, achieving food sovereignty can be particularly challenging. Community-led initiatives, urban agriculture practices, and policy changes can all contribute to advancing food sovereignty in these areas.

Food Desert

A food desert is an area that has limited access to affordable and nutritious food.

In the context of informal settlements, a food desert refers to an area where residents face significant challenges in accessing healthy, affordable, and culturally appropriate food.

Urban Agriculture

Urban agriculture, urban farming, or urban gardening is the practice of cultivating, processing, and distributing food in or around urban areas.

In informal settlements, this can involve rooftop gardens, vertical farming, and community plots as a solution to food insecurity.

Food Urbanism

Food Urbanism examines the complex relationship between food and the city, investigating how the thoughtful integration of food production into urban design and planning can achieve a form of new urban quality, measured by spatial character, community vitality, and ecological performance, all within a densifying city.

Food crisis factors

Factors include the rise in unemployment, a decrease in income, inflation (particularly of food prices), the weakening of social programs and the dismantling of public policies meant to protect and promote Food and Nutritional Security.

Other aspects affect food insecurity

Food crisis have profound impacts that extend far beyond immediate hunger. Economically, they provoke a sharp rise in food prices, making it difficult for the average person to afford basic necessities, thereby deepening poverty rates. Health-wise, chronic malnutrition can trigger serious health complications. In the realm of education, hunger can compel children to abandon school, either due to physical weakness or the necessity to work to support their families.

Socially, food crisis can incite unrest, migration, and conflict as resources grow increasingly scarce. The emotional strain is immense, as the perpetual anxiety over securing the next meal induces stress. Particularly, children grapple with the harsh realities of life at a tender age, taking a toll on their emotional well-being.

Food is a fundamental human right, and a food crisis is a significant infringement of this right. When people lack access to sufficient food, they are essentially being denied their inherent right to live with dignity. Human dignity, the concept that every individual deserves respect and equitable treatment, is profoundly compromised during a food crisis. Often, people resort to desperate measures for survival, undermining their self-respect and dignity.
The Grameen Bank

The Grameen Bank project started in 1976 as an action research pilot project in "Jobra" village in the Chattogram district of Bangladesh. In 1983, the pilot project was transformed into a bank to alleviate poverty and empower the marginalized poor in Bangladesh through micro-credit.

Grameen Bank model doesn’t ask for collateral as security for the loans, as a “payday lender” or a pawn shop might. Instead, loans are made to borrowers who have five references from people in the community regarding their ability and intent to repay the loan.

Introduce the economic model in economically deprived regions?

The success of The Grameen Bank relies more on a sense of collective responsibility and close community ties than on purely financial support, which makes this economic model extremely inclusive and sustainable.

Share Resource

In informal settlements, many of the resources we take for granted in formal cities often lack. There may be insufficient housing, a reliable electricity supply, or adequate job opportunities. In such cases, it is crucial to encourage and design ways to share resources. This can be sharing physical space, such as a communal garden, a communal kitchen, or a tool shed, or sharing skills and knowledge, such as sharing agricultural techniques or handicrafts. By sharing, everyone can access more resources and also build stronger ties in the community.

Education and Training

The education and training components of the Grameen Bank model help people gain the skills they need to sustain their lives and improve their quality of life. This education can include specific skills training, such as how to grow crops or make handicrafts, and broader knowledge, such as how to manage household finances or stay healthy. This education is diffuse because once a person has acquired a new skill or ability, they can spread it to other community members, thereby increasing the level of knowledge and skills of the entire community.

Cultivate Responsibility

The Grameen Bank model encourages mutual support and cooperation among community members, which can help them face and solve problems together. This model helps community members better understand their role and value in the community, and members are encouraged to take responsibility for their actions and decisions, which will further strengthen their sense of belonging to the community and make them more willing to engage in community building.
Kibera

In Kibera, one of Africa’s largest informal settlements, residents have found a new way of responding to the challenge of food insecurity. In the heart of the bustling, informal settlement they are championing an unusual form of urban farming: the sack gardens of Kibera.

The money farmers earn from selling vegetables goes into a savings and credit society they have formed, which in turn provides loans to young people to start their own businesses. Sack farming in Kibera has helped discourage people from planting crops near dump sites and sewers, which had been a common practice in the area. Many of the sewers contain heavy metals such as lead and mercury, creating a health risk to those who consume vegetables grown near them.

