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The public perception on the integration of the Earthship Homes in the city of Olst: A contribution to future of sustainable housing development and community resilience in the Netherlands

Bachelor Thesis

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Summary

This thesis explores the public perceptions of Earthship Homes in Olst, the Netherlands, as a contribution to sustainable housing development and community resilience. Finding sustainable ways to design future cities is essential because of the challenges brought on by climate change and the depletion of resources. Earthship Homes, developed by architect Michael Reynolds, are a form of sustainable housing development through their use of recycled materials, renewable energy sources, and on-site waste management systems. Despite their growing popularity worldwide, Earthship Homes remain relatively underexplored in research, prompting this study's unique focus on public perceptions in the Netherlands. Through surveys administered to both Earthship Homeowners (EH) and Not Earthship Homeowners (NEH), diverse viewpoints emerge, shedding light on the benefits and barriers associated with the Earthship Homes. While EH express satisfaction with their sustainable lifestyle and communal living experience, NEH raise concerns about practicality and aesthetic integration within the neighbourhood. While Earthship Homes offer a promising model for sustainable housing, their effective integration depends on understanding diverse perspectives and engaging the community in project development. Looking forward, policy initiatives should promote sustainable housing solutions while addressing concerns to encourage wider acceptance and ensure long-term viability. Ultimately, this research strives to gather knowledge for sustainable living practices and enhance community resilience in response to changing socio-environmental needs.

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Earthship Homes in Olst by Maarhuis, 2023.

1 Introduction

“The search for sustainable solutions to sculpt the cities of the future has become necessary due to the problems posed by climate change and resource depletion,” according to Saker (2023). In response to this urgent demand, the UN has set up the 2030 Agenda for sustainable development which outlines the 17 sustainable development goals (SDGs) (United Nations, 2015). In recent years, Earthship Homes has stood out as SDG 11 seeks to make cities and human settlements inclusive, safe, resilient, and sustainable (Yeboah, 2023). The Earthship design has emerged as a possible solution towards this sustainable urban development, by directly addressing sustainability in the building of houses and communities (Colby and Whitley, 2022).

Currently there are around 3000 Earthship Homes implemented around the world, with the majority in the US, some in Canada, Australia, Japan, South Africa, Bolivia, Mexico, Honduras, Russia, India, Spain, Belgium, UK, Scotland, and the Netherlands (Krosofsky, 2021). However, up until today Earthships remain a relatively under explored type of sustainable/alternative housing (Booth et al., 2023), and there is a lack of empirically supported studies that examine public perceptions regarding the benefits and barriers associated with these structures (Booth et al., 2021).

To address this knowledge gap, this research will focus on understanding the public perceptions regarding the Earthship Homes. Specifically, it aims to answer the main question: How does the public perceive the integration of Earthship Homes in the city of Olst as a contribution to the future of sustainable housing development and community resilience in the Netherlands? To delve deeper into the inquiry, the study will explore the sub-questions: What is the opinion of the public on the contribution of Earthship Homes to the future of sustainable housing development in Olst? and What is the opinion of the public on the contribution of Earthship Homes to the future of community resilience in Olst?

The Earthship Homes in Olst are the first and only Earthship Homes currently existing in the Netherlands (Vereniging Aardehuizen, 2022), and therefore serve as a unique case study for understanding their potential contribution to sustainable housing development and community resilience in the Netherlands. As a member of the United Nations, the Netherlands also needs to work on the SDGs regarding sustainable housing and sustainable communities. By understanding public perceptions regarding these structures this study tries to explore if Earthship Homes could be a possible contribution for the future of sustainable housing development and community resilience in the Netherlands. Ultimately, this research strives to gather knowledge for sustainable living practices and enhance community resilience in response to changing socio-environmental needs.

In this research, a survey has been used to gather data on public perceptions regarding Earthship Homes. The survey was designed to assess opinions on the integration of Earthship Homes in the city of Olst and their potential contribution to sustainable housing development and community resilience in the Netherlands. Participants were asked a series of questions related to their awareness of Earthship Homes, their perceptions of the benefits and barriers associated with these structures, and their opinions on their suitability for sustainable housing development and community resilience. The survey was distributed to residents of both the Earthship Homeowners and the surrounding neighbourhoods using QR codes. Data collected

from the survey responses were analysed to identify common themes and trends in public perceptions.

1.2 Structure

In the following sections, this paper will first examine the historical context of Earthship Homes, providing a detailed background to understand their development. The next section delves into the theoretical framework, discussing the concepts of sustainability, community resilience and cohesion, their interconnections, and how Earthship homes exemplify sustainable housing development. This will be followed by the methodology section, which will discuss data collection, data analysis, and ethical considerations. Next, the results will be presented, followed by a discussion on the differing perceptions of Earthship Homeowners and Not Earthship Homeowners in Olst regarding the sustainability and community impact of Earthship Homes. The limitations of the research will be addressed next. Finally, the paper will conclude with a summary of the findings and suggestions for future research on Earthship Homes and their contribution to the future of sustainable housing development and resilience in the Netherlands.

1.3 Background

Michael Reynolds, American architect and environmentalist known for his pioneering work in sustainable architecture (Earthship Biotecture, 2024), is best known for developing the Earthship concept, which involves creating self-sustaining homes using recycled materials, renewable energy sources, and natural systems for water and waste management (Earthship Biotecture, 2024). The architect designed his first Earthship with the explicit aim of creating a sustainable, self-sufficient home accessible for anyone to construct from local and recycled materials (see Figure 1) (Puisis, 2022). Reynolds founded Earthship Biotecture, an organization dedicated to promoting and building Earthship homes around the world, making significant contributions to the advancement of sustainable housing solutions (Earthship Biotecture, 2024). The Earthships in Olst were inspired by the Earthship concept of the Architect Michael Reynolds (Vereniging Aardehuis, 2022). Architect Michel Post of Orio Architects adapted the principles of the Earthship Concept to be able to implement them in the Dutch situation (precipitation, annual temperature, and subsoil) (Vereniging Aardehuis, 2022). As a result, the Earthships in Olst underwent adaptations by Architect Michel Post to align with Dutch environmental conditions, regulatory standards, and economic factors (Ankie, 2020).

