Alternative Food Networks and Green Infrastructures: Towards a community-based system for urban greenhouse growers in the Netherlands

Paper first received: 27 December 2024; Accepted: 06 January 2026; Published in final form: 08 April 2026
https://doi.org/10.48416/ijsaf.v31i1.694

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Abstract

Urbanisation, growing population pressure, and extreme weather conditions all contribute to food insecurity. In greenhouse farming, vegetables are harvested in a controlled environment, resulting in high-quality production with minimum resources. Such green infrastructures have also become promising in urban areas and non-arable lands. In this paper, I focus on community-based greenhouses in the Netherlands, which are primarily managed by volunteers and local residents, and on their varied conceptualisations of food production and innovation. I argue that these Alternative Food Networks are not homogeneous, and that their polymorphism reflects an intrinsic diversity in both organisational cultures and materiality. Despite this diversity, these green infrastructures converge in their emphasis on producing high-quality food and prioritising the management of nature and biodiversity, rather than any reliance on mechanical manipulation. My research involves conducting primary research studies, based on a mixed-method approach combining the use of surveys, semi-structured interviews, observational studies, and site visits around the Netherlands. I posit that community-based greenhouses constitute a hands-on agricultural practice that relies heavily on trust and on fluidity between consumers and producers. This fluidity is enacted through the interconnected roles and knowledge circulation within the greenhouse ecosystem. Understanding technology in use, experiential expertise – which often contains tacit components –, and a knowledge base that is critical to the effective operation of the greenhouse as a system, are integral to this innovative approach to agriculture. The paper examines the role of smart technologies and the emergence of visions in facilitating this ecosystem, while highlighting the vital interplay between growers and consumers in reimagining food production and sustainability.

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Biographical note

Meilin Lyu holds the European Inter-University Master in Society, Science and Technology, she has completed her PhD at the Department of Archaeology, researching on the topic of monitoring climate change effects and Greek archaeological site conservation.

Acknowledgements

I would like to express my sincere gratitude to Professor Stathis Arapostathis for his valuable guidance, and to all the reviewers for their constructive feedback and efforts in improving this paper.

Introduction

The Netherlands has a leading position in greenhouse construction. The country's horticultural industry is also an important economic sector for international export. As lifestyle routines and cognitive perceptions about food production have evolved over the years, consumers' preference for local and organic vegetables has increased. People's emotional connections with nature have also prompted them to engage in urban agriculture in metropolitan areas. Restorative greening activities have furthermore been strongly connected to enhanced mental and physical wellbeing, especially for socially and economically disadvantaged groups, such as stay-at-home elderly people, patients in hospitals and children in schools (Berkers and Geels, 2011; Artmann and Sartison, 2018).

Greenhouse installation can be seen as the outcome of interactions between nature, technology and society. However, in the context of the agro-industrial model, greenhouse agriculture is based on ideas of economies of scale in food production (Seyfang and Smith, 2007), with potential negative implications for the environment and social justice (Magis, 2010). Grassroots initiatives, acknowledging the limitations of consumer action, can emerge as powerful agents for radical socio-technical change and serve as a major gateway to engage in and enact food politics.

In this paper, I have undertaken an extensive primary research effort to explore the emergence of visions surrounding community-based greenhouses within the contexts of agro-ecological movements. These greenhouses, predominantly managed by volunteers and local residents in the Netherlands, challenge conventional notions of agricultural innovation. They represent a departure from commercial agricultural practices by prioritising ecological stewardship and biodiversity over industrialised processes. My research delves into the material entanglements and innovative solutions that these greenhouses have developed, highlighting their unique approach to technology appropriation. These innovative approaches represent a conceptual shift in agricultural practice, one that emphasises a hands-on, human-centric approach to food production. By examining how discourses and visions about sustainable food are intertwined with these greenhouses, I aim to gain a comprehensive understanding of their significance and impacts. Additionally, this interconnectedness among social actors, growers, and consumers forms the foundation for these greenhouses, altering the conventional understanding of how technology is used, experiential expertise is developed, and knowledge is circulated within this agro-ecological movement.

Essentially, this study highlights, on a case-by-case basis, the heterogeneity among four different alternative food networks, evident in their pluralistic approach to management cultures and material practices. The first family business (Onze), which leases allotments to individuals, prioritises chemical-free cultivation, and focuses on supplying local outlets, demonstrates a community-centred food system. In contrast, the second greenhouse (OudeBeer) exemplifies biodiversity through multi-layered plantations, fostering both ecological harvest and social cohesion by organising activities that engage volunteers. The third greenhouse, BoereGoed, a social enterprise run by disabled and unemployed volunteers, emphasises efficiency, having the highest crop output among our cases with minimal pesticide use, while leveraging its operations—such as cooling and packing facilities—as revenue streams. The final case, Oosterwold, represents a decentralised, experimental approach where individual households grow crops and contribute to local food networks by integrating natural cycles like rainwater recycling and soil regeneration.

The varying management styles challenge the notion that alternative food networks are homogenous, revealing instead a diverse spectrum of organisational motivations: some prioritise financial viability, while others seek to innovate and experiment with sustainable cultivation methods or create social experiments demonstrating urban-agricultural synergy. Despite these differences, they share a common objective: to revitalise barren land or outdated greenhouse facilities into vibrant ecosystems teeming with life, that contribute to social well-being, food quality, and environmental sustainability. Collectively, these case studies illustrate how alternative

food networks embody a pluralistic vision, not only in organisational structure but also in their material engagement with the environment. The broader goal seems to be to create a holistic environment that benefits both people and the planet.

Analytical Framework

Community-based initiatives (CBIs) have political meanings: they are a form of civic engagement where individuals rely on community self-strength to deal with societal problems. CBIs aim for autonomy and ownership, developing their business models to achieve financial stability without a focus on profit-making (Igalla et al., 2019, pp. 1182–1183). The paper focuses on the concept of 'community-based greenhouses initiatives' (CBGIs), expansive areas enclosed by glass panels, provided by local authorities and managed by dedicated groups of volunteers. These greenhouses are designed to be accessible to the public and frequently engage in commercial activities, such as direct sales to end consumers or participation in regional retail markets.

The analytical framework used in this paper is based on the Transformative Innovation Framework outlined by Schot and Steinmueller (2018), which provides a comprehensive understanding of transitions towards sustainability. The framework addresses three different framings of socio-technical system change, which each also touch on the roles of the policy makers and social actors involved. These framings do not replace one another over time but instead coexist and compete with one another. The Third Framing, in particular, plays a crucial role in our study as it highlights the need for transformative change to address social and environmental challenges like sustainable consumption, equality, and climate change. This framing suggests an inclusive and open process that involves marginalised social actors, which is an area that Schot and Steinmueller (2018) argue is still underdeveloped. The Transformative Innovation Framework, in contrast to continuing mass industrial production and high-end technologies, changes the directionality by focusing on alternative pathways and transitioning of all three aspects of change: social, behavioural, and technological. The framework also advocates for system policy transformation through learning, reflexivity, and societal experimentation (Schot and Steinmueller, 2018, pp.1562-1563).

For transformative change to occur, governance policies should be open to embracing diversity and coordinating horizontally between local, regional and national levels. Specifically, grassroots innovation and the role of civic movements and local communities in food systems are a major field of societal experimentation that concerns public support for alternative innovations and the selection of certain innovations in the regime. Community-based greenhouses, such as those explored in this paper, can be seen as collective efforts for self-governance towards transformative change in the agro-food landscape, as Alternative Agro-food Networks (AAFNs), in the Netherlands.

As suggested by its terms, AAFNs are alternatives to the conventional industrialised agro-food system which is held accountable for people's de-skilling and alienation from food (Psarikidou and Szerszynski, 2012). The concept of AAFNs challenges the homogenous, techno-centric agricultural approach that is driven primarily by productivity and economic growth, and seeks to reconnect to declining traditional farming practices. Growers' hands-on, task-based experiences have created a personal relationship with nature, sharing expertise and fostering discussions with one another, instead of conforming to the formalised system of knowledge embedded in techno-centric pathways such as standardised agronomic manuals, data-driven optimisation models, and prescriptive expert-led techniques. It can be said that AAFNs 'revitalise' both traditional and new knowledge about farming that are incorporated in growers' everyday tacit skills, such as soil tiling, crop diversity and plant spacing methods. AAFNs moreover 'relocate' knowledge systems about food, transcending specific localities and connecting people, expertise, and communities across spatial distances, creating new social spaces of communication. This includes embedded economic exchanges among producers, wholesalers, retailers, and consumers, as well as short food supply chains (SFSCs) such as direct sales and face-to-face

transactions. In essence, AAFNs deskill people from mainstream agro-food habits, reskilling them in a new agricultural food system that reestablishes forgotten farming knowledge, forming an alternative network with communities, experts, retailers, and consumers (Renting, Marsden and Banks, 2003; Allen et al., 2003; Psarikidou, 2021).

