Università degli Studi di Ferrara | DA Dipartimento Architettura Ferrara | Universiteti POLIS

Contextual Building Materials

Unfolding Meaning-Making Dynamics and Communities' Identities Towards the Production of an Ecologically Responsible Built Environment. The case of Sedentary Maasai Communities

Candidate: Laia Gemma Garcia Fernandez
DA Supervisor: Prof. Dr. Roberto Di Giulio
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Cycle XXXIV

International Doctorate in Architecture and Urban Planning

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A Isla, que llegó
Y al yayo Picacha y la yaya Pegota, que se fueron.

Abstract

English

This research looks at the production of the built environment and the decision-making dynamics through which building processes are implemented and perpetuated. It specifically highlights the role of construction materials through the lens of Material Ecologies, in an attempt to unpack its socio-cultural and environmental meanings. The research analyses the evolution of the Maasai building culture from the nomadic hut to the contemporary environment of rural settlements. By doing so, the analysis highlights underlying processes that inform the use, rise and/or neglect of certain building techniques and materials throughout time and space. The research develops alongside two case studies in which prototype public facilities were built by using innovative and locally sourced building materials. The development of the prototype buildings is central to understanding the impact and embracement of alternative building solutions by the local communities. Compressed Stabilised Earth Bricks were used in the construction of both projects, proposing an alternative to unecological and damaging materials such as the self-production of fired bricks. Community involvement, awareness campaigns, training workshops and meetings were held contemporary to the development of the projects to ensure a smooth transfer of the technique's specificities. Through the direct involvement of the researcher in the development of the built projects and the subsequent ethnographic research conducted in the two locations, this thesis assesses the viability of introducing a technological innovation in the local building culture. As such, through the research question: Considering the climate threats posed by the building industry, how can the understanding of communities' building materials choice become a valuable tool in the promotion and integration of ecological and contextual building practices? The research further analyses community perceptions and the possible impact of the built prototype through three different lenses: Dwelling, and how the meaning of home shapes the ways of inhabiting and building homes; Resources, building materials and which are the driving choice of such for the local community; and skills, looking at the role of local builders, architects and planners in proposing sustainable alternatives that are adapted to the habits and desires of the rural communities analysed. The discussion raises entangled pressures of modernity, power, status and representation among others, as well as key practical considerations of building materials such as durability, availability, thermal comfort or cost. Underpinning the premise that architecture can be understood as a cultural device embodying valuable information about users' behaviours, practices and beliefs, this research seeks to navigate environmental behaviour theories to find ecological and culturally responsive building solutions to the context of settled Maasai communities in Tanzania.

Italian

Questa ricerca esamina la produzione del mezzo costruito e le dinamiche decisionali attraverso le quali i processi edilizi vengono realizzati e perpetuati. In particolare, evidenzia il ruolo dei materiali di costruzione attraverso la prospettiva della Ecologia dei Materiali, nel tentativo di sviscerarne i significati socioculturali ed ambientali. La ricerca analizza l'evoluzione della cultura edilizia Maasai dal rifugio nomade agli edifici contemporani degli insediamenti rurali. In tal modo, l'analisi mette in luce i processi sottostanti che informano l'uso, l'adozione e/o la trascuratezza di determinate tecniche e materiali edilizi nel corso del tempo e dello spazio. La ricerca si sviluppa parallelamente a due casi studi in cui sono stati costruiti prototipi di strutture pubbliche utilizzando materiali da costruzione innovativi e di origine locale. Lo sviluppo dei prototipi edilizi è fondamentale per comprendere l'impatto e l'accettazione di soluzioni edilizie alternative da parte delle comunità locali. Mattoni di terra compressa stabilizzata sono stati utilizzati nella costruzione di entrambi i progetti, proponendo un'alternativa a materiali non ecologici e dannosi come l'autoproduzione di mattoni cotti. Coinvolgimento della comunità, campagne di sensibilizzazione, workshop formativi e incontri sono stati organizzati contemporaneamente allo sviluppo dei progetti per garantire un trasferimento agevole delle specificità della tecnica. Attraverso il coinvolgimento diretto della ricercatrice nello sviluppo dei progetti edilizi e la successiva ricerca etnografica condotta nei due luoghi, questa tesi valuta la fattibilità di introdurre un'innovazione tecnologica nella cultura edilizia locale. Pertanto, attraverso la domanda di ricerca: Considerando le minacce climatiche poste dall'industria edilizia, come può la comprensione della scelta dei materiali da costruzione delle comunità diventare uno strumento prezioso nella promozione e integrazione di pratiche edilizie ecologiche e contestuali? La ricerca analizza ulteriormente le percezioni della comunità e il possibile impatto dei prototipi costruiti attraverso tre diverse prospettive: Alloggio, e come il significato di casa plasmi i modi di abitare e costruire; Risorse, materiali di costruzione e quali sono le scelte determinanti per la comunità locale; e Competenze, guardando al ruolo dei costruttori locali, degli architetti e dei pianificatori nella proposta di alternative sostenibili adattate alle abitudini e ai desideri delle comunità rurali analizzate. La discussione solleva pressioni intrecciate di modernità, potere, status e rappresentazione tra gli altri, così come importanti considerazioni pratiche dei materiali di costruzione come disponibilità, comfort termico o costo. Sottendendo la premessa che l'architettura possa essere intesa come un dispositivo culturale che incorpora informazioni preziose sui comportamenti, le pratiche e le credenze degli utenti, questa ricerca cerca di navigare le teorie del comportamento ambientale per trovare soluzioni edilizie ecologiche e culturalmente rispondenti al contesto delle comunità Maasai stabilite in Tanzania.

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Moto. Also, this research project would not have been possible without the guidance of community groups in Maji Moto, especially the several women's saving groups that participated in the many activities that we organised; thanks to the local government of Maji Moto, the Mtendaji and the Mwenyekiti, for the trust in our time to build the much-needed Health Centre, and for the help provided at every step of the project development; and finally, I want to thank everyone in Maji Moto, for having accepted me as part of the community. Your kindness and warmth have made me find a new place to call home. I am truly indebted to everyone from whom I learned something about the fascinating Maasai culture, for having challenged my ideas and pushed me beyond anything I would have expected. Thank you.

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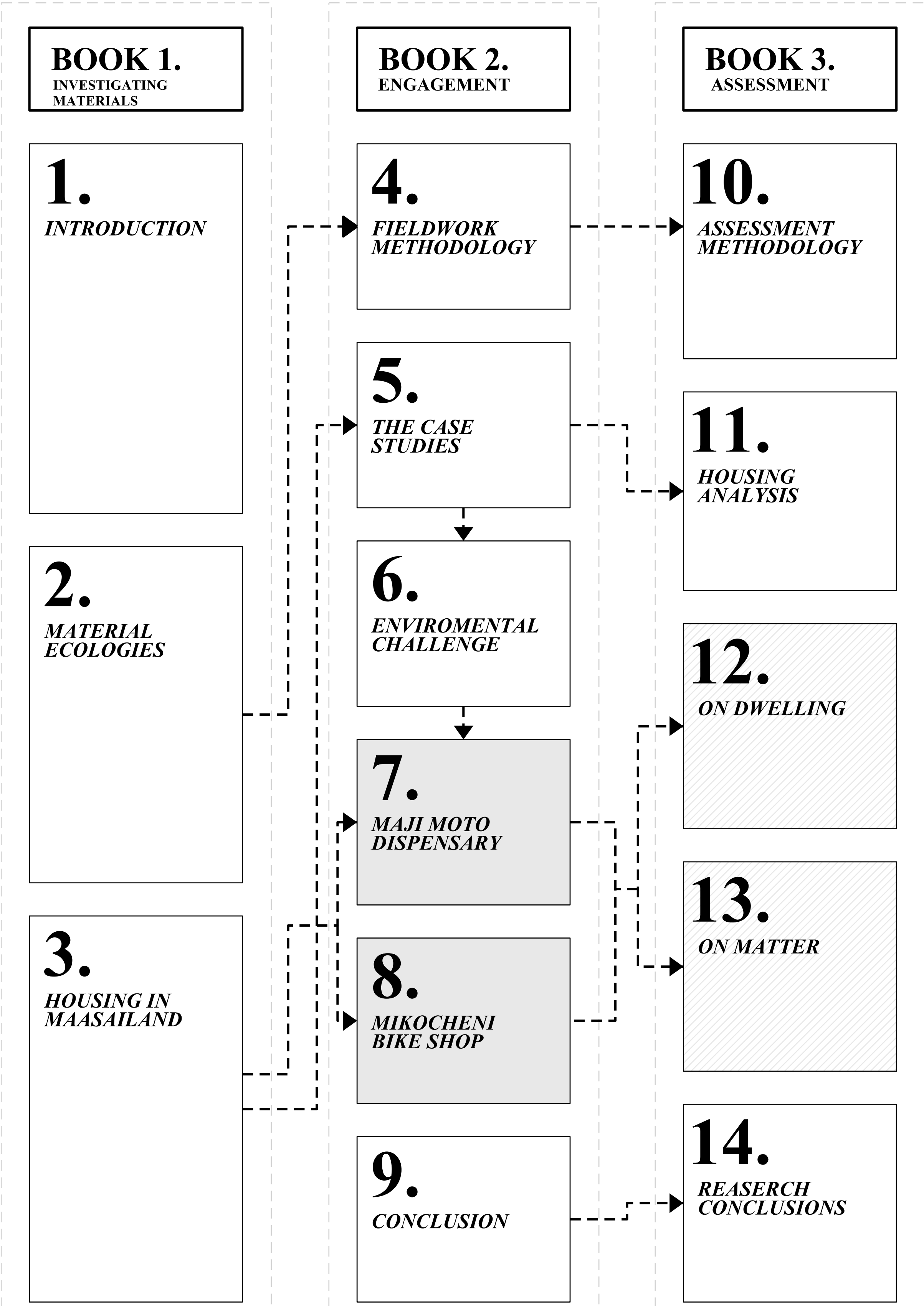
And finally to the only one, Carlos, who has never stopped believing in me. I love you.

Thesis summary

How to navigate this research



This book presents the debate, framing the research questions and introducing the case.

This book presents the prototype built projects as the milestone of this research. The last chapter also assesses the impact of the piolot projects.

Book 3 creates a discussion analysing the meaning of home and the driving choice of building materials.

List of Abbreviations

National Housing Corporation (NHC)

Register of Buildings (RoB)

Tanzania Mortgage Refinancing Company (TRCM)

Corrugated Roof Sheets (CRS).

Ngorongoro Conservation Area Authority (NCAA)

Corrugated Iron Sheets (CIS)

Compressed Stabilised Earth Bricks (CSEB)

Table of Contents

7 — Maji Moto Dispensary: First Built Prototype

8 — Mikocheni Bike Shop: Second Built Prototype

9 — Conclusions on PrototypeDesign

Book 3. ASSESSMENT

Chapter 10. Methodology: Assessment Stage

Chapter 11. Housing Analysis: Maji Moto and Mikocheni

Chapter 12. On Dwelling: Processes and Form

Chapter 13. On Matter: Driving Choice of Building Materials

Chapter 14. Research Conclusions

Investigating Materials in Maasailand

Book — 1

This book introduces the research that is presented in this PhD thesis. The objective of this introductory book is to give an understanding of the topic under investigation, the current debate on building materials and the role of architecture in development contexts. It also presents the Maasai case, which will be the focus of the following books. Once the research questions and objectives have been unfolded, Chapter 2 presents the theoretical approach used to analyse the case study. The framework is aimed at laying out the basis for analysing perception in the built environment, and more specifically in building materials. The approach of Material Ecologies contributes to defining how this thesis looks at material processes and vernacularity. Finally, Chapter 3 investigates the evolution of Maasai settlements throughout time and space, providing an in-depth analysis of the changes and challenges that nomadic communities have undergone in their journey towards a sedentary lifestyle. To sum up, this book wants to introduce the main research topic to the reader, giving an overview of the main theories applied to the case for researching materiality within Maasai communities.

BOOK 1.
INVESTIGATING MATERIALS IN MAASAILAND

Content

1 — Introduction: Case and Debate

This research examines the processes and dynamics that are involved in the formation of the built environment's meaning for Maasai communities in rural Tanzania. By navigating meaning-making dynamics, this thesis wants to elucidate the driving choice of building materials of the analysed communities. Building from the perspective of Ingold's ecological approach (2000), this research claims that the way in which people experience materials has a profound effect on resultant built forms, and eventually in people's lives (Tilley, 2007). By looking at people's everyday life dynamics, this research wants to analyse the existing entanglement between local and industrialised materials, offering a novel methodology to find material innovations that can be implemented successfully at the local level while contextual to the social and cultural fabric. As part of this thesis, I propose a framework in which the role of the architect is more that of a process-maker rather than a simple project designer, recognising our responsibility in the transition towards a material world that is environmentally conscious and culturally appropriate.

This chapter introduces the case study of this thesis, a sedentary Maasai community in northern Tanzania, by looking holistically at building materials and the main discourses around development architecture. As an ethnic group commonly known for its pastoralist nature, the Maasai gave up their nomadic lifestyle due to manifold constraints, both external and internal. This has resulted in a process of sedentarisation that has widely impacted their vernacular architecture, as new sedentary practices have required an adaptation of their buildings. More specifically, the building materials traditionally employed have been discarded as their level of permanence has required more adapted building techniques. Among the newly incorporated materials, the use of fired bricks has been widespread within Maasailand and in the rest of the country. The reason for the massive utilisation of these is their easy manufacture. The challenge is the biomass utilised to bake the bricks: local wood. In this way, the fragile savannah environment has been profoundly impacted by uncontrolled felling to produce fired bricks, among others.

Due to the huge impact of building materials production in our natural environments, several research innovations are being conducted to find suitable alternatives to the uncontrolled environmental destruction for which material extraction and production are responsible. However, material research has often lacked an account of the social and cultural appropriateness of material innovations, risking failure in its absorption by communities. With more emphasis on the case of low-income rural communities, the need is to find technological solutions that mitigate the effects of climate change through the use of available local resources while supporting communities' socio-cultural aspects.

This research project was conceived during my stay in a Maasai village while participating in the design and construction of a public facility. As an architect involved in the building process, I was always very keen to propose the use of locally available building materials. Throughout the entire process, I witnessed how most of my ideas for using for instance local soil were initially rejected by the local community. As a response to my frustration, I started thinking about my own perception of the built environment and how I could formulate a proposal to enquire how the significance of building materials and more in general architecture, is acquired by users. In this way, some years later I proposed to develop a building prototype by using a technological solution that will be presented in Chapter 6, solving a lack of access to healthcare while tackling the local issue of materials with an alternative technological solution. This research exposes both the development of two pilot projects and a further analysis of the impact of the built projects. Lastly, the research addresses how communities' perceptions are shaped by experiencing the built environment, concluding with some insights to further forecast adaptation by communities to ecological and contextual building solutions.

1.1 PROLOGUE

Throughout the long journey in architecture towards the completion of my studies I received presumably mainstream training, though back then I could not perceive the profound gaps in the educational curriculum of architecture studies. The lack of awareness about the responsibility of architecture in global processes of climate change and how to tackle it from the construction sector; the scarce theoretical base on the social responsiveness of the profession; the missing knowledge on community participation and the lack of accountability of urban planning and architecture in perpetuating social exclusion and inequalities. This gave me a sense of responsibility that I needed to fill with a more critical experience, but this did not happen until my fourth year when I took part in an internship programme with C-re-aid NGO to design a women's meeting centre in a rural village in Tanzania (2016). As part of the process of construction, I was constantly challenged by the need to balance community agency and expertise, sustainability and appropriateness, as well as by homeowner's idea of vernacularity, development and modernity. In an attempt to find answers to my questions, I embarked on a Master's programme at the Bartlett Development Planning Unit (UCL) after my graduation in Architecture (2018). During my journey at the DPU, I was able to look at development processes from diverse perspectives: from Foucault (1979, 2008) and Said (1978) as the theoretical departure points of post-development theories, to radical and decolonial visions of post-development such as those of Escobar (2012), Simone (2016) and Miraftab (2009).