These urban farms consist of a series of sacks that are filled with manure, soil and small stones that enable water to drain. From the tops and sides of these sacks, often referred to as multi-storey gardens, farmers in Kibera grow kale, spinach, onions, tomatoes, vegetables and arrowroot.
Case Study 03 - Isla Urbana, Mexico city

Create Economic Opportunities

The proceeds from the sale of vegetables are deposited into the savings and credit societies they make, which provide young people with loans to start their own businesses. At informal settlements, this model helps residents use their limited resources to create new economic opportunities and help them escape poverty.

Waste Recovery and Use

This method can transform waste into valuable resources using suck or other recyclables as planting containers. At Informal Settlements, many similar wastes, such as plastic bottles, old tires, etc., can be converted into planting containers, saving resources and reducing the amount of waste that accumulates.

Insulate contaminated land

In Sack Farm, suck provides protection for the crop by isolating it from external environmental contamination which can affect food safety. This approach is also helpful in informal settlements, especially where industrial contamination or waste disposal is premature, where bagged agriculture can provide a safe and healthy growing environment.

Adaptive farming

Sack Farm is also very flexible and adaptable and does not require large land areas to enable agricultural production even when space is limited. This is especially important in Informal Settlements, where living space is often very limited.

Insulate contaminated land

In Sack Farm, suck provides protection for the crop by isolating it from external environmental contamination which can affect food safety. This approach is also helpful in informal settlements, especially where industrial contamination or waste disposal is premature, where bagged agriculture can provide a safe and healthy growing environment.

Adaptive farming

Sack Farm is also very flexible and adaptable and does not require large land areas to enable agricultural production even when space is limited. This is especially important in Informal Settlements, where living space is often very limited.

Create Economic Opportunities

The proceeds from the sale of vegetables are deposited into the savings and credit societies they make, which provide young people with loans to start their own businesses. At informal settlements, this model helps residents use their limited resources to create new economic opportunities and help them escape poverty.

Waste Recovery and Use

This method can transform waste into valuable resources using suck or other recyclables as planting containers. At Informal Settlements, many similar wastes, such as plastic bottles, old tires, etc., can be converted into planting containers, saving resources and reducing the amount of waste that accumulates.

Insulate contaminated land

In Sack Farm, suck provides protection for the crop by isolating it from external environmental contamination which can affect food safety. This approach is also helpful in informal settlements, especially where industrial contamination or waste disposal is premature, where bagged agriculture can provide a safe and healthy growing environment.

Adaptive farming

Sack Farm is also very flexible and adaptable and does not require large land areas to enable agricultural production even when space is limited. This is especially important in Informal Settlements, where living space is often very limited.

Create Economic Opportunities

The proceeds from the sale of vegetables are deposited into the savings and credit societies they make, which provide young people with loans to start their own businesses. At informal settlements, this model helps residents use their limited resources to create new economic opportunities and help them escape poverty.

Waste Recovery and Use

This method can transform waste into valuable resources using suck or other recyclables as planting containers. At Informal Settlements, many similar wastes, such as plastic bottles, old tires, etc., can be converted into planting containers, saving resources and reducing the amount of waste that accumulates.

Insulate contaminated land

In Sack Farm, suck provides protection for the crop by isolating it from external environmental contamination which can affect food safety. This approach is also helpful in informal settlements, especially where industrial contamination or waste disposal is premature, where bagged agriculture can provide a safe and healthy growing environment.

Adaptive farming

Sack Farm is also very flexible and adaptable and does not require large land areas to enable agricultural production even when space is limited. This is especially important in Informal Settlements, where living space is often very limited.

Create Economic Opportunities

The proceeds from the sale of vegetables are deposited into the savings and credit societies they make, which provide young people with loans to start their own businesses. At informal settlements, this model helps residents use their limited resources to create new economic opportunities and help them escape poverty.

Waste Recovery and Use

This method can transform waste into valuable resources using suck or other recyclables as planting containers. At Informal Settlements, many similar wastes, such as plastic bottles, old tires, etc., can be converted into planting containers, saving resources and reducing the amount of waste that accumulates.

Insulate contaminated land

In Sack Farm, suck provides protection for the crop by isolating it from external environmental contamination which can affect food safety. This approach is also helpful in informal settlements, especially where industrial contamination or waste disposal is premature, where bagged agriculture can provide a safe and healthy growing environment.

Adaptive farming

Sack Farm is also very flexible and adaptable and does not require large land areas to enable agricultural production even when space is limited. This is especially important in Informal Settlements, where living space is often very limited.