This paper focuses on a comparative analysis of region-specific AFNs in the Netherlands. By contrasting individual cases, it reveals the comparative advantages, power dynamics, and value orientations embedded in local food systems. These in turn reflect the Netherlands' broader regional food identities: culturally, economically, and ecologically. Beyond the AAFN concept, this paper also engages with 'community-based' agriculture, which emphasises relational proximity and food system localisation. By focusing on localised regimes, the paper addresses the spatial heterogeneity in agricultural development between urban and rural zones. This heterogeneity is shaped by a "selective and voluntary regional closure" that reconnects production and consumption around particular places (Allen et al., 2003, p. 63). The resulting place-specific food types are rooted in distinct local contexts (Harvey, 1977). In doing so, local food initiatives become simultaneously both counter to and alternative to institutional agri-food practices, thus contributing to the broader concept of AFNs.

Finally, the paper introduces a technical and under-explored dimension of AAFNs in the Netherlands: greenhouse agriculture. While much AAFN research has emphasised the 'sociology of food markets' (cf. Cassol and Deggerone, 2024; Psarikidou et al., 2024; Hinrichs, 2000) only a few studies have examined the technological infrastructures underpinning agro-food networks (cf. Pimbert, 2018; Oosterveer and Spaargaren, 2012). Greenhouses represent a vital technological component of modern food production and offer a valuable lens for understanding the intersection of localisation, innovation, and sustainability in contemporary agro-food systems. For example, Lamalice et al. (2018), focusing on Arctic regions, assessed greenhouse agriculture through an agronomic lens by analysing factors such as soil pH, vegetable nutrient content, and greenhouse gas emissions. In these remote areas, greenhouses are used primarily to enhance food security and reduce environmental impact by optimising fossil fuel usage. They also serve to support mental well-being and reinforce cultural identity by enabling local food production. Similarly, Gailloux et al. (2023) offered a comprehensive study of greenhouse systems in Quebec, Canada, designed to improve food security in harsh climates. Beyond their agricultural function, these greenhouses also operate as community hubs for agro-education, social inclusion, and support for vulnerable groups, including low-income and homeless individuals.

However, community-based greenhouses (CBGs) in the Netherlands emerge from a markedly different socio-environmental context. Unlike Arctic greenhouses, which are designed to meet survival needs in extreme climates, Dutch CBGs do not arise from climatic necessity. Instead, many are repurposed from outdated infrastructure left behind by the industrial greenhouse sector. Operating at a low-tech scale and mindful of their inherent emissions footprint, these initiatives reflect a conscious shift towards sustainability within localised food systems. This paper examines the technological continuities and ruptures between CBGs and the dominant industrial greenhouse regime, with the aim of analysing how material infrastructures are reappropriated. It further explores how these repurposed systems have given rise to niche innovation spaces where emerging smart technologies are adapted and integrated in context-specific, community-driven ways. To relate to the socio-historical context of the greenhouse agricultural industry in the Netherlands, it is useful to consider the First Framing, which emphasises economic growth and industrial mass production. In line with this framing—where policymakers support mission-led research aimed at short-term, achievable outcomes (Schot and Steinmueller, 2018, p.1556) –, early greenhouse farming in the Netherlands was labour-intensive and relied on open-air horticulture and natural conditions. This period saw a rapid expansion of vegetable horticulture, making Dutch horticulture highly competitive in the European market due to its productivity (Berkers and Geels, 2011). Between 1945 and 1960, in the post-WWII context, the Second Framing emphasised a mercantilist economy and nationally oriented systems of innovation, further intensified by globalisation and increasing international entrepreneurial competition arising from foreign demand for

horticultural products. In this period, the Dutch government relaxed growing permits and made financial resources available to support expansion. Dutch farmers invested heavily in greenhouse technology to make efficient use of space, with the growth of vegetable horticulture expanding most rapidly during this period (Buurma, 2001).

It is important to understand the dialectic relationship between transformative change and Framings 1 and 2, where Framing 1 prioritises R&D-driven economic growth and Framing 2 strengthens national innovation systems and incumbent industrial actors. Incumbent food regime actors can exert their power to resist transitions towards grassroots innovations (Schot and Steinmueller, 2018), as is the case with community-based greenhouse initiatives, in order to protect their interests. From my primary research studies, I have learned that these community-based greenhouse initiatives aspire to scale up their operations to meet the growing demand for sustainable, locally-sourced food. However, they often necessitate governance support to facilitate their growth. The question that remains for exploration in this paper is: how can grassroots innovation not only be predominantly "fit and conform" to the industrial system but also be involved in "deeper transitions" in terms of "stretch and transform" to avoid niche stasis (Köhler et al., 2019, pp. 10-11). Consequently, as this paper shows, community-based food initiatives as grassroots innovation in the Netherlands have gradually opened up the niche-regime interface with industrial actors and the local government regarding social responsibility and sustainability.

Methodology

Case Study Research

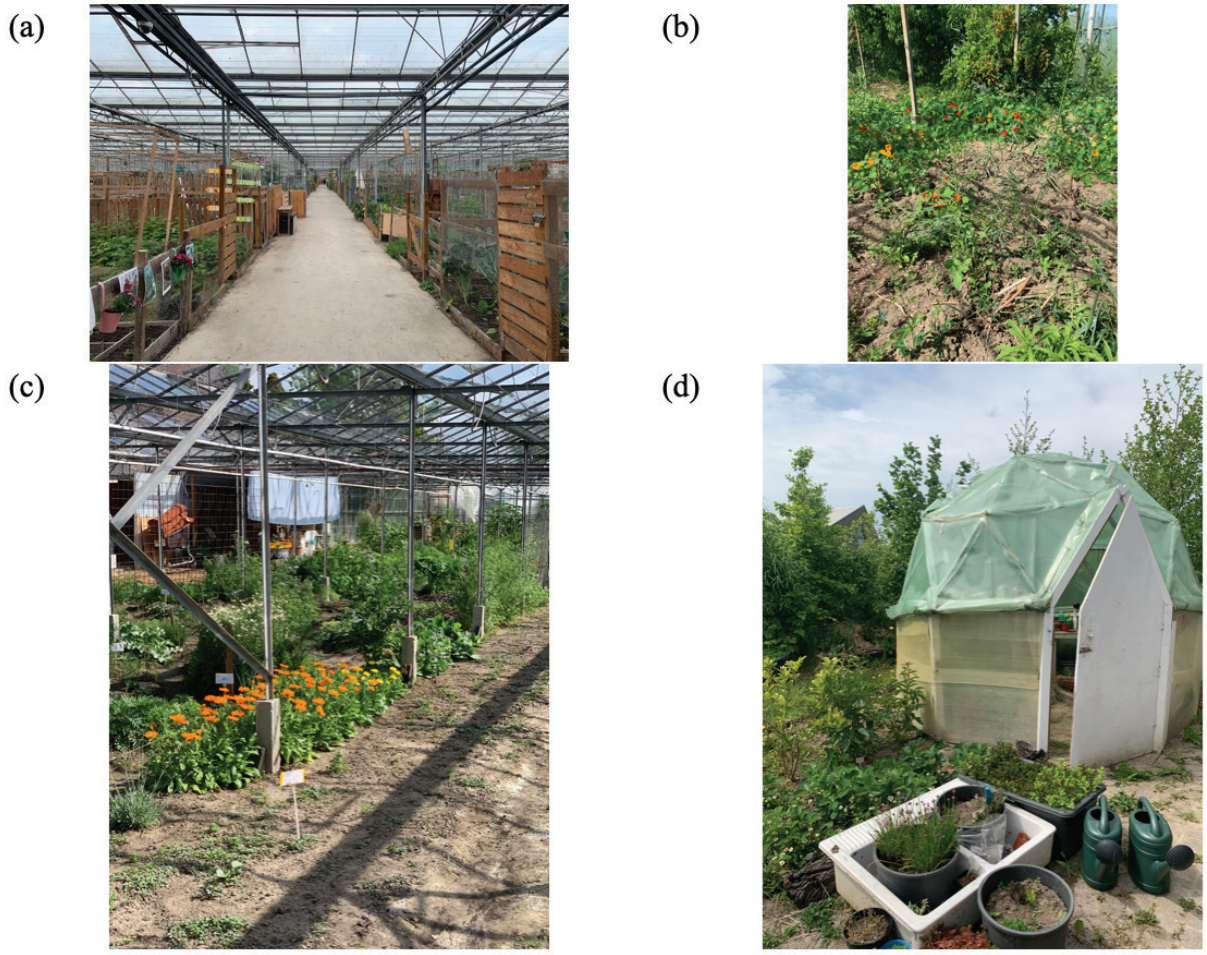

Illustration: (a) Onze (b) OudeBeer (c) BoereGoed (d) Oosterwold (photos taken by the author)

The case study research focused on four different community-based greenhouse initiatives: Onze Allotment in Almere, OudeBeer Social Organisation in Dordrecht, BoereGoed Social Organisation in Naaldwijk, and Oosterwold Food Cooperative in Almere. These organisations were identified through an internet search using selective criteria, including their geographical location, operational stability, attractiveness, and scale. The dates and time of the site visits were later confirmed via telephone and emails. The availability of the organisations was checked to confirm if the researcher could access the groups of volunteers and decision makers for interviews and surveys. The in-person site research took place in May 2022 in the Netherlands, and consisted of: semi-structured interviews with organisers, growers and volunteers; site visits of three to six hours for each of the four different organisations, including their packing sites, market stalls and the local neighbourhoods; and two forms of self-completed surveys, one with the organisations and the other with the customers. The surveys (in both paper and digital forms) were delivered to three organisations on the same day during the site visits, and in total 30 organisation surveys and 8 customer surveys were returned.