My experience as a development architect plus the exposure to enriching literature helped me to find a niche of special interest in the intersection between architecture and anthropology. I discovered a decent amount of literature concerned with the impact of socio-cultural practices in built forms and the rapid loss of vernacular architecture (Bonell and Van Geert, 2009; Watson, 2019). Driven by the role that indigenous knowledge has in the promotion of ecological innovations, researchers and practitioners are striving to find connections to local contexts by proposing environmentally sustainable designs (Rumana, 2007; Heringer, 2019). However, many have witnessed that efforts to revitalise vernacular architecture fail to win the approval of locals as external influences and new social values bias preferences towards standardised building materials (Kaitilla, 1994; Rapoport, 1983; Magutu, 2015). In view of this, other authors such as Livingston (1992), Beckman (1976), Memmot and Keys (2015), and Fathi (1969) have offered insightful analysis surrounding the shifting perception of communities regarding building materials. Drawing from such cases and considering my own struggle to reconcile material innovation and indigenous building traditions, I focused my MSc dissertation proposal on theories around the cultural responsiveness of architecture. The objective was to develop a tool to decode socio-cultural expressions embedded in the use of specific building materials in the context of rural Maasai communities. As such, I got interested in the theoretical work of Amos Rapoport, an architect and anthropologist working across cultures who laid the foundation for a new method of architectural enquiry: Environmental-Behaviour Studies (EBS), with the premise that built environments are conceived to give support to people's behaviours and activities (Rapoport, 1983). Departing from the theoretical perspective of EBS, Rapoport developed a method for identifying which elements of a given culture are of greatest significance and thus must be dealt with special care by the designer (Ibid.). The methodology involved the classification of cultural practices into 'core' and 'peripheral' followed by a three-tier system of meanings that would ultimately be useful in providing culturally adapted design guidelines (Rapoport, 1990). While the methodology was useful to be applied to secondary data as part of my dissertation, it soon turned inflexible and static for my case, as other aspects of people-environment relations became subordinated to the cultural significance of people's settings. Rapoport envisioned the use of such a methodology as a cogent standardise tool that is always based on theory. Considering the dynamism of cultures, the endlessly evolving relations existing between bodies and places and how both shape each other, such a rigid unidirectional framework tended to consider socio-cultural practices as easily classifiable. Additionally, a fieldwork conducted in 2021 in which I further became aware of the multiple variables existing when analysing people and their environments, pushed me to reassess the theoretical base of my research.

The focus on cultural aspects of the built forms, therefore, could only partially respond to my questions regarding people's driving choice of building materials. The social and environmental interactions within the context of the settled Maasai communities I was looking at, needed to be carefully analysed by acknowledging its multi-layer complexities. Material culture studies[1] offered a novel view to analyse the relation between people and objects, as the main concern of such an anthropological branch is to address how objects and their properties have a certain significance in people's lives (Tilley, 2007). While contributing to decoding socio-cultural expressions embedded in the material world of a specific group (Buchli, 2002), material culture attempts to look at the processes that bond people to places and objects. Furthermore, literature on phenomenology has stressed the various underlying patterns that define the essence of bodily environmental experiences, while enlightening as well, less visible qualities that relate to the vernacular world (Seamon, 1991; Harvey 1958). In the attempt to understand how these inter-relations could contribute to developing a holistic theoretical base for my research, I became interested in the vision of ecological anthropology offered by Tim Ingold (2000, 2007 and 2012). His approach seeks to envision a holistic anthropological enquiry, using ecology to look at the processes by which meaning has been given. This approach places the environment as an active agent in the creation and transformation of the meaning we give to the built environment.

1- Material culture studies is an interdisciplinary field of research that focuses on the study of material objects and artifacts as a way to understand and interpret human culture and society. It examines the ways in which objects and material things shape and are shaped by social, economic, political, and cultural processes.

Delving into the core of how meaning is created and how it influences our building material choices, has been crucial to elucidate communities' choice of building materials. The journey towards this research's findings has required me to look beyond my previous knowledge and fieldwork experience. By no means, embracing the approach of anthropological ecology has been both enlightening and challenging throughout this research path. It has equipped me with the tools to look at the contemporary built environment of Maasai communities, elucidating the intertwined dynamics that have shaped the spatial and material forms of buildings. Only by encompassing anthropological enquiry and architecture theory, it will be possible to propose alternative and contextual building solutions that advance in the search for adaptative solutions that mitigate the effects of climate change.

1.2 ARCHITECTURES OF (DE)DEVELOPMENT

In 1974, the philosopher Henri Lefebvre published a book entitled 'The Production of Space', bringing to light his conception of space as an entangled scenery of political and socio-cultural processes. Both in general and more specifically in architecture and urban planning, space has been understood as a container or objectified setting for human activities (Ordoñez et al, 2021). With Lefebvre, space was theorised beyond its materialisation for the first time, recognising it as a product and producer of processes and social relationships. In translating such concepts into the built forms, it is unfortunate to realise how the modern world is progressively neglecting the ancestral meaning of architecture as a supportive element in the development of societies. Buildings have become fetishised objects in which only the aesthetic aspects are to be taken into consideration. In such fetishisation of the built environment, socio-cultural and ecological aspects are denied, and the architectural work is just seen as an object produced by an individual expert. The individual authority of architectural works can only be blurred through a thorough revision of the social processes involved in its production. This becomes more evident if we look at indigenous building traditions, whose collective authorities have been progressively lost despite the deep connection existing between people, their surrounding environment and the materials involved in the way architectures are performed. In a recent article published by The New York Times (2020), the Nigerien Architect Mariam Kamara argued the need to reassess discourse around indigenous building technologies as not merely "contextual" but irreducibly logical. By analysing the environmental pressures of the Niamey countryside, she examined how buildings kept their interiors cool and well-ventilated through the use of heat-resistant earthen walls. She also remarked on the use of this traditional technique as environmentally sustainable and cost-saving. Yet, earth masonry is considered a poor building material by the majority of locals and therefore using mud bricks in her latest project was deemed a "provocative choice for a middle-class, urban project" (Snyder, 2020).

The evidence in support of using locally sourced materials is beginning to challenge material and technical hegemony within architectural practice.

Traditional vernacular architecture can be further improved by combining traditional materials and techniques with contemporary technologies. The difficulty lies in the fact that the symbolic value of modernity associated with certain building materials has taken precedence over functional requirements such as availability, cost or comfort (Kaitilla, 1994). Several authors have written about the socio-cultural and environmental significance that materials have in terms of identity, which in some cases prevents the adoption of locally sourced building materials (Livingston, 1992; Beckman, 1972; Rapoport, 1983). The rejection of traditional construction techniques seems by external eyes a common phenomenon among developing countries. Dwellers aspire to own such houses and prefer to adapt their traditional customs to these new westernised constructions despite 'not being architecturally accommodating of such behaviours or being climatically responsive' (Memmott & Davidson, 2008:60). Facing a similar demand for westernised materials in his own country, the former President of Tanzania, Julius Nyerere, remarked in a public address that 'the present widespread addiction to 'European soil' (cement) and tin roofs is a kind of mental paralysis' (Mwafongo, 1984:23). He also argued that if Tanzanian citizens wanted to progress more rapidly, they 'must overcome at least some of these mental blocks and biases against alternative building materials.' However, statements such as this demonstrate naivety as they do not consider the symbolic meaning that materials may have acquired in a specific context. In this case, the use of modernised building solutions provides a vision of a socio-cultural change, as they reflect an openness to expressing a new social identity (Rapoport, 2005).

Through a study conducted with C-re-aid NGO, it has been observed how innovative technologies which include locally sourced materials have often been rejected by local communities. Similarly, many other organisations and architectural offices have struggled to encourage the use of sustainable building solutions, as certain socio-cultural values and quality expectations are now opposed to notions of the traditional. Therefore, a thorough understanding of cultural values and environmental features and their implications is essential to avoid architectural solutions that might be rejected by local communities. At the same time, this research wants to look at the everyday life constraints that are diminishing the use of traditional materials, enlightening these processes by which local communities have created new values related to industrialised materials.

The complexities of a dynamic built environment hinder the understanding of users' material perception as intertwined socio-political, environmental and economic structures also influence the decision-making process. The challenge is to find ways to promote the use of locally sourced building materials that are culturally acceptable by communities while contextual to the environmental conditions of places. As such, this research wants to highlight the methods and tools that professionals working in the built environment can use to promote sustainable and contextual building practices.

1.3 HOLISTIC DEBATE ON BUILDING MATERIALS

The expansion of a globalised construction market has led to an increasing immateriality and loss of identity in the built environment (Croyle, 2020). As a result, societies have tended to see building materials as products rather than as resources, leading to the dissociation of people from their environment. In the global south and particularly in indigenous contexts, populations are still very connected to their environmental resources. The responsible use of materials for construction is a key element in promoting sustainable management of these resources. Tackling this issue means acknowledging that a change in the construction industry is required to reduce the emissions associated with material production, as the only response towards a decarbonised future. As such, the current challenge in the context of the global south lies in effectively utilising and supplying affordable, innovative building solutions by using locally available materials, as a way to reach the urban poor who constitute around 70% of the population (Magutu, 2015). Two main reasons are proposed here as to why this research looks at contextual and ecological materials:

The contribution of locally sourced materials in mitigating and adapting to climate change

The production of building materials accounts for around 40% of the total energy consumption within the construction industry, mostly through the production of cement and steel (Mankelow et al., 2010). According to the IPCC Report (2019) and the Paris Agreement (2016), there is an urgent need to adopt measures to reduce GHG emissions and the construction sector plays an important role in achieving this goal.

Historic and traditional building techniques regulate temperature flows with passive cooling systems whilst often making use of local materials such as stones or earth, in turn reducing power demands, the need to transport material long distances and improving building material sovereignty (Beckett and Ciancio, 2012; Orsini and Marrone, 2019). The vernacular mud houses in many African contexts still provides many valuable examples. In the case of Nigeria, Architect Demas Nwoko (Croyle, 2020) employs traditional cooling systems by using locally sourced materials. Unfortunately, many contemporary architecture strategies have largely avoided considering local climate conditions by incorporating active cooling systems, neglecting the knowledge embodied in vernacular passive cooling systems. The present dissociation of architecture with place has led to a rise in global emissions, as active cooling systems release 1 gigatonne of annual GHG emissions (Foroudi, 2020) with air-conditioners consisting of 20% of the total electricity used by buildings (IEA, 2018).

At the local level, theorists have identified that there is also a need to put in place measures that control the excessive pressure on certain natural resources such as woodlands (used as timber or as fuel to bake bricks by large-scale industries) to mitigate adverse weather effects as draughts and excessive rainfall. Also, the proper management of local resources contributes to the knowledge of the close environment, leading to better adaptation to climate change.

Local materials' key role in promoting environmental justice and the autonomy of local communities

For thousands of years, humans have utilised the environment, transforming the materials found in the surroundings to generate construction systems that are attuned to (and in part constrained by) the geological, climatic and cultural conditions of a given place. For this reason, Habitat International Coalition-Latin América (HIC-LA) has recently launched a manifesto where it argues the need to recognise the importance of and right to create constructions that use and build upon traditional knowledge (TK) by using local materials and adapted techniques. The use of these technologies has the potential not only to reduce the impact of construction on the environment but also to boost circular economies by employing producers of construction materials and skilled workers. Alongside this, it can help to strengthen the social fabric, improve communities' adaptive strategies of resilience and foster a sense of belonging. Furthermore, according to Turner (2018) the equitable supply of locally sourced materials also contributes to the autonomy of societies, encouraging self-sufficiency by reducing the pressure on the mainstream construction market.

In the case of indigenous communities, the built environment is also an important aspect of their heritage, as traditional buildings have been part of their identifying symbols and lifestyles. This helps in claiming and re-asserting their own identity and autonomy (Rowland, 2002). As such, the use of traditional building techniques enables people to better incorporate within residential, utilitarian and communal spaces, their cultural patterns as well as symbols of their beliefs and values.

1.4 THE RESEARCH PROJECT

This section addresses the overall objective and case studies of this PhD research. Firstly, it outlines the aims and objectives of the thesis, alongside the research questions divided according to two different research stages. Secondly, it introduces the case studies that have been investigated throughout the development of the research project, which will be explored more in-depth in the following chapters.

1.4.1 AIMS AND OBJECTIVES

This research revolves around two main objectives. On the one side, it wants to shed light on the impact that prototype-built infrastructures have in the context of rural Tanzania. Besides that, the overall aim of this thesis is to reveal the underlying processes by which meaning is given to the built environment, and how its perception influences people's choice of building materials alongside the resultant built forms. Through an analysis of meaning-making dynamics within people's everyday lives, this research wants to shed light on the ways that societies will adapt and embrace the urgency of transitioning towards a decarbonised and contextual building future.

To achieve its objective, this research analyses people-environment relations through the use of an action-led and process-oriented ecological approach, by looking at the biosocial, cultural, sensorial and spatial aspects that contribute to the meaningful and active involvement of people within their settings.

By focusing on the case of rural Maasai communities, more specifically in two locations in Northern Tanzania, this research has been developed in two stages that are differentiated both methodologically and in terms of the expected results. For this reason, each stage involves different objectives directed to respond to the thesis' research questions:

Overall research question

Considering the climate threats posed by the building industry, how can the understanding of communities' building materials' choice become a valuable tool in the promotion and integration of ecological and contextual building practices?

Engagement Stage

1. What are the benefits of introducing innovative building techniques such as the Compressed Stabilised Earth Bricks in the context of under-resourced rural communities?

2. Which elements are essential to achieve a successful integration of any given innovative building solution?

3. How should a community-led built prototype be designed to become a catalyser contributing to the ecological transformation of the local building culture?

Assessment Stage

4. What are the environmental processes by which dwellers give meaning to their homes and to what extent do building materials contribute to the creation of such meaning?

5.	How are building materials constantly perceived and experienced and how do such experiences drive people's material choices? How do environmental and socio-cultural aspects determine building materials' perception?

The proposed research questions address the following aims and objectives:

1.	To assess the viability and potential of built prototypes in the context of under-resourced rural communities, and how these projects can influence the local building culture by proposing environmentally conscious and socially viable building solutions.

2.	To analyse indigenous knowledge and current building traditions to assess the adaptation to innovative and sustainable building techniques that tackle material scarcity, climate efficiency, adaptability and other material constraints.

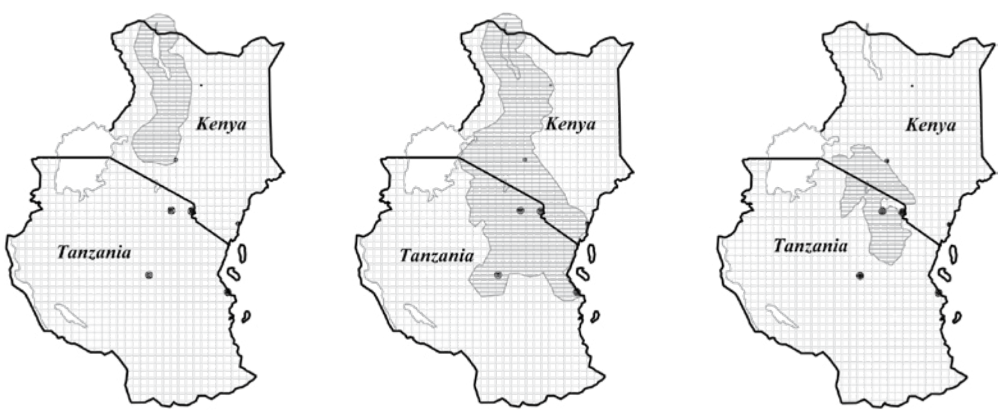
3.	To gain a critical understanding of the architect's role and responsibility in the several phases of community development projects, from viability assessment to the design process and the subsequent impact assessment.

4.	Looking beyond the built forms, to reveal underlying social, ecological and relational processes that shape the meaning that societies give to housing, to ultimately unpack key aspects of design projects' material sustainability.

5.	To explore the core drivers of material choice in the context of self-built housing in Maasai communities and its relationship with both socio-cultural processes and material properties.

1.4.2 INTRODUCING MAASAILAND: FROM NOMADISM TO SEDENTARISATION

Despite the tribe's oral history surrounding their origins in The Great Rift Valley (Waller, 1976), the current extent of Maasailand has been reduced to the area around the border between Kenya and Tanzania (Coast, 2000) [Figure 1.1]. These lands have been the home of the Maasai for centuries, where they

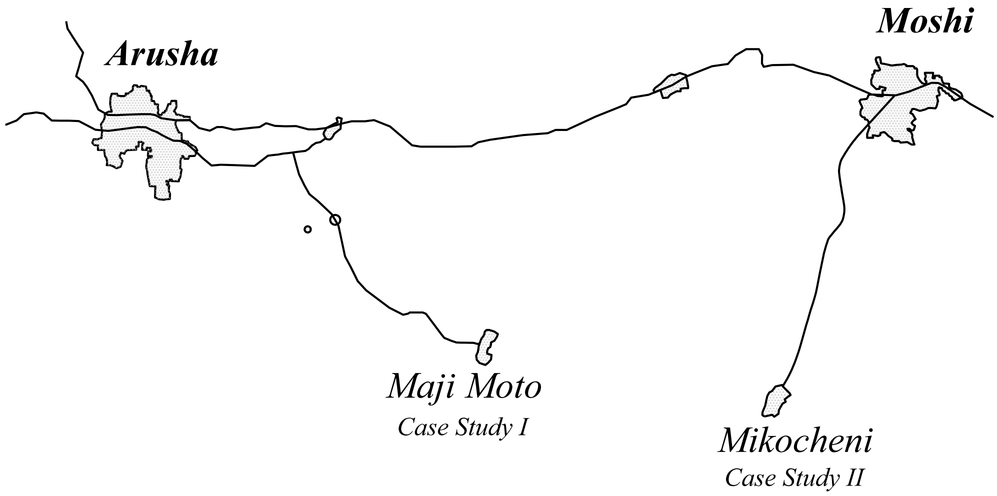


1.1 Evolution of the geography where Maasai communities have inhabited. Own illustration have practised nomadic pastoralism in search of water and pasture for their cattle (Sambu, 2018).