Figure 1 - Self-build with walls constructed from tires (Vereniging Aardehuizen, 2022).

An Earthship is distinguished from mainstream housing by its design for self-sufficiency (Ankie, 2020). This emphasis on self-sufficiency not only reduces the ecological footprint of Earthships but also fosters a greater sense of independence and resilience among their occupants (Puisis, 2022). The Earthship Homes in Olst are characterised by a south-facing glass facade, thermal mass provided by a sheltered north wall made of tires, excellent insulation, natural ventilation, its own drinking water purification, grey water filtration, composting toilets, energy generation with PV panels, lower fixed costs, green spaces (see Figure 2), and eco-friendly design (Vereniging Aardehuizen, 2022). Apart from promoting sustainable living, Earthships embrace the principle of *'Centraal Wonen'* (in English, Central Living) (Ankie, 2020). This concept underscores mutual solidarity, making ecological building and living accessible to all, while encouraging the sharing of collective facilities and fostering respect and communication among residents, thus balancing individual freedom naturally within the community (Ankie, 2020).

Figure 2 - Focus on greenery in- and outside the neighbourhood (Vereniging Aardehuizen, 2022).

2 Theoretical Framework

Sustainability, as a concept, is concerned with the tension between the aspirations of humankind towards a better life on one hand and the limitations posed by nature on the other hand (Kuhlman and Farrington, 2010). Or in simpler terms, “that which can be maintained over time,” according to Heinberg (2010). This means that any society that is unsustainable cannot be maintained over the long term (Heinberg, 2010). Sustainability presumes that resources are finite and should therefore be used conservatively and wisely with a view on long-term priorities and consequences in the ways in which resources are used (UCLA, 2023). Oftentimes, the concept of sustainability is used interchangeably with the concept of sustainable development (Maryville University, 2020). However, sustainability encompasses the responsible management of resources to meet the needs of present and future generations across environmental, economic, and social dimensions (Maryville University, 2020). On the other hand, sustainable development specifically refers to the pursuit of long-term economic prosperity and societal well-being while safeguarding resources for future generations (Maryville University, 2020). To sum up, sustainability means emphasising humanities need to balance the needs of the present with the conservation of resources for future generations.

Sustainability is linked to community resilience and cohesion, as both concepts emphasise the importance of responsible resource management and social support networks for long-term well-being (Albarracin et al., 2024). In Earthship communities, this connection is evident through their emphasis on communal living, resource-sharing, and self-sufficiency, all of which contribute to both sustainability and community resilience (Vereniging Aardehuizen, 2022). The concept of community resilience is frequently employed in conversations about integration and cohesion (Centre for Local Economic Strategies, 2014). Both community cohesion and resilience are considered to be important factors for residents to feel satisfied with where they live (Centre for Local Economic Strategies, 2014). “This is because residents in a cohesive and resilient community tend to feel supported by those around them, feel a sense of belonging, and socialize with others in their community, all of which are important for a person’s mental health and social well-being,” according to Centre for Local Economic Strategies (2014). Cohesive and resilient communities are also less likely to experience neighbourhood problems, like anti-social behaviour and waste mismanagement (Centre for Local Economic Strategies, 2014). Community cohesion is a big part of the Earthship communities, as they rely on strong communal relationships (Carmen et al., 2022). The Earthship community is tight and helpful because residents frequently work together on various initiatives and pool resources together (Carmen et al., 2022). This emphasis on communal living and resource-sharing is therefore considered one of their core principles (Vereniging Aardehuis, 2022). This mutual solidarity of the Earthship community also contributes to greater community resilience (Vereniging Aardehuis, 2022). Community resilience refers to the ability of a community to withstand and recover from adverse events or challenges, such as natural disasters, economic downturns, or social disruptions (Carmen et al., 2022). It is aided by self-sufficiency and decentralized systems, as also evidenced in the design of Earthships (Carmen et al., 2022). Earthships where possible (re)use locally available residual materials, raw materials and natural processes and services, and are self-sufficient in energy, water supply and purification (Vereniging Aardehuis, 2022). In short, it's about a community's capacity to bounce back and thrive in the face of difficulties.

The emphasis on community cohesion and resilience in Earthship communities aligns with the broader understanding of sustainability and resilience, highlighting the importance of fostering strong social bonds and adaptive capacities within communities to address challenges effectively (Magis, 2010). Although sustainability and resilience are different concepts, they are frequently interconnected and referenced together (Marchese et al., 2018). Their main similarity is that they both refer to the state of a system or feature over time, focusing on the persistence of that system under normal operating conditions and in response to disturbances (Derissen et al., 2011). They differ in terms of scale, as sustainability is focussed on larger spatial scales and longer temporal scales, and resilience could be achieved by one temporal or spatial scale at the expense of each other (Derissen et al., 2011). In the context of community development, sustainability initiatives tend to focus on preserving traditional methods of resource use, livelihoods, environmental knowledge, and environmental resources (Marchese et al., 2018). In contrast, resilience initiatives tend to focus on adapting to new conditions, creating new environmental knowledge, creating innovative uses of traditional knowledge, and improving living conditions and employment (Marchese et al., 2018).