Create Economic Opportunities

The proceeds from the sale of vegetables are deposited into the savings and credit societies they make, which provide young people with loans to start their own businesses. At informal settlements, this model helps residents use their limited resources to create new economic opportunities and help them escape poverty.

Waste Recovery and Use

This method can transform waste into valuable resources using suck or other recyclables as planting containers. At Informal Settlements, many similar wastes, such as plastic bottles, old tires, etc., can be converted into planting containers, saving resources and reducing the amount of waste that accumulates.

Insulate contaminated land

In Sack Farm, suck provides protection for the crop by isolating it from external environmental contamination which can affect food safety. This approach is also helpful in informal settlements, especially where industrial contamination or waste disposal is premature, where bagged agriculture can provide a safe and healthy growing environment.

Adaptive farming

Sack Farm is also very flexible and adaptable and does not require large land areas to enable agricultural production even when space is limited. This is especially important in Informal Settlements, where living space is often very limited.
Isla Urbana is formed by an interdisciplinary group of designers, urbanists, engineers, anthropologists, educators, and artists dedicated to demonstrating how rainwater harvesting is a viable solution for Mexico’s water crisis.

Isla Urbana has designed an environmentally, socially and economically sustainable rainwater harvesting system to collect and clean rainwater for homes, schools and health clinics. The system is inexpensive, easy to install and provides approximately 40% of the annual water supply for individual homes. If implemented on a large scale throughout Mexico City, this simple technology could provide 30 percent of the city’s water and help provide a sustainable source of water for 12 million Mexicans who lack access to clean water.

Rainwater harvesting systems promote sustainable water management practices, alleviate urban flooding, alleviate poverty, reduce carbon emissions, and provide a reliable source of water for the residents of Mexico City and the nation as a whole.

Integrating Isla Urbana into informal settlements could dramatically address the issues of water scarcity and sanitation. Given the informal and often self-organized construction of buildings, roof surfaces can be optimized as collection points for rainwater. The harvested rainwater can supply individual households with a significant portion of their annual water needs, reducing reliance on unreliable and potentially unsafe water sources. The system’s affordability and ease of installation suit the limited resources available in these settlements. Moreover, if supplemented with essential filtration or purification methods, this system could ensure a safer, cleaner water supply, contributing to the improved health and well-being of settlement residents and promoting an environmentally sustainable practice.
Site Analysis

Brazil, officially the Federative Republic of Brazil, is the largest country in South America and in Latin America. At 8.5 million square kilometers and with over 217 million people.

Rocinha, which means little farm in Portuguese, is the largest favela in Brazil, located in Rio de Janeiro’s South Zone between the districts of São Conrado and Gávea. Rocinha is built on a steep hillside overlooking Rio de Janeiro. Most of the favela is on a very steep hill, with many trees surrounding it. Around 200,000 people live in Rocinha.

89% of housing worldwide is built illegally. In highly urbanized Latin America, one-third of all city dwellers live in informal conditions. Favelas, in Brazil, a specific informal settlement located within or on the outskirts of the country’s large cities. A favela typically comes into being when squatters occupy vacant land at the edge of a city and construct.

Favelas in Brazil have a unique and complex urban planning and architectural structure, largely resulting from their organic, unplanned growth over time. They are often found on hilly terrain, with houses built in close proximity, creating a patchwork of structures that climb steep slopes and spread across the landscape.

CHAPTER 02
Rethinking Food Crisis

Abundance within Scarcity Food Security in the Favelas of Brazil

Fig/Favela
Timeline

Favelas emerged as informal settlements in the late 19th century, driven primarily by urbanization and poverty. Over time, the favelas have faced social and economic challenges, including problems related to crime, violence, and limited access to essential services. The Brazilian government has implemented various programs and initiatives to improve favelas' living conditions. While progress has been made, favelas still struggle with socioeconomic disparities and inadequate infrastructure.

Over the past century, despite attempts from public policies to address informality in Rio de Janeiro, the growth of informal settlements has outpaced that of the formal city, both in quantity and size. This trend has been influenced by three key factors, which include public policies, critical cartography, and academic discourse.

Abundance within Scarcity Food Security in the Favelas of Brazil

Rocinha Expansion Map

The original favela

1900
1920
1940
1960
1980
2000
2020

Food Security
Middle-income
Lower-income
Lower-income
Low-income

Favela housing project
Food Security
FIFA World Cup
The Olympics
Zero Hunger
"More Cities"

Brazilian Revolution
Pnad.ma Pada
Industrialization

Population growth & rapid urbanization
Food Security
The favela population experienced significant growth spurt.