Given the nomadic character of this ethnic group, the shelter has generally been treated as temporary and consequently, the materials employed to build the vernacular Maasai hut or enkaji must be readily available in the semi-arid savanna environment. Traditionally, un-intensive materials were frequently used and then discarded, enabling pastoralist groups to move away whenever was needed and at neither cost nor waste. This circular system shows the intimate connection existing between the Maasai lifestyle and natural resources, rooting their practices to the surrounding environment while becoming co-dependents from one another.

The arrival of German colonies in Northern Tanzania by the end of the 19th Century marked the beginning of a series of forced evictions that have become a common pattern amongst indigenous groups. Ever since the beginning of land administration by Germans first and after by British colonies, the Maasai have been pushed off from their territories due to the privatisation of lands for game hunting and in the name of wildlife conservation (Goldman, 2011). Nowadays the reality remains one of violent forced evictions that threaten the survival of the few semi-nomadic Maasai groups living in the Loliondo area in Arusha Region (Gouverneur, 2023). The largest displacement of Maasai communities from natural protected areas to official settlements happened in 1967, right after the introduction of the so-called Villagisation Policy by Tanzanian President Julius Nyerere. Such a plan was enacted to encourage nomadic communities to live together to provide access to basic health care and education facilities. As a result, Maasai were displaced to areas where they could no longer practice pastoralism, being forced to abandon their semi-nomadic lifestyle. This new permanent condition pushed communities to progressively adapt to farming as a main source for providing livelihoods. The inevitable change to a sedentary lifestyle has impacted the Maasai in many ways, from the erase of indigenous practices to their social organisation and daily routine. But most importantly, this abrupt change is having major implications for the provision of housing. The temporary Maasai hut is not suitable anymore, and therefore, the traditional house built with mud and sticks is now being replaced by more durable and resistant materials. The lack of technical construction knowledge and the scarcity of available resources in new settlements have hindered the capacity of Maasai communities to self-build adapted housing solutions that are safe and thermally appropriate. The lack of access to durable materials that are locally available but economically accessible has impacted the quality and sustainability of permanent constructions. Such systematic change of lifestyle is increasingly demanding in terms of natural resources use, due to a "radical, abrupt and frequently excessive rapid cultural change" (Rapoport, 1983: 254).

In an effort to analyse the existing challenges of the contemporary Maasai built environment, this research has focused on two different case studies of rural communities in Northern Tanzania. The two areas have been selected for several reasons: first of all, the settlements are mostly populated by Maasai ethnic groups. These are located in two regions in northern Tanzania, Kilimanjaro and Arusha [Figure 1.2]. The two villages share several commonalities in terms of environmental challenges and spatial forms; however, these have different levels of urban development. None of the villages is connected to an urban area through a system of public transportation, leaving their populations isolated. Most importantly, in both settlements, there has been an ongoing collaboration between the community and C-re-aid NGO to design and build public infrastructures as prototypes by using alternative and sustainable building solutions.



1.2 Situation map containing the location of the two case studies of the research project. Own illustration

Located in Arusha Region, Maji Moto is the village where this research started with the construction of a health centre, thought as a case study building to prototype the use of Compressed Stabilised Earth Bricks. It is populated mostly by Maasai ethnics who gave up pastoralism to focus on farming, keeping only a small number of livestock for self-consumption. They settled down permanently after the implementation of the villagisation policy in the region in 1975.

Mikocheni is divided into different sections from which 'Mikocheni Maasaini' is home to a Maasai pastoralist group. The village is located in the Kilimanjaro Region, under Moshi District. The settlement was populated before the implementation of the villagisation policy, as a consequence of the construction of Nyumba ya Mungu reservoir. In 2018, a public bike shop led by Maasai women was built in Mikocheni Maasaini, becoming the second case study prototype analysed in this research.

1.5 ORIGINAL CONTRIBUTION TO LITERATURE

Considering the climate threats posed by the building industry and the vulnerability of indigenous communities in front of the progressive loss of natural resources, this thesis wants to unfold the mechanisms that societies, and more specifically architects, must adopt within the built environment to transition towards a decarbonised building future. To do so, this research has necessarily looked at materials in all its forms; from the matter and its physical properties to the social beliefs attached to them. Different from Architecture Theory, which commonly focuses on spatial forms, aesthetics and highly technological building solutions, this research relies on the foundation of Material Culture Studies. Recent research on Material Culture has highlighted how material properties have been given a secondary role in the creation of meaning and attachment, as if the qualities of the spaces we inhabit were not informed by materials that encode cultural symbols, having the capacity to influence users' behaviours. This approach proposes an original contribution to architectural research by looking at the appropriateness of architecture in socio-cultural contexts.

Paramount in providing a novel approach to the holistic analysis of building materials has been the research framework on Material Ecologies adapted from Tim Ingold (2000). This theoretical basis poses material properties as undetachable from their social meaning, being an active agent of form-making and human action. As we are continuously evolving, so our material perception does, being dynamic and informed by our involvement with people and places. Allen (1998) reminds us where the term 'material' comes from; the Latin mater, which means 'mother', demonstrates that "far from being the inanimate stuff typically envisioned by modern thought, materials in this original sense are the active constituents of a world-in-formation" (Ingold, 2007:12). Therefore, this research provides an original contribution to knowledge by seeing building materials from a perspective that considers both its importance within the self-construction of homes in local settings, but that also recognises the role of traditions, social beliefs and environmental factors if successful projects want to be implemented. Thus, this research believes that the analysis of building material significance must become an integral part of the viability analysis to integrate ecological material innovations in local settings. To do so, the methodological Chapters 4 and 10 provide a detailed account of the tools and methods that professionals working in similar contexts can apply to successfully implement contextual participatory-design building projects and a further impact assessment.

More specifically, this research contributes to unpacking forces that shape the political economy of building materials within the context of settled Maasai Communities in Northern Tanzania. By having Material Ecologies as a base, this research has sought to develop a framework for analysing the meaning of the Maasai built environment from a perspective that considers the everyday life engagement of people and place as a core to develop ecological and contextual built proposals. In doing so, several chapters throughout the thesis (Chapter 3, 6, 11, 12 and 13) have focused on providing a detailed account of the evolution of Maasai building techniques, its changes and dynamics from the nomadic shelter to the contemporary 'modern' built houses. This has contributed to gaining a depth of knowledge into the specificities of Maasai traditions and everyday life and their relation to the environment they inhabit, as well as the policies enacted by the government. To understand material flows and use in Maasailand, this thesis mainly looks at two main aspects: dwelling, and the processes by which communities have progressively created a sense (or not) of home; and how the use of different building materials throughout history has influenced contemporary sedentary Maasai communities. To enable that, elements such as the geography of the area, the weather, the environmental condition of dwellings such as humidity, textures, temperature, and light, as well as the interaction with non-humans are paramount in building the story of how spatial meaning is given by those who inhabit the villages. The perception of building materials that informs decision-making in local constructions is necessarily part of a complex and heterogeneous process of contextualisation within a bio-dependant environment.

Analysing the evolution of the Maasai built environment has necessarily raised a series of essential questions about vernacularity and its intertwined relation with modernity. The study of vernacular architecture has been, ever since the beginning of industrialisation, a topic of controversial debate in the realm of architectural theory. In the nineteenth century, the dichotomy between 'capital A' and vernacular architecture became visible within the Western context, understanding the latter as an anonymous type of architecture entailing a differentiated historical path and placed in opposition to the "ugliness of the industrial world" (Upton, 1990:206, in Vellinga, 2011). The discourse followed a progressive tendency to separate the natural, indigenous and spontaneous vernacular from the forms of modern, privileged architecture (181). Its categorisation has resulted in the homogenisation of the phenomenon, analysed under a common pattern and over-romanticised as an honest, original and unselfconscious architecture. Its highly contextual practices, community's skills and strategies of adaptation have been blurred under the premise of its 'authenticity', denying the pressures under which vernacular forms have been erased or conserved. As a result, the concept of vernacularity in the Western tradition has solidified as the 'architecture of the other', perpetuating the self-definition of 'Western Modernities' (182). Despite several theorists have openly questioned the mainstream concept of vernacularity (see Highlands, 1990; Upton, 1993; Miller, 1995), most of these arguments have happened within the field of anthropology or social science in general, remaining almost uncriticised by a large sector within the practice of architecture. The romanticisation of vernacular building techniques has led to the failure of countless development projects across regions. Two salient examples that have been highly controversial are the cases of Mexicali, by Christopher Alexander, and New Gourna, by Hassan Fathy.

Throughout the 20th century, several authors devoted their time to the identification and study of vernacular architecture across the world. Some of the most salient examples are Architecture Without Architects: An Introduction to Non-Pedigreed Architecture (Rudolfsky, 1964), Shelter and Society (Oliver, 1964) and House, Form and Culture (Rapoport, 1969). They aimed to document and understand indigenous building techniques, moved by the rapid change and threats that some traditions were undergoing (Vellinga, 2013). More recently, Julia Watson has published Lo-TEK: Design by Radical Indigenism (2019), showing examples of sophisticated indigenous designs forging ecological knowledge for a damaged contemporary built environment. Also, a compilation of indigenous practices approached holistically is the book Vernacular Architecture in the 21th Century: Theory, Education and Practice (2006), written by Marcel Vellinga and Lindsay Asquith. The book, beyond compiling contemporary indigenous practices, proposes a critical approach to the study of vernacular architecture, offering a novel interdisciplinary view of the phenomenon. From my point of view, such willingness to unpack the processes by which indigenous skills survive or disappear has not been as much considered in development practices in the latest decades. Throughout my experience working in Tanzania, I have witnessed how organisations and international institutions have proposed design solutions based on indigenous traditions falling into the same trap as many other architects in the past. What is disregarded in contemporary development architecture is the process by which communities have strategically adapted their built forms to multiple factors, including extreme weather conditions, market pressures and access to industrialised materials. As such, this research wants to offer a critical approach to developing contexts, which is required to prevent yet more failures of much-needed public projects in the present and future and to propose innovative and contextual-built interventions. As such, I hope that this thesis can contribute to elucidating some of the material and spatial complexities that situate the debate of vernacularity at the forefront to tackle access to decent housing for rural indigenous communities, overcoming the sometimes-naïve distinction between vernacular and modern.

Lastly, questions about how building materials are experienced and what environmental impacts result from their usage must be at the core of building materials research. To do so, this research has been pioneering in the development of prototype-built interventions with the objective of assessing communities' perception of building materials and the viability of sustainable locally sourced materials to be absorbed by the local building culture. The project has also been a pioneer in that it has implemented the use of an innovative building solution aimed at shifting to more sustainable building techniques. The technicalities, opportunities and challenges of the proposed technological solution are exposed in detail in Chapter 6. The main prototype-built intervention has been developed through a participatory-action research methodology (exposed in Chapter 4), providing an original approach to foster the inclusion of communities in decision-making processes. While such an approach might be challenging for professionals in the realm of architecture as it might fall out of the training received in many cases, I hope that the presented action-research built projects contribute to expanding the knowledge on how architects should be positioned within the context of development projects working with vulnerable communities.

2 — Material Ecologies: Theoretical Framework

This chapter is devoted to laying out the theoretical approach of this research project. The main framework is presented under the premise of material ecologies, justifying its relevance and application to the case under analysis. As such, the first section (2.1) is introduced with a justification of the chosen theoretical framework as applied to the case study for this thesis. It sets the basis for analysing material and spatial perceptions of the built environment, through the lens of the ecological approach. Section 2.2 lays out the main approach for understanding material processes and choice in the case of Maasai settlements. Section 2.3 positions the researcher within the context of vernacular architecture, providing the theoretical basis for justifying the understanding of vernacularity as a continuous process of becoming. Finally, the last section (2.4) concludes with some highlights of the research's framework.

As part of my research, I have found the environmental experience of 'dwellers', 'users' and 'occupants' of a structure indispensable when considering the significance of the built form. Therefore, I have developed the theoretical framework for my methodology from Ingold's ecological approach influenced by the phenomenological literature of Heidegger, Merleau-Ponty and David Seamon (2002, 2018). Standing on the foundation of Environmental-Behaviour Studies and relaying in other mid-level theories of critical architecture such as the ones of Kim Dovey (1985, 2005) and Marcel Vellinga (2007), this research situates the researcher and practitioner in the context of an active engagement between the population under analysis and its environment.

2.1 ANALYSING PERCEPTION IN THE BUILT ENVIRONMENT

Over the last few decades, Tim Ingold has bridged two facets of anthropology that have progressively diverged from each other: material culture studies and ecological anthropology[1] (Schiffer, 1999; Ingold, 2000, 2012). In doing so he combines the study of built artefacts and objects, central to the study of material culture, with the study of non-human actors such as animals and plants, weather, landscapes and so on, that are examined in ecological anthropology. Ingold claims that both material objects and non-humans need to be studied as unified to grasp the complexities of situated human beings, as both are "the fundamental condition of life" (Ingold, 2012:431). In his book The Perception of the Environment (2000), Ingold lays the foundations of his ecological approach to material culture, though some of his recent writings have further enriched and re-assessed the theory presented, such as the much-criticised discussion articles on Materials Against Materiality (2007) and Towards an Ecology of Materials (2012). These texts provide the main reference for the application of the ecological approach in the theoretical framework of this thesis.

1- Ecological anthropology is a subfield of anthropology that focuses on the relationships between humans and their environment. It explores the ways in which different cultures and societies interact with and adapt to their natural surroundings.

With the objective of laying out and justifying an ecological approach to the perception of the environment, Ingold carefully analysed how several branches of anthropological science and psychology had looked at environmental perception over the last century. In examining social and cultural anthropology, he laid the basis for exploring how environmental perception operates through the connections between ecological psychology and phenomenology[2]. Whilst I will not go into the detail of these approaches for the purpose of length and focus, it is essential to look at key concepts from the last two fields - psychology and phenomenology, as they are acutely relevant to the development of Ingold's ecological approach.

2 - For more details, all these enquiry approaches to perception are carefully analysed in chapter 9 of The Perception of the Environment (2000), where Ingold highlights the several theories and figures to remark in the evolution of the understanding of perception.

A common model within psychological study treats the mind as a "data processing device" that receives inputs from the environment, constructing representations of the world inside people's heads (Ingold, 2012). However, this has since been challenged. J.J Gibson understood the mind as an embedded organ which has the power to influence bodily senses rather than simply being acted upon by external stimuli. In doing so he refuted the idea of the environment and the mind as separable, unifying them conceptually (Gibson, 1979). Through his theory, perception is achieved without detaching people from the environment they inhabit, "as opposed to the self-contained individual confronting a world out there" (Ingold, 2000:4). Gibson's approach to perception opens up new possibilities for enquiring meaning from an ecological perspective that encompasses both the bodily meaningful experiences as well as culturally transmitted information. In taking the reference from Gibson's ecological psychology, Ingold developed his ecological approach to perception, challenging both the idea of the truly independent individual and the distinction between the disciplines of anthropology and psychology:

"For we now recognise that such processes as thinking, perceiving, remembering and learning have to be studied within the ecological contexts of people's interrelations with their environments. We recognise, too, that the mind and its properties are not given in advance of the individual's entry into the social world, but are rather fashioned through a lifelong history of involvement in relationships with others. And we know that it is through the activities of the embodied mind (or enminded body) that social relationships are formed and reformed. Psychological and social processes are thus one and the same. And the discipline that will be called into being to study these processes, whatever we choose to call it, will be the study of how people perceive, act, think, know, learn and remember within the settings of their mutual, practical involvement in the lived-in world." Ingold, (2000:171)

While the literature I had previously engaged with was mainly concerned with the socio-cultural codes that influence decision-making in the design of built environments, Ingold's ecological approach to perception situates such social and cultural schemata within the biological life of bodies in its environment.

