

FIGHTING POVERTY THROUGH URBAN AGRICULTURE IN BEIRUT

Addressing environmental and food related issues through the establishment of a school for urban permaculture in Beirut.

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Research Plan
Design Brief
Design

Complex Projects

ABSTRACT

What role can education play within the future of food production in Beirut? That is the main question which this article is exploring. Lebanon is currently in one of the world's worst financial crises in recent history, hitting the lower classes most (World Bank, 2021). Increased poverty rates resulted in a situation where people are barely able to obtain food. This article examines the relation between education and poverty through the use of news articles, papers, personal conversations, and site visits. It will first explain the inaccessibility of high quality education for the lower classes within the Lebanon, Secondly it argues that the situation combined with the economic crisis leads to increased numbers of poverty and hunger. The article concludes with a proposed project that teaches the Lebanese people how to grow their own crops, in order to increase independence and reduce poverty. The toxic landfill on the project site, which is the old trash dump of Beirut, will be rehabilitated through implementation of phytoremediation, and will be maintained through a sustainable agriculture approach named permaculture. Future steps should be taken to inform designers how the project should be shaped and carried out spatially.



FIG 1: Educational inequality within Beirut and its consequences (Broersen, 2021)

INTRODUCTION

After facing a civil war and a destructive explosion the city of Beirut, once called "Paris of the Middle East", is now a shadow of its former self (Haidrani, 2020). Today, the city faces challenges like the highly divided society, it's jammed roads, the pollution and the non-existent public space. Not to mention the hyperinflation that was caused by the explosion, which increased the rates of poverty and hunger among the lower classes. For them it's a struggle to make enough money to afford food (AFP, 2021). Meanwhile, the higher classes are able to study at high quality universities and have the prospect of obtaining a job abroad, resulting in a Brain Drain.

PROBLEM STATEMENT

The main challenge that this article will be addressing is the hunger within the lower classes. The poverty within Lebanon is caused by a combination of the hyperinflation and the high dependence on food imports. This

caused the average food price to increase with 400% (Trading Economics, 2021). As a consequence, children within lower income families are forced to drop-out of school at an early age and start working to support their families. Eventhough it's food production is low, Lebanon has the highest amount of arable land within the Arab region (Collelo, 2021). This potential remains unutilized due to the lack of proper education about agriculture (FAO, 2021).

RESEARCH QUESTION

What role can education play within the future of food production in Beirut?

EDUCATION

1.1 Inequal access to quality education

The quality of the Lebanese educational system is internationally recognised. The World Economic Forum (2013) ranked the

country 10th in overall quality of education. In the beginning of October 2021, students from TU Delft got the chance to visit the Lebanese American University (LAU) within Beirut. They were amazed by the large gardens, and beautiful sandstone buildings located within the campus. However, the Lebanese students they met told them of the expensive fees that had to be paid in order to get high quality education, which is only available at private campuses like LAU. The tuition fees for these schools can range from 15.000 up to 30.000 USD annually (LAU, 2021), which is only affordable for the high-income families. More than half of the students at similar institutions desire to find work abroad and leave the country. After graduation, a majority of them succeeds resulting in a Brain Drain. (Vohra, 2021)

Meanwhile, the ones who can't afford the tuition fee lack any prospect on getting qualitative education. This includes the lower class, but also a growing proportion of the middle class as education gets more expensive. (Nader, 2021) These people have two options; The first is to attain one of the public schools. However a lack of funding from the government results in a generally low quality of public education. The second option is to join one of the affordable private schools. Most of these rely heavily on funding from sectarian religious communities. These schools have differences in the topics that are being taught, which results in low quality education and fuels division among the society (StateUniversity, 2021).

Within Beirut, the income class of the family determines the academic possibilities of their child. This is contrasting with the Dutch system where the overwhelming majority has access to quality education. Here, public schools and universities are heavily subsidised by the government, improving their quality and keeping them affordable. Tuition fees come down to approximately 2500 USD, which is a fraction of what the quality private institutions in Lebanon are taxing. 79% of the Dutch population falls within the middle class (Kochhar, 2017) and can afford the tuition fees. Dutch students from the lower

classes or ones that struggle to afford it can get extra subsidizing, and have the option to borrow money against minimal interest rates. This makes it that all classes have access to quality education.

1.2 Dropping out due to poverty

Approximately 30% of the students at public schools don't finish their secondary education because they need to start generating an income for their families (Alami et al., 2021). Lower-income families need all the support they can get as the food prices have rapidly increased in the past year. After the blast, the Lebanese pound lost 90% of its value on the black market, and because 84% of the food is imported (FAO, 2021), this resulted in a tripling of the food price (Trading Economics, 2021). In the meantime, minimum wage remained staggered at 675.000 LBP (Country Economy, 2021). This used to be worth around 400 USD in 2019, now in 2021 it is worth roughly 30 USD. Families are now spending five times the minimal wage on food (AFP, 2021), resulting in increased levels of hunger and poverty. The World Bank describes it as one of the planet's worst financial crises since the 1850s (World Bank, 2021). (FIG 1)

Conclusion on education

To recap, there is a large inequality within the Lebanese education system. An minority of the Lebanese people can afford the high tuition fees of the high quality private institutions. More than half of the students that graduate here leave the country. The remaining part of the population can choose between low quality education in either public schools or sectarian private schools. The sectarian schools help fuel the division between communities in Lebanon. A large proportion of the students within the lower class have to drop-out before finishing secondary school and start generating an income to support their families. Since the average food price tripled due to the hyperinflation, whilst local food production remained low.

AGRICULTURE

2.1 The unutilized potential

Even though only 16% of the food within Lebanon is locally produced, its agriculture sector has large potentials. Ironically, the country has 240.000 acres of arable land, which is the largest amount within the Arab world (Collelo, 2021). During the students visit to Beirut, they met with various Lebanese professors, architects, students and inhabitants. Among them was an architect from the Dutch Embassy called Rani al Raji. He mentioned the interest from Lebanese people to learn about agriculture, and the potential for Lebanon to become a regional market leader. It's favourable climate makes it suitable to grow certain exotic crops like avocado, lime, and mango. These can be traded with neighbouring Arabian countries against profitable margins. (Raji, 2021)

Lebanon lies within the Mediterranean climate region. The current production of crops is spread around the country. Olive, grape, wheat, and potato farms are located land inward, and farms that produce fruits like orange, lemon, apples and bananas are situated on the coast. The climate is generally subtropical and characterised by its hot, dry summers and mild, humid winters. Most precipitation falls in winter due to storms coming in eastward from the Mediterranean sea. The majority of the rain falls in the Lebanese mountains which creates the various rivers that flow through Lebanon. In summer there is barely any precipitation, so the rivers are mainly formed by melted water from the Lebanese mountains (FAO, 2007). Around a quarter of the farmland in Lebanon is irrigated through its rivers, and the remaining portion through rainfall (Collelo, 2021). (FIG 2)

However, the development of the Lebanese agriculture sector is held back. Lebanese farmers and their worker are low-skilled, therefore they struggle to produce these high quality crops. Additionally, they behave in unsustainable agriculture activities which include over-fertilization and inefficient water

use (FAO, 2021). Over-fertilisation results in soil degradation, which is a lack of nutrients in the ground that plants need to grow. Also, the rivers are an important source of water for the farmers, although inefficient irrigation leads to water losses and ground erosion (FAO, 2021). Furthermore, the rivers face challenges of pollution and climate change. Around 65% of the total sewage in Lebanon is ends up in rivers and coastal waters (UNDP, 2021). These polluted rivers become unsuitable for irrigation but are in some cases still used (FAO, 2021). In summer, the melted water in the Beirut River gets mixed with a significant amount of sewage and wastewaters. The snow coverage in the mountains is usually enough to provide the inland farms with a sufficient amount of water for irrigation for the summer. However, due to the effects of climate change, it is estimated that 40% of the snow coverage will be lost in 2040, which will have a catastrophic impact on the agriculture sector (Lyon, 2010). Therefore striving towards a more sustainable future should be of importance for the future of the agriculture sector.