Rocinha is considered an administrative region.

1966
1996
2010
2016

The Rocinha "Bar" area
The world's first favela
The world's first favela
The world's first favela

Abundance within Scarcity
Food Security

14

14

14

14

14

14

14

14

14
The “Abundance within Scarcity” in informal settlements is a revolutionary concept that captures the latent potential for value generation and opportunity creation in environments typically viewed as deficient. Contrary to conventional perspectives of poverty, informal settlements are imbued with a vibrant cultural fabric and social capital, often overlooked due to their external circumstances. This paradigm shift invites us to challenge and re-evaluate our preconceptions of scarcity in these urban enclaves, encouraging a reassessment of them as hubs teeming with hidden assets and untapped potential.

It underscores the significance of pioneering strategies, such as urban agriculture, as a transformative mechanism that converts the illusion of scarcity into a profusion of opportunities, serving as an example of innovative solutions in seemingly unfavorable conditions. This perspective offers a hopeful and promising lens through which critical socio-economic issues such as food security and community empowerment can be addressed.

In emphasizing the inherent strengths and resilience of the communities in informal settlements, it advocates for a transformative and empowering approach toward tackling poverty and insecurity. It calls for the creation of abundance in the face of perceived scarcity, reminding us that within each challenge lies an opportunity waiting to be harnessed. It also highlights the necessity of participatory and inclusive urban planning, stressing that community members themselves must be active agents in reshaping their environments and futures.

Data Source: ArcGIS, Google Map, OpenStreetMap
Built in opposition to all precepts of hygiene (no water, no sewage, not the least bit of cleanliness, no garbage removal) they are like large filthy latrines covered with excrement and other waste of the human existence, heaps of dirt and rottenness that feed clouds of flies and attract all kinds of diseases and impurities into the city streets.

Architecturally, favela homes are typically made of a variety of materials, including brick, concrete, and scrap materials, reflecting the limited resources and informal construction practices. Many homes are multistory, designed to accommodate growing families in the constrained space, and balconies and rooftops are often used as communal spaces.

Despite the lack of formal planning, favelas have developed intricate networks of narrow, winding alleys, stairs, and paths that serve as the main circulation routes. These routes, while often challenging to navigate, contribute to a strong sense of community and shared space.

Lack of Infrastructure
Many favelas lack adequate infrastructure for sanitation. This includes access to clean, running water, and proper sewage systems. As a result, waste is often discarded improperly, leading to pollution and health risks.

Overpopulation
Favelas are often densely populated, which exacerbates sanitation problems. The high number of people living in a confined space can lead to the rapid spread of diseases due to poor sanitation.

Poverty
Many residents in favelas live in poverty, which means they lack the resources to invest in proper sanitation methods. This can result in unsanitary living conditions and practices.

Government Neglect
Favelas are frequently overlooked by governmental authorities, resulting in a lack of funding and attention to these areas for sanitation infrastructure and services.

Limited Space
Sanitation Problem

“Built in opposition to all precepts of hygiene (no water, no sewage, not the least bit of cleanliness, no garbage removal) they are like large filthy latrines covered with excrement and other waste of the human existence, heaps of dirt and rottenness that feed clouds of flies and attract all kinds of diseases and impurities into the city streets.”
Sewage System

Rio de Janeiro faces a significant sewage and sanitation problem, with the majority of its sewage entering the rivers, lagoons, and ultimately the ocean without treatment. This issue is compounded by insufficient trash removal, which leads to informal sewage systems mixing with garbage and exacerbating natural disasters during heavy rain. \(^\text{16}\)

In favelas, sanitation systems often require multiple small systems instead of a single large one to adapt to varying conditions such as topography and spatial constraints, and to ensure access for all residents. \(^\text{17}\)

Fig.10 Sewage spilled onto the street

Waste on the corner of street
Due to the lack of garbage management agencies, favela residents leave garbage piles in the streets, which are mostly organic and attract insects and rats, spreading viruses such as plague in the residential areas.

Because of the topography, stormwater runoff carries trash down the slope to eventually sink and contaminate groundwater. This contaminated and unsafe water is eventually recycled back to the Favela.

Waste Pickers Classification

Autonomous waste picker
Autonomous waste picker works to sort recyclable materials on the streets or in open dumps and sells them to junk shops or waste pickers’ associations. This type of picker is not associated with waste pickers’ cooperatives or associations.

Organized waste picker
Organized waste picker is an employee of a waste pickers’ cooperative or association.