Both 'bodies' and 'environment' are intimately entangled in the development of everyday life. The result of this situated activity shapes how we look at built forms and leads to the creation of personal meanings attached to these. Relying on this approach to perception, Ingold coined the concept of the 'meshwork' inspired in the 'flesh'[3] of phenomenological philosopher Merleau-Ponty (1968). Both concepts stress the idea that the world is sentient and that the tangible reality opens up to the perceiver as the perceiver opens up to reality (Ingold, 2012). The entanglement of the meshwork recognises that settings that are usually understood as mere creations led by people's actions and desires, should be conceived as active agents in the formation of decision-making dynamics.

3 - The flesh refers to the fundamental and pre-reflective intertwining of the body and the world. It is not simply the physical flesh of the body but encompasses the lived body, the body as experienced and lived by the subject. The flesh is a dynamic and ongoing process of embodiment that connects the perceiving subject with the perceived world. Merleau-Ponty (1968)

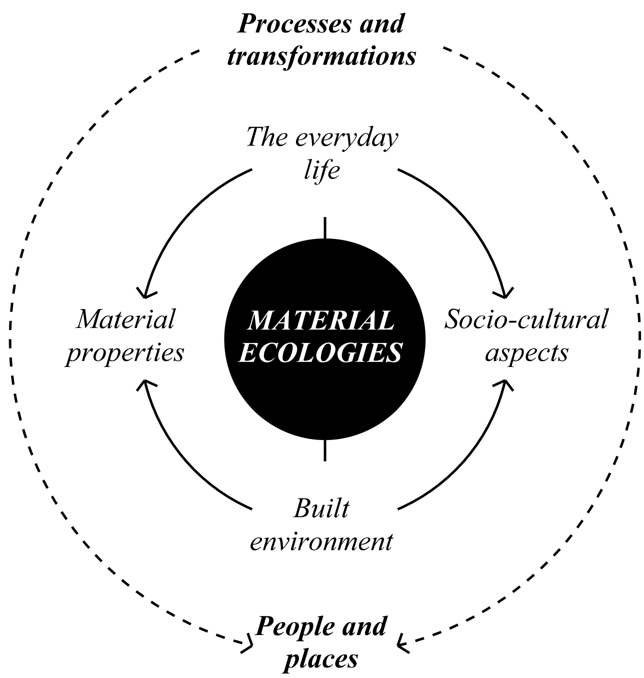
The notion of a meshwork foregrounds the premise that each of us is ultimately, a being-in-the-world, as stated by Heidegger (1962). Heidegger's work stresses the impossibility of separating our being from the world we dwell in. Likewise,just as we come into being continuously, our living environment is constantly coming-into being. Merleau-Ponty (1962) describes our existential condition as a full-body immersion from birth into the world around us. Taking this phenomenological standpoint, we are the result of an involvement with the world that emerges while we perceive and evolve alongside it (Ingold, 2000). If engagement with the environment is dynamic, variable and mutable, then such activity resembles more closely an act of becoming-in-the-world, rather than a more static being-in-the-world. As Haraway (2008:244) argues, "Becoming is always becoming within a contact zone where the outcome, where who is in the world, is at stake". This process-like engagement recognises the agency of environments. It is important to highlight some key aspects of this concept's definition from an ecological perspective. First of all, Ingold (2000:20) argues that the environment is not to be confused with nature, as that would leave us as outsiders while we are continuously engaging with the environment that surrounds us. Also, contrary to mainstream anthropology that sees environmental perception as a cultural construction of nature (Ibid.), in this approach to the ecology of life, the environment is necessarily a relative term. This is because it can only exist with evolving organisms. Similarly, organisms can only be found in a specific environment. Thus, each environment will develop alongside those who inhabit it, and its meaning will be as much personal as social for every person. The environment is in continuous change and its development is always necessarily incomplete. Whilst there is life going on, it will continuously be under construction.

By applying an ecological and holistic approach to environmental perception, Ingold collapses the idea of isolated agents by shifting the focus to the meaningful relations of 'agents-in-an-environment'. As he roots his ecological anthropology in the psychological views of Gibson (1979) and Bourdieu's theory of practice[4](1977,1990), he sets up the basis for placing perception and cognition "within the practical contexts of people's ongoing engagement with their environments in the ordinary course of life" (2000:167). Besides that, by using phenomenology as a methodological enquiry, Ingold seeks to analyse people's meanings within the experiences of their relational contexts rather than as being pre-inscribed in our physical reality.

4 - The theory of practice posits that individuals' actions and behaviours are not just a reflection of the social structures and cultural norms in which they are embedded, but these are also rooted in what he calls 'habitus', which refers to the set of dispositions that shape individual's perceptions, attitudes, and actions (Bourdieu, 1977). These so-called habitus are shaped and performed within the contexts where their practical activities occur (Ingold, 2000).

2.2 BUILDING MATERIALS: PROCESSES AND TRANSFORMATIONS

The ecological approach presents a sophisticated framework to the study of Material perception by bridging socio-cultural aspects and environmental traits [Figure 2.1]. Several theorists researching the significance of building materials



2.1 Material ecologies' Theoretical framework. Own illustration have argued that the concept of materiality has progressively obscured a sensibly located inquiry into materials (Ingold, 2007; Simondon, 2005). Within the field of material culture, the study of materiality seeks to unpack the existing relationship between people and objects, going beyond the properties of the material itself. Instead, materiality looks at the processual and socio-political significance of materials for people (Tilley, 2007). In doing so, the actual material properties are left in the background. To fully grasp materials' meaning, properties, and qualities, as well as their transformational capacities and affordances must be examined as well. This approach to material culture resonates with what Aristotle coined as Hylomorphism[5], a philosophical theory that considers all existing physical entities as formed by two opposite parts: the matter and the form. As such, the inert matter awaits to be given form, as if the resulting shape is always imposed upon an irrelevant type of raw material (Ingold, 2012). Thus, the prevailing form can be analysed on the basis of socio-cultural impositions. While the traces of social and cultural interactions cannot be denied, these are always limited by the properties offered by the material involved, as well as by the contextual processes of each specific environment. Aristotle's hylomorphism negates thus the flows and movements of the raw material, as well as the diverse and dynamic set of possibilities bestowed by the materials' properties [431]. Likewise, the dichotomy between enforcing form and passive matter is witnessed in David Pye's design theory. In his theory, he proposes a distinction between 'properties' and 'qualities'. According to Pye (1968: 47; in Ingold, 2012), properties are "objectively and scientifically measurable" while qualities are subjective, "they are ideas in people's heads which they project onto the material in question".

5 - In hylomorphism, matter is considered as potentiality or the raw material out of which things are composed. It is the indeterminate and underlying substratum that can take on different forms and qualities. Instead, form represents the organizing principle or structure that shapes matter into a particular object or entity.

The risk with theories that detach the material from its contextual meaning, is that they reproduce an understanding of the material world that is neither holistic nor instructive. As Conneller argues (2011), knowledge of material properties should not be set apart from the experience with the material itself but instead should be constructed alongside its material effects. Ingold proposes to look at material properties from a different angle, understanding these as 'histories' that speak about what they are or what transformations they undergo if treated in particular ways (Ingold, 2012: 434). In line with his ecological understanding of materials, he argues that these are not static entities and that every material is in a constant process of becoming. Engaging with material histories is essential to unpack the several realities that can be experienced. Therefore, embracing materials' trajectories is to acknowledge the processes of formation in which "materials of diverse kinds come to take on the forms they do" (Simondon, 2005:46).

Ingold defines materials as "matter considered in respect of its occurrence in processes of flow and transformation" (2012:439). Appropriating such a concept as part of one's practice implies recognising the blurred boundaries over which an analysis can be implemented. This approach might seem too uncertain in its application for some. However, moving away from the hylomorphic model of thought in which the person stands outside without engaging, unleashes possibilities for discovery between raw elements and finalised building materials. It is in this 'between process' that this research seeks to explore. Such a paradigmatic shift is also exemplified by Ingold [431] as a change from 'objectness'[6], to flows and formative processes wherein matter comes into being. To look at materials from this perspective, Conneller (2011) argues that applying an ecological perspective to the study of materials is almost like becoming an alchemist. Here, material is analysed by what it does instead of by what it is, considering the particular situation and the specific ways in which it has been treated. Learning from materials' flows requires time and careful observation, to capture transformative processes and diverse patterns of change. Materials continuously carry their properties which can be discovered by people's active engagement with them, giving "matter its due as an active participant in the world's becoming" (Barad, 2003:803). This change in perspective prompts us to think "from the materials, not about them" (Ingold, 2012: 437) and to "find the consciousness or thought of the matter-flow" (Deleuze & Guattari, 2004: 454).

6 - In material culture, the concept of objectness refers to the quality or characteristics that make an artifact or object distinct from other things in the environment. It refers to the perception and recognition of an object as a discrete and meaningful entity with its own properties, functions, and symbolic significance. In this way, the underlying material properties are left as secondary.

In paying attention to matter's properties, the assets and constraints that prompt users' behaviours can be assessed, exploring the various reasons behind specific material-body relations, alongside their adjustments and changes through time and space. For example, if we look at the trajectory of sun-dried bricks over decades in the Tanzanian context, it is possible to witness how its use has declined contemporarily to a decay in the perception of the material itself. It could be claimed that the reason behind the disuse of these bricks is society's will to modernisation and a shift in aesthetic taste regarding the built environment. While this statement is not necessarily incorrect, it only considers socio-cultural pressures, underestimating the relevance of some specific properties of the material such as its durability, permeability, strength and so on. Societal development and modernisation have, undoubtedly, modified the needs and demands of worldwide dwellers, impacting thus how certain material properties become essential or cease being suitable. If productivity and time investment are increasingly being factored into a capitalist-driven society, the use of demanding materials that require constant repair will eventually disappear from communities' building traditions. As a result, more durable materials such as concrete which have come about through processes of industrialisation have contributed to a shift that develops alongside a change in perception of what is good and what is bad. This leads eventually to newer categorisations of social status amongst inhabitants. This two-fold process exemplifies, in my opinion, why material properties and socio-cultural significance cannot be analysed as independent attributes. These processes constantly feed each other in shaping people's perception, changing how materials 'become'.

Ingold's ecological approach embraces the uncertainty of material processes in an attempt to bridge the gap between the resultant built environment and societies' bodily engagement in the world. This perspective should encourage everyone working in the production of space to find novel ways to view our material reality, recognising our responsibility in a world that urges us to find sustainable solutions in the fight against the climate crisis.

2.3 VERNACULAR (ECO)LOGICAL MODERNITIES

The relevance of indigenous building knowledge in the context of this research has pushed me to engage with theories and literature that address the notion of vernacularity, considering its multiple dynamics and complexities. The application of Ingold's ecological perspective to the analysis of vernacular architecture offers a novel approach to unpacking the manifold relationships that exist between people's everyday spatial practices and their cultural and environmental settings.

Reproducing vernacular building techniques without understanding socio-cultural, economic and environmental dynamics of the specific contexts where a project is to be developed, diminishes community's identities and perpetuates western's colonial legacy. Miller (2001) argues to examine processes of consumption[7] to fully grasp how built forms become valuable to inhabitants; an essential task though not usually considered in the field. By enquiring vernacular knowledge through the lens of Ingold's ecological approach, the processes and complexities of the entangled becoming of the built environment can be assessed, paying attention to the perpetually variable and continuous modulation of a community's building practices. Whilst vernacular architecture has usually been seen as stable and passive (Rudofsky, 1964), its value resides precisely in its active, contextual and conscious process of (re)generation. Such dynamics should be at the core of any research concerning vernacular practices, understanding the production of space as essentially rooted in specific environments and responding to supportive and adaptive strategies. Vernacular building knowledge is inherited through generations and is well-known for relying on ecological resources and the use of locally sourced building materials (Rasulo, 2003). In attempting to incorporate vernacular knowledge into professional building practices, the challenge resides in unlearning mainstream design patterns to analyse the multiple ecologies associated with vernacular forms from the bottom up. Vellinga (2013:584), established the basis for building an ecological approach to the study of vernacular knowledge:

7 - Processes of consumption in the built environment are influenced by various factors, including individual preferences, cultural norms, economic considerations, technological advancements, and sustainability concerns. They shape the relationship between individuals, objects, and the physical spaces they inhabit, reflecting the dynamic nature of people within the built environment.

"If the aim is truly to learn from vernacular architecture, what is needed instead is a holistic, integrated and critical approach that complements the study of the environmental qualities and performance of vernacular architecture with an examination of its social, political and economic aspects. In particular, it is necessary to look at the dynamic interrelation of all these aspects in specific cultural and historical contexts and at the way in which this is influenced by human agency and practice. Such an approach requires researchers from natural sciences, arts and humanities, and social sciences backgrounds to communicate and work together, rather than to confine themselves to their own disciplinary discourses."

According to Vellinga's statement, the practice of architecture urges to be radically reformed, addressing methodologically all the forces that shape the built environment. He rightly problematises the lack of a holistic approach to the study of vernacular architecture, which undoubtedly resonates with Ingold's ecological perspective. The built environment, regardless of any categorisation, is the result of several spatial, socio-cultural, environmental, political and economic forces, and therefore, spatial ecologies must be addressed considering its complexities. According to this, it would be reductive to see vernacular architecture as "fundamentally different or inherently more sustainable" than other forms of architecture, as both are the result of a dynamic and complex system of inter-relations (Vellinga, 2013:585). This implies blurring the boundaries of pre-imposed architectural categories, which hinder a holistic and integrated understanding of the discipline. Only after this, might we be capable of learning from traditional forms; understanding what has been relevant to local communities and what has been discarded because it does not suit them anymore. Specific technologies and indigenous material knowledge, deeply embedded and contextual, have been shown to offer innovative possibilities when applied to contemporary building forms. Likewise, advanced technologies can be efficiently incorporated into indigenous contexts, solving long-lasting technical issues with newer techniques that are accessible and affordable.

Let's think, for example, of the Compressed Stabilised Earth Bricks used in this research's case studies. The introduction of such an innovative technique within the semi-arid context of Maasai villages in Tanzania tackles high levels of deforestation happening due to excessive production of fired bricks. These became popular in Tanzanian rural contexts as an upgrade to the traditional mud brick, which was less durable and waterproof. These are produced in-situ by using local resources (soil, water and firewood), however, they do not provide a sustainable solution for the local context. Despite this, the technique is deeply embedded in the local context and continues indigenous masonry skills. Its widespread use has endangered the livelihoods and environment of surrounding villages.

Someone might think that fired bricks cannot be considered a vernacular technique in this specific context, as the burning process has been integrated more recently through cultural assimilation. The technique was introduced in the country by German Colonialists in the 19th century. Likewise, the sun-dried brick that local communities have been building with for centuries, was earlier integrated by observing other material techniques beyond Maasai areas. At this point, the question to be made is: when is a building tradition considered vernacular? Is it possible to find pristine cultures where knowledge is encapsulated and never inherited from other traditions? Hassan Fathy (1969) wisely problematised this, arguing that a building tradition can be considered such as long as the builder overcomes a problem by adapting the craftwork to it, thus establishing a novel habit.

This vision generates new possibilities for questioning the concept of authenticity usually associated with vernacular architecture while exploring the processes that essentially connect vernacular with the modern; continuously

8 - In this sense, syncretic dynamics refer to the processes and outcomes of syncretism, which is the merging or blending of different beliefs, practices, or cultural elements from multiple sources or traditions. Unlike the belief that western culture it has not been part of such exchange, syncretism is a phenomenon experienced by all contemporary cultures.

moving alongside one another. The 'western' contemporary built environment is inevitably the result of syncretic[8] dynamics that have evolved, intersected, changed and adapted forms through centuries of transitional pressures and interactions. Being concerned with the erosion or resistance of vernacular forms against modernity reveals a misguided interpretation of the impact of modern processes in vernacular traditions (Upton, 1993), denying socio-ecological adaptations and the right to development of indigenous communities. If we recognise the agency of processes of all kinds and that these are connected in time, we must thus erase the dichotomy between vernacular and modern, understanding both of these as inevitable 'roads of modernity'. As Vellinga argues (2013:584) "Just as there has never been a noble savage, there is no noble vernacular and there can be no traditional 'fixes' to our contemporary problems". Thus, stereotypical representations must be avoided in an effort to discover the multiple ecologies implied in the construction of our present and future built environment.

2.4 CONCLUSIVE REMARKS

This chapter has presented the theoretical argumentation upon which this thesis stands, highlighting how Ingold's ecological approach can holistically unpack the complexities of people's situated perception of their built environments. The objective is to shed light on the processes by which building practices acquire their meaning, considering everyday inhabitant's engagement with their living environments. The understanding of the material world's perception as an ecological, ever-changing process, rather than as static, emphasises the ongoing relation between people, landscapes and artefacts, as part of an interconnected system of ecological nets. People's relation with materials is grounded, physical and process-oriented, constantly shaped by social relations and cultural identity.

