# Research Plan aE Studio

## Personal Information

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## Studio

**Name of the studio:** Architectural Engineering
**Design tutor:** Anne Snijders
**Research tutor:** Jos de Krieger
**Argumentations of choice of the studio:**
Architectural Engineering Studio has a strong focus on integrating design strategies in which circularity, energy transition, and synergy with ecosystems are crucial. These are crucial for the development and transition of our future world. As a future architect, I am willing to gain a deeper understanding and solid experience in these aspects.
On the other hand, the research method of "flow' provides me with a new insight into understanding the metabolism of our environment. I believe this method could contribute to architectural design more systematically and rationally.

# Graduation Project: Urban Harvest

Experiencing the local bio-loop in cities

Keywords: bio-loop, organic wastes, biobased material, community space

## Problem Statement

### City, food and people

Cities cover only 2% of the world's surface but consume 75% of the world's food and energy resource. (Steel, C. 2013) The relationship between food and cities is essential to our modern lifestyle. The modern food industry provides cities with adequate food products, however, the connection between people and the full cycle of food is weakened. (Steel, C. 2013) The consequences of this disconnection deserve our attention.
As our cities keep developing, and 68% of the world population is projected to live in urban areas by 2050. (UN,2018) it is crucial for us to rethink the connection between cities, people and food.

Health Issue
In our post-industrialized world, the ability to preserve and transport food has made it possible for cities to sprawl far beyond their rural hinterlands. (Steel, C. 2013) Due to the convenience and cheap price products that the modern food industry has supplied us, most of us live in ignorance of the effort it takes to feed us, and what they feed us.
Cities are becoming merely the consuming place of food. Food arrives in our plate as an isolated product, disconnected from its past, therefore it seems inconsequential and open to abuse. This leads to more food waste, for the value of the food culture is less understood and valued by people. (FAO, 2019) Furthermore, the urbanization, industrialization and greater prosperity are shifting people's diet to containing more and more meat products, which is a very environmental costly food to produce. (FAO, 2006)

Waste Issue
Waste is a by-product of life itself. In the global food chain, waste is the missing link: the vital element that makes or breaks the entire cycle. (Steel, C. 2013) As city dwellers are disconnected to the hinterland, they are also less aware of the cost of waste treatment.
Our cities are the biggest consumer of food. However, the huge amount of organic

waste from our cities and countryside, from producing, processing, and consuming food, is traditionally managed through composting, landfill, and incineration. (Arup,2017) Under the perspective of circular economy, the conventional linear – disposal model should seek for a change to a circular value chain where organic waste could become an important resource. (Sharma. P, 2021)
The current construction industry is in the phase of change under the perspective of the circular economy. The development and use of alternative low-impact material and reversible building solutions to improve the quality of construction products is central to the current debate. This reveals an opportunity to untapped the embedded value of organic waste as a new resource for the built environment.

## Definition

*organic waste:*
Vegetal wastes from food preparation and products, including sludges from washing and cleaning, materials unsuitable for consumption and green wastes. They originate from food and beverage production, and from agriculture, horticulture and forestry.

*Bio-loop:*
The bio-loop is a concept proposed by Arup company. It demonstrates a new model for food production and organic waste regeneration which forms a full cycle.