Waste picker under contract
Waste pickers under contract are usually in junk yards, in the public municipal sector or even work for waste pickers’ associations or cooperatives.

Waste Picker
Waste pickers work to separate waste with recyclable potential to convert these materials into financial resources and, thus, guarantee their daily sustenance.

Waste pickers are responsible for around 90% of recycling in Brazil. Despite their invisibility, they perform an essential service for the sustainability and health of Brazil.⁹
Harnessing the untapped potential of Brazil’s informal settlements, known as Favelas, I venture into a novel approach towards favela food security. Try to push boundaries by transforming the seemingly resource-limited spaces into powerhouses of sustainable urban agriculture propelled by resource optimization and community participation. This venture innovatively intertwines ecological sustainability, socio-economic empowerment, and urban development domains. The plan and design for urban agriculture in Favelas embark on a journey to redefine scarcity, emphasizing resilience, self-sufficiency, and the collective strength of the informal settlements.

Illegal Electrical Wiring and Water Pipe

Favela’s residents face water instability, and despite the formal water network established as part of the slum urbanization program, many of the poorest residents still live at the end of the water network and simply can’t get there when water is scarce. So they choose to use PVC piping to carry water from illegal connections to the mains to the entire community. Residents also collectively and secretly connect to the grid and the sewer pipes beneath the slums.19

Symbol of Favela

The favelas demonstrate the incredible ability to maximize limited space. They create multi-use and flexible solutions in spatially constrained environments. The pipelines can be used as guiding paths for navigation or to delineate public spaces within the dense and complex environment of the favela.

The intricate network of pipes can be seen as a symbol of solidarity and interconnectedness, with informal settlement dwellers sharing space and allowing neighbors’ pipes to cross their own space. They are connected and supportive of each other.

CHAPTER 04
Scarcity to Abundance: The Verticulture Agriculture in Favela

Illegal Electrical Wiring and Water Pipe

Favela’s residents face water instability, and despite the formal water network established as part of the slum urbanization program, many of the poorest residents still live at the end of the water network and simply can’t get there when water is scarce. So they choose to use PVC piping to carry water from illegal connections to the mains to the entire community. Residents also collectively and secretly connect to the grid and the sewer pipes beneath the slums.19

Symbol of Favela

The favelas demonstrate the incredible ability to maximize limited space. They create multi-use and flexible solutions in spatially constrained environments. The pipelines can be used as guiding paths for navigation or to delineate public spaces within the dense and complex environment of the favela.

The intricate network of pipes can be seen as a symbol of solidarity and interconnectedness, with informal settlement dwellers sharing space and allowing neighbors’ pipes to cross their own space. They are connected and supportive of each other.
**Design Goals**

The fundamental principle for addressing food security in Brazil's informal settlements, Favela, lies in innovatively harnessing existing physical and socio-ecological resources for urban agriculture within limited resources and space. This primarily entails exploiting building gaps, elevation, and rooftops for food production. These underutilized spaces and terrain differences change presents an abundant opportunity for residents to cultivate a variety of crops.

**Sustainable waste management system**

Organic waste can be repurposed into nutrient-rich compost as soil for urban agriculture, closing the resource loop and supporting healthier plant growth. Additionally, it aids in waste reduction and addresses sanitation issues often prevalent in these areas.

**Manage hillside run-off and water collection**

Rainwater can be captured and directed to urban farms without power use by working with gravity. These measures help manage stormwater, reducing flood risks and soil erosion while providing a reliable irrigation source.

**GreenRise: Elevating Urban Agriculture**

Urban agriculture on the rooftops alleviates heat island effects and improves the overall settlement microclimate. As well as offering environmental benefits, these initiatives also provide income-generating opportunities and educational platforms for community members, promoting self-sufficiency and resilience.

This design for urban agriculture within informal settlements contributes to local food security and protects their food sovereignty. It helps build multifunctional, sustainable, resilient community-led agriculture to truly tap into the abundant potential of these seemingly “scarcity” regions.

**Concept Model**

The model aims to represent the principles of inserting urban agriculture in Brazil’s informal settlements, visualizing how underutilized spaces can be transformed into valuable assets for food security and community resilience.

The nails puncturing the surface embody the innovative interventions that challenge and disrupt the status quo and the introduction of agriculture into the cracks and gaps of the favela’s fabric, exploiting rooftops. The threads connecting these nails represent stitching together these fragmented residual spaces and systems into a cohesive, supportive, and resilient network.