The integration of sustainability and resilience principles in sustainable housing development, demonstrated by Earthship homes, highlights the importance of fostering adaptive capacities and resource efficiency at both individual and community levels (Saker, 2023). Sustainable housing development could be best understood as a "human-ecosystem equilibrium in meeting human needs, or a way for the current generation to get their needs met without compromising the ability of future generations to have their needs met," according to (Colby and Whitley, 2022). The focus of sustainable housing development lies on issues such as limited resources, especially energy, and how to reduce the impact on the natural environment (Roufechaei et al., 2014). "In this regard, sustainable housing development can be considered as a helpful means to protect natural resources using energy efficiency parameters to minimize energy consumption," according to Roufechaei et al. (2014). Earthships also work on the minimization of energy consumptions, because they require less dependence on fossil fuels and centralized power networks since they are able to generate large volumes of solar and wind energy (Saker, 2023). Another example is that they have energy storage technologies, such as massive batteries and innovative thermal storage systems which deliver on-demand electricity even when the generation of renewable energy is low (Saker, 2023). However, the term sustainability in housing is not limited to energy efficiency and the fight against climate change; "it also refers to the economic, social, and environmental sustainability of individuals in houses, families, and communities," according to Yeboah (2023). It therefore also has a strong focus on making cities and human settlements more inclusive, safe, resilient, and sustainable, and assuring sustainable consumption and production patterns (Yeboah, 2023). The Earthship Design aligns with the principles of a circular economy, complementing the United Nations' development objectives concerning food, energy, clean water, shelter, waste management, and sewage treatment (Donovan, 2020). A circular economy could be best understood as a system that promotes the responsible and cyclical use of resources, possibly contributing to sustainable development (Moraga et al., 2019). According to Donovan (2020), "there is no better way to start a circular economy model than with the Earthship concept."

In conclusion, the intertwining concepts of sustainability, resilience, and community cohesion form the foundation of Earthship communities, illustrating how an integrated approach to sustainable housing development can address environmental, social, and economic challenges. By emphasizing responsible resource management, communal living, and adaptive capacities, Earthship Homes showcase a model for achieving long-term sustainability while fostering community resilience. Moreover, the integration of sustainability and resilience principles in sustainable housing development underscores the importance of balancing present needs with the conservation of resources for future generations. In the following section, the conceptual model is presented as a framework for understanding public perceptions of Earthship Homes in Olst regarding sustainability and resilience. This model encompasses perspectives form both Earthship Homeowners and Not Earthship Homeowners, offering a complete picture of public opinions and its relationship to sustainable housing development.

2.1 Conceptual Model

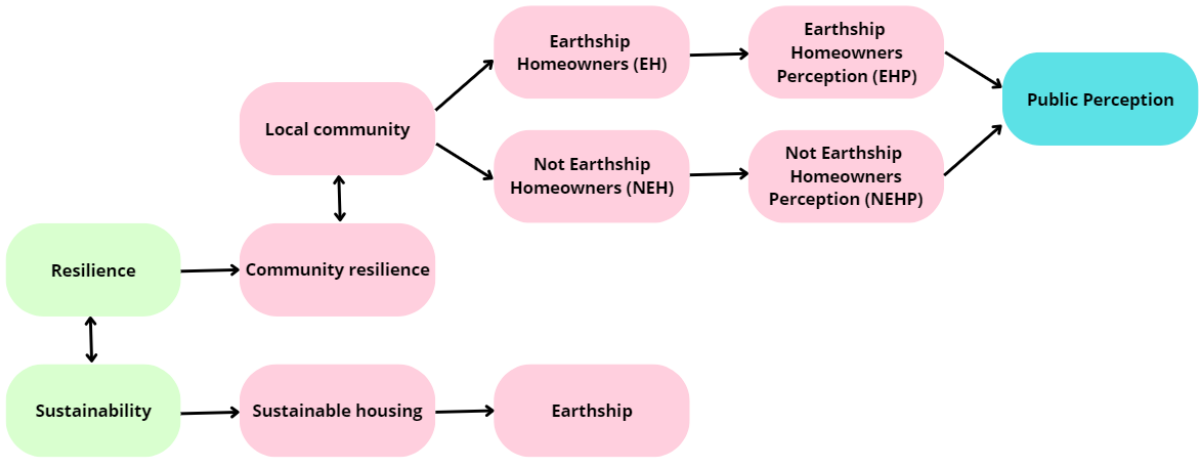

Figure 3 – Conceptual Model

As illustrated in Figure 3, 'Public Perception' acts as a measurement of public opinions regarding the contribution of Earthship Homes to a sustainable future, particularly in terms of sustainable housing development and resilience.

Meanwhile, 'Resilience' and 'Sustainability' represent key aspects under consideration in this research. The study aims to explore how these factors interrelate and collectively influence public perceptions concerning the role of Earthship Homes in fostering sustainability and resilience. Both 'Resilience' and 'Sustainability' are closely tied to the local community, as it determines the extent to which these qualities are present in Earthship Homes in Olst.

Furthermore, the 'Local Community' can be divided into Earthship Homeowners (EH) and Not Earthship Homeowners (NEH). By integrating the perspectives of both groups, this research strives to offer a comprehensive analysis of public perception from all relevant stakeholders.

3 Methodology

The aim of this research is to explore the public perceptions regarding Earthship Homes in Olst, and to achieve this, a survey has been chosen as the primary research method. This method allows for gathering information from a sample of individuals (Scheuren, 2004). The sample is a fraction of the population being studied (Scheuren, 2004), which consists of the Earthship Homeowners and the Not Earthship Homeowners. The survey used in this research will mostly consist of open-ended questions, instead of close-ended questions. Open-ended questions have the advantage of "discovering the responses that individuals give spontaneously, and thus avoiding the bias that may result from suggesting responses to individuals, a bias which may occur in the case of close-ended questions," according to Reja et al. (2003). It was also shown that respondents to the open-ended question produce a much more diversified set of answers than respondents to the close-ended form (Reja et al., 2003). Conducting a survey with open-ended questions offers a strong methodology for exploring public perceptions towards Earthship Homes in Olst, allowing for an understanding of the diverse viewpoints within the community without biassing respondents towards predetermined responses.

3.1 Data Collection

The participants of the survey include the members of the local community in Olst, including both Earthship Homeowners (EH) and Not Earthship Homeowners (NEH). The participants are reached by distributing printed QR codes of the survey to both Earthship Homeowners (EH) and the Not Earthship Homeowners (NEH) via their mailboxes. The printed QR codes were distributed twice in response to participants who had expressed interest in completing the survey but found that the initial deadline had passed within a few days. To ensure that those who missed the opportunity could still participate, a second delivery of QR codes was sent to their mailboxes. This distribution occurred on April 3rd and April 8th.