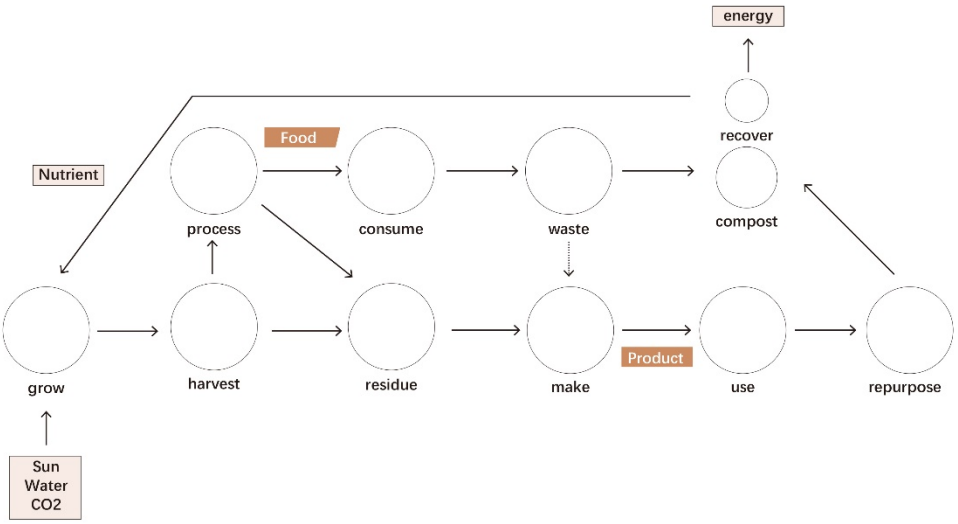



figure 1. illustration of 'bio-loop'

**Objective**

The urban food system is not isolated, it is connected with all aspects of people's daily life and the environment we live in. Therefore, I would like to take the current food system as the agent to question how we dwell in cities, and respond to it by designing an architecture project which propose an urban environment to foster stronger and healthier relationship between people and food.

The project will be based in Amsterdam, the biggest metropolitan region of the Netherlands. It provides an opportunity to explore what can the current food system be improved under the circular economy perspective. Furthermore, I will explore how can the organic food cycle be integral in a neighborhood scale in the future urban context, and how will this benefit people's health and lifestyle, as well as their living environment.

On an architectural level, my design proposes a community space for the Houthaven neighborhood, Amsterdam, with the theme 'experiencing the value of bio loop', in which food is the embedded social and physical mechanism for the community practice. It will develop a project that reacts to the following two aspects:

<u>Technical aspect: Improve the self-sustainability of urban neighborhood by bio-loop of food</u>

The concept of bio-loop indicates that nature can serve as the endless feedstock for our daily life and our built environment. (Arup,2017) By reflecting on the current agricultural system, the great amount of pre-consumer waste, as well as the loss of connection with the hinterland is what we have always overlooked. However, it indicates new potentials to improve this situation.

On the one hand, the use of agricultural organic waste in building construction would possibly allow the exploitation of its untapped value with a positive impact not only from an environmental perspective but also from a technical, social, and economic standpoint. On the other hand, by developing community scale urban farming practice, people can regain their connection with a more accessible 'hinterland'. The local products can benefit the neighborhood by partly gaining its food independence.

<u>Social aspect: Food as the agent of health and locality for community practice</u>

Understanding and valuing the food cycle will offer people a way to reflects on the disconnected, industrialized food culture, and eventually lead to a healthier diet and sustainable lifestyle.

Food is also a powerful medium in our society to connect people with places, as well as people and people. Amsterdam is a metropolitan, a new neighborhood as Houthaven reflects this character of heterogeneous while maintaining its identity from the local context. A community space in such a neighborhood will need to strengthen both characters and seek common value. The design will develop its thematical program, especially participable activities for community practice with

the theme to understand and value food culture. (Zhao, Q. 2020)
All in all, the project aims to propose a healthier lifestyle for the residents as well as a vitality generator for the community life.

**Overall design question**

How to design a mix-use community center as the entrance building of the Houthaven neighborhood, Amsterdam, integrated with the bio-loop of food in program and reflects the urban scale bio-loop through architectural qualities, contribute to the neighborhood on healthier relationship with food as well as sustainable community practice?

***Sub-questions:***

1. How to implement the bio-loop concept in the current Amsterdam region? How can upcycling organic agricultural waste from Amsterdam region provides potential material for Houthaven community center building?
2. How will the bio-loop of food translate into specific architectural program for the Houthaven community center? How to make it feasible and participle for the residence?
3. To what extent can the integration of the bio-loop mechanism reduce the impact of consumption of the Houthaven neighborhood?