The model starts with individual nails. Then the threads intertwine and weave to form a robust and stable network gradually. It represents the interconnectedness of urban agriculture systems, the utilization of resources, and the synergy of the community working together to weave a sustainable urban agriculture fabric.
In the newly envisioned Rocinha community, a diverse network of community clusters has been formed, inspired by the economic model of Grameen Bank. This model operates at three scales, each playing its unique role in the broader community ecosystem.

At the macro scale, large regions are organized around the principle of self-sustaining economies circularly. Farm markets play a central role in this vision by producing and selling crops to stimulate the local economy and obtain funds to supplement the operation of the macro-region.

The macro-divided regions are further divided into meso-regions framed by shared infrastructure. These meso-regions strengthen connectivity within the community, allowing resources to flow more efficiently throughout the community. It aims to improve the living environment and enhance food security in the surrounding communities.

Finally, there is the micro-level, which is centered on each community member, each of whom plays a different but important role in the community, supporting each other and sharing the responsibilities and tasks of the community.

The new community partition differs from conventional community division - it is not planned on a circular scale on a plane but uses vertical divisions based on contours. This division fully uses topographic features, allowing each community to take full advantage of its unique topography, further enhancing community cohesion and creating dynamic and vibrant economic and ecologic systems.
Preserve virgin forest mountains because of their rich biodiversity and because forests can control soil erosion on hillsides.

Take advantage of the hillside terrain to purify, collect and store stormwater runoff and grey water to provide a stable and free water source for urban agriculture.

Unique urban agriculture designs are developed to address the issues of space and resource constraints. These designs incorporate urban agriculture into the living spaces of favela residents, utilizing spatial verticalization and multi-functionality. Examples include rooftop agriculture, vertical farming, and mushroom cultivation.

Farmers’ Market
Farmers’ market occupies the vacant space in the valley. This space serves as a platform for commodity exchange and community interaction. Any surplus food produced by the slum community is transported to the agricultural market if it is not consumed locally. This allows the community to prevent food waste while also gaining economic benefits. The income generated from the sale of these goods is reinvested in community development, creating a cyclical system that enhances community autonomy and self-sustainability. The agricultural market is also a vibrant social space. It encourages residents to interact with each other, share their stories, culture, and local agricultural products.

Biodigester
Biodigester is a system that converts organic waste through composting into valuable products, including nutrient-rich fertilizer and biogas. It also solves Favela’s waste management problems.

Primary Forest
Preserve virgin forest mountains because of their rich biodiversity and because forests can control soil erosion on hillsides.

Water Collection System
Take advantage of the hillside terrain to purify, collect and store stormwater runoff and grey water to provide a stable and free water source for urban agriculture.

Unique urban agriculture designs are developed to address the issues of space and resource constraints. These designs incorporate urban agriculture into the living spaces of favela residents, utilizing spatial verticalization and multi-functionality. Examples include rooftop agriculture, vertical farming, and mushroom cultivation.

Farmers’ Market
Farmers’ market occupies the vacant space in the valley. This space serves as a platform for commodity exchange and community interaction. Any surplus food produced by the slum community is transported to the agricultural market if it is not consumed locally. This allows the community to prevent food waste while also gaining economic benefits. The income generated from the sale of these goods is reinvested in community development, creating a cyclical system that enhances community autonomy and self-sustainability. The agricultural market is also a vibrant social space. It encourages residents to interact with each other, share their stories, culture, and local agricultural products.

Biodigester
Biodigester is a system that converts organic waste through composting into valuable products, including nutrient-rich fertilizer and biogas. It also solves Favela’s waste management problems.
Strategy - Working With Gravity

“Working with gravity” ingeniously harnesses gravitational potential energy, eliminating the need for electrical power. In this sustainable model, water naturally flows to the central growing area due to gravity, ensuring plants are amply irrigated without additional energy inputs and water supply.

Waste pickers contribute to this closed-loop system by transporting organic waste from higher elevations to lower biodigesters. Biodigesters convert organic material into biogas. The resulting biogas, lighter in density, ascends naturally to supply households throughout the community.

Strategy - Water Collection System

The water collection system can harness and optimize the use of local water resources, including rainwater runoff and greywater, for the sustainable irrigation of rooftop agriculture.

Water Capture and Storage:
In areas prone to hillside run-off, the water collection system captures and stores the run-off in water tanks. Rooftop space utilization also takes rainwater harvesting into account.

Greywater Recycling:
In areas prone to hillside run-off, the water collection system captures and stores the run-off in water tanks. Rooftop space utilization takes rainwater harvesting into account, reducing reliance on water supply.