For the data collection, Qualtrics has been selected as the platform for administering the survey. "The UG has a Data Processing Agreement with Qualtrics, which legally binds the supplier to protect the data you collect under conditions stated by the UG," according to Rijksuniversiteit Groningen (2022). By using Qualtrics the privacy of the survey data could be ensured. As Qualtrics is not a storage system the survey data will be secured in the Google Drive of the University of Groningen, as they are provided with a sufficient safety mechanism based on the agreements between Google and the RUG.

Given the local context, the surveys were conducted in Dutch. This decision is based on the recognition that not all participants may feel sufficiently comfortable expressing their perceptions in English. However, for the purpose of analysis, discussions, and conclusions, the findings drawn from these surveys have been translated by the researcher. The analysis of this data gives the opportunity to get a better understanding of the factors that influence the public perspective towards the contribution of Earthship homes to the future of sustainable housing development and community resilience in the Netherlands. Ultimately the goal of the survey is to be able to give an answer to the main research question: How does the public perceive the integration of Earthship Homes in the city of Olst as a contribution to the future of sustainable housing development and community resilience in the Netherlands?

3.2 Data analysis

The collected survey data underwent a detailed analysis to gain insights into public perceptions regarding Earthship Homes in Olst and their potential contribution to sustainable housing development and community resilience in the Netherlands. The analysis is structured based on the categories established in the survey questions, ensuring a coverage of all aspects related to the research objectives. These categories are made for the survey questions of both the EH and the NEH.

For the Earthship Homeowners, the analysis covers five key thematic categories. First, 'Experience and Satisfaction', which evaluates personal experiences and satisfaction levels. Second, 'Perceptions of Sustainability', which explores the EH views on the sustainability features of Earthship Homes, their alignment with personal values, and any associated benefits or challenges. Third, 'Community Engagement', assessing the sense of community, engagement among EH, and the impact on community resilience and cohesion. Fourth, 'Challenges and Adaptations', identifies challenges faced by homeowners, adaptive strategies, and solutions for limitation related to Earthship living. Finally, 'Future perceptions', which captures EH vision for future improvements, the evolving role of Earthship Homes, and whether they recommend this housing option.

Similarly, for the Not Earthship Homeowners, the analysis also covers five thematic categories. First, 'Perceptions of Earthship Homes', which evaluated thoughts and impressions of Earthship Homes, familiarity with the concept, and considerations related to living in these homes. Second, 'Sustainability and Resilience', focusses on the importance of sustainability and resilience, and views on how Earthship Homes contribute to these aspects. Third, 'Community Dynamics', examines the broader sense of community in Olst, relationship between EH and NEH, and the impact on community cohesion. Fourth 'Challenges and Concerns', addressing concerns about Earthship Homes, perceived challenges, and community responses. Finally, 'Future Perspectives', captures visions for future housing development, the role of Earthship Homes, and their influence on community resilience. The data collected from both surveys' categories is analysed and compared with each other. This allows for identifying common themes and trends, and differences in the public perceptions.

3.3 Ethical Considerations

Using a survey as the research method entails ethical considerations to ensure the well-being and rights of participants. There needs to be ensured that participants are fully informed about the purpose of the survey, their rights, and how their data will be used. The printed papers with QR codes, that were delivered to the participants, included the researcher's email address, allowing participants to contact the researcher directly. The stored data will be erased once all research steps are completed and the data is no longer needed for the study. Consent must be voluntary, and participants must have the option to withdraw from the survey at any time. There should also be measures taken to protect the confidentiality of participants' responses. This included using anonymous surveys or ensuring that personal identifying information is kept separate from survey responses. Participants' privacy should be respected throughout the survey process. This includes safeguarding their personal information and ensuring that survey responses cannot be linked back to individual participants without their explicit consent.

4 Analysis and Results

A total of 13 surveys were collected to explore public perceptions regarding the integration of Earthship Homes in Olst and their potential contribution to sustainable housing development and community resilience in the Netherlands. This includes seven surveys from Earthship Homeowners (EH) and six from the Not Earthship Homeowners (NEH). The analysis is structured to provide a clear understanding of each group's perspectives, organized into thematic categories that align with the survey questions. Organizing the analysis into specific thematic categories offers several advantages.

Firstly, the categorization, as presented in the data analysis, ensures a focused exploration of different aspects related to Earthship Homes. Each category is designed to delve deeply into different dimensions of their experiences and perspectives. This approach allows for a detailed examination of EH satisfaction levels, sustainability beliefs, community dynamics, adaption strategies, and future aspirations. Similarly for the NEH, the categorization allows for a clear understanding of their views on Earthship Homes, concerns about sustainability and community cohesions, and expectations for future housing developments.

Apart from this, the structured approach facilitates comparative analysis between EH and NEH responses. By comparing data across corresponding categories, common themes, trends, and difference in perceptions emerge. This comparative analysis enriches the understanding of how different groups perceive Earthship Homes and sustainable housing initiatives, highlighting areas of consensus and divergence.

4.1 Earthship Homeowners

4.1.1 Experience and Satisfaction

The analysis indicates that all participants of the survey perceive living in an Earthship positively. They describe their experience as relaxed and comfortable, with 57% of participants also highlighting the presence of strong communal relationships.

'It gives me a sense of freedom, pride and satisfaction because this house allows me to live almost self-sufficiently, in a social environment where people look out for each other.' [Participant 4]

The participants share a common motivation for choosing to live in an Earthship: the desire to lead a more sustainable lifestyle.

'The realization that our lifestyle is unsustainable within planetary limits.' [Participant 7]

As a result, future-proof living has become a core value, with sustainability and self-sufficiency at its core.

The participants were asked to grade the overall functionality and performance of their Earthship. This has been graded with an 8,3 on average.

4.1.2 Perceptions of Sustainability

The Earthships contribute in several ways to a sustainable way of living.