My graduation project can be divided into two sections. It investigates and explores the opportunities to improve the bio-loop as well as the connection between food and people on both urban scale and community scale. The two bio-loop both contribute to the final design project on different aspects.

In the research section, I will focus on the current food supply system between the cities and the hinterland. This is what functions now in the food network and will probably, at least partly remain the same in the future. I will explore how the bio-loop concept can contribute to reducing the impact of urban consumption by making use of organic waste for building materials for cities. The research of material and bio-loop concept will be implemented in the design section.
In the design section, I propose a community space for the Houthaven neighborhood with the theme of “bio-loop of food”. It explores a future vision of our relationships with food and cities in the future. Food becomes an integral part of the local organic cycle. This local cycle and the territorial cycle from the above section both contribute to the local identity and healthy environment of the community.

**Thematic Research Question**

How can upcycling organic agricultural waste from Haarlemmermeer provides potential building materials for Amsterdam?

*Hypothesis*

Upcycling organic waste from the agricultural land in Amsterdam metropolitan region can improve the self-sufficiency of building materials in Amsterdam.

***Sub-questions:***

*1. What is the available agricultural organic waste resource in Haarlemmermeer region?*

(Material flow analysis + mapping, identifying and distinguishing the main natural resources available at the city neighborhood area in order to understand what kind of processes are currently in place and the opportunities of implementing new upcycle strategies.)

(Data analysis on the quantitative aspect of these organic waste flow, this offers an background for the following research.)

*2. How to transform the identified waste resource into building materials considering its full life-cycle??*

(Case studies on the application of the identified organic waste as building materials.)

*3. What are the properties of these building materials, and their own bio-loop? (Literature study)*

*4. How does these new bio-loop influence the material flow between Haarlemmermeer and Amsterdam?* (Flow research and design of the proposed new bio-loop, and also integrate them with the current organic waste flow to see the differences.)

**Other research subjects for the design**

*Community:*

community center architecture
social housing architecture
community practice network

*Food production:*

tradition of allotment garden
healthy diet
low-tech urban farming

*Sustainable architecture:*

design for disassemble
energy-neutral

**Methodologies**

Mapping

Mapping is important for the territorial analysis of the potential organic waste flow in the Haarlemmermeer neighborhood. By focusing on the agricultural landscape, the potential organic waste streams can be identified and analyzed.

Literature study

The research will start with understanding and systematically demonstrating the current organic waste stream of Haarlemmermeer region. It is important to have a clear view of the current resources and to seek the potential waste flow in the new system. This part of the study will be based on a literature study of available data and resources.

Case study

The second part of the research focuses on the potential of making use of organic waste as building materials. This part will contain case studies of how to transform the identified organic waste material in to building materials. The case study will focus on the material character of the organic waste, the potential product, its belonged building layers and the technique required for the transformation.

Material flow analysis

The third part of the research is a combination of the previous two parts of the research. By adding the new flow process of transforming organic waste into building materials to the current flow chart, new potential bio-loop will be formed. More quantitative analysis will be done to form an accurate vision of the bio-loop in Haarlemmermeer region. The final flow chart will show how these bio-loops shifts the current linear-disposal model and improve the self-sustainability of Amsterdam.

Research by design

The last part the research will define what material discovered above will be used into the design of Houthaven community center. The property of the material will be taken in to consideration as well as the site condition and specific need of the project.

**Relevance**

My graduation project focuses on exploring the potential of achieving a bio-loop of food between cities and hinterlands. Furthermore, it provides a vision of how can the organic food cycle can be integral in a neighborhood scale in the future urban context.