Sustainable Irrigation:
Due to the organic expansion of the building, there are many small and inaccessible gaps between informal buildings that can be used as water storage space. The collected rainwater and recycled greywater will provide a sustainable source of irrigation for the rooftop agriculture, ensuring the farms remain productive even in times of water scarcity.

Flood Mitigation:
By capturing and reusing runoff and greywater, the design will also help mitigate flooding issues often experienced in favela communities due to steep hills, heavy rains and inadequate drainage systems.

Education and Empowerment:
By implementing these systems, local institutions can provide educational opportunities for residents to learn about water conservation, sustainable irrigation, and the importance of resource management in achieving food sovereignty.

By integrating water resource management and urban agriculture, this water system aims to create a self-sustaining ecosystem in favelas, addressing food and water security.

Abundance within Scarcity: Food Security in the Favelas of Brazil
Abundance within Scarcity: Food Security in the Favelas of Brazil

Strategy - Biodigester and artificial wetland
Biodigestion is a biological process that occurs when organic matter is decomposed by bacteria in the absence of oxygen to create biogas. Throughout the decomposition process within the biodigester, solid waste, or sludge, accumulates. Once removed, the solid waste can be repurposed as a valuable resource. After a sufficient drying period, it can be used as a nutrient-rich fertilizer for agricultural applications. This not only minimizes waste but also contributes to a circular economy by returning nutrients to the soil.
This thesis highlighted the urgency of the urban food crisis. It provoked me to think deeply about two key issues: First, rapid urbanization has gradually increased the distance between cities and the countryside, blurring the connection between urban dwellers and food cultivation and production. Second, the overdependence of cities on food from the field has led to a food system that needs to be more stable and sensitive to external factors, resulting in large fluctuations in food prices.

Particularly in informal residential areas such as Favela, residents face even more severe resource and spatial constraints. They live in an environment where resources appear to be scarce at first glance. However, upon deeper exploration, I found that Favela’s unique geography and rich community culture offered unforeseen opportunities to solve the problem.

To this end, I proposed an innovative solution: using the concept of a circular economy to bring multidimensional urban agriculture to the fragmented open spaces within the Favela. This solution would bring hitherto untapped opportunities to these communities and allow residents of informal housing areas to enjoy improved food sovereignty and food security.

My methodology is transformative, putting resources into the links that have value. I strive to move away from a fixed frame of mind and rethink how to transform negative resources into proactive ones, thus giving a new definition to “Scarcity.”

The three main elements of crop cultivation are water, soil, and sunlight. Water management plays a crucial role in this process in an area like Favela, where water is limited. I introduced systems design that intercept and capture the flash flood runoff that causes building slides and intercept road sewage buildup in Favela, deposit it in tanks, and feed it into irrigation and rainwater harvesting systems for urban agriculture. The nutrients the crops need come from the byproducts of the biodigester - waste - and this organic fertilizer comes from the garbage that would otherwise be deposited on the street, causing pollution and disease. This indirectly provides the opportunity for waste scavengers, who are indigenous to Brazil, to participate in creating the system.

In designing this closed-loop system, I used a fill-in-the-blank and derivative approach. I listed the vacancies and existing resources and cultures within the link and then reconfigured and reconnected them.

The Favela region’s unique topography allows gravity as a driving force for resource transfer without any external input or support. In addition, the slope of the Favela area exposes more of the façade space to the sun, providing great opportunities for vertical agriculture.

In this process, I profoundly experienced the importance of exploring and discovering opportunities in problems and looking beyond them to possible solutions. I recognize the integral role of community residents in this process. They are the beneficiaries of solutions and the subjects of action. Therefore, it is not enough to understand the benefits of urban agriculture; we also need to act. Urban residents need to use and even participate in the process of urban agriculture. Through visualization, we can make urban agriculture a part of urban life and landscape, allowing city dwellers to visualize the food process from planting to harvesting, deepening their connection with food and nature. This connection will enhance their food security, help them build a sense of responsibility towards nature and the community, and strengthen community cohesion.

Overall, this thesis aims to lead people to rethink the relationship and value of agriculture, cities, informal residential areas, and seemingly discarded objects. I strongly believe that for informal residential areas, urban agriculture is not only a way to solve food problems but also a tool to improve ecology, build communities and reform lifestyles. This was my original intention when designing this urban agriculture project, and it is a philosophy I have maintained throughout its implementation.