2.2 Sustainable urban agriculture

More than 88% of the Lebanese people live in cities (Fanack, 2009), and are disconnected from the countryside due to the lacking infrastructure. People from the lower classes that live in Beirut don't have access to large plots of land are thus are unable to start large scale farms (FAO, 2021). Therefore, integrating urban agriculture within Beirut could make farming accessible for Lebanese, although this has to be implemented in an sustainable and space efficient way.

A branch of agriculture that focusses on the production of high quality crops within restricted amount of space, whilst maintaining the environment is called permaculture. Permaculture focusses on mixing different types of crops that work together and so create a microclimate that produces food in

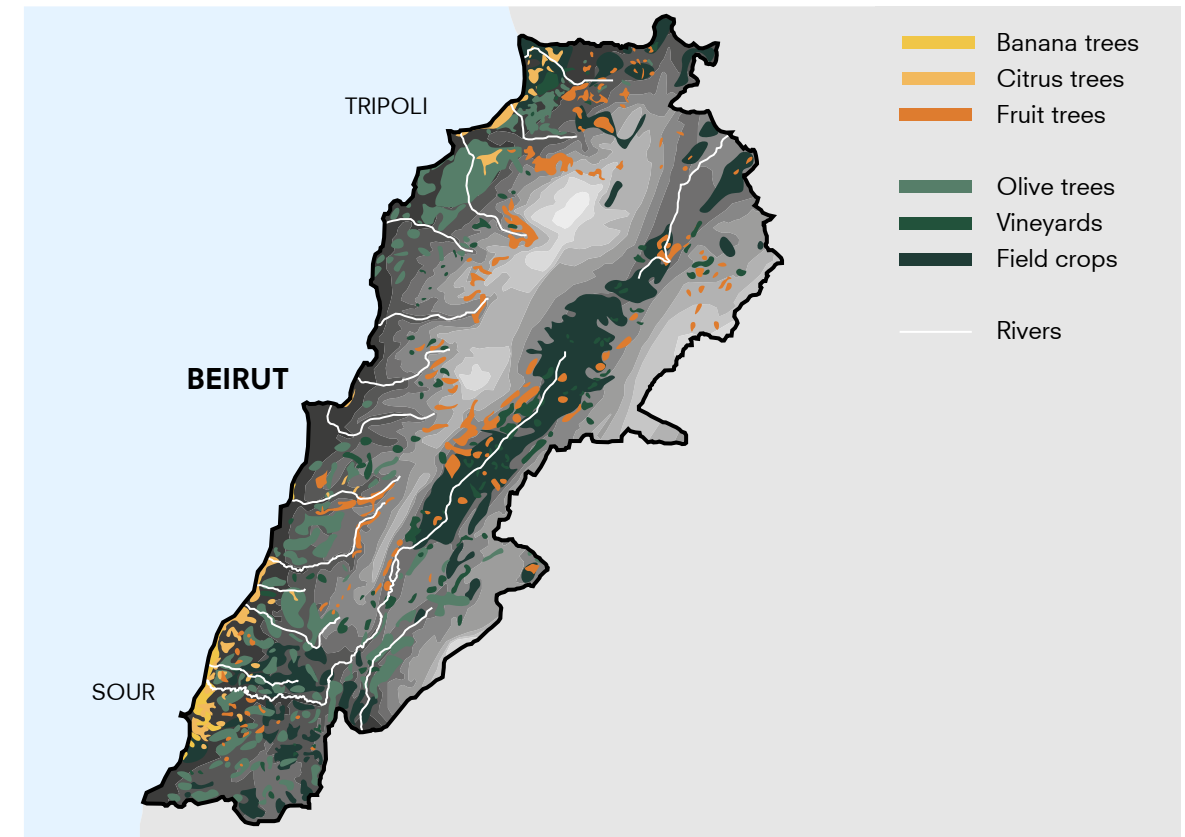


FIG 2: Rainfall, rivers and distribution of crops production in Lebanon (FAO, 2007)

Conclusion on agriculture

every season and stays green all year long (Van Diepen, 2021). In order to enhance the independence of the Lebanese people from the food market price, whilst improving the environment, public educational about permaculture should be established.

To summarize, only a small percentage of the food within Lebanon is locally produced. Luckily, the county has the potential to upgrade its agriculture sector, due to the high amount of arable land and its favourable climate. However, the current sector preforms in unsustainable practices like over-fertilization and inefficient water use. In combination with the present environmental issues of pollution and climate change, these challenges pose a risk for the sector in the future. Therefore, the agriculture within Lebanon needs to shift towards a more sustainable approach, which can be achieved through the establishment of a public education on permaculture. Permaculture is a branch within the agriculture sector that focusses on mixing different crops in order to create a healthy microclimate. It produces high quality crops all year around and can be applied on a small scale.

SITE STRATEGY

The area where the project will be developed is located within Beirut around the mouth of the Beirut River. The river, as well as the highways and topography, form physical borders which cut the area in six districts with distinct characteristics. Three of which are the residential neighbourhoods Rmeil, Bourj Hammoud, and Karantina, and are described as low- to middle income neighbourhoods. Bourj Hammoud is defined as one of the most densely populated areas in the Middle East (Hartrick, 2015). The other three districts are the port, the industrial area and the empty landfill on the coast.