By looking at this research from an ecological perspective, human-environment relations are brought to the forefront. In doing so we understand these as a process of dwelling, moving against the idea that communities simply occupy a given setting, using it at their convenience. It is a constant engagement in which we come to dwell in the spaces we live in, actively shaping and being shaped by these. Looking at this research's case studies under the lens of such a framework becomes especially necessary in the case of the Maasai landscape, in which vernacular forms are intertwined with the tensions of progress and modernity. Contrary to Richards's claim "In our age of infinite technical resources, the simplicities inherent in the very nature of building must not be overlaid by the worship of progress" (Richards et al., 1985:14), this thesis wants to highlight that the revival of vernacular 'low-tech' technologies will not happen by acknowledging its value as oppositional to progress. Recognising the phenomenon as inevitably part and parcel of our society becomes crucial in finding the proper tools to address it, thus avoiding misleading fatalism: a sense of desertion and acceptance of the effects of globalisation and therefore, the erasure of any form of traditional knowledge. Instead, focusing on unpacking identities' formation through people-environment interactions, including undergoing processes of modernisation, may enlighten socio-cultural patterns, leading to a top-down transformation of our consciousness and responsibility towards the multiple ecologies of the place we inhabit. Therefore, this thesis seeks to look at ecological pathways within the context of globalisation rather than negating it. The analysis of contemporary tensions from a process-led ecological instance, breaks down the dichotomy of modernity vs tradition, finding the spaces of opportunity in the intersection between indigeneity, innovation and contextual building practices. As a result, considering the multiple local and external factors that influence the rise or neglect of indigenous building traditions, new possibilities for enabling the ecological transformation of our built environment may be forged, fostering new sustainable and climate-resilient built environments. In the attempt to find answers to the loss of vernacular ecological building practices, looking holistically at material ecologies appears as a wayfinding path of self-acknowledgement. Inhabiting a world of earth, sky, weather and so on is a reminder of our responsibility in the becoming-of-the-world.

The use of ecological anthropology as part of this thesis' theoretical framework has been a reasoned and consistent decision considering the need for radical approaches to the study of our current building practices and their implications in the climate crisis. Ecological anthropology addresses climate change by looking at the entangled dynamics of humans' engagement with the environment, exploring socio-cultural factors and how these have an impact on our environment.

The objective behind using an ecological angle is to understand how the analysed community understands and experiences their built environment, the impact of climate change and how such understanding shapes their response to it. Another important aspect is to analyse how these communities use and manage their natural resources, and how these practices contribute to or mitigate the effects of climate change. Finally, ecological anthropology should also consider the ways in which socio-cultural and economic systems contribute to the perception of the built environment, and how these can be transformed to promote contextual and sustainable building solutions. Using such an approach to deepen people's perception of the built environment, and specifically the use of building materials, allows overcoming the obstacles that separate us from the 'world out there'. If we keep seeing ourselves as inherently detached from the environment and its ecologies, we will not be able to truly face the obstacles posed by the climate crisis. In considering ourselves as agents-in-an-environment, we are bound by body to be in place (Ingold, 2000). Therefore, we have a unique opportunity to tackle the impact of our actions, creating channels of care and reparation under the system of the meshwork, embracing the environment as a place in constant evolution that we must carefully dwell in.

3 — Housing in Maasailand: The Evolution

This chapter wants to give a detailed account of the housing situation in Tanzania, from national policies and their impact in rural areas to the socio-spatial specificities of dwellings within the case of Maasai communities. Chapter 3.1 starts with an examination of government-led housing policies in Tanzania at the national level, while Chapter 3.2 will look at the development of housing policies and their impact in rural Tanzania, with a focus on the Villagisation Policy which led to the process of sedentarisation of Maasai communities (3.2.1). Chapter 3.3 provides an overview of Maasai settlements' evolution across three pivotal historical moments, to examine the social and spatial features that have been specific to each of these periods. Section 3.3.1 will focus on the characteristics of Maasai villages before 1967. After that, section 3.3.2 examines how the introduction of the Villagisation Policy impacted the social organisation and consequently the housing types of nomadic communities. Section 3.3.3 investigates the longer impact of the implemented policy in the new rural settlements. Lastly, section 3.3.4 looks at the contemporary built environment of rural Maasai communities 50 years after the activation of the policy, providing some conclusive remarks on the current features of rural settlements and their housing condition.

3.1 PUBLIC HOUSING INITIATIVES IN TANZANIA

According to the World Bank (2021), half of the urban population in Tanzania lives in densely populated informal settlements or slums, mostly in inadequate housing conditions. Only 30% of the population has access to basic sanitation systems, while 36% have access to electricity and 57% to basic water provision. Moreover, it was stated by the Tanzanian Housing Census released in 2012 that around 3 million housing units must be built in a span of 10-15 years to meet the national housing demand (Tanzania Invest, 2021).

Access to decent and affordable housing is declared a fundamental right by Article 24 of the Tanzanian constitution. As a consequence, several public institutions have been established throughout time to alleviate housing poverty, nevertheless without much success (Kironde, 2021). The National Housing Corporation (NHC) was established after the country's independence by an act of parliament n. 45 (Kwanama, E, 2015), aiming to mitigate the housing problem faced by millions of urban and rural dwellers in the country. The NHC was active until 1972 when the corporation tasks were transferred to the Register of Buildings (RoB) by the act of parliament n. 13 in 1971 (National Housing Corporation, 2021). The RoB was in charge of managing and delivering the housing acquired at the national level under that act. In 1990, the RoB was dissolved and the responsibilities were again entrusted to the present NHC (ibid.). However, the NHC never had a stable place and fell under the responsibility of the Ministry of Health for a while, then the Local Governments and in 2019, the Ministry of Land, Housing and Human Settlement Development (Kironde, 2021). As part of the ministry's responsibilities, diverse initiatives such as housing cooperatives have been encouraged by the government since 1962, but due to mismanagement and other bureaucratic weaknesses, such initiatives lost strength in the early 80s. Also, employer-based housing programmes were proposed to deliver housing by public institutions and parastatals to public employees, however, it also fell short in addressing financial difficulties. Other initiatives have included the creation of housing finance mechanisms such as the Housing Loan Fund and the Tanzania Mortgage Refinancing Company and Land Delivery Schemes[1]. Currently, the NHC is defined as a 'Real Estate Development and Management Firm', and through their Strategic Plan approved in 2015, they envision building 300,000 commercial and housing units before 2025. This brings to light how the state-led delivery approach for affordable housing is increasingly being overtaken by private housing market participants (Africa Housing Finance, 2021).

1 - The Government through the Ministry of Lands, Housing and Human Settlements Development in 2002 initiated the 20,000 Plots Project in Dar es Salaam City whereby, the survey plots are allocated on a cost recovery basis to ensure sustainability.

The unstable movement of the housing department across ministries has played an important role in the detriment of any proposed housing policy. The National Housing Policy that was formulated in 1981 never got implemented due to a lack of budget planning, but most importantly because of the economic shift of the government towards a Market driven economy (Kwanama. E, 2015). The roles of the National Housing Policy were then transformed by a series of policies such as the National Land Policy of 1999 and the National Human

Settlement Development Policy in 2000 (Kironde, 2021). The formulation of a specific policy addressing the housing problem would have been beneficial to tackling de lack of quantity and quality of access to a dignified house for the Tanzanian population.

3.2 HOUSING POLICIES IN RURAL TANZANIA AND MAASAILAND

In Tanzania, over 40 million people live in rural areas, representing 69% of the total population (Tanzania Invest, 2020). This is translated into 8 million rural households across the country, out of which more than 80% of these are built informally by using self-help savings. This has, in turn, led to a proliferation of substandard structures (Africa Housing Finance, 2021). The lack of access to financial plans for rural dwellers makes it even more challenging to build dignified houses, forcing many young people to migrate to urban areas in search of better jobs and financial benefits (Munishi, 2013).

The lifestyle of rural dwellers living across the country is being threatened as innumerable challenges to maintain and protect their income-generating activities keep arising. Some of these challenges are the detriment of pastoralist communities' cattle, a decline of agriculture due to the reduction of crop prices, and the ever-lasting lack of public services and infrastructures (Mbonile and Lihawa 1996). The triggers of such difficulties are twofold: on the one side, the effects of climate change are causing struggles as long periods of drought with high temperatures and unpredictable floods prevent peasants from relying on their crops harvesting, accentuating food insecurity. On the other side, there are political factors (Munishi, 2013): the government favours development policies in urban areas at the expense of the rural ones (Tacoli & Mabala, 2010), together with strict land privatisation policies and forced evictions[2] across the country. Considering the problems just mentioned, it is undeniable that rural migration is one of the main drivers of rapid urban population growth which leads to unplanned crowded slums, especially in Dar-es-Salaam (Kironde, 2012).

Unfortunately, this is a reality especially for Maasai communities living in the north-eastern part of the country, who have been progressively forced to migrate from their traditionally owned lands ever since the arrival of the German colonisers by the end of the 19th century (Goldman 2011). Continuous forced evictions due to the privatisation of lands were consolidated with the formulation of the Ujamaa Policy of 1967. The villagisation plan had a major impact on the lifestyle of Maasai communities since 1975 when it became compulsory for pastoralist communities and other indigenous groups to group themselves in rural villages.

2 - Read the letter written by the UN Permanent Forum on Indigenous Issues, to stop Maasai forced evictions in 2022. https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2022/06/Statement_Loliondo_letterhead.pdf

3.2.1 THE IMPACT OF THE VILLAGISATION POLICY

The issue of housing in Tanzania has been in the hotspot of the political agenda since the declaration of the Ujamaa Villages Plan in 1967 under the first independent government of Tanzania led by Julius Nyerere[3]. This socialist policy, also known as the 'villagisation' policy (Cannon, 1999), aimed at encouraging nomadic communities to shift to a sedentary lifestyle by settling in official villages (García, 2019). The villagisation plan was first formulated before independence by the British Colony under the premise of unifying the country's peasants to foster cooperation among each other and strengthen the economy through the exportation of goods (Kjekshus, 1977). Shortly after independence (1961), Nyerere envisioned Ujamaa with the ultimate goal of providing access to education, health care and other public infrastructures to all Tanzanian citizens, an achievable objective only if communities living in scattered and isolated areas were to be regrouped in social villages.

3 - After gaining independence from the British Government, Nyerere became the prime minister of Tanganyka in 1961. Tanganyka became a republic one year later and by 1964 the unification with Zanzibar led to the integration of the two as Tanzania, with Julius Nyerere as president of the newly formed republic.

During the first years of the Ujamaa Villages Plan, policymakers did not target Maasailand in the northern of the country, as they were seen as problematic to achieving the programme's implementation (Nyerere, 1968). It was not until 1975 that 'Operation Imparnati'[4] was created to reorganise the Maasai around villages. At this point is important to note that beyond the application of the villagisation policy, the Maasai had already started to organise themselves under ranching associations[5] since 1964. Such ranching associations were created as cooperatives to manage livestock production and to promote the entry of the Maasai into the modern economy (Moris and Colby, 1975). The difference lies in the fact that after the implementation of Operation Imparnati, families were forced to permanently settle in a specific place instead of moving across areas following their two-pasture rotational grazing systems.

4 - The operation imparnati, implemented under the "Operation Arusha" was specifically thought to achieve the villagisation of the pastoralist Maasai. In fact, imparnati means in Maa language, permanent habitations. (Ndagala, 1982)

5 - The Tanzanian Range Development and Management Act of 1964, pursued by the ministry of agriculture, was aimed ad creating ranching association for the Pastoralist Maasai Communities.

Additionally, despite the strict plans proposed by the government, the implementation of the programme had been moving very slowly by 1976. As such, being the government concerned with the success of the villagisation plan, it was decided to set a deadline by which all people in rural areas had to settle down in given villages. To beat the deadline, many families left their dwelling places abruptly or were forced by armed soldiers who destroyed their houses (Kjekshus, 1977). An example of the struggles that many rural dwellers had to undergo is expressed by Chronicler Matango who wrote about the forced resettlements in the Mara region:

"All works had to be suspended until the shelter was built to accommodate the family. This was not a simple job because they had to start preparing the building materials – travel to the bush to cut, assemble and take all the building materials on their heads to the village building sites; people had to travel to find the thatch. Some people were lucky, they were invited to share (temporary) accommodation with families who had at least a house erected at the village site before the move. Others with their children had to suffer from the cold and December rains under the trees. [...] In certain areas where the militia

did not strike, people rushed in panic to build temporary accommodations in unplanned village sites. The entire division was in motion. Moving, moving in panic to the unplanned villages. Thus, creating new villages in areas which are not even surveyed, on water, school or dispensary – virtually no facility to maintain the population there or any plans to bring any, but only to serve the purpose of moving into the development villages." (Matango, 1975; in Kjekshus, 1977)

The dramatic account of forced resettlement expressed by Matango was common to diverse ethnic groups living in isolated areas. However, due to the nomadic lifestyle of Maasai communities and as a consequence their temporary built houses, it was easier for them to move with their goods to other places. Thus, the resettlement of communities living in Maasailand was physically activated under the mentioned Operation Imparnati in 1976. Being the new villages provided with accessible water supplies, proper grazing areas and proximity to public facilities, it was very likely that the Maasai would easily move to the newly allocated areas. According to Ndagala (1982), the Arusha Region authorities organised a series of seminars with district leaders to inform them about the different phases of the resettlement and to ensure a smooth implementation of the operation. Each respective leader would then be in charge of organising further seminars with the population to train them in the basic requirements for living in permanent settlements. After that, groups of households that had agreed to live together would be involved in choosing an area and be allocated a plot of at least ½ acre to build their houses. In his analysis of the Maasai resettlement programme, Ndagala (1982) mentioned that once each family had received a plot, there would be an implementation team in charge of ensuring the appropriateness of the constructions. At this stage of the process, inadequate management and resources plus the inability to supervise construction, often led to unsuitable dwelling types.

Such an abrupt disruption of everyday life and traditional practices could not happen without triggering a further change in the way people live and inhabit their land. A more sedentary lifestyle brought novel ways to design and build, however, the essential knowledge required to build permanent houses was lacking among the Maasai. Because of this, the Government led by Nyerere launched a programme to promote adequate self-construction directed to people living in villages. The Better Rural Housing Campaign was implemented in 1974 through the launch of two programmes: the Village Management Training Programme and the Rural and Urban Construction Units Programme, with the "objective of encouraging the rural people to build better houses for themselves in the context of durability of dwellings, improved standards of hygiene, and better building skills" (Kwanama, 2015). These initiatives had the potential to serve as catalysers in strengthening community adaptation, but unfortunately, the programme became overwhelming for the government and by the beginning of the 1980's got suspended due to a lack of resources and equipment (ibid.). Thus, rural communities that lacked the instruments and knowledge for building permanent houses had to find their means and resources to adapt to the new sedentary situation, mainly through the support of community-based approaches. Contrary to what is experienced in urban areas, where only 46% of housing is privately owned, 88% of the rural population build their own houses on owned lands. This shows the potential for producing better constructions and adapting the building to the household requirements avoiding crowded and insalubrious conditions. The challenge of providing affordable and quality housing in rural areas is closely linked to limited access to financial resources and affordable building materials. The natural landscape that surrounds rural villages has been usually abundant of resources that can potentially be used for construction. However, the environmental degradation caused by the rapid growth of rural population and the overexploitation of natural resources, endangers the availability of local materials such as straw, poles, bamboo and timber (Kwanama, 2015). The proximity to towns and the rise of a globalised market economy has shifted the local perception towards an appeal for shiny and modern materials. Looking at the National Housing Census of 2012 [Figure 3.1], it can be found that 66% of the rural population still lives in houses whose walls are built with non-industrial materials such as poles and mud or soil bricks, while 45% of the population live in houses roofed with thatch. In terms of access to proper sanitation systems, the 2012 census estimated that 76% of the population had access to pit latrines and 8% did not have access at all to any toilet facility, which indicates that most rural dwellers fall under this condition. Likewise, by 2012 only 21% of the population had access to electricity, which again, puts into perspective the lack of existing infrastructures in rural areas.

The change in socio-cultural patterns and the need to build more permanent houses has influenced the interest of rural dwellers in accessing more durable and stronger building materials such as concrete and corrugated roof sheets (CRS). With all these new requirements and trends, the current challenge in rural areas lies in finding attractive housing solutions that are at the same time affordable and adapted to the local conditions by using sustainable building materials.