Onze operates as a family-run business that leases individual greenhouse allotments to interested growers for personal food production. In addition to leasing, Onze cultivates crops for sale at its on-site food shop and to external retail outlets. OudeBeer, located just outside the city of Dordrecht near a highway and several warehouses, is a volunteer-run initiative. It emphasises ecological relations between organisms, and its greenhouse facility is shared with a commercial grower. BoereGoed functions as a social enterprise, also largely managed by volunteers, and provides work opportunities for individuals facing employment barriers or living with disabilities. Lastly, in the Almere Oosterwold region—spanning 43 square kilometres—there are currently around 1,500 resident households, with projections of 15,000 households within the next decade. The chairman of the *Coöperatie Stadslandbouw Oosterwold* (Oosterwold Urban Agriculture Cooperative) has described it as the largest urban farming project in the world. Oosterwold's development model mandates that 59% of the area be allocated to urban agriculture, while residents have autonomy in designing their housing, water systems, waste treatment, and energy supply.

During my visits, all the organisers provided general background information about their greenhouse operations. Observational notes were taken to contextualise the interviews and survey responses. A total of 21 short semi-structured interviews were conducted using open-ended questions that explored topics related to social identities and motivations, greenhouse technologies and sustainability, institutional challenges and opportunities, and social networks. The interviews were carried out using opportunistic sampling during short breaks, typically lasting 8 to 10 minutes each for volunteers and growers. While each interview was brief, the number of interviews conducted was relatively high, allowing for a broader range of perspectives. All participants were informed in detail about the purpose of the study and were assured that their participation was voluntary and that their names would be kept confidential and used solely for academic research.

The organisation survey was furthermore used to examine the competencies, motivations, and perspectives of employees and volunteers in three of the four community-based greenhouses. As one of the cases studied (Oosterwold) had individually-owned greenhouses in a community and therefore did not match the survey design questions, it was considered more effective to conduct a higher number of interviews rather than surveys. The survey originally contained 26 questions, multiple choice except for one open-ended question. One survey question was not analysed in this study since several participants preferred not to specify their countries of origin. Moreover, the consumer survey examined the customers' perceptions of the food quality of community-based greenhouses and the consumption patterns in two of the four case studies, since these two greenhouses had their market stalls with frequent visitors outside of the organisations. Because customers usually have very little time or interest in filling out a questionnaire, the survey comprised 15 questions. All surveys were handed directly to the participants and received back from them, and analysis was performed using Google Forms and Numbers (MacBook software).

Aspect	Onze	OudeBeer	BoereGoed	Oosterwold
Location	Almere	Near Dordrecht, by roads & railway	Naaldwijk	Oosterwold, Almere
Year Founded	2012	2013-14	2017	2020-21
Greenhouse Type	Commercial greenhouse	30-40-year-old commercial greenhouse	30-40-year-old commercial greenhouse	Self-built/purchased/ second-hand materials
Size	Unspecified	4000 m2	7500 m2	43 km2
Main Objective	Promote intercultural integration & self-production	Recreation, healing, autonomy	Social employment, integration & care	Self-sufficient urban agriculture community
Core Values	Diversity, social interaction, learning	Autonomy, ideological freedom, enjoyment	Social inclusion, empowerment	Independence, sustainability, self-management
Organisational Structure	Family-run business, leasing allotments	Volunteer-based, low hierarchy	Social enterprise, volunteer-led	Decentralised, resident-driven
Business Activities	On-site food store, external outlets	On-site food store, external outlets, web-shop	On-site food store, external outlets, web-shop, regional stores	External outlets
Functioning / Activities	Individual allotments, education, workshops, community support	Recreational gardening, experimental projects	Social rehabilitation, packaging, sales	Collective and individual farming, autonomous housing
Types of Produce	Exotic crops, Surinamese varieties	Yacon, chilli peppers, niche varieties	'Forgotten vegetables', niche & health-promoting	Diverse, individually chosen crops
Technological Approach	Low-tech, organic solutions, individual choice	Low-tech, nature-driven, no interventions	Minimal chemical use, organic & chemical pest control as needed	Low-tech, recycled materials, circular practices
Customer / Participants	Multi-ethnic community members, immigrants	Volunteers, people with disabilities, general public	Vulnerable populations, volunteers, social-minded consumers	Diverse residents seeking autonomy, sustainable living
Inclusivity Emphasis	Highest ethnic diversity, cross-cultural engagement	Autonomy, self-development, enjoyment	High, social rehabilitation & job access	High, community-based decision-making, self-reliance
Sustainability Focus	Organic composting, energy-efficient methods	Circular ecological management, minimal interventions	Moderate (some use of chemicals), energy-efficient logistics	Strong: circular solutions, recycling, low energy

Semi-Structured Interviews with Commercial Greenhouse Stakeholders

The interviews were conducted between March and May 2022. Participants were selected from greenhouse companies – both large businesses and SMEs – and innovative start-ups, and also included individual experts and technicians, academics, and government policy makers, all of whom were contacted through by email or from their website. Their expertise and knowledge were based on strong theoretical and empirical foundations. Due to spatial restrictions, some respondents shared their views via written emails. The majority of the semi-structured interviews, however, were conducted through video calls and in-person meetings, each lasting 30 to 45 minutes, transcribed using Otter.ai and later reviewed in full. In total, 18 semi-structured interviews were conducted successfully, with an additional eight short written email responses. All of the interviewees

were briefed in detail on the purpose of the study, with an electronic letter of invitation to participate. As some of the interviewees were uncomfortable with audio-recording, those conservations were documented with note-taking.

Four Dimensions of methodological tool for Community-Based Greenhouses Initiatives (CBGIs)

From my literature review and scope research with the social actors, I developed an analytical method comprising four key assessment criteria, including Motivations, Inclusivity, Sustainability, and Scalability, in order to evaluate my empirical data at a later stage.

The Motivation criterion studies social actors' reasons to engage in community-based greenhouse initiatives (CBGIs). Inclusivity, as a criterion, revolves around the active involvement of citizens as co-creators in the development of community-based greenhouses. Here I evaluate the degree of inclusive participation, self-governance, and ownership of public space (Artmann and Sartison, 2018; Edelenbos et al., 2020). The Sustainability criterion primarily analyses the intersection between environmental and techno-economic sustainability. I examine how CBGIs strike a balance between economic viability, environmental soundness and social justice in the long term (Spaargaren et al., 2012). Lastly, Scalability, as a criterion, assesses the potential of CBGIs to scale up their impact and access higher levels of decision-making. I also analyse the empirical evidence regarding the upscaling of small-scale initiatives to understand the feasibility and challenges of expansion (Seyfang and Smith, 2007).