The empty landfill is an interesting site for the project, as it provides the most space for food production. However, the soil is built up from trash landfill and is highly toxic (Saliba, 2017). Phytoremediation offers a sustainable solution by cleaning the landfill with pollutant absorbing plants, although it will take several years until the land is clean enough for crops to be cultivated (Nagendran, 2006). Until then, the project will focus on alternative spaces to grow food. Apartments within Beirut are often provided with a large balcony and rooftop terrace, which can be suitable spaces for crops to grow. Food production within the city can be largely expanded if people are thought how to integrate agriculture within the urban fabric. (FIG 3)



FIG 3: Replacing the curtains in Bourj Hammoud with crops (Broersen, 2021)

PROJECT DEFINITION - CONCLUSION

Research shows that high quality education within Beirut is inaccessible for the lower class. They have the possibility to either go to a low quality public school or a sectarian one. The inflation in combination with the import dependence caused food prices to rapidly increase, while the minimum wage stayed low. This resulted in increased poverty rates and hunger. Students from the lower class are forced to work in order to support their families, hence they drop-out before finishing secondary education. However, the project could convince them to finish their education by providing them with a better alternative which teaches them useful skills. That could be a public school which integrates vocational education on urban agricultural within its curriculum. In short: an "Agriculture Campus". It will teach the students how they can perform permaculture within an urban setting, using various spaces like land, balconies and rooftops. By doing so the project aims to make the residents more independent from the food prices by giving them the tools to produce their own crops. However, the project should address a sustainable agenda when realised, as land and water pollution need to be diminished and climate change poses a critical risk for the agriculture sector in the future.

REFLECTION

The choice for the subject initially started with an interest in how education shapes a person. The difference between income groups became clear during the site visit in Beirut. This is when the research gained the ambition to help the lower classes within Beirut. After speaking to Lebanese architects and professors, it became clear that the agriculture sector had unutilized potential. This was further explored back in the Netherlands, through excessive research in news articles and papers. The results make a proposition for a building typology, which will be given form in further research. Through the study of case studies related to (agricultural) education the future design brief should be given form.



FIG 4: Atmospheric collage (Broersen, 2022)

PROJECT AMBITIONS

Based on the research conclusions, the project will encompass a public agriculture school which focusses on sustainable food production in an urban setting. The project aims to make Beirut's inhabitants less dependent on country's food imports while improving their environmental awareness. The school attempts to achieve this by creating a structure wherein agriculture is integrated and which is part of a healthy ecosystem where crops are produced and biodiversity is enhanced.

The agricultural method used for teaching is permaculture, which uses the cooperation of various plants and animal species to create a small ecosystem. The key to the creation of this ecosystem is biodiversity, as it improves natural soil fertility and prevents the spread of plant diseases. Therefore, trees will need to be planted as their shade creates various microclimates. Having shaded areas

protected by the tree's canopy allows for the growth of a greater variety of crops (Oregon State University, 2016). Other than shading, trees also clean the soil, improve its fertility and form a habitat for wildlife (Chester, 2018). Hence, large trees need to be integrated on site in order to establish the permaculture.

Within Lebanon, a suitable candidate is the Ficus tree, which grows up to 18 meters high and has a wide canopy providing plenty of shade. These trees were previously planted along the boulevard of Beirut's city centre where they provided comfortable microclimates for public life. However, in order to create an image for the city to present itself with, they were replaced by palm trees which offer no shade. This is one example that shows a lack of care for the public by the government (Raji, 2021). The Ficus tree will be given new life within the site where it provides shade for crops, animals and people.



FIG 5: Integration of agriculture within Beirut (Broersen, 2022)

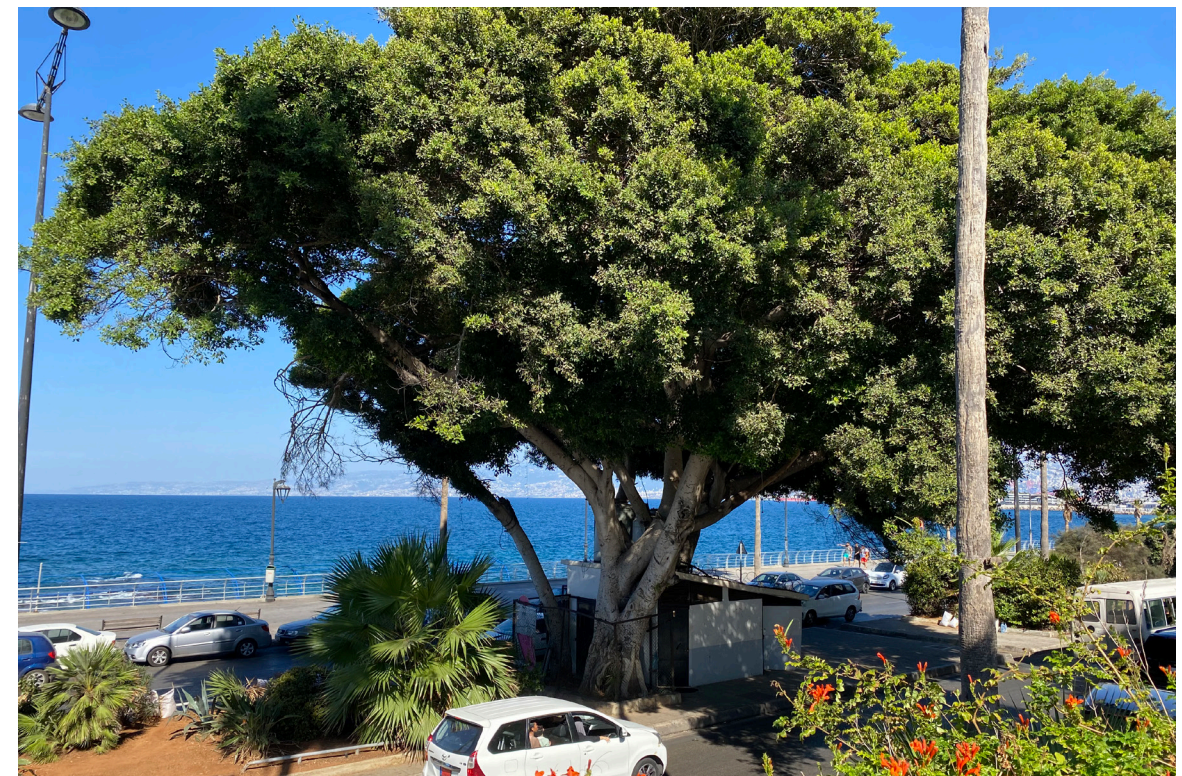


FIG 6: The only Ficus tree remaining on Beirut's boulevard (Broersen, 2021)

SITE AMBITIONS

The chosen site is located on the former trash dump of the city. The Ficus trees in combination with other pollutant absorbing plants will cleanse the toxic landfill through the use of phytoremediation. In the future the area will be transformed into a neighbourhood with a mixture of housing, cultural and leisure activities. The project site encompasses 64.300 m² and is located centrally within the area. The majority of the site is assigned as a public farm that functions as an educational space for the school, and as a small park for the public. The water basin will be used to separate the land into a public and a private area. The school will be centrally located on the site and overlook the farm in all directions. This creates visual connections with the ecosystem which helps in supervising the crops. The school will mainly be approached by pedestrians who access from either the waterfront or the green spine. Alternatively, there are parking spaces located for the teachers and a car drop-off point for the students.

BUILDING AMBITIONS

The building will be integrated within the ecosystem by merging with the landscape and responding to the height of the surrounding trees. The roof of the building can't reach higher than the canopy of the trees, which will range from 10 to 18 meters. Therefore, the building is given a maximum height of 10 meters but with the possibility to be submerged up to 5 meters deep.