Households by building materials used for floors (%)	Num	%
Earth / sand	NA	60
Cement	26,37	37,2
Ceramic tiles	NA	1,3
Animal dung	NA	0,6
Palm/bamboo	NA	0,6
Terrazzo	NA	0,2
Wood planks	NA	0,2
Vinyl or asphalt Srips	NA	0
Parquet or polished wood	NA	0

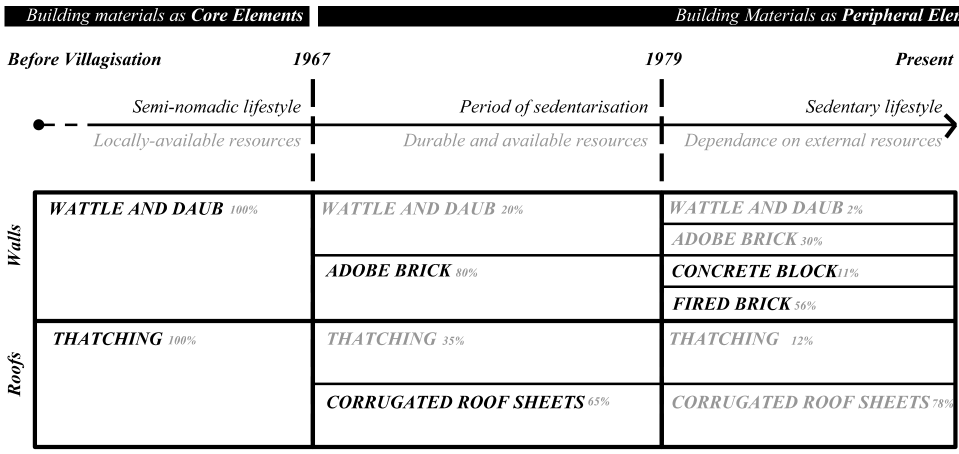
Households by building materials used for roofing (%)	Num	%
Iron sheet	46,28	65,4
Grass/leaves	NA	25,4
Mud and leaves	NA	7,9
Other	NA	1,3

Households by building materials used for walls (%)	Num	%
Baked bricks	13,97	26,3
Sun dried bricks	33,03	26,3
Pole and mud	34,43	23,5
Cement bricks	15,47	20,3
Grass	1,09	1,6
Stone	0,94	1
Timber	0,51	0,6
Timber and iron sheets	NA	0,3
Tent	NA	0,1

3.1 Main building materials of housing in Tanzania. Source: adapted from Tanzania Housing Census of 2012

3.3 THE EVOLUTION OF THE MAASAI SETTLEMENT: SOCIO-SPATIAL FEATURES

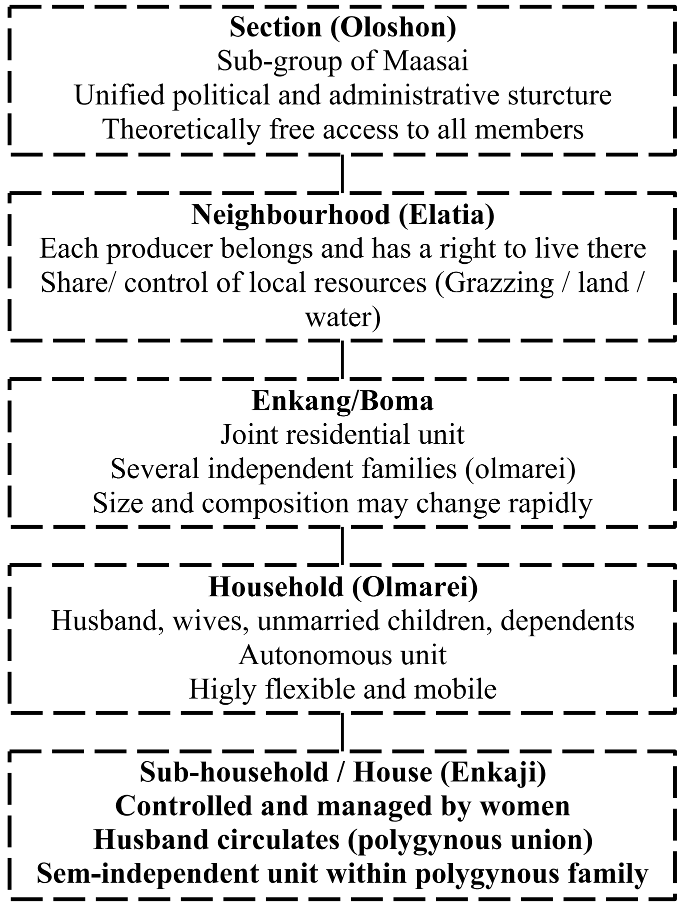
The architecture that populates the planet has historically taken shape through the influence of a specific geographical and climatic location, socio-cultural conditions, historical events and political changes. An example of this are indigenous communities, who have always found a way to adapt their built forms and habits to the climatic conditions and resulting resources, by valuing and learning from the surrounding landscape. Many researchers have remarked on the importance of learning from indigenous traditional knowledge, as it is key to the preservation of the environment. In many parts of the world, indigenous communities have been able to protect their natural habitats through balanced management of the territories in which they live. In this case, is the traditional knowledge existing in the production of indigenous built forms that is of interest, as well as the specific know-how acquired to enable the use of available resources. The current climate emergency caused partly by unsustainable construction and use of the built environment, has put into perspective the need to learn from how indigenous communities have looked after their traditional habitats. In the attempt to understand the evolution of the Maasai house throughout time and space [see figure 3.2], the following section will provide an account of the socio-cultural factors and resulting spatial forms that have given shape to the Maasai built environment, from the nomadic hut to the patterns of the contemporary Maasai house.



3.2 Material's evolution throughout history in Maasailand.

3.3.1 BEFORE VILLAGISATION POLICY (1967)

Maasai communities have historically learnt to utilise the assets of the Savanna environment, which is characterised by being semi-arid with bimodal periods of rainfalls. The resultant landscape, which is mostly populated by grasses,



3.3 Structure of social organisation of the Maasai ethnic group. Own illustration adapted from Coast (2000)

bushes and acacia trees (Smith, 1999), has been home to the Maasai in Kenia and Tanzania for centuries.

Social Organisation

Originally, pastoralist Maasai were known for migrating seasonally to places where they could find water and pasture for their cattle away from big towns. Once the required resources were found, they would build their settlements for shorter or longer periods according to the seasonal changes. The patterns of the temporary Maasai settlement are intimately linked to the social structure of this ethnic group, which can be viewed in Figure 3.3. In terms of social organisation, a settlement is positioned under a unified administrative structure or section, which theoretically is accessible to all Maasai members (Coast, 2000). Each settlement is composed of a grouping of Bomas. The boma is a joint residential unit, which comprises several households or Olmarei. Inside the gate of each boma, the livestock of the several households is also enclosed. According to Homewood and Rogers (1991), the boma represents the ideal of the Maasai tradition, which allows the necessary cooperation among dwellers over the cattle. It is important to note that the relationship among the different household units staying in the same boma is not necessarily based on familiar affiliation (Coast, 2000).

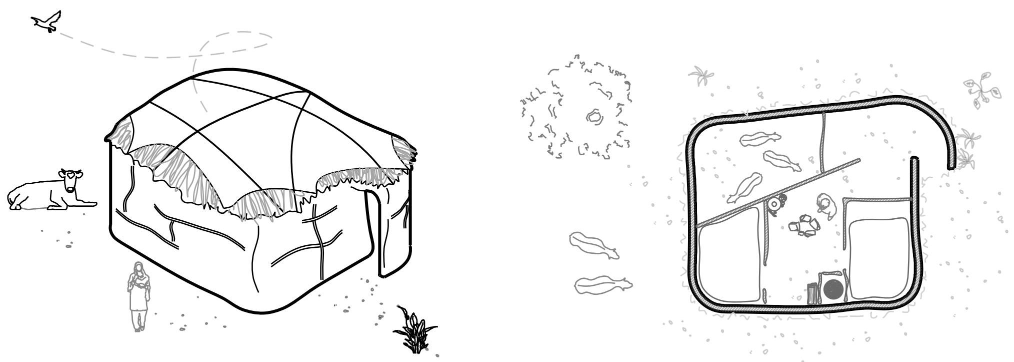
The Olmarei consists of several houses or Enkaji, with families structured as follows: the husband, several wives, the children of each wife and in some cases, other dependants. Despite the husband being the head of the family, he does not own any of the houses. Under the household, each house is built and belongs to the wives and the husband would stay periodically in the different wives' houses, where they live with their children.

Spatial organisation

The round shape of the traditional boma is essentially linked to the pastoralist lifestyle of Maasai communities and their reliance on cattle. Circular structures provide the strongest form for a fence to be protected from wild animals. Spatially, a boma is characterised by a large, squared gate made with thorny bushes enclosing other similar gates to keep the livestock. The several households would then be scattered between the external fence and the inner gates [Figure 3.4]. Each household has a specific gate close by where their livestock is kept. Traditionally, bomas have been populated with a large number of families, normally between 6 to 12 members (Jacobs, 1965). The spatial arrangement of the houses that constitute a household is not arbitrary. As explained by a Maasai leader in a village visited during fieldwork, the house of the first wife is usually built in the right side of the livestock's enclosure gate. The second wife would then build her house on the left side of the gate and the third wife would build her house on the right side of the first wife's house. This set pattern would follow

3.4 Maasai boma in the Loliondo Region made with bush fences. Source: African People and Wildlife Website the same structure whenever a newly married woman would join the household.

The form of the traditional Maasai house consisted of a protruded oval-shaped wall to enable the space for a small entrance with no windows. The spatial arrangement of the house interior was very basic and dark, with very few divisions to separate sleeping areas from the space for the livestock cubs. In the centre of the house, there would be an open space where to place the fire [Figure 3.5].



3.5 Axonometric view and floor plan of a typical indigenous Enkaji. Walls are built with the wattle & daub technique and thatched roof. Own illustration.

Materiality

Given the semi-nomadic character of the Maasai, shelter has generally been treated as temporary and consequently, the materials employed to build a traditional Maasai house must be readily available in the dry-savanna environment. Thus, un-intensive materials such as straw, grass, bushes, small branches, cow dung, ashes and mud were used to build the temporary houses that would then be abandoned. Normally, the walls of the enkaji were built with wattle and daub, an indigenous construction technology consisting of a wooden framework made out of bushes' branches and straw, which are placed under the ground until they are firm [Figure 3.6]. This net of poles would then be tied together with the use of reeds. Once the wall structure is standing, it would be filled and plastered from the outside with a mix of mud and cow dung. Similarly, the building's roof was built with lighter branches, creating a curved structure tied again with reeds (Tyman, 2013). Grass would then be placed on top and in between the branches, to be finally smeared with the same mix of cow dung and mud (Coast, 2000). After drying under the sun for some days, the layer should become waterproof, at least for a while. In case of leaking, the roof could be additionally covered by pieces of leather or plastic, whenever available [Figure 3.7]. An important factor to consider when analysing the material and shape of the Maasai house is the fact that women own their property and are therefore responsible for the construction and keep-up of the house. Such responsibility turns into a very demanding task after the rainy season, when women have to repair potential cracks in the plastered wall in case where the roof leaks [Figure 3.8].

This has strongly conditioned the features of the enkaji, as only light materials that do not require heavy lifts or long transportation are used. Talle (1987) describes women as the 'head of houses', which has given them a certain level of economic and domestic autonomy. In terms of housekeeping and financial management, wives manage cooperatively most of the daily activities and are active in decision-making processes (Coast, 2000).

3.6 Maasai Enkaji under construction.
Source: Jhon Tyman

3.7 Enkaji covered with leather to avoid leaks during rainy season.
Source: Jhon Tyman

3.8 Maasai women repairing their houses after the rainy season. Source: Jerzy Strzelecki. Creative Commons License

3.9 Family boma in Mikocheni fenced with strong wood poles. Source: Own picture

3.3.2 THE IMPACT OF VILLAGISATION (FROM 1967 TO 1976)

The formulation of the Ujamaa Policy in 1967 and its subsequent compulsory application in 1976, brought about significant changes in the socio-spatial organisation of the pastoralist communities living in the northeast of the country.

Boma

After the creation of social villages by the Tanzanian government, many families living together had to split to stick to the settlement plans. The Maasai boma as the main residential unit survived the operation, however, it drastically reduced its size and the number of people who inhabited it. Several authors have noted such a trend (Coast, 2000; Ndagala, 1982; Potkanski, 1993). Despite citizens being allocated in plots that could be shared by a maximum of 10 families, it was witnessed how the traditional Boma tended towards one household, against the 6 to 12 families' boma existing before the application of the policy. According to Potkanski (1993), the reasons were mainly two: on the one side, due to ecological reasons, wealthier families have tended to prefer having their cattle separately, reducing thus the amount of work and possible transmissions of diseases. On the other side, the consolidation of a market-driven economy in the country has given rise to the individualisation of social life. This change might also be highly influenced by individual land ownership preferences by the government. Thus, the existing collaborative reasoning of multi-household bomas is progressively disappearing.Specific pasture fields were allocated to pastoralist Maasai under subdivision of land policies, and bomas were normally distributed along accessible roads at a distance ranging between 500 metres to 1 kilometre between each other (Ndagala, 1982). All these changes influenced how bomas were built. Instead of using thorny bushes to delimit the residential units, families started to fence with strong poles [Figure 3.9]. The reduction of households in a boma necessarily led to higher levels of security. As Ndagala observed in the section of Monduli Juu (Arusha Region) after five years of Operation Imparnati, the boma as a unit was still a circular cluster but households were enclosed by their livestock's gates instead of being around the external fence. He also noticed that most of the families had planted big trees to reinforce protection and shade. These changes highlight the increasing levels of Maasai sedentarisation after just 5 years since the operation.

The Enkaji or Maasai house

The traditional Enkaji built with light branches and coated with mud and cow dung for both walls and roof has completely disappeared in Tanzania, however, some of these examples may still exist in the areas of Maasai Mara in Kenia. With the materialisation of the Ujamaa policy in Maasailand after 1976, most of the spatial and material features of the enkaji were transformed to suit a more sedentary lifestyle.

For stability purposes and simplicity of construction, the shape of the houses shifted from being oval-shaped to circular [Figure 3.10]. Also, light branches that were used to build the walls were changed by stronger wooden poles, that could be found in bigger trees or bought in nearby areas. Despite the higher strength of the walls, windows were still rare as these were hard to execute with branches. The external layer of the walls was still made with cow dung and mud. Likewise, the plastered and curved roof was too weak to be weather-resistant for more than one or two seasonal periods, so a stronger roof structure was introduced [Figure 3.11]. With a tall central trunk, a structure of wooden beams was tied from the wall to the middle pole, creating the base in which a thatched roof would be laying. The thatching technique consists of a layering of dry vegetation such as straw, water reeds or grasses. The thickness of the thatched roof should be at least 12 cm to protect it from heavy rainfalls.

3.10 Axonometric view and floor plan of a round Maasai house. Walls are built with the wattle & daub technique and thatched roof. Own illustration

3.11 Round thatched house with mud and poles walls in Maji Moto, surrounded by a bush fence. Source: Own picture

With this new structural roof, only the external part of the thatch layers should be changed after the rainy season. Additionally, to protect the fragile mud walls from rain, the roof structure was usually built with a little overhanging to avoid constant repairing of cracks. Most of the mentioned shifts in building techniques led to the progressive removal of women's primary role as builders. This will be more visible towards the 80's when industrialised materials start to populate the Maasai settlements.

All the changes described above were mostly adopted by observation of other communities when the Maasai started to mingle in villages. While doing fieldwork in Mikocheni village in Kilimanjaro Region, most of the Maasai neighbours mentioned how they started building their rooves with thatching technique after they had come to live close to 'Swahili' people, referring to Tanzanian citizens who migrated from the coastal areas of the country. Also, according to Ndagala (1982), the Maasai in Arusha Region would have learnt the new techniques from the Waarusha group. As well, some of the campaigns launched by the government in 1974 to assist rural communities, helped to build more adapted houses in the first years. Another factor was pointed out by Coast (2000), who stated that in some protected areas as the Ngorongoro Conservation Area Authority (NCAA), families building permanent houses had to stick to the norm of adopting thatched roof houses and replace the traditional mud/dung enkaji.