Navigating Agro-food Landscapes in the Netherlands

The Dutch Commercial Greenhouse Industry

In the ever-evolving Dutch greenhouse industry, greenhouse farming is concentrated in 'Greenports' such as Westland, Oostland, and Venlo, which are knowledge-intensive agribusinesses with a strong global presence. These Greenports consist of small family-owned companies, covering an area of approximately 4,000 hectares and involving around 3,000 vegetable producers. Their proximity to the port of Rotterdam and neighbouring countries like Belgium and Germany facilitates easy access to international markets. Dutch vegetable horticulture had a total export value of around 8.7 billion euros in 2023 (Statistics Netherlands, 2024), with potatoes, tomatoes, cucumbers, and peppers accounting for 90% of vegetable production, making the Netherlands the largest food exporter to Europe (Kasmire et al., 2013; Pannekoek et al., 2005). Significant strides have been made since the turn of the millennium, bolstered by a strategic long-term agreement with the government known as *GlaMi* (Greenhouse Horticulture and the Environment Agreement). This agreement set forth ambitious targets, aiming to curb carbon emissions, promote sustainable energy utilisation, and drastically reduce the use of pesticides and nutrient inputs. Consequently, the industry's energy efficiency led to the generation of surplus energy, contributing to the national consumption (Gerritsen et al., 2014, p. 11). To foster further growth, the government actively supported energy-efficient greenhouse technologies through subsidies and collaborations with commercial entities, which paved the way for the emergence of new greenhouse clusters. Exploring alternative energy sources, such as renewable electricity, solar heat storage, and geothermal energy, has become a priority in the bid to reduce reliance on natural gas. Furthermore, a series of food quality and safety standards have been prominent (Breukers et al., 2008, pp. 7–8), although more than half of the Dutch greenhouse produce does not contain pesticide residues (p. 28). Organic greenhouse produce is still at a small scale in the Netherlands, mainly consisting of tomatoes, peppers and cucumbers.

Despite these efforts, the greenhouse industry grapples with significant challenges, especially since the dissolution of *Productschap Tuinbouw* (producer authority), which once served as a central governing body (Gerritsen et al., 2014, p. 16). The absence of a unified authority has hampered efficient knowledge exchange and research collaboration among growers, and therefore innovation diffusion. While larger players can afford private research initiatives, smaller enterprises focus primarily on cost-cutting measures and meeting operational license requirements (Gerritsen et al., 2014 p.17). Moreover, the industry's attention is drawn

to critical issues such as water management, where solutions are being sought to achieve zero emissions of minerals (nitrogen and potassium) into the water systems by 2027 (Gerritsen et al., 2014 p.11). As the global economic and energy crises persist, concerns are mounting over the management of outdated greenhouses which occupy valuable space and impede the development of more sustainable alternatives. The removal of greenhouses could create space for other essential developments, and presents potential possibilities for exploring ways to integrate greenhouses into the surrounding environment for recreational and healthcare purposes (Breukers et al., 2008). Against this backdrop, the emergence of community-based greenhouses provides an interesting approach that addresses some of these weaknesses and offers promising solutions to pressing challenges in the sector.

Alternative Agro-food Networks (AAFNs) in the Netherlands

In the post-industrial era, Veen and Dagevos (2020) proposed a shift from 'consumption' to 'prosumption', a concept originally coined by Toffler (1980), seamlessly blending the once distinct realms of production and consumption (p. 2). While both terms involve a self-managing approach, they present a striking contrast: one involves buying food, the other empowers consumers to create consumption opportunities for their peers (p. 4).

While alterity remains a central analytical entry point, recent sociological review work (Michel-Villarreal et al., 2025) has demonstrated that AFNs cannot be understood solely through their oppositional stance or their counter-hegemonic positioning against the standardised, productivist model (Williams, 1977; Ilbery & Bowler, 1998). Hoffman (2016), drawing on practice theory and sustainability transitions, argues that the "translation processes" described by Smith (2007a) involve a form of de-routinisation, in which social actors unsettle habitual practices within specific social contexts. Such moments of change or creativity manifest through the articulation of actor–network relations and the emergence of innovative practices that gradually consolidate and reshape existing routines. Introducing this perspective helps clarify why AFNs exhibit pronounced heterogeneity: their socio-material practices are not fixed expressions of a stable 'alternative', but are continuously reconfigured as actors translate values, technologies, and knowledge into new forms of food production and social organisation.

Rather than constituting a coherent alternative bloc, AFNs display marked heterogeneity, reflected not only in their organisational forms but also in their socio-material arrangements, value orientations, and degrees of market embeddedness—often blurring the very boundaries that the notion of 'alterity' presupposes. This diversity is not a conceptual weakness but a defining characteristic: AFNs differ in governance structures, technological configurations, labour regimes, proximity relations, and cultural framings of 'good food'. Such variation aligns with the broader dynamics emphasised in Schot and Steinmueller's (2018) Third Framing, which views these initiatives as plural and situated sites of socio-technical experimentation that challenge the dominant food regime. It is precisely this internal heterogeneity—rather than alterity alone—that motivates my analytical focus on community-based greenhouse initiatives (CBGIs), whose practices, technologies, and aspirations reveal how AFNs can diverge widely even within a single national context.

In addition, recent literature has introduced a North–South distinction. In the Global North, AFNs often emerge in response to demands for food quality (such as taste and safety), ethical consumption, and social justice movements challenging the dominant agri-food system. In contrast, AFNs in the Global South arise from practical grassroots responses to food inaccessibility, functioning either as informal systems or entrepreneurial models that serve culturally diverse and economically constrained communities. These initiatives—such as emerging cases in China and India—are shaped by local economic marginalisation, environmental constraints, and recent disruptions such as the COVID-19 pandemic (Abrahams, 2006; Bhattacharjee, 2024; Xu, 2025). Still, the power of AFNs' alterity lies in their ability to 're-socialise' and 're-spatialise' the dominant regime (Renting, Marsden and Banks, 2003).

At a more abstract level, AFN research is in essence driven by the aspiration for food systems that "are environmentally sustainable, economically viable, and socially just" (Allen et al., 2003, p. 61). The forms AFNs take are deeply embedded in the political, institutional, and cultural contexts of their emergence (Ilbery and Holloway, 1997). Many of the terms in the AFN literature—environmental values, regional identities, quality conventions, consumer cultures—ultimately circle back to the socially constructed nature of food quality (Renting, Marsden and Banks, 2003, p. 393). The academic literature on AFNs is well-established, offering theoretical depth and empirical richness. Rather than reproducing these general frameworks, this study shifts towards a critical comparative analysis tailored to the Netherlands. Beyond the notion of 'alterity', this paper conceptualises AFNs as morphologically heterogeneous systems whose diverse and often unpredictable forms emerge from the situated practices, experiential knowledge, and socio-cultural orientations of the actors who constitute them (Xu, 2025).

At a national level in the Netherlands, the Omgevingswet (Environment and Planning Act) underscores the significance of active participation between local government and citizens. Efforts have been made to reconnect metropolitan residents with food production, symbolically fostering dialogue between citizens and farmers (Van der Schans, 2010, p. 40). Such participatory frameworks are increasingly shaped by the Quadruple Helix model, which brings together academia, the public sector, private enterprises, and civil society to drive co-creation (Stephens, 2025).

Within this context, pilot projects such as NU Spaarpas—a loyalty card system that rewards the purchase of local, fair-trade products with redeemable points for public transport—illustrate the Dutch government's willingness to support experimental initiatives. While Alternative Agro-Food Networks (AAFN) in the Netherlands are still consolidating for broader dissemination, these legal and policy innovations signal a top-down yet holistic strategy. By re-localising value chains and forging stronger ties between state institutions and civil society (Stephens, 2025, p.2), there is growing potential to scale up community-based initiatives. This emphasises the need for government institutions to engage with local communities, respect their needs, and involve them in decision-making processes (Seyfang and Smith, 2007).

In our case studies, greenhouse farming technology is inherently driven by efficiency, achieved through extensive mechanisation. It aims to minimise time and labour costs associated with traditional farming practices, while pursuing ambitious growth outputs to maximise profits and promote the international export of the Dutch national image. However, the emergence of Community-Based Greenhouse Initiatives (CBGIs) provides an alternative perspective by adopting socially responsible and environmentally sustainable approaches to food production. During my visit to the Oosterwold neighbourhood, I had the opportunity to learn about the local residents' hand-made or custom-made unheated greenhouse designs, the variety of plants they cultivated, and their spacing techniques and irrigation methods. The neighbourhood's local food cooperative plays a vital role in coordinating crop production and distribution. Each resident grows specific vegetables in designated quantities, as guided by a dedicated cooperative-developed mobile app. Onze, a social enterprise, leases small greenhouse allotments to nearby residents who strongly value health benefits associated with traditional self-cultivation practices, strictly avoiding the use of chemical fertilisers. Volunteers at the OudeBeer social enterprise also reject industrialised food production, actively promoting sustainable agriculture through continuous experimentation with the land. For instance, they created an indoor pond to encourage amphibians to reproduce, and implemented biological composting methods. To foster community interaction, De OudeBeer organises various activities for immigrants, primarily from the Middle East, such as tea gatherings and cooking sessions. The core values of this organisation emphasise the joy, unhurried pace, and therapeutic benefits of food growing. Additionally, they invite horticultural specialists to share their knowledge with the organisation in exchange for free allotment usage. Similarly, the BoereGoed social enterprise provides employment and volunteer opportunities for unemployed and disabled local residents. BoereGoed operates an air-conditioned storage and packing facility, manages multiple local sales outlets, and offers delivery services. Its strong social agenda has attracted interest from both individual customers and

commercial greenhouse companies that value its inclusive approach.