The building is teaching about taking care for the environment, which it expresses through its integration within the ecosystem but also through its reduced energy consumption. Passive cooling strategies will be integrated within the structure with the use of vernacular methods, which can be found in traditional Lebanese architecture. To separate hot air from cold air, ceiling will be at least 4 meters high, and roughly 30% - 60% of the façade will be openings to stimulate natural ventilation. All sun exposed façades will have an overhang which shelters the windows from direct sunlight (Melki, 2006). Additionally, a canopy structure will cover the building and provide it with balanced shading whilst creating a new microclimate. The buildings material itself needs to contain a high thermal mass to absorb heat, and a light coating to reflect sunlight. (Omar, 2020)

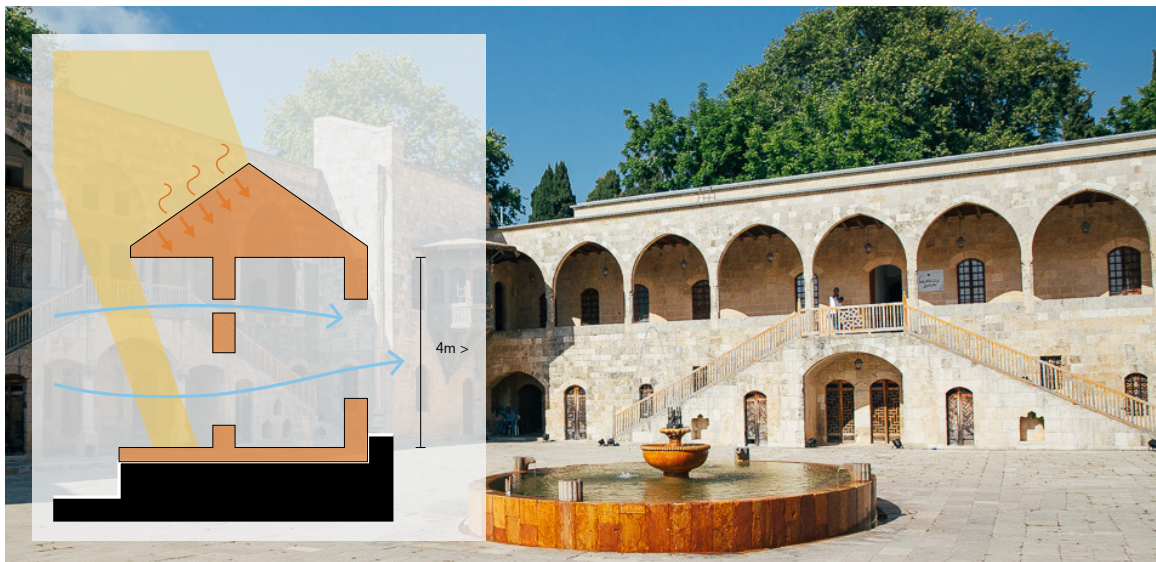


FIG 7: Traditional Lebanese architecture using passive cooling techniques (Atlas Obscura, 2021)

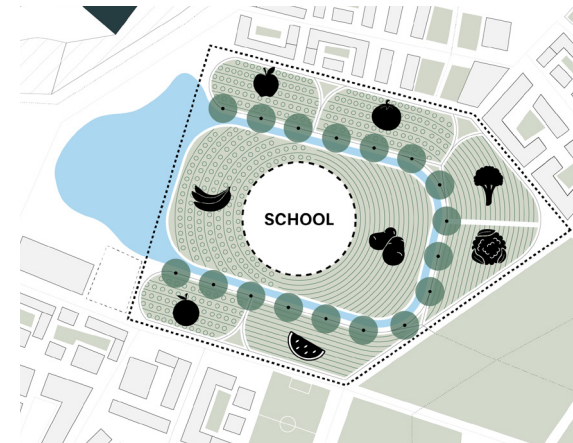


FIG 8: Variety of crops (Broersen, 2022)

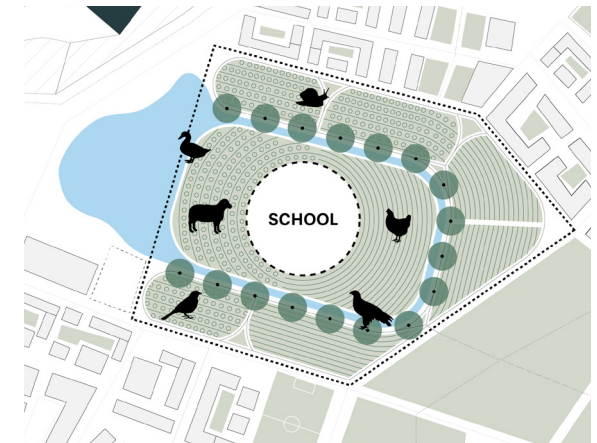


FIG 9: Cattle and wildlife (Broersen, 2022)

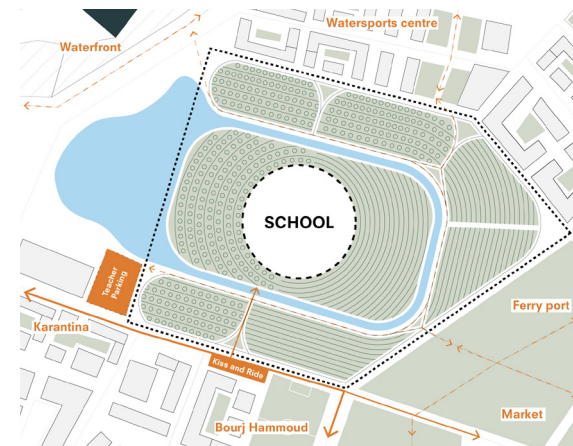


FIG 10: Accessibility (Broersen, 2022)

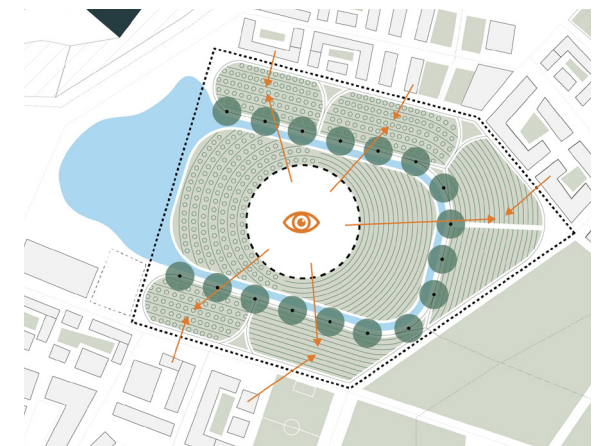


FIG 11: Visual connections (Broersen, 2022)

URBAN RULES

- Site: 64.300 m²
- Public space: 38.500 m²
- Private space: 25.800 m²
- GFA: 12.750 m²
- Maximum footprint: 25.800 m²
- Maximum height: +10 m
- Maximum depth: -5 m
- Floors: 3
- Setback requirements: N/A