3.3.3 AFTER VILLAGISATION (1976 ONWARDS)

The implementation of the villagisation plan applied in Maasailand in 1976, led to a forced modernisation process impacting directly in the selection of building materials (Raikes, 1986). This noticeably influenced the entrance of the Maasai community into the market economy[6]. In very few years, most of the settlements in which pastoralist communities had been allocated started to be populated with shiny rooves built with Corrugated Roof Sheets (CRS). The arrival of this material has been probably the most revolutionary element in the lifestyle of rural communities in Tanzania. As Coast pointed out, the presence of CRS for roofing "may be both a cause and an effect of increasing levels of sedentarisation" (2000:38). This process led to the loss of traditional knowledge, and an increasing reliance on external resources and building materials. These are expensive and as a consequence, contributed to the impoverishment of rural dwellers. Since that period, it became common for men to migrate to bigger towns looking for jobs to improve the household's financial capacity (Munishi, 2013).

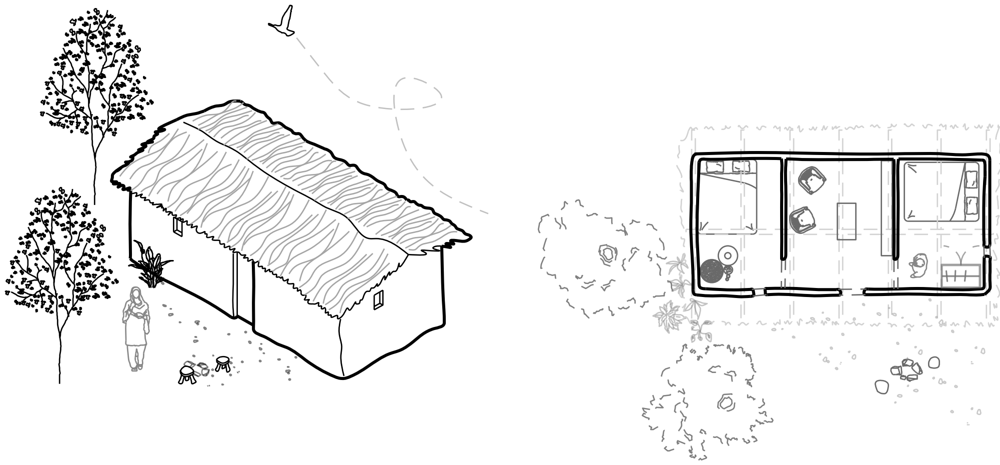
6 - Entrance in the market economy trigger other essential changes in the Maasai lifestyle, such as having to go away looking for jobs and generally being in need of extra-income to afford such materials.

This period also marked a departing point towards the fundamental change (in some cases dissolution) of the spatial organisation of bomas. With individual household bomas and the progressive reduction of cattle, the round form of the plots lost its essential function. As part of the government's allocation of plots for villages, many people switched to rectangular plots. However, those communities who remained practising pastoralism, kept the round shape of Bomas while reducing considerably its size and form.

The origins of the modern Maasai house

The definitive turn towards 'modernised' buildings away from the traditional enjaki was marked by the emergence of the squared wall. Literature around such change in building techniques has widely accepted the term 'modern' to describe the new type of house that encapsulates the influence of bigger cities and consequently, the modern world. Some of the examples are described by Coast (2000), Kipuri, (1989) and Ndagala (1982).

The typology of houses with squared or rectangular walls was already common among other urban and rural areas. The reason for desiring such change was clear - A square-shaped building enables the use of industrialised materials such as corrugated roof sheets (Kipuri, 1989). The benefits were several. First of all, houses would need way less maintenance and leaks in the roof would disappear. Also, with the new building system, it became much easier to create bigger openings such as windows and doors. In terms of distribution [Figure 3.12], a rectangular shape is more versatile to enable the inclusion of internal partitions, which would be normally two lateral rooms with a central entry space used mostly as storage. Lately, the central space has become a sort of living room with spare furniture such as a sofa or chairs. This is because people would still spend most of their time outside and only use their homes for sleeping.



3.12 Typology of widespread rectangular house made with adobe bricks and roofed with thatch. Own illustration

7 - The Wameru, are a branch of Maasai ethnic groups. It is further explained in chapter 7 as part of one of the villages' analysed in the case study

Building this new type of wall was possible due to the use of rectangular bricks, which differently to poles and mud, can be easily laid on top of a small foundation forming straight walls and corners. Most of rural communities had been using mud bricks since the early 60's to build their houses, such as the Chagga or Wameru[7]people. These bricks are commonly known as adobe bricks. Adobe bricks can be produced hand-made with a wooden formwork with a rectangular shape [see Figure 3.13]. and using a mix of materials such as mud, water and straw, then sun-dried. Once the brick wall has been raised by using a mortar consisting of the same mix of the bricks, a layer of plaster made with mud, water and hashes is applied on the external surface [Figure 3.14].

3.13 Adobe bricks being produced with mud and straw.
Source: C-re-aid Website

3.14 Boma in Maji Moto with two houses built with adobe bricks and plastered with mud. Source: Own picture

The use of bricks leading to rectangular walls and the introduction of CRS had other direct implications for the building system. First of all, an adobe brick wall should be laying on top of a foundation and could not be made by introducing the bricks a few centimetres into the ground as women used to do with wooden poles. To build a foundation, it was required to use cement, which was mixed with gravel and stones. Additionally, to build the corners of the wall it is advised to use cement mortar, as a way to give them more strength. Lastly, to place the structure in which the roof would be laying, the beams need to be straight, which hinders the chance of using poles from the surrounding landscape. All these new materials required to build a 'modern' permanent house were indeed fostering the need for industrial materials. The location of new villages in proximity to roads connected to larger city centres was also crucial in enabling rural communities to access a wide range of industrial building materials.

As it was highlighted earlier, the role of women in construction was significantly relegated to a secondary role as a direct consequence of the more sedentary lifestyle (Ndagala, 1982). Before, women were in charge of the construction and maintenance of their houses. Later on, with the introduction of industrialised materials, specialised labour became key and many of the required works needed to be made by skilled workers. With such change, men became the drivers of new construction as they had the financial capacity to purchase building materials. After many centuries of constant repairing of buildings after the rainy season, women got relieved from such a demanding task[8], and construction is now an "area of cooperation among men" (Ndagala, 1982:33).

8 - There are some exceptions on this and today still in some Maasai communities, women build the walls of their wattle and daub houses.

3.3.4 THE CONTEMPORARY BUILT ENVIRONMENT

The current extent of Maasailand spreads across different regions in northern Tanzania and southern Kenya. In Tanzania, the regions of Arusha, Mara and Kilimanjaro are the main areas where Maasai communities are settled. In some areas like Mikocheni (one of the case studies), villages still appear to have similarities with the boma structure, by practising mainly pastoralism and with a considerable number of houses built with mud and thatching techniques. In some other areas like Maji Moto (second case study), where the community has widely adopted agriculture as the primary means of livelihood, dwelling types are more heterogeneous. It is possible to find some houses built with mud, but these are very few, while thatched houses have almost disappeared.

The evolutive analysis here discussed aims to describe the built forms as they currently appear. But not only. This building evolution is also relevant in that it sheds light on the typology of houses that most of the dwellers aspire to have. It has been observed a significant tendency towards 'modern' building types, where the personality and status of homeowners can be read throughout their dwellings.

Material features

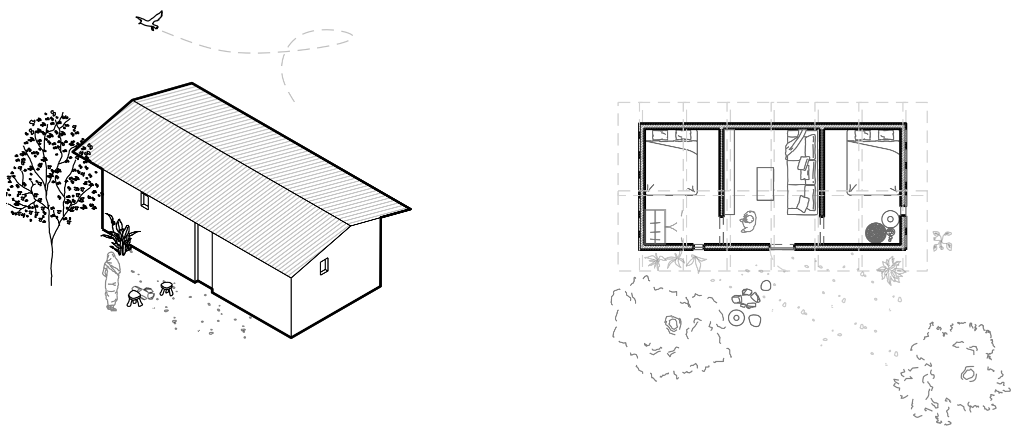
Soon, pastoralist communities such as the Maasai started experiencing the effects of a sedentary lifestyle. Through a process of trial, improvement and failure, they managed to adjust the remaining features of the indigenous enkaji to the new condition, and as a consequence, the forms and techniques have been changing accordingly.

In terms of building materials, the use of adobe brick has become obsolete. Being mud the main component of the plaster applied to the adobe brick, cracks would constantly appear and these need to be fixed after the rainy season. Such activity, traditionally made by women became highly demanding for women who had more important things to do, such as working or taking care of their kids. Adobe bricks have been largely rejected lately in favour of newer building materials. Therefore, in search of higher levels of durability, rural communities learnt to produce fired bricks, that are known as being stronger and more durable. These are an 'improved' version of adobe bricks, consisting of mud bricks that bake for 48 hours in a stacked hand-made kiln [Figure 3.15]. After mud crystallises, bricks become stronger and look similar to industrial ceramic bricks, despite these having a less neat finish, as can be observed in Figure 3.16. Fired bricks need to be assembled with a cement mortar and are normally plastered as well with cement and a final layer of gypsum and colour. For fired brick walls to get the required strength and stability, of a concrete foundation needs to be in place, tiding it together from the top with a concrete ring beam. As a result, large amounts of cement are required to build a house, increasing the costs of materials and transportation. At the same time, given the increased durability that buildings have acquired with their use, cement and concrete have become the paradigm

3.15 Hand-made oven with ready fired bricks inside. The surface has been covered with mud and cow dung. Source: Own picture

3.16 Fired bricks after baking 48 hours. These are ready to be used in construction. Source: Own picture of good-quality building materials in rural contexts. Cement is also used for the finishing of floors, that have lately become paved. Some of the wealthier families have also managed to put floor tiles, which have become popular in rural areas.

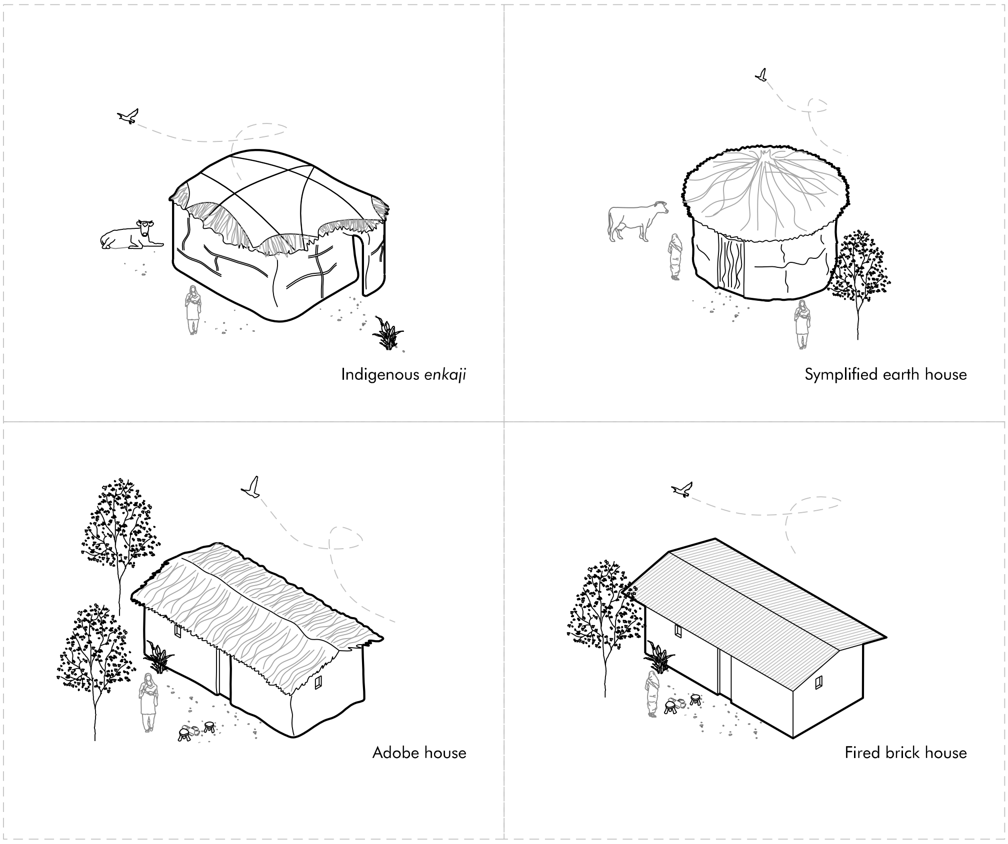
On the other hand, the use of thatch has almost been obscured with the rise of CRS. Rural communities have easily learnt to assemble the sheets and to prepare the roof structure with wooden beams accordingly. CRS are very light and easy to transport and are available in every small shop in rural areas. Also, the price of this material dropped significantly as it was fully introduced into the building culture. As a result, the lately widespread houses built with adobe bricks [see again Figure 3.15] have mostly been neglected with a higher availability of fired bricks. This typology of house, built generally with similar arrangements to previous adobe houses, has become very common within the rural Maasai landscape due to its simplicity but increased durability [Figure 3.17].



3.17 Typology of improved rectangular house made with fired bricks and CRS. Own illustration

Spatial features

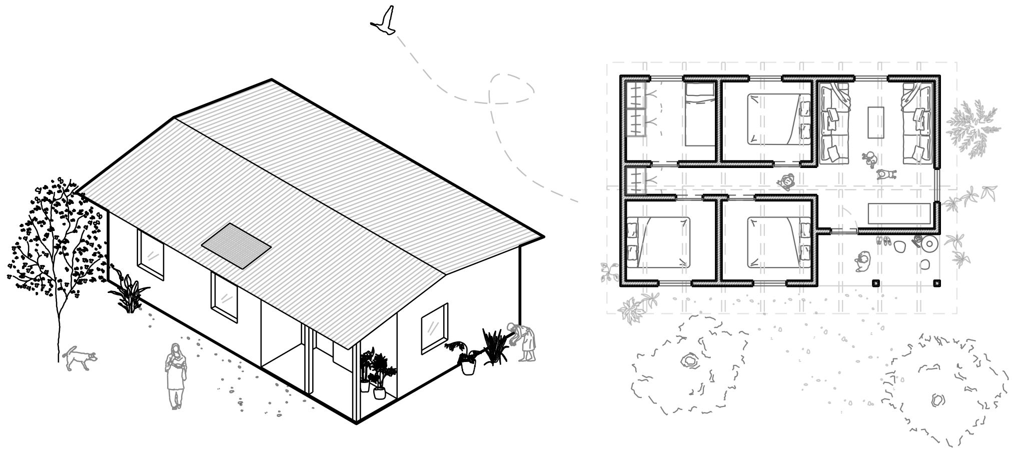
Communities have learnt to adapt their needs to the new lifestyle beyond the use of more durable building materials. A sedentary lifestyle has naturally led to families spending more time at home, especially women and kids. The indigenous hut that was just supportive for shelter and storage has transformed into a more lived space that encapsulates people's dream and desires. By looking at Figure 3.18, the previously analysed evolution is exposed including the contemporary building typology. Besides the simple three-rooms house shown earlier in figure 3.18, rural dwellers have expanded their expectations



3.18 Evolution of housing typologies in Maasailand. Own illustration

and desires in regard to their houses. In fact, many houses appear in form to be more similar to existing dwellings in bigger cities than to the traditional houses [Figure 3.19]. Throughout the process of observation to other cultures

3.19 Fired brick house under construction in a Maasai area close to Arusha. Source: Own picture and learning from the everyday experience with their dwellings, houses encapsulate many more needs and desires. As a result, houses have grown in size, form and investment. A typical house built with fired bricks or concrete blocks has at least 3 or 4 rooms positioned along a corridor where kids and the mother sleep [Figure 3.20]. Spacious living rooms equipped with tables, shelves and sofas, are quite common in most of the newly built houses. Each room has a large window with aluminium frames and glass, as well as an entrance door built in the same way. The emergence of the living room with a table is a practice borrowed from western culture. In fact, still today many families spend most of the time sitting around a tree outside the house and use the living room mostly at evening watching TV or in case they have visitors. Another important element that has been incorporated in the functional program of a house is the porch. By spending time usually outdoors, the shade of the porch has become a central element where most of the life happens. It is usual to see kids sitting on the porch's floor, doing their homework, taking a nap or playing with other kids.