The application of a circular economy approach to divert part of the organic waste stream – coming from both agriculture and green areas within our cities and from the countryside - towards use in construction, offers an opportunity to reduce the consumption footprint of cities and improve the economy of rural areas. The use of organic waste would result in healthier products with a reduced environmental impact for the construction sector. In particular when considering that these components could be returned to the biosphere at the end of their service life, thus releasing the embedded nutrients to the soil. (Arup,2017)

The design of the architectural project as the community center of the Houthaven neighborhood in Amsterdam functions as a showcase of this bio-loop inside the urban residential neighborhood. It also retains the allotment garden tradition of the local. In the context of a compact urban district, it might be difficult to reach the level of self-sufficiency, however, it is worth trying to reduce the dependency of the linear supply system and creating local organic cycle in the urban environment.

| | Dates | Week | Research Focus | Design Focus |
|---|---|---|---|---|
| **P1** | 20-26 Sept | 4 | Developing concept research plan | |
| | 27 Sept - 3 Oct | 5 | Developing research plan | |
| | 4-10 Oct | 6 | Developing research plan | |
| | 11-17 Oct | 7 | Developing research plan | |
| | 18 - 24 Oct | 8 | Finish research plan, draw flow scheme | Design theme |
| | 25 - 31Oct | 9 | Present research plan for P1 | Design theme |
| | | | | |
| **P2** | 1-7 Nov | 10 | Research: waste flow in Haarlemmermeer | Site analysis |
| | 8-14 Nov | 11 | Research: organic waste material | Community center case study |
| | 15 - 21 Nov | 12 | Arrange findings | Community practice case study |
| | 22 - 28 Nov | 13 | improve flow scheme + Arrange findings | Define program |
| | 29 Nov - 5 Dec | 14 | improve research paper | Define size of the project |
| | 6 - 12 Dec | 15 | improve research paper | Conceptual design |
| | 13 - 19 Dec | 16 | improve research paper | Conceptual design |
| | 20 - 26 Dec | 17 | Hand in research paper draft | Conceptual design |
| | 27 Dec - 9 Jan | | | |
| | 10 - 16 Jan | 18 | finalize research paper | Prepare P2 presentation |
| | 17 - 23 Jan | 19 | finalize research paper | Prepare P2 presentation |
| | 24 - 30 Jan | 20 | | P2 presentation |
| | | | | |
| | 31 Jan - 6 Feb | | | |
| **P3** | 7 - 13 Feb | 21 | design based on research | Finalize concept design |
| | 14 - 20 Feb | 22 | design based on research | Making narratives |
| | 21 - 27 Feb | 23 | | Improve design |
| | 28 Feb - 6 Mar | 24 | | Improve design |
| | 7 - 13 Mar | 25 | | Improve design |
| | 14 - 20 Mar | 26 | meet research tutor *in P3* | Improve design |
| | 21 - 27 Mar | 27 | | Plan drawing |
| | 28 Mar - 3 Apr | 28 | | Prepare P3 Presentation |
| | | | | |
| **P4** | 4 - 10 Apr | 29 | | Improve design |
| | 11 - 17 Apr | 30 | | Detail design |
| | 18 - 24 Apr | 31 | | Detail design, model |
| | 25 Apr - 1 May | 32 | | Detail design |
| | 2 - 8 May | 33 | | Detail design, model making |
| | 9 - 15 May | 34 | meet research tutor *in P4* | Prepare drawings, model |
| | 16 - 22 May | 35 | | Prepare drawings, model |
| | 23 - 29 May | 36 | | Prepare P4 Presentation |
| | | | | |
| **P5** | 30 May - 5 Jun | 37 | | Prepare final presentation |
| | 6 Jun - 12 Jun | 38 | | Prepare final presentation |
| | 13 Jun - 19 Jun | 39 | | P5 |
| | 20 Jun - 26 Jun | 40 | | P5 |
| | 27 Jun - 3 Jul | 41 | | P5 |

**Literature**


Arup. (2017). *The Urban Bio-Loop*. Author. Retrieved from https://www.arup.com/perspectives/publications/research/section/the-urban-bio-loop

FAO. (2006). Livestock's long shadow. https://www.fao.org/3/a0701e/a0701e.pdf

FAO. (2019). FAO: 14% of the world's food is lost between harvest and retail. https://www.globalagriculture.org/whats-new/news/en/33821.html