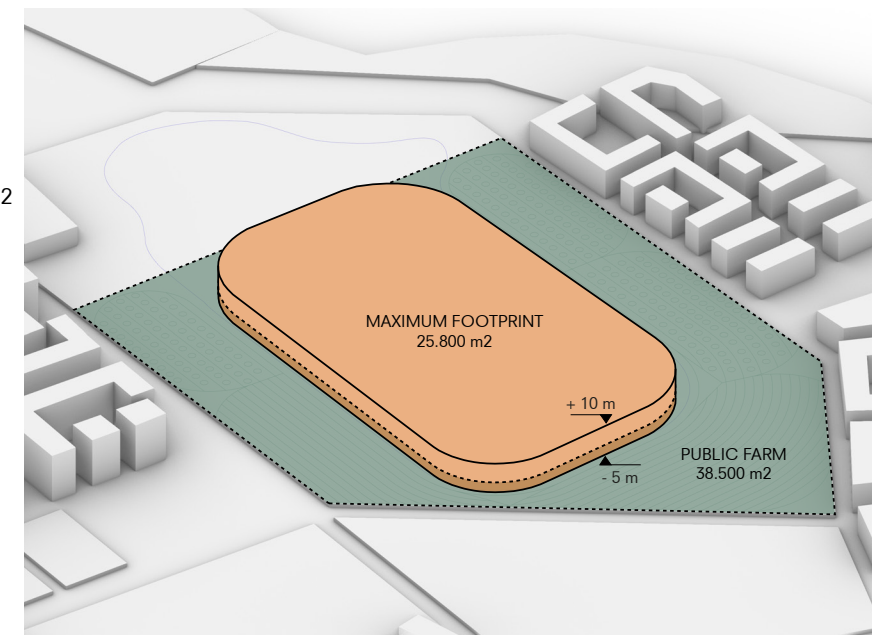


FIG 12: Maximum hight and footprint (Broersen, 2022)

PROGRAM AMBITIONS

It is typical in Middle Eastern schools to mix primary and secondary education within one campus. Therefore, this shall also be applied for the project. Primary school starts with an theoretical approach where formal education includes topics like the importance of taking care for the environment. Secondary education will shift more on vocational classes about the process of planting, growing and harvesting crops within an urban environment.

Designing a classroom like home reduces anxiety and improves empathic development (Long, 2018). Furthermore, it can demonstrate the students how they should apply agriculture at their apartments in the form of urban farming. The "Liwan" is the central room within a traditional Lebanese apartment, and is often connect to an outdoor space with the potential to grow crops. These spaces can be integrated within the classroom design to enhance the comfort of the students and to make the agriculture education more applicable to their home-situation.

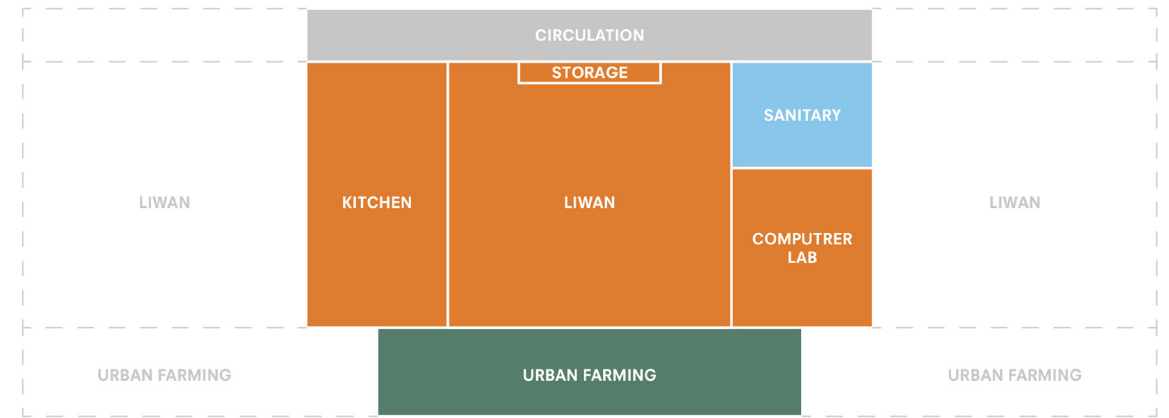


FIG 14: Secondary school classroom layout (Broersen, 2022)

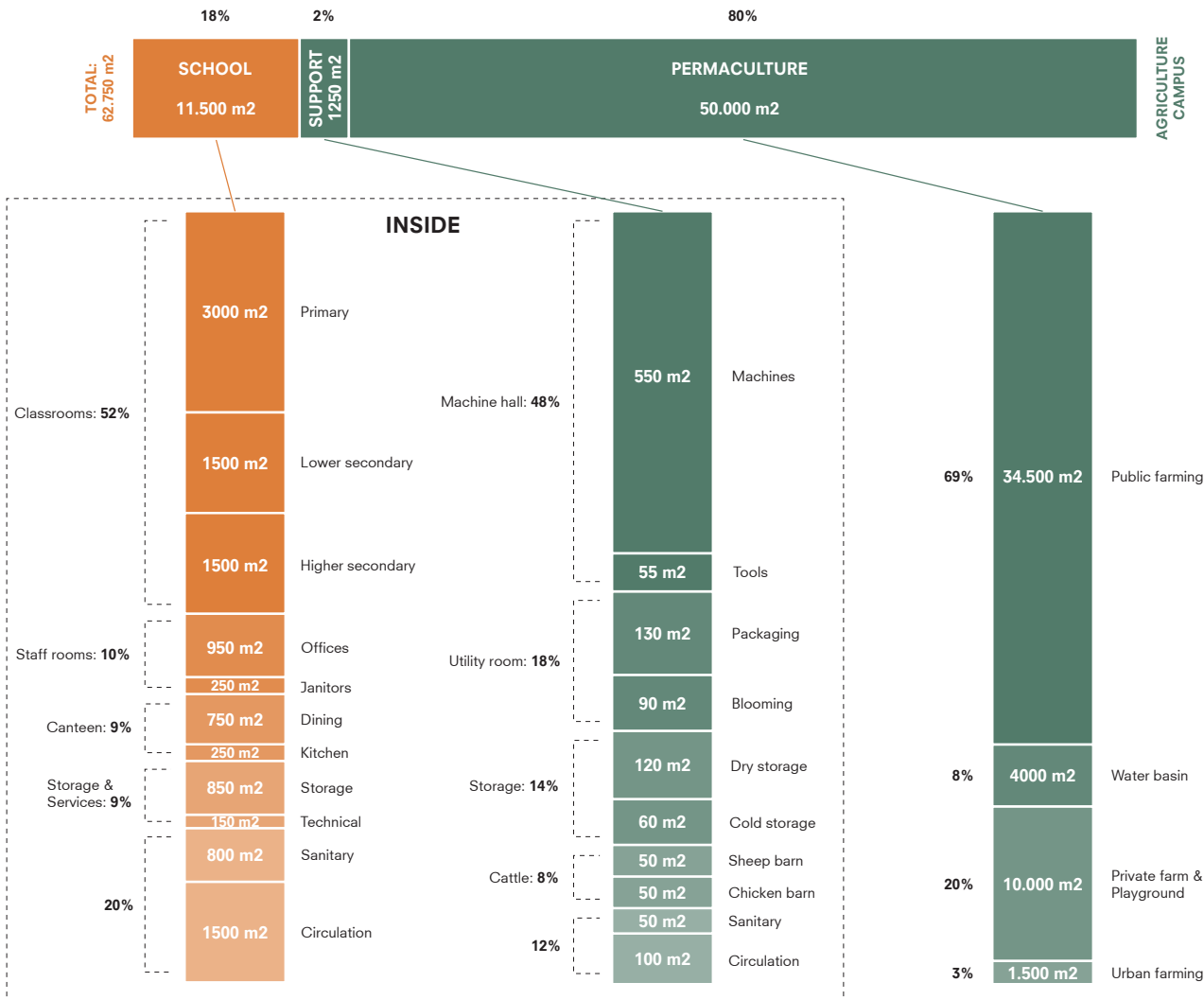


FIG 13: Program bar (Broersen, 2022)