'Lots of room for biodiversity in this neighbourhood, lots of building materials with low environmental impact. A lot of own responsibility when it comes to e.g. wastewater treatment, own energy generation, supporting-and pioneering-other sustainable initiatives. [Participant 2]

Another example relates to composting toilets and self-sourced water, which will become an ever-increasing plus in the event of scarcity. All these measures together contribute to the overall resilience and self-sufficiency of the Earthship Homes.

'Earthships are the example of how and what is also possible.' [Participant 7]

Earthships do align with their personal values regarding sustainability in several ways, such as the use of natural and second-hand materials, the presence of lots of greenery, self-sufficiency in water and electricity and the proximity of nature.

'I get very happy with lots of nature around me as opposed to the stone deserts in other residential areas.' [Participant 2]

However, EH have experienced both benefits and challenges associated with living in an Earthship in terms of sustainability. Benefits include the use of sunlight for heating, low to no energy costs and a decent climate resilience. Challenges include mistakes during the construction phase that had to be repaired, moisture problems in the wet climate of the Netherlands, and the pioneering challenge of discovering everything on your own.

'We had many challenges during the construction phase. When building yourself, you encounter mistakes that you have to fix. That is sometimes difficult, but instructive.' [Participant 2]

4.1.3 Community dynamics

The sense of community is by 71% of the EH experienced as warm and pleasant.

'We built everything together and that automatically creates a bond. Partly because of that, it is easy to lend each other stuff or take initiatives together.' [Participant 5]

However, the other 29% does not experience this feeling all the time.

'I imagined something very different about the sense of community. Building together is really different from living together. We do that more side by side rather than with each other.' [Participant 3]

Overall, residents of the Earthships generally enjoy pleasant and familial relationships with each other, maintaining adequate privacy. Participation in community initiatives varies among residents of EH, with some actively engaging in activities while others remain more reserved, resulting in differing levels of involvement and interaction with their neighbours.

The EH believe that Earthships promote resilience and social cohesion in Olst by encouraging green initiatives and diversifying the local community. Several social projects and sustainability initiatives have emerged from the Earthship Homes, including the establishment of local associations and foundations. These initiatives have in turn led to new projects that contribute to the social environmental resilience in Olst.

4.1.4 Challenges and Concerns

The EH have experienced different challenges related to living in an Earthship. Most participants mentioned they experienced challenges related to remedial work because of some choices made during the construction process, which contributed to additional costs and increased construction time. Apart from this, two participants also mentioned problems related to community living.

'Making decisions within meetings is not always pleasant.' [Participant 3]

There are different lifestyle changes people have made to be able to live in an Earthship. Examples that were given are no longer being able to flush the toilet, no use of chemical cleaning products, and not being able to park their car next to their homes. However, two participants mentioned that they did not feel the need to adjust their lifestyle to live in an Earthship.

'The word 'have to' does not apply here. I was able to leave elements of my lifestyle behind because I moved into an Earthship.' [Participant 4]

All participants indicated that they do not perceive their lifestyle changes as restrictive. They cope with these lifestyle changes rather creatively.

'Discuss with neighbours that experience the same issue, oftentimes we can come to a joint solution.' [Participant 7]

4.1.5 Future Perspectives

When asking about the changes or improvements that the participants would like to see within the Earthship community a diverse set of answers was given. The points that were mentioned included reducing the number of casts for ecological balance, implementing a different heating system for 'het Middenhuis', improvements in the layout of 'het Middenhuis', and finding a solution for the surface of the parking lot. In addition, other improvements included increasing participation in 'Groenwerkdagen', creating a covered bicycle parking area for visitors and organizing more joint activities aimed at influencing public opinions on the climate crisis.

Participants perceive Earthships as evolving models of sustainable housing developments, serving both as exemplars of what is achievable and as inspirational hubs for fostering sustainable initiatives.

'We remain an example, but increasingly better options emerge.' [Participant 2]

Overall, all participants are positive about the project, but indicate that they would prefer to build with more sustainable materials such as a wood frame, instead of car tires as walls. Despite different preferences and limitations, they continue to see the project as inspiring, especially because of the common building process and the opportunity to share experiences with others.

'We learned a lot from the construction and realization. We are happy to share these experiences to interested parties, such as during tours. There are successful and less successful parts. People can choose what they adopt from these.' [Participant 7]

4.2 Not Earthship Homeowners

4.2.1 Perceptions of Earthship Homes

Eighty-three percent of the NEH have a negative attitude towards Earthship Homes as a housing option in Olst. Most of them mention their concerns about the lifespan of these types of homes and that they do not find them aesthetically pleasing. One participant holds a slightly more optimistic view regarding the Earthship Homes.

'Beautiful, as long as it is executed properly.' [Participant 6]

All participants are familiar with the Earthship concept. The most important characteristics of Earthships are seen as building with sustainable materials and strong communal relationships.

All participants mentioned that they never considered living in an Earthship themselves. Additionally, except for one participant, none of them knew anyone living in an Earthship.

4.2.2 Sustainability and Resilience

The participants were asked to rate the importance of sustainability and resilience when selecting a place of residence, which averaged at 5.7.

All participants responded 'No' when asked if they believe Earthships contribute to sustainable housing developments and resilience in Olst.

Half of the participants expressed a preference for not seeing any particular sustainability features further implemented in housing projects within Olst. However, the other half mentioned examples of home batteries, and that building with natural materials should be stimulated more.

4.2.3 Community Dynamics

All participants, except for one, mentioned that they experience a pleasant atmosphere within their community. The other participant mentioned having little to no contact with their neighbours.

'Everyone knows each other and is there for each other.' [Participant 4]

Most participants noted that there is little to no contact between the residents of the Earthship Homes and the rest of the neighbourhood.

'You say hi to each other. That's all.' [Participant 6]

One participant noted that while there is some contact, it remains limited, and that it is uncommon to enter grounds of the Earthship Homes.

Out of the results it becomes clear that 83% of the participants feels like the Earthship Homeowners do not influence the community cohesion within Olst.

'No, I think they mainly concern themselves with each other and the A12.' [Participant 4]

One participant mentioned being very annoyed by the behaviour of the Earthship Homeowners and believes it negatively impacts community cohesion in Olst.