As such, my examples of on-site farm shops, a local restaurant with community-supplied vegetables, off-site vegetable deliveries and farmers markets, are all considered as 'heterogenous' methods of retailing which have intimate physical relations with the production of food, as well as close social relations with food producers. Their organic, fresh and quality products have also 'redefined' market values and shortened food miles (Psarikidou, 2021).

A Four-Dimensional Analytical Method for the Socio-Technical Assessment of CBGIs

Motivations of the Social Actors

Based on my surveys, the most common motivations cited by respondents participating in community-based greenhouse farming include education and learning, socialisation, and concerns about the environment and climate change. Additionally, respondents strongly identified with reasons related to mental and physical health, as well as experiences connecting with nature or spirituality. From the research, I observed that respondents demonstrate high environmental awareness and actively limit their environmental impact through changes in their consumption behaviours and practices: "if I put more effort into it, I think I could even buy less from supermarkets, my personal dream would be to never need them again". In addition, these respondents valued the personal interactions with the consumers and green economic growth. They expressed strong aversion towards industrialised mass produced food: "I think it's a bad cycle if they purchase extremely cheap vegetables from supermarkets…people don't consider the environmental costs and social costs where so many people get cancers from the chemicals in those vegetables". Although voluntary labour challenges the traditional understanding of the cost of labour, our case of a community-based greenhouse demonstrates a different value system. Here, unpaid contributions reflect what one interviewee described as "a normative surplus in their relation to the desire for a just and sustainable food system" (Psarikidou and Szerszynski, 2012, p. 36), showing how ethical commitments and shared social values can be a substitute for financial compensation.

Furthermore, rather than being directly inspired by higher institutional values such as economic growth or Sustainable Development Goals (SDGs), community-based greenhouses are inherently a culturally-embedded practice encompassing a diverse range of personal lifestyle choices and expectations. For example, some growers emphasised the health benefits of organic food systems and the climate-related conditions of community-based greenhouses. One respondent from OudeBeer especially enjoyed the aesthetic beauty of the greenhouse garden: "I can just sit here and do nothing. It's so beautiful. We can take them when the vegetables are ready, we can take them home. So I eat organic. So, what else do I want." Another respondent from Onze stressed the medical benefits of organic food. To some extent, they were motivated largely by personal reasons rather than by environmental awareness.

Our case studies demonstrate that community-based greenhouse growers, in contrast to supporting the globalised food system with its extensive spatial and temporal dimensions, strive to foster social relationships by engaging in traditional, land-based agricultural practices. Most participants aim to reduce their environmental impact by changing their consumption behaviours and pursuing food self-sufficiency through physical labour and minimising the involvement of intermediaries. Several respondents expressed strong aversion to artificial fertilisers and chemical pesticides, instead preferring products of higher quality in terms of aroma, taste, safety, and nutrition. Additionally, social objectives are paramount for these community-based agricultural organisations, where agricultural activities are commonly approached as a 'serious hobby' with educational and social benefits.

Inclusivity

These case studies show that community-based greenhouse farming is characterised by cooperation, where participants share their crop cultivation success and organise recreational activities, fostering trust and social

bonds. This form of cooperation enables the cultivation of political capabilities, emphasising civic values like social justice and community membership (Glover et al., 2005, p. 77). It is evident in BoereGoed's strong social objectives, where daily operations are supported mainly by volunteers and people with disabilities. As a result, ethical criteria indirectly influence local communities' purchasing of BoereGoed's products, and the greenhouse's potential to help people who are unable to work in normal work settings.

At De OudeBeer, the operating principle goes against capitalistic values, focusing on the fun, slow, and healing effects of growing food, allowing volunteers to develop their own ideological social ideas and individual autonomy (Glover et al., 2005). For instance, individuals with disabilities working at a nearby market are offered free allotments at OudeBeer to grow their own food. The organisation also provides a versatile platform for people to explore their interests, "growing cacti or mushrooms, or somebody else just wants to do the technical stuff like building furniture, and so everybody can find something they want. There's a place for initiative and experimentation." I found that trust and hands-on approaches were emphasised, with a reliance on contextualised local knowledge rather than formal knowledge systems. Foods and other products were given regularly without financial expectations, fostering personalised, mutual social relations. The positive attitudes toward prosumption suggest that growing food had become a rewarding experience itself, promoting the 'right choice' without conscious awareness of social responsibilities (Shove and Walker, 2010, p. 18).

Onze has the highest score of international diversity rated by the respondents since the majority of growers have immigration backgrounds, «you can have contacts with different people, different cultures and having contact as you would normally not have in your own socialisation". The organisation therefore offers a platform for citizens to get involved and get to know one another in an alternative social setting outside of government, the market and daily social circles (Glover et al., 2005). We thus see that our case study communities are aware of diversifying race and/or class-based discrepancies in participatory development (Artmann and Sartison, 2018).

All the greenhouses in our case studies had maintained low organisational hierarchies, with people who otherwise had difficulties accessing job markets. Disabled people and retired elderly persons formed significant parts of the workforce. More than half of the volunteers were over 50, with retirees and unemployed respondents making up 46.7% of the survey group. By engaging a range of social actors, particularly vulnerable groups, community-based greenhouses can serve as empowering social niches that foster diverse and innovative activities. However, these initiatives often face challenges due to limited full-time commitment and availability from both project leaders and volunteers. Survey participants selected 'effective organisational leadership', 'good relationships with colleagues', and 'democratic management' as key factors influencing greenhouse efficiency. These findings underscore the importance of a democratic structure as the foundation of inclusivity, particularly in terms of representation, information sharing, and internal transparency within these community initiatives (Igalla et al., 2019).

Technological Dimension and the Quest for Environmental Sustainability

There are three levels of social power influencing the directionality of the sustainability transition in the greenhouse industry, namely: regime power, dispositional power, and niche power (Spaargaren et al., 2012). The sustainability of agriculture has to be compatible with the socio-political environment, which is related to concepts of education, security, equity, employment, recreation, etc. (Cui and Smit, 1993). Government regulations have influenced Dutch food practices at the regime level, specifically; that is, the level that represents the most 'anchored' (Spaargaren et al., 2012, p. 12) principles affecting all institutions in a society. Society is taking into account the hidden social and environmental costs inherent in industrial mass production. As large food retailers are remarkably powerful actors determining the value chains van grond tot mond (from farm to fork), they can also influence the tactical strategies for daily activities of the greenhouse industry with their dispositional power. My interviewees in the greenhouse industry described the current transitions toward

sustainability concepts as follows:

> *Now it's also about energy saving. Trials conducted in Bleiswijk have shown that, when I first started, we used around 45 cubic meters of gas per year. I believe the current average is now 22 cubic meters. There are also other crops that have a positive energy balance, meaning we can allocate the saved energy to those crops. It's a popular topic.*

I argue that in mainstream, well-established Dutch greenhouse practices, there are both comparative openness and existing lock-in mechanisms in the system. My review of the Dutch greenhouse industry shows that at the dispositional level, the use of energy-efficient technologies has caused a drastic change through collaboration with universities and private research sectors. With the emergence of new research and agents contributing to innovation systems, users and applications are moving forward to meet demands for sustainability (Spaargaren et al., 2012).

By contrast, community-based greenhouses are introducing 'alternative' changes by maintaining their circular, low-tech visions and solutions using traditional agricultural practices. They believe that, intrinsically, high-tech solutions cannot solve sustainability issues. As is commonly known, the 'technical fix' approach is often used to address food-related challenges. However, my empirical study has shown that all of the initiatives examined practice sustainable, land-based agriculture—except BoereGoed, which still makes minimal use of chemical inputs in its production. These initiatives thus sustain themselves by working with, rather than against, the ecological conditions that shape agricultural production. My respondents all hoped for circular and energy-efficient low-tech solutions, with the use of renewable and clean energy sources. Diffusion of the existing low-tech and renewable energy technologies has opened up new possibilities for sustainable food production and new social ideas (Seyfang and Smith, 2007). Some of the more radical community-based agricultural initiatives have viewed technology as being related to how natural systems work. They aim to create regenerative landscaping that is sustainable by itself without human interventions. Moreover, another reason why community-based agricultural initiatives tend to use low-tech solutions is that high-end technologies require significant time and large-scale deployment before they become affordable. Social initiatives usually lack the financial means to implement them.