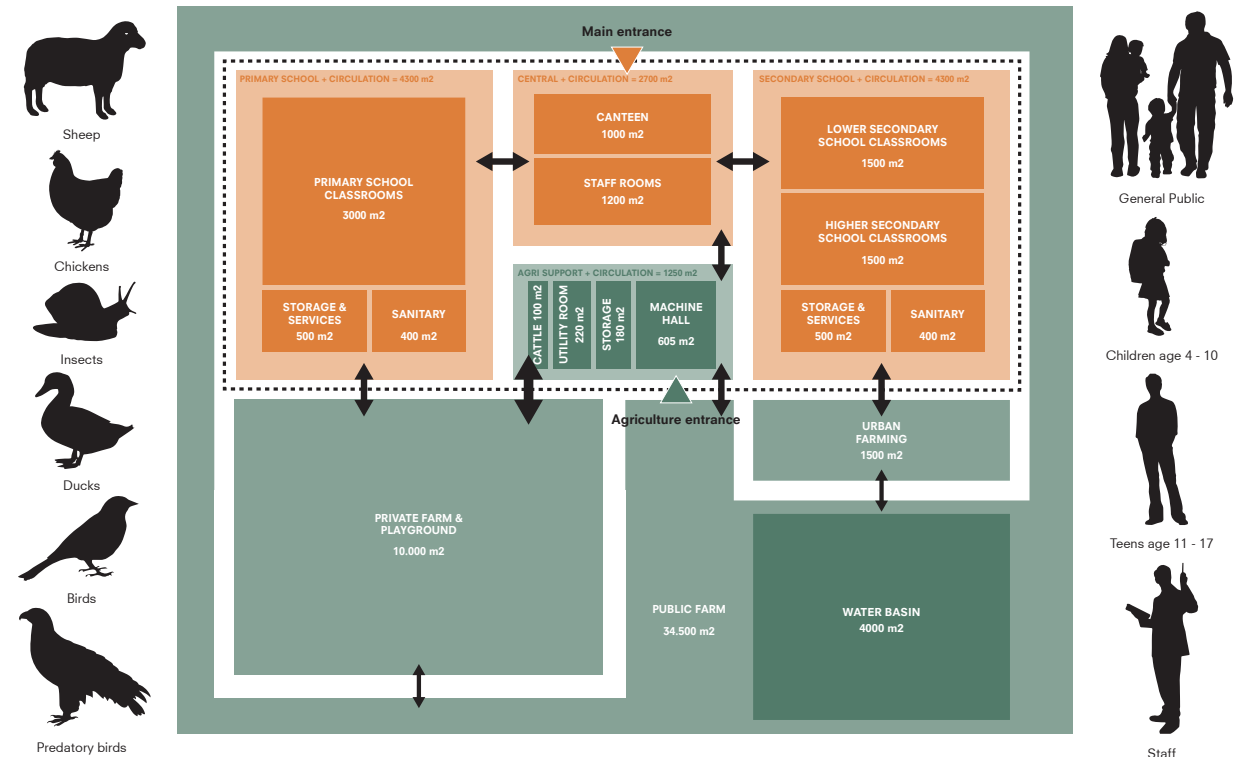


FIG 15: Relationship diagram (Broersen, 2022)



FIG 16: Strip cropping (Wageningen University & Research, 2020)

INTRODUCTION

As a consequence of Beirut's port explosion in 2020, 217 people died and thousands were injured. The blast caused a hyperinflation with a decrease of the value of the LBP by 90%, which had a major impact on the food prices since Lebanon is highly dependent on its food imports, resulting in an increase of the food price by up to 400%. As a result, families from lower income households are forced into poverty and now struggle to obtain sufficient nutrition. They have to resort to extra support of their children, who are often removed from school so they can take part in generating a family income, being one of the causes for the poverty cycle to repeat itself in the future.

As a foreigner, I am looking at Lebanon's dependence on its food imports and ask myself: 'Why don't they grow more of their own food?'. The research shows that Lebanon contains 240.000 acres of arable land, which is the largest amount of arable land in the Arab world. However, a lack of funding and education in agriculture makes the sector resort to old-fashioned and unsustainable practices of farming. Notable examples are the large scale monoculture

farms, which create an environment where crop disease can easily spread. Furthermore, poor water management affects soil erosion, degradation and desertification, wherein 60% of all arable land in Lebanon is at risk. The lack of knowledge within the agriculture sector led me to my research question: 'How can agriculture education facilitate the people of Beirut?'

The Agriculture Campus is proposed to combat the dependence on food prices, school dropout rates and unsustainable farming practices. It teaches biodiversity as a critical factor for establishing sustainable agriculture, as it prevents the spread of crop disease, enhances plant and animal life and as a result improves soil fertility. The project will be located in a newly built neighborhood within the area of Beirut Anchored, bringing the agriculture education to the people, the school focuses on sustainable practices of crop production on small and large scale. Preparing the students to utilize their balconies and rooftops as urban farming spaces in order to enhance self-sustainability.

CONCEPT

Agriculture education and biodiversity will be central in the building's design. Inspiration is taken from Strip cropping (, a study that was conducted by Wageningen University (2020) which focuses on a farm layout that balances efficiency and biodiversity. The layout creates strips of which the width varies between 3, 6 or 9 meters; these have shown to improve plant and insect life. The crop groups within the strips will be rotated seasonally in order to maintain soil fertility. The building mass will align with the strips so the crops can rotate over the building. This creates an interaction between the classrooms and the different crop groups which vary every season.

Furthermore, principles within structuralism were studied by looking at examples from Herman Hertzberger. He uses a single module to build up his project and uses hallways and stairs as study and meeting spaces, rather than solely circulation space. The modules within the project are created by placing three classrooms in a row, aligned with the

strip. The strip of crops remains continuous by raising it on top of the module (FIG 17). These modules will be assembled into varying arrangements, creating various interactive spaces in between them.