'Yes, the propagate slogans of Xtinction Rebellion (trash cans and lampposts) with pamphlets on public facilities. Very disturbing, stick this in your own house.' [Participant 6]

4.2.4 Challenges and Concerns

The results indicate that all participants have concerns about the Earthship Homes in Olst. Most participants specifically mentioned the lifespan of these houses, leading them to not view Earthships as a viable long-term option.

'I am in favour of sustainable housing, but I do not feel like the Earthships are really sustainable. For example, one house is for sale (10yrs old) and the foundation is already not good anymore. In the long run it does not seem sustainable to me.' [Participant 4]

Except for the technical concerns, there are also concerns related to their aesthetics.

'When entering Olst at the Earthship Homes you are confronted with a very messy neighbourhood. Do not think this is a good representation for Olst.' [Participant 5]

The potential challenges or disadvantages of implementing sustainable houses like Earthships include concerns about their lifespan, the messy appearance of the neighbourhood, construction quality issues, and conflicts arising from the behaviour and attitudes of some residents, which may create friction within the community and affect the area's overall appearance.

'The views of some of the residents are very prevalent and intrusive (stickers on lampposts), this actually seems to cause friction within the community of Olst.' [Participant 4]

As a result of this, all participants would react negatively to an increasing presence of Earthship Homes in Olst.

4.2.5 Future Perspectives

When looking at the future, participants indicate that they would like to see more sustainable housing options within Olst, but not in the way that the Earthships are constructed.

'I think Olst has pioneered a few projects in sustainable housing (Earthships, 'the Olstergaard'), but it is still in its infancy. I believe the community needs more regular housing to solve the shortages so that people do not keep looking for housing.' [Participant 4]

In addition, participants expressed a desire for further research into future-proof living, highlighting several promising initiatives already underway.

'House2Start has set up a nice project here in Olst for starters.' [Participant 6]

5 Discussion

The theoretical framework underpinning Earthship communities illustrates the interconnectedness of sustainability, resilience, and community cohesion. Sustainability, defined as the balance between human aspirations and environmental limitations, emphasizes responsible resource management and meeting the needs of present and future generations. This concept aligns with the Earthship model's emphasis on communal living, resource-sharing, and self-sufficiency, which contribute to both sustainability and community resilience. Community resilience, the ability to withstand and recover from challenges, is fostered in Earthship communities through self-sufficiency, decentralized systems, and strong social bonds.

The findings from both Earthship Homeowners (EH) and Not Earthship Homeowners (NEH) provide insight into diverse perspectives regarding the integration of Earthship Homes in Olst and their potential contribution to sustainable housing development and community resilience in the Netherlands. EH expressed overwhelmingly positive experiences and perceptions, highlighting Earthships' contribution to sustainable living and resilience. They valued self-sufficiency, sustainability features, and community cohesion, despite challenges in construction and lifestyle adjustments. NEH, however, exhibited scepticism towards Earthships, citing concerns about longevity, aesthetics, and community integration. While recognizing sustainability's importance, NEH participants question whether Earthships represent viable long-term housing solutions.

Regarding Earthship Homes' contribution to sustainable housing development in Olst, EH viewed them as exemplars of sustainable living, showcasing resource efficiency and community resilience. Their positive experiences and perceptions underscore Earthships' potential to advance sustainable housing goals. In contrast, NEH expressed concerns regarding Earthships' lifespan and visual impact on the community. Despite recognizing the need for sustainable housing options, NEH preferred alternatives to Earthships.

Concerning Earthship Homes' contribution to community resilience in Olst, EH emphasized the positive impact of communal living and resource-sharing on social cohesion and resilience. They cited Earthships' role in fostering green initiatives and diversifying the local community as evidence of their resilience-building potential. However, NEH perceived limited interaction between Earthship residents and the broader community, raising doubts about Earthships' influence on community cohesion. Some NEH expressed annoyance with Earthship residents' behaviour, suggesting potential friction within the community.

Overall, public opinion on Earthship Homes' contribution to sustainable housing development and community resilience in Olst reflects a divergence between EH and NEH perspectives. EH largely view Earthships positively, recognizing their role in promoting sustainability and resilience, while NEH harbour reservations, citing concerns about longevity, aesthetics, and community integration. Bridging this gap requires addressing technical and aesthetic concerns, enhancing community engagement, and fostering broader acceptance of sustainable housing solutions. Moving forward, collaborative efforts involving Earthship residents, local authorities, and community members are essential to advancing sustainable housing development and resilience in Olst and beyond.

6 Limitations

Initially, the research plan involved employing interviews to gather data on the public perceptions regarding Earthship Homeowners and the Not Earthship Homeowners. However, there has been a switch to doing a survey, because there was a limited number of people willing to participate in the interview. This may have led to limitations in the quality of the collected data.

Although surveys often lead to gathering data from a larger sample size, the participants may have experienced less freedom to express their thoughts and elaborate on their opinions. Additionally, the survey may not have allowed for the exploration of unexpected themes or insights, as the survey followed a predetermined set of questions. Despite the survey's reliance on open-ended questions to encourage the participants expressions, it may not have elicited the same level of detail as interviews.

Another limitation that needs to be considered is that the survey methodology may introduce biases, as respondents self-select to participate. This could potentially skew the findings towards individuals who hold stronger opinions about Earthship Homes. Additionally, the sample size, particularly of Earthship Homeowners, may not fully capture the diversity of perspectives within the community. Moreover, the study's focus solely on Olst may limit the generalizability of its findings to other regions or countries. Furthermore, the research predominantly explores perceptions at a single point in time, which may not fully capture the evolving nature of public perceptions towards sustainable housing solutions like Earthship Homes.

7 Conclusion

Based on the analysis of both Earthship Homeowners and Not Earthship Homeowners in Olst, it is evident that Earthship Homes represent a unique model of sustainable housing development. The perspectives of Earthship Homeowners highlight the positive aspects of living in these sustainable houses, including a strong sense of community, self-sufficiency in resource management, and a commitment to sustainable living. Their experiences underscore the potential of Earthship Homes to contribute to sustainable housing development and community resilience, aligning with global agendas such as the United Nations' Sustainable Development Goals.