Gemeente Amsterdam. (2021, January 21). Amsterdam in 2050: een groene, leefbare stad voor iedereen. Retrieved from https://www.amsterdam.nl/bestuur-en-organisatie/college/wethouder/marieke-doorninck/persberichten/amsterdam-2050-groene-leefbare-stad/

Hitti, N. (2021, May 25). Rowan Minkley and Robert Nicoll recycle potato peelings into MDF substitute. Retrieved from https://www.dezeen.com/2018/12/12/rowan-minkley-robert-nicoll-recycle-potato-peelings-mdf-substitute/

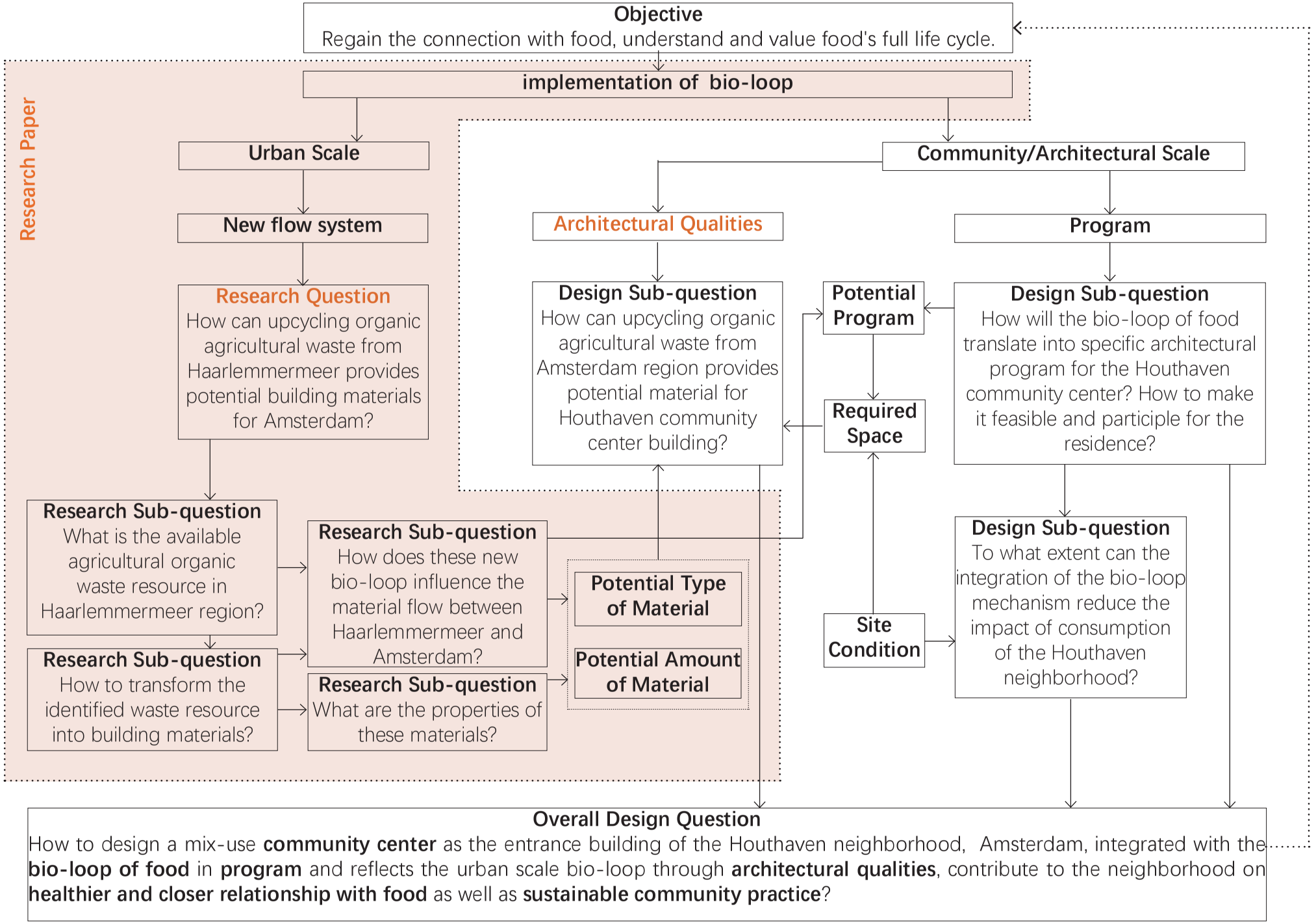
Sharma, P., Gaur, V. K., Sirohi, R., Varjani, S., Hyoun Kim, S., & Wong, J. W. (2021). Sustainable processing of food waste for production of bio-based products for circular bioeconomy. *Bioresource Technology*, *325*, 124684. https://doi.org/10.1016/j.biortech.2021.124684