Greenhouse Design

Many of the greenhouses used by these organisations are at least 30 years old and have been inherited from previous commercial growers. As a result, some of the mechanical parts are rusty and the glass panels are leaky. However, at Oosterwold, greenhouse growers have more freedom to select the type of greenhouse design and many have been built from second-hand materials. One respondent explained: "*I made this from PVC. And I bend it in boiling water, and then flatten it with an angle. And then you can screw it together.*" Despite their advantages, greenhouses can be vulnerable to heat stress; over 30% of respondents reported high temperatures and ventilation problems in the summer. In winter, unheated greenhouses can be as cold as outside and lack of lighting can be a major issue. As one Oosterwold resident explained, "*the biggest problem in the wintertime here is the lack of light. So no matter how cold or how warm it is, there's not enough light and then the plants won't grow.*" Another issue that was highlighted was the location of the greenhouses, particularly in the case of Oudebeer. As one respondent from Oudebeer put it, "*because of the cars and also the railroads, the pollution is also coming on the roof and with rainwater, at the end, it's also coming in.*" The proximity to roads and traffic was a concern, with pollution from traffic damaging the organisation's image.

Pest Management

One of the prominent challenges faced by all four organisations revolves around dealing with snail and occasional mice invasions. De OudeBeer adopts a hands-off approach, allowing nature to take its course and even embracing the presence of creatures within their greenhouse. As they put it, "*people are part of the life, the plants are. The insects are, even the mice are, everything's part of life that's within these walls.*" Onze and BoereGoed, on the other hand, utilise biological agents and alternative methods to manage pests. At Onze,

decisions on pest control are mostly left to individual growers, like using eggshells to deter snails as "*they don't like sharp things*". BoereGoed, with the highest production output among our case studies thanks to 66.7% of volunteers involved in packing, sales, and delivery, tries to minimise the use of chemical products but resorts to them when biological methods are insufficient to control heavy predator infestations. In contrast, De OudeBeer's founder, who hoped that any problems would be resolved by nature's balance between living creatures, firmly believed that all living beings, including insects and mice, are essential components of life within the greenhouse. As a result, at De OudeBeer they refrain from using any biological control agents and instead have created a small pond in the field to support amphibians, which naturally prey on slugs and insects. Lastly, at Oosterwold, pests are regarded as "*little neighbours*" and their presence is accepted without taking aggressive measures for eradication. By adopting these diverse approaches, each organisation strives to strike a balance between managing pests and preserving the ecosystem within their unique settings.

Soil Management

The study participants emphasised the connection between soil-based greenhouse production and the superior taste and quality of their produce. To achieve this, they collect compost from public parks in the autumn and use it to prevent calcification and to aid worm digestion. At Onze and Oosterwold, the emphasis is on individual growers' self-management and environmental consciousness. Specifically, at Onze, a central station plays a vital role in the composting process, where «all the green waste we collect, we compost it and hand it back to the company that makes the compost". In the Oosterwold community, various soil management practices are evident. Some residents use pigs to digest surplus vegetables, while others apply cotton as natural ground cover combined with compost to create fertile, weed-free garden beds. Others adopt a more hands-off philosophy, allowing "nature to take its course", believing that human intervention disrupts the natural balance. In contrast, BoereGoed has been actively exploring ways to improve soil health and optimise space efficiency, as indicated by approximately 30% of their respondents. One method they experiment with is crop rotation, wherein cauliflower and other crops are rotated to avoid having one large plot solely dedicated to cauliflower. This strategy aims to optimise the soil's health and overall space utilisation. By adopting these distinct soil management approaches, each organisation strives to optimise its greenhouse production and contribute to a more sustainable environment.

Water and Energy Management

Currently, none of the three community-based greenhouses has implemented a dedicated water recycling system. BoereGoed and OudeBeer have encountered difficulties in establishing such systems, primarily due to their limited scale and lack of technical infrastructure. In contrast, many private greenhouse growers in the Oosterwold community have adopted a more proactive approach by collecting rainwater or sourcing water from nearby natural resources, reflecting more decisive individual efforts towards water conservation.

To evaluate energy consumption effectively, one must consider not just the food production process but also the stages of processing, packaging, and delivery, as Veen et al. (2020) emphasise. BoereGoed, with its logistics structure that involves individual customer routes, storage, and cooling, employs energy-consuming measures. The air-conditioning temperature is maintained at around 16 °C, and for inner storerooms storing strawberries and blueberries, the temperature is kept at approximately 6°C. Additionally, the organisation has made efforts to transition towards more environmentally friendly delivery methods, "we [tried to] work with electric vehicles. It's not 100% but we do it in little steps, delivery by bike." At OudeBeer, a computer-controlled system, provided by the neighbouring commercial grower, helps maintain greenhouse temperatures. If the temperature falls below 4 degrees, the system activates a natural gas heater to warm up the greenhouse. However, this dependency on the neighbouring commercial grower has led to some tensions, particularly concerning the use of chemicals and soil management practices.

Crop Management

At Oudebeer, yacon (tuberous roots from Latin America) and chilli peppers are the signature crops, representing their unique identity. Similarly, BoereGoed has been actively exploring "forgotten vegetables", those that "supermarkets are not usually interested in supplying even though they are really beneficial for your immune system". The Oosterwold community boasts a diverse range of crops, driven by individual grower preferences. However, the limited space and pest-control challenges within these greenhouses have led to certain types of crop being excluded from cultivation. For example, one grower explained that they avoid cultivating crops like potatoes because these require too much space and are highly susceptible to pests. Instead, they prefer to buy them from organic supermarkets.

n terms of consumption volumes, our survey indicates that 76.7% of respondents rely on greenhouse production for less than 50% of their total diet. Similarly, among purchasing consumers, 75% report a partial reliance (<50%) on greenhouse products. There was not a single respondent who exclusively based their entire diet (100%) on greenhouse production. These findings indicate that although CBGI production plays a significant role in the dietary patterns of respondents and consumers, it is not yet the sole source of their food consumption.

Section Summary

In essence, community-based greenhouses do not share the same problems as commercial ones as regards energy and sustainability issues. For example, commercial growers need to limit nutrient leeching and to maintain certain water quality of their drains. They furthermore have issues with freshwater supply during droughts, and energy costs for daily operations. Through technological diffusion, we could envision that the opportunity for community-based niches lies in circular solutions, where cities produce a lot of waste in terms of organic waste, heat, CO_2, wastewater, etc. These forms of waste could be further integrated for agricultural production.

Unlike commercial greenhouses, these initiatives prioritise the roles and values of social actors over material and technological innovation. I contend that these food initiatives could offer new modes of production and consumption by embedding ethical capital and social capital into the economy. Commercial greenhouses, whose entire production processes are opaque to consumers, hardly contribute to the social welfare of citizens, unlike community-based greenhouses. Acting as an alternative pathway, CBGIs could demonstrate their natural ways of production and land management, in which they grow rare vegetable species, educate people in ethical social principles, enhance community socialisation, and adopt sustainable technologies.

Reflecting on Scalability

From their everyday decisions about food, to resident participation, community-based greenhouses act as a contrast for re-thinking mainstream practices. Their ideological commitments form the basis to counter the hegemony of mass food production and reflect on quality of life and self-sufficiency. I argue that community-based food projects in general could support deeper transition with a higher degree of reflexivity in agricultural practices.

Each of these case studies exhibits unique characteristics that offer opportunities for scaling up their impact. In Oosterwold, residents follow a structured approach by growing specific vegetables in designated quantities, using the food cooperative's app. The potential to compete with larger greenhouse industrial actors by delivering smaller, yet consistent quantities throughout the year signifies an opportunity for vertical scaling to higher levels of decision-making, as its food cooperative director explained: "I'm quite convinced that we have the potential to compete with like, greenhouse industrial actors. With smaller quantities…we can deliver throughout the year throughout the season, at least not 12 times a year but 12 times a season."

Onze stands out for its international diversity, attracting different ethnic groups with its offering of a protected environment to grow exotic plant species. The close relationship with growers, including expert feedback, workshops, walking tours, and equipment support, positions Onze for horizontal scaling by replicating its successful model in multiple locations.

Both OudeBeer and BoereGoed are driven by deep-rooted beliefs and values. OudeBeer emphasises sustainable farming practices, while BoereGoed focuses on providing social care for vulnerable populations. The potential for scaling up in these cases lies in expanding deeply and further enhancing community trust and networking through participatory tools.

An essential avenue for wider scalability of community-based greenhouses lies in niche crop production. Our case studies reveal that while many grow the same standard crops as large-scale commercial greenhouses (e.g. tomatoes and cucumbers), differentiation is achieved by cultivating medicinal herbs and rare, exotic species. For instance, Onze has made Surinamese crops its brand identity, tapping into the demand for quality produce of such origins and fulfilling the desire for active participation in producing culturally significant ingredients, "I think we have more than 150 cultures in the city…but then certain ingredients are not for sale throughout the year, what we observe is that people would like to get involved to produce it themselves".