However, the viewpoints of Not Earthship Homeowners also shed light on challenges and concerns associated with this alternative housing model. Issues such as doubts about the lifespan of Earthships, aesthetic concerns, and perceived conflicts with community cohesion are significant considerations. These different perspectives highlight the need for careful and thoughtful planning in sustainable housing projects. It is essential to consider everyone’s opinions and address potential issues that may arise.

While Earthship Homes present promising solutions for sustainable housing development, their implementation requires careful consideration of various factors, including the liveability of the Earthships, community integration, and aesthetic appeal. Future initiatives should aim to address these concerns of the NEH while taking advantage of the natural benefits of Earthship Homes to promote sustainable living practices and enhance community resilience. By integrating these perspectives, stakeholders can develop a balanced approach to housing development that balances ecological, economic, and social dimensions. By encouraging conversations, raising awareness, and addressing concerns, stakeholders can work towards consensus-building and collective action. Additionally, using Earthship Homes as an educational resource and live example can showcase their potential and inspire broader adoption of sustainable housing practices.

Reflecting on the strengths and weaknesses of this study, the insights from both the EH and NEH in Olst are valuable. However, the small sample size and potential biases are limitations. For further research, expanding the sample size, and exploring perceptions across a wider geographical range is recommended. Longitudinal studies could provide insights into the long-term impact of Earthship Homes. Policy recommendations include providing financial incentives and creating supportive regulations for sustainable housing developments. Additionally, encouraging community involvement and creating awareness can help address concerns and misunderstandings regarding sustainable housing. These actions can help make sustainable housing more popular, leading to a more resilient and sustainable future.

In conclusion, the public’s perception of Earthship Homes in Olst as a contribution to the future of sustainable housing development and community resilience in the Netherlands is diverse. While Earthship Homes may not be the perfect solution, they serve as examples from which valuable lessons can be learned, contributing to ongoing discussions and efforts towards sustainable housing development and community resilience. Earthships serve as an example to what alternative possibilities exist, providing valuable learning experiences from both their successes and shortcomings.

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Appendixes

Appendix A: Survey Guide 1 - Earthship Homeowners

Introduction

Hello there!

First of all, I thank you for participating in this survey. This is part of the completion of my bachelor's project and the main focus of my bachelor thesis, which I do at the University of Groningen, as you already know.

In this survey I will ask you questions about your personal view on the contribution of the Earthship Homes in Olst to the future of sustainable housing development and community resilience.

The survey will be conducted with both the Homeowners of the Earthship Homes and the Not Earthship Homeowners, to gain a better understanding of the public perceptions.

It is important for you to know that this survey will remain completely anonymous. Only I, and if I really need my direct supervisor, will have access to this data. If you wish to opt out of participating in the study at a later date, you can notify me at any time and your participation will be removed from the study completely.

This is all the information that is important for you to know, feel free to ask if you have any more questions.

Before we start, please be sure that I carry no judgment. I am simply trying to understand the area and what people think has been good or not and what has worked or not.

Ok, thank you. Let's start!

Appendix B: Survey Guide 1 – Questions (Earthship Homeowners)

Experience and Satisfaction

1. Can you describe your experience living in an Earthship Home?
2. What is the most prominent feeling that motivated you to choose an Earthship Home as your residence?
3. How satisfied are you with the overall functionality and performance of your Earthship Home, on a scale from 1 to 10? (Where 10 is extremely satisfied, and 1 is extremely unsatisfied)

Perceptions of Sustainability

4. From your perspective, how do Earthship Homes contribute to what you understand as a more sustainable way of living?
5. In what ways do you feel Earthship Homes align with your personal values related to sustainability?
6. Have you noticed any benefits or challenges associated with living in an Earthship Home in terms of sustainability?

Community Engagement

7. How would you describe the sense of community within the Earthship community in Olst?
8. Do you actively engage with other Earthship Homeowners or participate in community initiatives?
9. How do you think Earthship Homes foster community resilience and cohesion within Olst?

Challenges and Adaptations

10. What are some of the challenges you've faced living in an Earthship Home, if any?
11. Can you share any instances where you've had to adapt your lifestyle or habits to accommodate living in an Earthship Home?
12. How do you address any limitations or difficulties associated with Earthship living?

Future Perceptions

13. Looking ahead, what changes or improvements would you like to see in the Earthship community in Olst? (name two)
14. How do you envision the role of Earthship Homes evolving in the broader context of sustainable housing development in the region?
15. Would you recommend Earthship living to others interested in sustainable housing options? Why or why not?

Appendix C: Survey Guide 1 – Questions (Earthship Homeowners) I Dutch Version

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Ervaring en Tevredenheid

1. Kunt u uw ervaring van het leven in een Aardehuis beschrijven?
2. Wat was voor u het belangrijkste gevoel dat u heeft gemotiveerd om een Aardehuis als uw verblijfplaats te kiezen?
3. Hoe tevreden bent u over de algehele functionaliteit en prestaties van uw Earthship-woning, op een schaal van 1 tot 10? (Waarbij 10 zeer tevreden is, en 1 zeer ontevreden)

Percepties van Duurzaamheid

4. Vanuit uw perspectief, hoe dragen Aardehuizen bij aan wat u beschouwt als een duurzamere manier van leven?
5. Op welke manieren voelt u dat de Aardehuizen aansluiten bij uw persoonlijke waarden met betrekking tot duurzaamheid?
6. Heeft u voordelen of uitdagingen opgemerkt die gepaard gaan met het leven in een Aardewoning op het gebied van duurzaamheid?

Maatschappelijke Betrokkenheid

7. Hoe zou u het gevoel van gemeenschap binnen de Aardehuizen in Olst beschrijven?
8. Hoe is uw contact met de andere bewoners van de Aardehuizen en neemt u deel aan gemeenschapsinitiatieven?
9. Hoe denkt u dat Aardehuizen veerkracht en sociale cohesie binnen Olst bevordert?