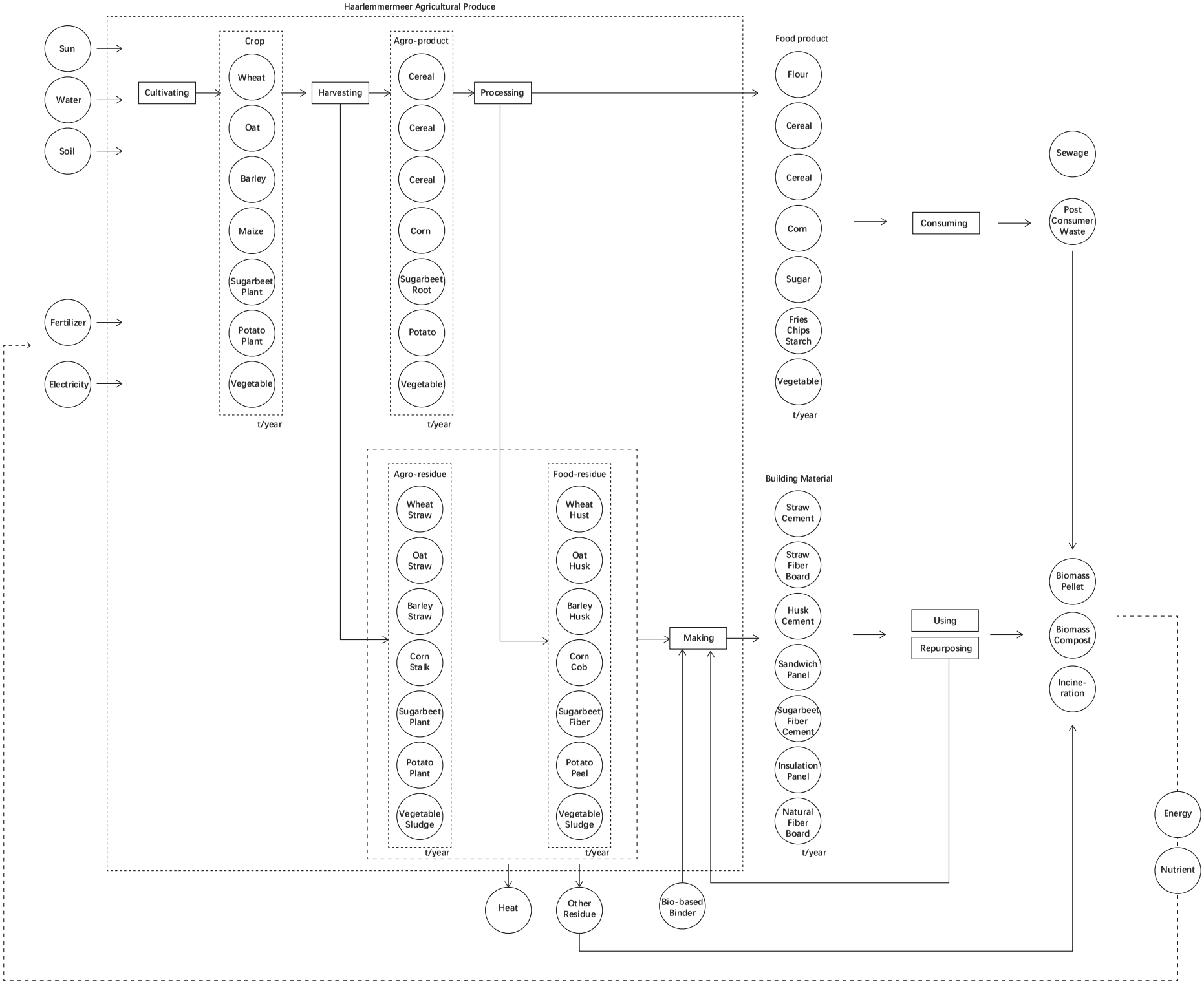
Steel, C. (2013). *Hungry City: How Food Shapes Our Lives* (Reissue ed.). London, The UK: Vintage UK.