However, scaling up community-based initiatives faces challenges related to legislative frameworks. Interviewees working in community-based gardens and permaculture mentioned the complexity of governmental structures and the high costs associated with obtaining legal authorisations: «we make sure that we don't cease to exist…the money we get is insufficient and incidental; we work hard to get money from the government". Despite these obstacles, community-based greenhouses have begun to influence the broader landscape. Government officials now acknowledge their potential to promote self-management and self-sustainability within neighbourhoods: «the commissioners would like to learn the self-management and self-sustainable aspects of this neighbourhood and the Minister also does hold regular meetings to hear representative voices in the neighbourhoods".

Furthermore, one of the most frequently discussed topics during the interviews was about ensuring food security by means of community-based greenhouses. While organic, high-quality produce from community-based greenhouses can attract higher prices and demand from restaurants, some critics view these initiatives as exclusive to the affluent, potentially affecting food equity on a broader scale, as «rich people's toys and greenwashing; local communities should not grow their own food". However, others working in agriculture-related fields perceive community-based greenhouses as a parallel development alongside commercial agriculture, which can satisfy urban food needs, raise awareness about the way food is produced, and provide contact with nature as an alternative food network system: «for instance, incorporating schools into the farm environment… and creating spaces at the front where people can relax and enjoy themselves."

Our interviews revealed that private industrial actors have shown little interest in community-based developments and have generally remained disengaged from collaborative efforts, with comments such as «I am not in a position to comment". Similarly, the discrepancy between social initiatives and government response is evident, as the latter is burdened by legislative frameworks. As a result, these community-based initiatives largely operate independently, despite the potential for local and municipal governments to play more active roles in addressing their specific demands and promoting multi-stakeholder dialogues (Van Veenhuizen and Danso, 2007). As such, the relational power at the niche level could be viewed as a collective network bringing about wider cultural changes in society. At the same time, I argue that community-based initiatives need the conjoined efforts of institutions, professional associations, and government policies to acknowledge their ideological motivations, enable them to multiply, and impact wider society in aggregate form.

Conclusion

In conclusion, community-based greenhouses exhibit diverse approaches to both management and innovative practices. Some prioritise local, chemical-free food production, while others emphasise ecological diversity and social engagement through volunteer activities. Certain initiatives focus on operational efficiency and financial sustainability, while others experiment with decentralised, nature-based solutions.

The commonality of these case studies, despite their projected heterogeneity, is that they all positively impact various forms of capital: they enhance social capital through knowledge exchange and interpersonal skill development, and cultural capital by fostering diversity and volunteerism, which strengthens community bonds. In terms of financial capital, these initiatives show potential in satisfying local demands with robust community support. Such initiatives not only enhance local food quality but also contribute to broader social cohesion, which are essential elements of sustainable community development.

Yet our empirical evidence reveals a series of common challenges that underscore the complexity of these initiatives. Foremost among these challenges are the intensive physical labour demands inherent in greenhouse farming. Participants often find themselves grappling with tasks that include labour-intensive and time-consuming activities such as weeding and watering, which can dissuade long-term volunteer commitments. Organisational coordination also emerges as a critical challenge. Limited resources and high volunteer turnover rates at the outset of projects can disrupt effective management and be further compounded by the overwhelming workload. Furthermore, these initiatives are susceptible to natural disasters, such as storms or fires, which can lead to significant setbacks and losses. From a financial perspective, community-based greenhouses prioritise community benefits over profit, leading to economic limitations for those aspiring to pursue full-time greenhouse farming careers. Additionally, there is often a shortage of volunteers, stemming from certain cultural norms and privacy concerns, which hinder shared greenhouse facilities' acceptability. Finally, the social-economic attitudes of Dutch consumers, influenced by the trading culture, present another challenge, as there is insufficient support for local products.

In synthesis, the common characteristics of community-based greenhouses reveal their pivotal role in sustainable food production and community development. They prioritise nature management over industrialised solutions and foster strong social bonds through local engagement. These initiatives aim to create better food chains by enhancing quality, diversity, proximity, and price, while promoting social solidarity and sustainable agricultural practices. However, there are challenges that underscore the imperative of balancing community benefits with economic sustainability, including financial resilience, support networks, natural disasters, volunteer shortages, and integration into broader markets. In this delicate balance of opportunities and challenges, community-based greenhouses emerge as transformative agents in advancing sustainable, community-oriented food systems and local development.

Moreover, in relation to the Transformative Innovation Framework, we have observed that community-based food initiatives open pathways for dialogue with industrial actors and local governments around social responsibility and sustainability. However, their governance networks and relationships with established industrial actors remain in flux. Specifically, there is room for improvement in linking capital, that is, the ability to establish vertical connections with higher authorities and access additional resources and opportunities. Several respondents in our case studies expressed the wish to cooperate with private greenhouse industries, expanding opportunities in the areas of low-cost adaptive facilities to further strengthen resource recycling management, as well as enterprise marketing strategies. In this respect, governments and knowledge institutions must step in to help. We have seen that these initiatives are useful «localism" governance practices and are becoming embedded in sustainability policies (Brandsen et al., 2017; Seyfang and Smith, 2007). However, they have not yet reached a stage to achieve «bottom-up" social changes (Spaargaren et al., 2012). The sociological attitudes within these greenhouse initiatives reflect a desire for stronger partnerships with university

institutions, which play a key role in knowledge dissemination. They believe that such collaboration would lead to long-term impacts, enabling communities to validate and adapt new technologies themselves, rather than relying on external actors or ad-hoc solutions to address ongoing challenges. Community-based food initiatives should also actively reach out for expert advice which is made freely available by some consultancy agencies. Furthermore, ensuring land availability, accessibility, and suitability is of paramount importance for successful soil-based agricultural initiatives (Van Veenhuizen and Danso, 2007). Regulatory frameworks must create enabling policy instruments that formally recognise community-based initiatives as a form of permanent land use in city planning. By doing so, government land permissions could unify scattered community-based initiatives, giving them stronger social representation and facilitating more meaningful participation in urban policy decisions.

Empirically, this paper has "zoomed in" on four community-led greenhouse initiatives as situated sites of innovation within the Dutch horticultural sector. It has also bridged an existing research gap in empirical research to study specific operations and performances of community-based initiatives (Edelenbos et al., 2020; Igalla et al., 2019). These cases demonstrate that AFNs cannot be reduced to their oppositional stance or to the commonly emphasised attribute of proximity (Marsden et al., 2000); rather, they embody multiple expressions of alterity through alternative values (care, solidarity, biodiversity), alternative governance cultures, low-tech and circular technologies-in-use, and experiential, relational knowledge systems. Bringing Schot and Steinmueller's (2018) transformative innovation framework into dialogue with the AFN concept allows us to interpret these forms of alterity not as static differences from the dominant regime but as directional changes: plural, situated, and socio-material reconfigurations that enact transformative possibilities in everyday practice. In doing so, the paper addresses a gap in the AFN literature, which has tended to under-theorise the processual, practice-based, and technological dimensions through which community-based initiatives challenge incumbent regimes. The analytical framework developed here therefore contributes to a more nuanced understanding of AFN heterogeneity, showing how CBGIs articulate diverse transition pathways, and why such heterogeneity matters for broader sustainability transformations. In short, in order to successfully integrate these greenhouse initiatives further into our current systems, we need to revisit our food production and consumption patterns through an ethical, not just economic, lens.

References

Abrahams, C. (2006) 'Globally useful conceptions of Alternative Food Networks in the developing south: the case of Johannesburg's urban food supply system', *Online papers archived by the Institute of Geography, School of Geosciences, University of Edinburgh*. Available at: http://hdl.handle.net/1842/1465

Allen, P., FitzSimmons, M., Goodman, M. and Warner, K. (2003) 'Shifting plates in the agrifood landscape: the tectonics of alternative agrifood initiatives in California', *Journal of Rural Studies*, 19, pp. 61–75. https://doi.org/10.1016/S0743-0167(02)00047-5

Artmann, M. and Sartison, K. (2018) 'The role of urban agriculture as a nature-based solution: A review for developing a systemic assessment framework', *Sustainability*, 10(1937), pp. 1–32. https://doi.org/10.3390/su10061937

Berkers, E. and Geels, F.W. (2011) 'System innovation through stepwise reconfiguration: The case of technological transitions in Dutch greenhouse horticulture (1930–1980)', *Technology Analysis and Strategic Management*, 23(3), pp. 227–247. https://doi.org/10.1080/09537325.2011.550392

Bhattacharjee, S. (2024) 'From Farmer to Consumer: Exploring Proximity and Direct Selling Initiatives of Organic Farmers of Delhi NCR During COVID-19', *International Journal of Sociology of Agriculture and Food*, 29(2), pp. 61–81.