Uitdagingen en Aanpassingen

10. Wat zijn enkele van de uitdagingen waarmee u te maken heeft gehad bij het leven in een Aardehuis, indien van toepassing?
11. Kunt u voorbeelden delen waarbij u uw levensstijl of gewoonten hebt moeten aanpassen om te kunnen leven in een Aardehuis?
12. Hoe gaat u om met eventuele beperkingen of moeilijkheden die gepaard gaan met het leven in een Aardehuis?

Toekomstperspectieven

13. Wat voor veranderingen of verbeteringen zou u graag zien in de Aardhuis gemeenschap in Olst? (noem er twee)
14. Welke rol zie je Aardehuizen spelen bij het vormgeven van de toekomst van huisvesting en gemeenschapsveerkracht in de regio?
15. Zou u het wonen in Aardehuizen aanbevelen aan anderen die geïnteresseerd zijn in duurzame huisvestingsopties? Waarom wel of waarom niet?

Appendix D: Survey Guide 2 – Not Earthship Homeowners

Introduction

Hello there!

First of all, I thank you for participating in this survey. This is part of the completion of my bachelor's project and the main focus of my bachelor thesis, which I do at the University of Groningen, as you already know.

In this survey I will ask you questions about your personal view on the contribution of the Earthship Homes in Olst to the future of sustainable housing development and community resilience.

The survey will be conducted with both the Homeowners of the Earthship Homes and the Not Earthship Homeowners, to gain a better understanding of the public perceptions.

It is important for you to know that this survey will remain completely anonymous. Only I, and if I really need my direct supervisor, will have access to this data. If you wish to opt out of participating in the study at a later date, you can notify me at any time and your participation will be removed from the study completely.

This is all the information that is important for you to know, feel free to ask if you have any more questions.

Before we start, please be sure that I carry no judgment. I am simply trying to understand the area and what people think has been good or not and what has worked or not.

Ok, thank you. Let's start!

Appendix E: Survey Guide 2 – Questions (Not Earthship Homeowners)

Perceptions of Earthship Homes

1. What are your thoughts or impressions of Earthship Homes as a housing option in Olst?
2. How familiar are you with the concept of Earthship Homes, and what do you perceive as their main features or benefits? (name two main benefits)
3. Have you ever considered living in an Earthship Home, or do you know anyone who does? If so, what factors influenced your decision or perception?

Sustainability and Resilience

4. How important are sustainability and resilience considerations when choosing a place to live, on a scale from 1 to 10? (where 10 is extremely important and 1 is extremely unimportant)
5. How do you think Earthship Homes contribute to sustainable housing development and community resilience in Olst? (name three things)
6. Are there any specific sustainability features or practices you would like to see more of in housing developments within the community?

Community Dynamics

7. Can you describe the sense of community within Olst, particularly in relation to housing choices?
8. How do you perceive the relationship between Earthship Homeowners and Not Earthship Homeowners in the community?
9. In what ways do you think Earthship Homes impact community cohesion within Olst?

Challenges and Concerns

10. Are there any concerns or reservations you have about Earthship Homes or sustainable housing developments in general?
11. What potential challenges or drawbacks do you see in adopting sustainable housing practices like those seen in Earthship Homes? (name two challenges/drawbacks)
12. How do you think the community might respond to the increasing presence of Earthship Homes in Olst? Positive? Negative?

Future Perspectives

13. Looking ahead, how do you envision the future of housing development and sustainability practices in Olst?
14. What role do you see Earthship Homes playing in shaping the future of housing and community resilience in the region?
15. What role do you see Earthships playing in shaping the future of housing and community resilience in the region?

Appendix F: Survey Guide 2 – Questions (Not Earthship Homeowners) I Dutch Version

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Percepties van Aardehuizen

1. Wat vindt u van Aardehuizen als woonoptie in Olst?
2. Hoe bekend bent u met het concept Aardehuizen, en wat beschouwt u als hun belangrijkste kenmerken of voordelen? (noem twee belangrijkste kenmerken/voordelen)
3. Heeft u ooit overwogen om in een Aardehuis te wonen, of kent u iemand die dat wel doet? Zo ja, welke factoren hebben uw beslissing beïnvloed?

Duurzaamheid en Veerkracht

4. Hoe belangrijk zijn duurzaamheid en veerkracht voor u bij het kiezen van een woonplek, op een schaal van 1 tot 10? (waarbij 10 extreem belangrijk is en 1 extreem onbelangrijk)
5. Denkt u dat Aardehuizen bijdragen aan duurzame woningbouwontwikkelingen en de veerkracht binnen de gemeenschap van in Olst? (zo ja, noem drie zaken)
6. Zijn er specifieke duurzaamheidskenmerken die u graag meer zou willen zien in woningbouwprojecten binnen Olst?

Gemeenschap Dynamiek

7. Kunt u het saamhorigheidsgevoel van uw wijk beschrijven?
8. Hoe ziet u de relatie tussen bewoners van de Aardehuizen en de bewoners van de rest van de wijk?
9. Denkt u dat de bewoners van de Aardehuizen saamhorigheid binnen Olst beïnvloeden?

Uitdagingen en Zorgen

10. Heeft u zorgen over Aardehuizen of duurzame woningbouwontwikkelingen in het algemeen?
11. Welke potentiële uitdagingen of nadelen ziet u bij het invoeren van duurzame woningen zoals de Aardehuizen? (noem twee uitdagingen/nadelen)
12. Hoe denkt u dat de gemeenschap zou reageren op de toenemende aanwezigheid van Aardehuizen in Olst? Positief? Negatief?

Toekomstperspectieven

13. Vooruitkijkend, hoe ziet u de toekomst van duurzame woningbouwontwikkelingen in Olst?
14. Welke rol ziet u Aardehuizen spelen in het vormgeven van de toekomst van huisvesting en de veerkracht van de gemeenschap in de regio?

15. Zijn er veranderingen of initiatieven die u graag uitgevoerd zou zien om duurzame leefopties voor inwoners in Olst te bevorderen?