U.N. (2018, May 16). 68% of the world population projected to live in urban areas by 2050, says UN | UN DESA | United Nations Department of Economic and Social Affairs. Retrieved from https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html

Viva, L., Ciulli, F., Kolk, A., & Rothenberg, G. (2020). Designing Circular Waste Management Strategies: The Case of Organic Waste in Amsterdam. *Advanced Sustainable Systems*, *4*(9), 2000023. https://doi.org/10.1002/adsu.202000023

Zhao, Q., & Zhou, K. (2020). Research on the community co-production practice: A Case Study of London and Changsha. *Landscape Architecture Frontiers*, *8*(5), 46–59. https://doi.org/10.15302/J-LAF-020037


Objective
Regain the connection with food, understand and value food's full life cycle.
implementation of bio-loop
Research Paper
Urban Scale
New flow system
Research Question
How can upcycling organic agricultural waste from Haarlemmermeer provides potential building materials for Amsterdam?
Research Sub-question
What is the available agricultural organic waste resource in Haarlemmermeer region?
Research Sub-question
How to transform the identified waste resource into building materials?
Research Sub-question
How does these new bio-loop influence the material flow between Haarlemmermeer and Amsterdam?
Research Sub-question
What are the properties of these materials?
Potential Type of Material
Potential Amount of Material
Community/Architectural Scale
Architectural Qualities
Design Sub-question
How can upcycling organic agricultural waste from Amsterdam region provides potential material for Houthaven community center building?
Program
Design Sub-question
How will the bio-loop of food translate into specific architectural program for the Houthaven community center? How to make it feasible and participle for the residence?
Potential Program
Required Space
Site Condition
Design Sub-question
To what extent can the integration of the bio-loop mechanism reduce the impact of consumption of the Houthaven neighborhood?
Overall Design Question
How to design a mix-use community center as the entrance building of the Houthaven neighborhood, Amsterdam, integrated with the bio-loop of food in program and reflects the urban scale bio-loop through architectural qualities, contribute to the neighborhood on healthier and closer relationship with food as well as sustainable community practice?


Haarlemmermeer Agricultural Produce
Sun
Water
Soil
Fertilizer
Electricity
Cultivating
Crop
Wheat
Oat
Barley
Maize
Sugarbeet Plant
Potato Plant
Vegetable
t/year
Harvesting
Agro-product
Cereal
Cereal
Cereal
Corn
Sugarbeet Root
Potato
Vegetable
t/year
Processing
Food product
Flour
Cereal
Cereal
Corn
Sugar
Fries Chips Starch
Vegetable
t/year
Consuming
Sewage
Post Consumer Waste
Agro-residue
Wheat Straw
Oat Straw
Barley Straw
Corn Stalk
Sugarbeet Plant
Potato Plant
Vegetable Sludge
t/year
Food-residue
Wheat Hust
Oat Husk
Barley Husk
Corn Cob
Sugarbeet Fiber
Potato Peel
Vegetable Sludge
t/year
Making
Building Material
Straw Cement
Straw Fiber Board
Husk Cement
Sandwich Panel
Sugarbeet Fiber Cement
Insulation Panel
Natural Fiber Board
t/year
Using
Repurposing
Biomass Pellet
Biomass Compost
Incine-ration
Heat
Other Residue
Bio-based Binder
Energy
Nutrient