Botes, L. and Van Rensburg, D. (2000) 'Community participation in development: Nine plagues and twelve commandments', *Community Development Journal*, 35(1), pp. 41–58.

Brandsen, T., Trommel, W. and Verschuere, B. (2015) 'The state and the reconstruction of civil society', *International Review of Administrative Sciences*, 83(4), pp. 676–693. https://doi.org/10.1177/0020852315592467

Breukers, A., Hietbrink, O. and Ruijs, M. (2008) *The power of Dutch greenhouse vegetable horticulture: An analysis of the private sector and its institutional framework*. The Hague: LEI Wageningen UR.

Cassol, A., & Deggerone, Z. A. (2024). Sociology of food markets: Evolving of the state of the art and recent theoretical and methodological contributions. *Redes, 29*(1).

Cui, Y. and Smit, B. (1994) 'Sustainability in agriculture: A general review', *Agriculture, Ecosystems and Environment*, 49, pp. 299–307.

Edelenbos, J., Molenveld, A., Mojanchevsak, K. et al. (2021) 'Community-based initiatives in the urban realm: What conditions their performance?', *Journal of Environmental Planning and Management*, 64(9), pp. 1689–1712. https://doi.org/10.1080/09640568.2020.1837088

Gailloux, C. et al. (2023) *CommunoSerre: Enjeux sociaux et techniques des serres communautaires urbaines dans les quartiers défavorisés*. Montréal: Institut national de la recherche scientifique.

Glover, T.D., Shinew, K.J. and Parry, D.C. (2005) 'Association, sociability, and civic culture: The democratic effect of community gardening', *Leisure Sciences*, 27, pp. 75–92.

Hamstead, M.P. and Quinn, M.S. (2005) 'Sustainable community development and ecological economics: Theoretical convergence and practical implications', *Local Environment*, 10(2), pp. 141–158.

Hinrichs, C. C. (2000). Embeddedness and local food systems: Notes on two types of direct agricultural market. *Journal of Rural Studies, 16*(3), 295–303.

Hoffman, J. G. (2016). From resistance to transformation: Politics of experimentation with new energy systems. [Thesis, fully internal, Universiteit van Amsterdam].

Igalla, M., Edelenbos, J. and Van Meerkerk, I. (2019) 'Citizens in action: What do they accomplish? A systematic literature review of citizen initiatives', *Voluntas*, 30, pp. 1176–1194. https://doi.org/10.1007/s11266-019-00129-0

Ilbery, B. and Bowler, I. (1998) 'From agricultural productivism to post-productivism', in Ilbery, B. (ed.) *The Geography of Rural Change*. London: Longman.

Ilbery, B. and Holloway, L. (1997) 'Responses to the challenge of productivist agriculture', *Built Environment*, 23(3), pp. 184–295.

Köhler, J. et al. (2019) 'An agenda for sustainability transitions research: State of the art and future directions', *Environmental Innovation and Societal Transitions*, 31, pp. 1–32. https://doi.org/10.1016/j.eist.2019.01.004

Lamalice, A. et al. (2018) 'Building food security in the Canadian Arctic through the development of sustainable community greenhouses and gardening', Écoscience, 25(4), pp. 325–341. https://doi.org/10.1080/11956860.2018.1493260

Marsden, T., Banks, J., & Bristow, G. (2000). Food supply chain approaches: Exploring their role in rural development. *Sociologia Ruralis, 40*(4), 424–438.

Magis, K. (2010) 'Community resilience: An indicator of social sustainability', *Society and Natural Resources*, 23(5), pp. 401–416. https://doi.org/10.1080/08941920903305674

Maestripieri, L., Giroletti, T. and Podda, A. (2018) 'Solidarity Purchasing Groups in Italy: A critical assessment of their effects on the marginalisation of their suppliers', *International Journal of Sociology of Agriculture and Food*, 24(3), pp. 393–412.

Michel-Villarreal, R., Vilalta-Perdomo, E., Hingley, M., & Canavari, M. (2025). Rethinking alternative food networks: unpacking key attributes and overlapping concepts. Agroecology and Sustainable Food Systems, 49(3), 415–442. https://doi.org/10.1080/21683565.2024.2420831

Oosterveer, P., & Spaargaren, G. (2012). Green consumption practices and emerging sustainable food regimes: The role of technologies in reconfiguring the agro-food system. In G. Spaargaren, P. Oosterveer, & A. Loeber (Eds.),

Food practices in transition: Changing food consumption, retail and production in the age of reflexive modernity (pp. 131–158). Routledge.

Pimbert, M. P. (2018). Food sovereignty, agroecology and biocultural diversity: Constructing and contesting knowledge. Routledge.

Psarikidou, K., Taylor, S., Roughton, M., Dowbiggin-Lamb, N., & Martin, S. (2024). Policies for transforming the UK's food system: Insights from Brighton and Hove's local community [Policy brief]. University of Sussex. https://sussex.figshare.com/articles/report/Policies_for_transforming_the_UK_s_food_system_insights_from_Brighton_and_Hove_s_local_community/27331407?file=50079123

Psarikidou, K. (2021) *Reclaiming the Knowledge Economy: The Case of Alternative Agro-Food Networks*. Singapore: Palgrave Macmillan. https://doi.org/10.1007/978-981-16-6843-2

Psarikidou, K. and Szerszynski, B. (2017) 'Growing the social: Alternative agrofood networks and social sustainability in the urban ethical foodscape', *Sustainability: Science, Practice and Policy*, 8(1), pp. 30–39. https://doi.org/10.1080/15487733.2012.11908082

Renting, H., Marsden, T. and Banks, J. (2003) 'Understanding alternative food networks: exploring the role of short food supply chains in rural development', *Environment and Planning A*, 35(3), pp. 393–411.

Ribeiro, A.P. et al. (2020) 'Organising alternative food networks (AFNs): Challenges and facilitating conditions of different AFN types in three EU countries', *Sociologia Ruralis*, pp. 1–27. https://doi.org/10.1111/soru.12331

Schot, J. and Steinmueller, W.E. (2018) 'Three frames for innovation policy: R&D, systems of innovation and transformative change', *Research Policy*, 47(9), pp. 1554–1567. https://doi.org/10.1016/j.respol.2018.08.011

Seyfang, G. and Smith, A. (2007) 'Grassroots innovations for sustainable development: Towards a new research and policy agenda', *Environmental Politics*, 16(4), pp. 583–603. https://doi.org/10.1080/09644010701419121

Shove, E. and Walker, G. (2010) 'Governing transitions in the sustainability of everyday life', *Research Policy*, 39, pp. 471–476. https://doi.org/10.1016/j.respol.2010.01.019

Smith, A. (2007a). Translating sustainabilities between Green Niches and socio-technical regimes. *Technology Analysis & Strategic Management, 19*, 427 – 450.

Spaargaren, G., Oosterveer, P. and Loeber, A. (2012) 'Chapter 1: Sustainability transitions in food consumption, retail and production', in Spaargaren, G., Oosterveer, P. and Loeber, A. (eds) *Food Practices in Transition: Changing Food Consumption, Retail and Production in the Age of Reflexive Modernity*. London: Routledge, pp. 1–31.

Stephens, R.J.S. (2025) 'Quadruple Helix co-creation and cities: Behavioral and institutional changes in innovation capacities and cultures', *Cities*, 157(105579), pp. 1–11. https://doi.org/10.1016/j.cities.2024.105579

Statistics Netherlands (2024) 'Dutch agricultural exports worth nearly 124 billion euros in 2023'. *CBS*. Available at: https://www.cbs.nl/en-gb/news/2024/10/dutch-agricultural-exports-worth-nearly-124-billion-euros-in-2023

Van der Schans, J.W. (2010) 'Urban agriculture in the Netherlands', *Urban Agriculture Magazine*, 24, pp. 40–42. Available at: https://edepot.wur.nl/411126

Van Veenhuizen, R. and Danso, G. (2007) *Profitability and sustainability of urban and peri-urban agriculture*. Rome: Food and Agriculture Organization of the United Nations.

Veen, E.J., Dagevos, H. and Jansma, J.E. (2020) 'Pragmatic prosumption: Searching for food prosumers in the Netherlands', *Sociologia Ruralis*, pp. 1–23. https://doi.org/10.1111/soru.12323

Williams, R. (1977) *Marxism and Literature*. Oxford: Oxford University Press.

Xu, C. (2025) 'AFN as Bricolage: towards an alternative notion of "alterity" as "hybridity"', *International Journal of Sociology of Agriculture and Food*, 31(1), pp. 53–69. https://doi.org/10.48416/ijsaf.v30i1.561