URBAN IMPLEMENTATION

The school is located on the green spine within the new neighborhood of Beirut Anchored. The green spine forms a major public axis that connects the densely populated area of Bourj Hammoud to the waterfront. The farmland will be publicly accessible and function as an education park, hosting pavilions as study spaces for the school and public. The water basin will be oriented towards the other side and contain spots for fishing. (FIG 19)

The road to the south of the plot is the main road that connects the Agriculture Campus to the rest of Beirut. Along this road is a Kiss and Ride dropoff spot which will be the main access for most students.

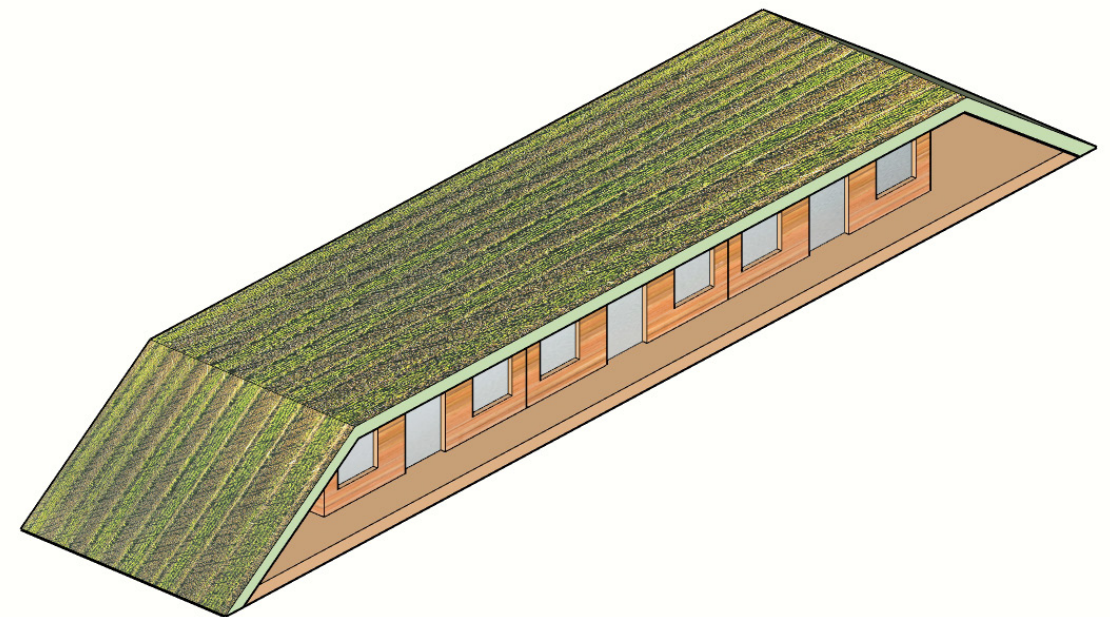


FIG 17: Project module (Broersen, 2022)

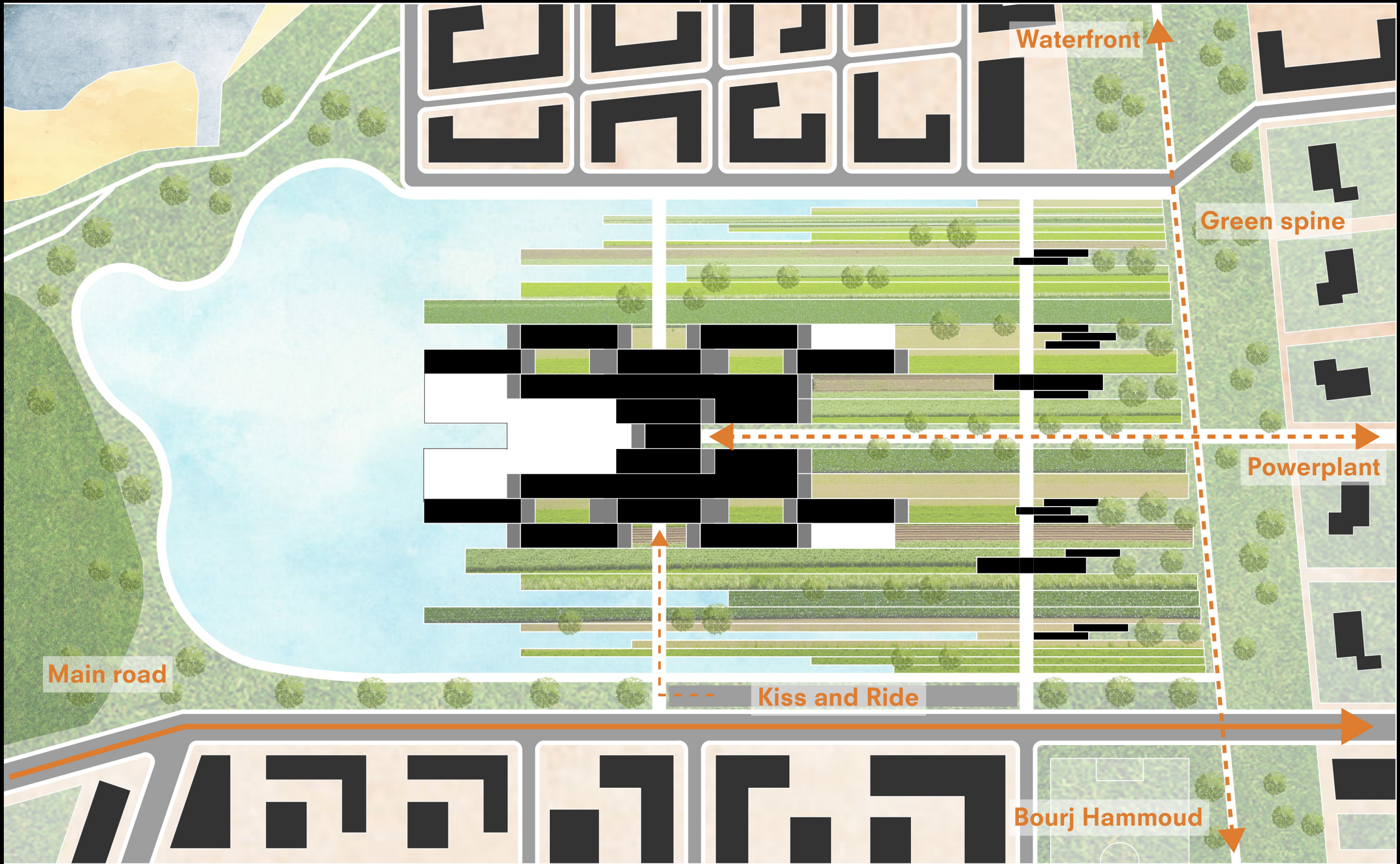


FIG 18: Site plan 1:1000 (Broersen, 2022)