Conclusion

Fig.12 Seu João Bolinha (Mr. John Soapbubble), as he is known in the streets of Favela da Maré in Rio de Janeiro, street vendor of soapbubbles, makes children happy when he passes. Brazil.
“Planet of Slums” focuses on the rapid growth of slums in cities around the world, especially in the developing world. Davis argues that the rise of slums is a result of globalization, economic inequality, and failed policies that have neglected the urban poor.

It analyzes the causes and consequences of slums, including issues such as overcrowding, lack of basic services such as water and sanitation, and high rates of crime and violence. How the informal settlements are often ignored or marginalized by governments and policy-makers.

“Planet of Slums, Mike Davis

The book examines how cities can be designed and organized to support sustainable and healthy food production, distribution, and consumption. The book covers a range of topics related to food and urbanism, including the history of urban agriculture, the impact of food systems on public health and the environment, the role of community-based food initiatives, and the challenges and opportunities of integrating food into urban planning and policy.

Food Urbanism: Typologies, Strategies, Case Studies, Craig Verzone
Acknowledgments

With the deepest sense of gratitude and affection, I wish to express my appreciation to all those who have played instrumental roles in bringing my thesis to fruition.

I sincerely thank my thesis advisor, Elizabeth Dean Hermann, for her unwavering support, motivation, and immense wisdom over the past year. Her guidance was invaluable throughout the research and writing phases of this thesis.

My second advisor, Adrian Fehrmann, deserves special thanks for his insightful suggestions and continual guidance.

My heart felt appreciation goes to the RISD landscape faculty - Johanna Barthmaier-Payne, Suzanne Mathew, Courtney Goode, Jacob Mitchell, Colgate Searle, Emily Vogler, whose consistent support and encouragement fueled my journey through these three years.

To my friends and classmates in MLA 2023, your collaboration, feedback, and support have been pivotal.

Lastly, to my family, your unwavering love and support provided the foundation for all this work.

Thank you all from the bottom of my heart.

Reflection

During the COVID-19 pandemic, I found myself confronted with the tangible reality of the fragile connection between food and the city. It was an awakening that led me to investigate food crises in urban areas, a journey that formed the backbone of my thesis.

The repercussions of our shifting urban-rural dynamics came into sharp focus during my research. This gradual displacement of agriculture from cities has directly contributed to a fragmented food system. While Brazil served as my geographical focus, the implications of my findings extend far beyond. The struggle communities in Brazil face against the backdrop of the global food crisis shed light on our interconnected vulnerabilities in the face of systemic and socio-economic challenges.

Yet, within this adversity, I saw potential. The crisis facing the informal settlements also presented an opportunity for innovative solutions. The untapped power of urban agriculture in these spaces offered a path to address food insecurity from within the community. My focus on the Favelas was not just about managing a problem but also empowering these communities to leverage their strengths.

In designing strategies, I was guided by principles of sustainability and resilience. The idea of integrating urban agriculture within the city’s residual spaces, capitalizing on gravity, was not only about pragmatic problem-solving but also a statement on harnessing the inherent potential within these spaces.

Reflecting on my thesis journey, it is a transformative experience that significantly broadened my perspective as a landscape architect. It was more than an academic exercise - it served as a reminder of the power and potential of combining innovative design with sustainable practices and the critical role of landscape architecture in shaping resilient urban futures. Beyond the keywords of ‘Informal settlements,’ ‘Urban agriculture,’ and ‘Food insecurity,’ my thesis has underscored the importance of viewing our work through human resilience, community empowerment, and systemic sustainability.
9. Fred Onserio, headmaster of Stara rescue centre and school, waters vegetables in the sack gardens in the school grounds.
11. ibid.
12. ibid.
13. ibid.
21. ibid.
22. ibid.
23. ibid.

Abundance within Scarcity Food Security in the Favelas of Brazil

Image citations
Fig2 “Ten Years of NYÉLÉNI – Much to Celebrate! - International Planning Committee for Food Sovereignty (IPC).” International Planning Committee for Food Sovereignty (IPC), June 18, 2021. https://www.foodsovereignty.org/ten-years-of-nyeleni-much-to-celebrate/.
Fig6 ibid.
Fig8 ibid.
Bibliography


Fred Onserio, headmaster of Stara rescue centre and school, waters vegetables in the sack gardens in the school grounds.


Speech from “To remodel Rio de Janeiro,” delivered by the physician Marcos Pimenta, one of the inventors of the “farta problem,” at the Rotary Club in October 1926


Abundance within Scarcity Food Security in the Favelas of Brazil