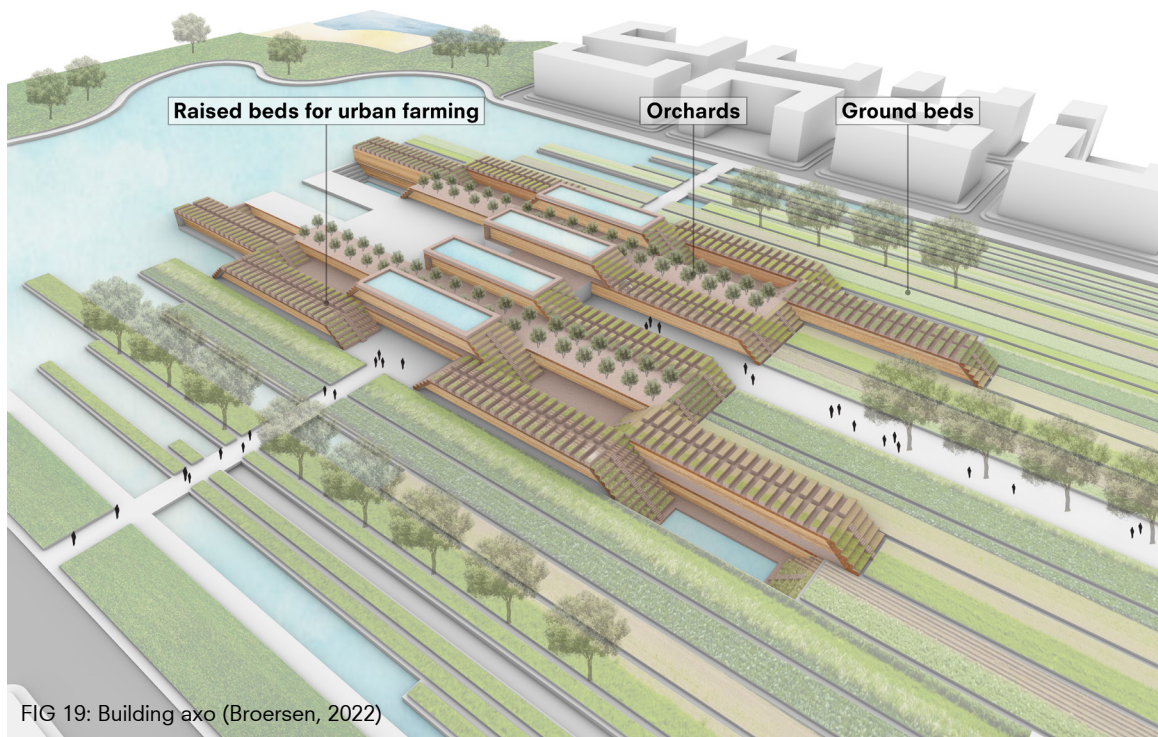


FIG 19: Building axo (Broersen, 2022)

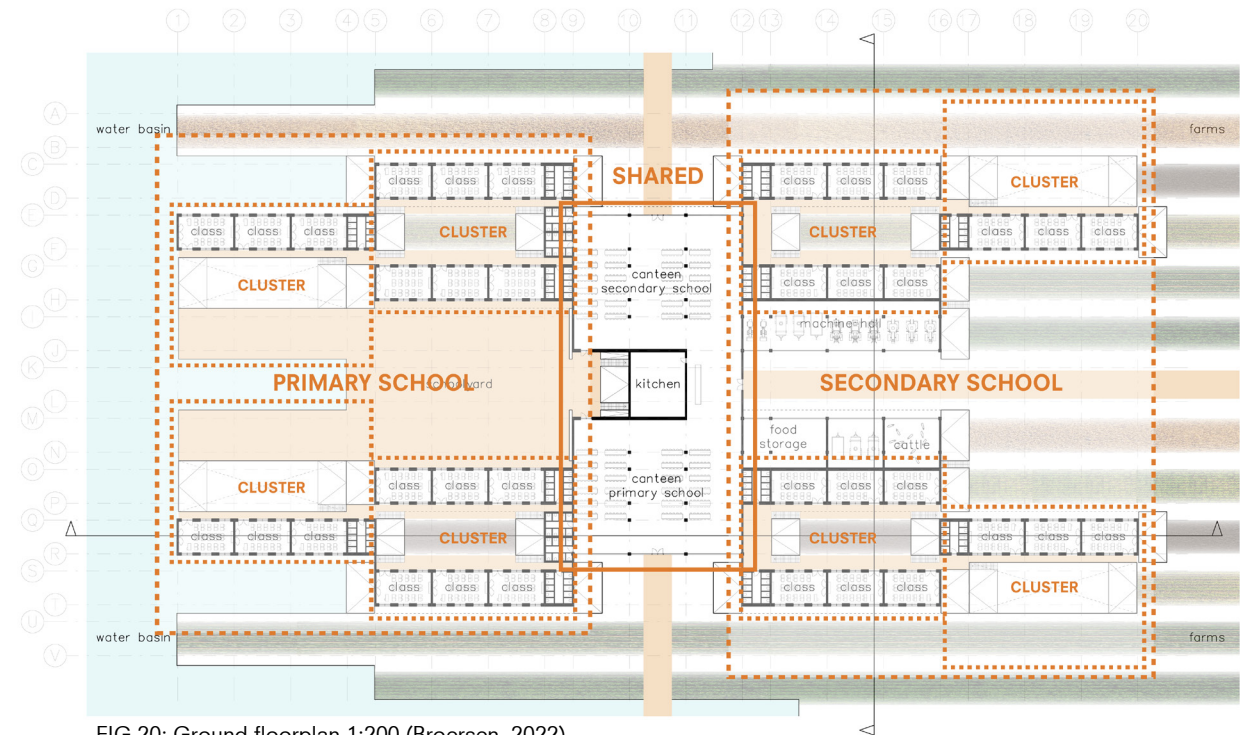


FIG 20: Ground floorplan 1:200 (Broersen, 2022)

DESIGN

The building hosts raised beds for urban farming and orchards on its rooftops while traditional ground beds are located on the public farm (FIG 19). A wing typology is implemented wherein primary school and secondary school are separated into a western and eastern wing with a shared program in the middle. Both wings are subdivided into clusters where 6 to 9 classrooms are connected through a patio (FIG 20). The patios will function as a meeting, teaching or study space for these students, and will be given variety through the creation of their own identity which will be determined in collaboration with the students (FIG 21). A schoolyard and a public tribune are created in between the clusters, and can be utilized as a space for large gatherings and play or as a space for public lectures to educate the wider public about sustainable crop growth.

The young students need to be more protected from the public eye. Therefore the primary school is oriented towards the water

basin. The flow of primary school students passes through a shared program, to the clusters, into the classrooms. Which creates a transition from public to private space. In contrast, students from secondary school become more self-sufficient and independent. Therefore the wing of the secondary school is oriented outwards to the public farm of which they have most interaction with. The access for the secondary school doesn't pass through a shared program but has multiple entrances that lead directly into the clusters.

The contrasts in the open and closed characters between the primary and secondary school are also expressed in the outer facades, wherein the primary school wing has smaller windows, thus expressing its protected character. The secondary school wing has large open windows, connecting the classrooms to the public farms. All facades that face the patios have large window openings, establishing interaction between the patio and the classroom.



FIG 21: Atmospheric collage patio (Broersen, 2022)

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