3.20 Improved fired brick house which represents the housing expectations of the Maasai community. Own illustration

An interesting pattern that has been noticed among families' plots is that older houses are never demolished. In fact, whenever accessing to a private plot it is common to find several buildings built with different techniques. The newest building is usually the one in which the family live, and older buildings built in most cases with adobe bricks or poles and mud would be used as kitchen or as a chicken coop. As well, the toilet, which in most cases is a pit latrine, is built detached to the house. Both the kitchen and the toilet are usually built separately as most of the houses in rural areas do not neither running water nor sewage systems. Thus, toilets are built outside to avoid smells entering the house.

The objective of this section was to provide a general analysis of the housing evolution in Maasailand [see again Figure 3.2 and 3.19]. The information presented is based on literature and personal observation, however, due to the vastness and diversity of Maasai communities, the data cannot reflect the specific condition of the different areas inhabited by Maasai people. For this reason, the following section wants to bring into light specific housing situation in Mikocheni and Maji Moto. An exhaustive analysis of the case study houses will be provided for the two villages where the build prototypes have been carried out.

Engagement

Book — 2

This book presents the Engagement Stage: six chapters that build upon the core exploration of this research, the participatory-led built prototypes. With the aim of building an understanding around the specificities of the case studies and the prototypes, the book begins with an introduction of the methodology that has been developed throughout this phase. Driven by an active, curious and ecological approach, the researcher positions herself alongside the main research method: participatory-action. After that, the two case study settlements are presented in a detailed manner, including their historic formation and urban patterns. Within this context, the following chapter introduces the environmental challenge that has provided the need to prototype an alternative building solution; justifying the use of the Compressed Stabilised Earth Bricks. The following two chapters are specially dedicated to providing an account of the different phases of the prototype buildings: from analysis and contextualisation discussed previously, to the development of the design and the construction phases. Thus, the Maji Moto Health Centre and the Mikocheni Bike Shop are investigated, providing the reader with a detailed account of the projects' main features. Finally, the last chapter makes an impact review of the two public buildings two years after opening.

BOOK 2.
ENGAGEMENT

Content

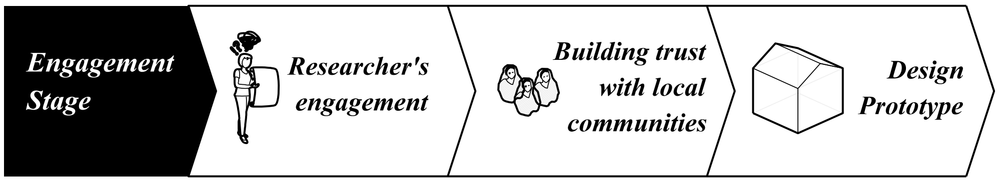
4 — Fieldwork Methodology: Engagement Stage

The process-oriented approach of this research aims to emphasise the lived experience of people in their environments as a way of analysing built interventions. This research has developed an iterative methodology that looks beyond the boundaries of design research[1]. Widely influenced by process research and ecological anthropology, this thesis' fieldwork has revolved around ethnography as a cross-cutting method . It has involved the use of different methodologies over time, recognising fieldwork as uncertain and risky by definition (Castañeda, 2006) and addressing its contingent nature and the multiple variables that may influence research outcomes. Ecological anthropology embraces such uncertainty as it develops alongside the diverse and ever-changing relationship of people and environment: acknowledging the simultaneous volatility and impact of everyday interactions.

The three years over which the fieldwork was undertaken have been categorised into two main research stages, differentiated both by methodology and outcome. The first part of fieldwork has been named the 'Engagement Stage', which is characterised by an active, curious, open, immersive and experimental position towards the research's aims.

1 - According to the definition of Findeli (2010) "design research is a systematic search for and acquisition of knowledge related to general human ecology considered from a designerly way of thinking, i.e. a project- oriented perspective". Despite my research was objectively project-oriented in its beginning, the designing aspect soon became secondary in the attempt of answering wider questions of people-environmental relations and built environment's perception.

This chapter will explain the key methodologies used during this fieldwork stage, led by action-oriented design research. This was developed with a participatory-oriented agenda, seeking to produce a built prototype as one of the research's outcomes [Fig. 4.1]. Throughout 2018 and 2019 I actively participated in daily social and cultural activities, while cooperatively developing the design and construction of the prototype building in Maji Moto; one of the two communities that form this thesis' case studies. Later in 2021, after a pause due to the Covid-19 pandemic, I embarked in the second stage of fieldwork; the assessment stage, which I will introduce in Chapter 10 (Book 3).



4.1 Key elements of the developed methodology during the Engagement Stage. Own illustration

Having been trained in mainstream architecture, looking at fieldwork from a process-oriented perspective and trying to unpack people-environment dynamics beyond instrumental and project-led outcomes has been challenging but essential. My experience working as an architect in under-resourced contexts in Tanzania and Guinea Bissau requires analysis regarding my role within these communities. Several reflections about my positionality and understanding of the local challenges pushed me to question if I was able to really grasp embedded community issues and environmental characteristics to propose an adapted design to the local setting. Because such a feeling has accompanied me throughout the research process, and because I am aware that many other professionals working in the field have incrementally struggled to respond similar questions, I have devoted part of this chapter to the challenges stemming from my position within the community of Maji Moto. Research methods that combine participatory-action with ethnography and design research will be carefully examined; shedding light into the structure, challenges and opportunities found in the field and how these have been holistically tackled.

4.1 RESEARCHER POSITIONALITY

Something that has accompanied me throughout the entire research process has been the title of Mzungu. As a white person, this is the first word one learns when landing in Tanzania. Mzungu derives from the Swahili verb zunguka, which literally means 'to wander around' (Mponda, 2013). The word is used to commonly name foreigners, especially 'white western' people. In the beginning it felt quite irritating that despite people knowing my name, I would just be the mzungu amongst the Maasai. Other attributes such as being a woman, an architect and a PhD student were relevant for the community to position myself (Fisher, 2015), but definitely, my whiteness prevailed over the rest in many instances. It took me a while to recognise that the way I analysed and understood the reality was filtered through my privilege and experience as a European woman. Luckily, throughout the time living in Maji Moto I had the chance to interact with a series of diverse actors that enabled me to begin to better grasp the nuances of my own positionality and the way it was displayed within the research context.

First of all, after being introduced to the community by the organisation I was working with, I met with members of the local government to discuss the project they wanted to implement. I also lived with a local family, which gave me a perspective into the everyday life in the village, including social and family dynamics. Thirdly, due to my past involvement in another project (2016), several public meetings held regarding the development of the new dispensary building and my presence in the everyday life of the village, I had the chance to meet many local villagers. Ultimately, I was also able to interact with two other team members of C-re-a.i.d. (an NGO) both of whom were local to Maji Moto, as well as Tanzanian nationals and international professionals. Conversations with work colleagues prompted many reflections of common experiences of foreignness, as well as discussions on cultural behaviours - both amongst ourselves and with community members. Such broad interactions with different stakeholders and villagers helped me to progressively build relationships while dealing with being Mzungu. Issues such as race, gender and class related to my whiteness have surely influenced the research methods that I have used over time. As David Harvey (1999:272) noted, "the personal is political" and therefore, as a non-indigenous person working with indigenous communities, I embody the privilege that arises from colonial legacies and present ongoing dispossession of indigenous groups. When researching cross-culturally, avoiding essential reflections on privilege and positionality would be, as suggested by Porter (2004), a loss of knowledge and possibilities that are blinded by our own privileged position. The un-learning of privilege, besides being key to cross-cultural research, is crucial in accepting how our position in the research process often operates to maintain status and power. By 'losing one's privilege', new world views open up, benefiting the relationship with research participants and the final outcome of the research as a whole (Landry & MacLean, 1996).

My background in architecture and the role I had within the development of the projects would inevitably put me in a position of power alongside the local community. This is not uncommon in international development projects, but rather is a situation in which most fellow architectural professionals find themselves in. Considering the many challenges and ethical limitations involved in cross-cultural research and practice, I believe in the urgency of deconstructing the performance of the architects' role. This starts by engaging in active involvement with local communities and a genuine will to use one's expertise to promote positive change. Beyond attempting fair and equitable engagement of local communities, the acknowledgement of our own power in directing projects' outcome must be examined in order to address the harmful dynamics that have forged the concept of 'white saviourism' (Fanon, 1970; Willuweit, 2020). Challenging discourse around the supposed 'heroic performances' of white saviours should drive a change in power dynamics, ultimately "giving back agency to local actors in shaping the underlying ideologies of development work and philanthropy" (Willoweit, 2020:3). As such, the recognition of the researcher's own preconceptions and their power of influencing the outcome of any research assists in knowledge gain in the fieldwork, both for the engaged participants and the research team.

As fieldwork inevitably leads to the discovery of new paths and learning for the actors involved, it is paramount to constantly self-reflect as part of the commitment to undertake engaged and impactful research. However, as Parizeau and Pacheco-Vega (2018:7) note, reflexivity also finds its own limits as "all knowledge is partial and situated, and acknowledging our positionality allows us to contextualise the limits of the knowledge we produce." As such, they acknowledge the impossibility of being fully reflexive and of constantly controlling our position to others. We must also acknowledge that we cannot fully reflexively know our positions/relationships to others, and therefore this uncertainty is an essential part of research (ibid). Embracing uncertainty and accepting imperfection does not have to contradict attempts to grasp differences and inequalities within vulnerable groups, to ultimately benefit the community under study.

4.2 BUILDING INCREMENTAL TRUST WITH LOCAL COMMUNITIES

Due to the reasons presented in the previous section, building trust with the local community was both challenging and rewarding at the same time, but necessary to achieve the implementation of the prototype project. Since the aim of this research has been intimately linked to processes of inhabitation and building, witnessing daily environment-people interactions and situated practices of appropriation has enabled me to build a contextual understanding of dweller's perspectives. At the same time, such local needs and aspirations are informed by the way we are and the manner in which we create meaningful relationships with others (Rigon, 2022). It is thus essential to look at these interactions when participatory processes are involved in the development of any project. The recognition of people's multiple identities contributes to grasping local needs and internal power relations. Considerations such as gender, age, class, ethnicity and so on, usually play a major role in the development of social processes (ibid). Therefore, my involvement in the daily life of Maji Moto has been paramount to deepen understanding of local dynamics, the agency of diverse actors and how their power influences outcomes. This became key in drafting the participatory-led activities that took place throughout the design of the built prototype.

Initially, my desire was to participate in the village's local life as any other inhabitant did. This should have been easy but I was not a typical villager, and unsurprisingly, the community was startled to find a young white woman trying to adapt to traditional customs. Living with the family of one of the organisation's local managers gave me the chance to approach community members beyond my work duties. However, despite the initial efforts to be accepted as part of the community by 'going native'[2], I soon realised that creating strong ties with community members would not necessarily happen by obscuring my own identity. Forging an honest relationship with diverse actors could valuably happen through difference and respect (Huxley, 1997; Lacey, 2021), softening the boundaries and looking beyond such duality between locals and the external researcher. I discovered how enriching it was to build up trust from an honest position of openness towards learning from local customs as well as finding nuances and common ground across different stakeholders. In this regard, I clearly stated the reasons behind my stay in the village, avoiding disproportionate expectations concerning the objective of my stay and the specific project in which I would be working, whilst being up-front about my professional interests and field of expertise. After the construction of a Women's meeting centre as part of a volunteering project, I travelled several times in 2017 to meet the local government, with the objective of planning the construction of the new health centre. I participated in focus groups exploring the possibility of employing different building techniques in its construction. My commitment across several years progressively showed inhabitants that I was there to stay, unlike the many aid workers that had been passing through for some weeks for a symbolic and alienated construction project. As such, through an immersive involvement in the development of Maji Moto's daily life, I incrementally learnt to deal with different situations and actors, adapting the design proposal as I was spatialising the complex Maasai socio-cultural system. By 2018 I was not a complete foreigner anymore, which enabled me to explore the complexities of the built environment from within people's perspectives. I visited construction sites and had conversations with multiple local bricklayers, listening to their points of view and learning from their experiences. I was invited to traditional celebrations, from weddings to age initiation ceremonies, which gave me the opportunity to interact with a variety of actors with different

2 - 'Going native' typically refers to the act of adopting or immersing oneself in the lifestyle, customs, and culture of a particular place or community. It often implies a desire to fully integrate and experience life as a local, rather than remaining an outsider. It is worth noting that the has been criticized for its colonial undertones and potential for cultural appropriation.

ages and experiences. Ultimately, I witnessed how speaking Swahili became a pivotal element towards my inclusion in the community. The effort of learning their language forged new types of bonds, which resolved into openness and honest confidence from local neighbours. Thanks to that, I had meaningful informal conversations with dwellers about access to resources, inner conditions and materiality of their homes, which were key in determining the materials and techniques to be used in the prototype building.

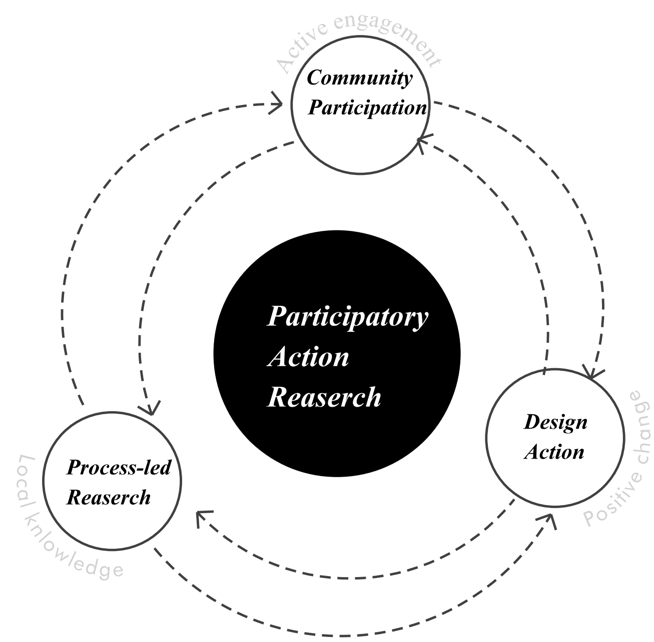
Overall, my direct involvement with the community of Maji Moto lasted around four years, after which I could look back and see how building and maintaining rapport is a complex exercise that requires patience, transparency and time. While I was extremely privileged to spend long periods of time doing active research, I need to acknowledge the difficulty that the whole process involves. Unfortunately, resources are usually limited when dealing with cooperative design projects and are commonly dedicated to more tangible outcomes such as the physical construction itself. For this reason, participatory-led design remains in many cases symbolic or tokenistic. It has been throughout my long-term and direct involvement in local activities that I have aimed to understand the socio-cultural complexities of the built environment beyond merely looking at the spatialisation of architecture (Simpson, 2011). In this sense, the ethnographic exercise of building trust with community members in the field of architecture, acknowledges the complex relationality of human beings (Bell, 2019), a radical act that puts users at the forefront of any spatial intervention.

4.3 PARTICIPATORY-ACTION RESEARCH

The engagement stage of this research's fieldwork has emphasised the value of processes as stressed by Ingold (2012), highlighting the benefits of fostering the co-production and management of social habitats. Rather than designing with a built outcome in mind, this methodological engagement has looked at methods that reveal the richness laying in the process of construction development and the actors involved; from material extraction to local workforces. The focus on process-led interventions builds upon the recognition of the community as an independent actor that is key to ensuring the efficient implementation of any given project (Rigon, 2022). Beneficiaries should always be considered "an active and essential partner of government and development agencies" (2022: 4), celebrating the diversity of knowledges and skills involved in the process as a valuable source of expertise that fosters projects' sense of belonging. Under these premises, this research has relied on Participatory-Action Research (PAR) to motivate the design and construction of prototype public buildings [Fig. 4.2].

Participatory-Action combines education, research and action with the objective of bringing about transformative social change (Hall, 1993). Through the use of PAR, community-built interventions trigger a democratic and collaborative process that involves key actors with different backgrounds. PAR recognises that "ordinary people also produce knowledge that is useful in struggles for change, and the research process itself becomes an important arena for making change" Dyrness (2011: 203). The variety of stakeholders involved has ranged from community leaders, local government members, and community women's groups, to individual villagers and associations of young workers. Whether directly on-site or by taking part in the decision-making processes, all these actors have been key to the design and construction of the village's health centre [check figure 4.3 for details of the actors involved]. A considerable number of inhabitants have been involved in the process to some degree. This has fostered the community's sense of ownership and a commitment to campaigning for and maintaining the much-needed governmental support to run the essential activities of the dispensary.

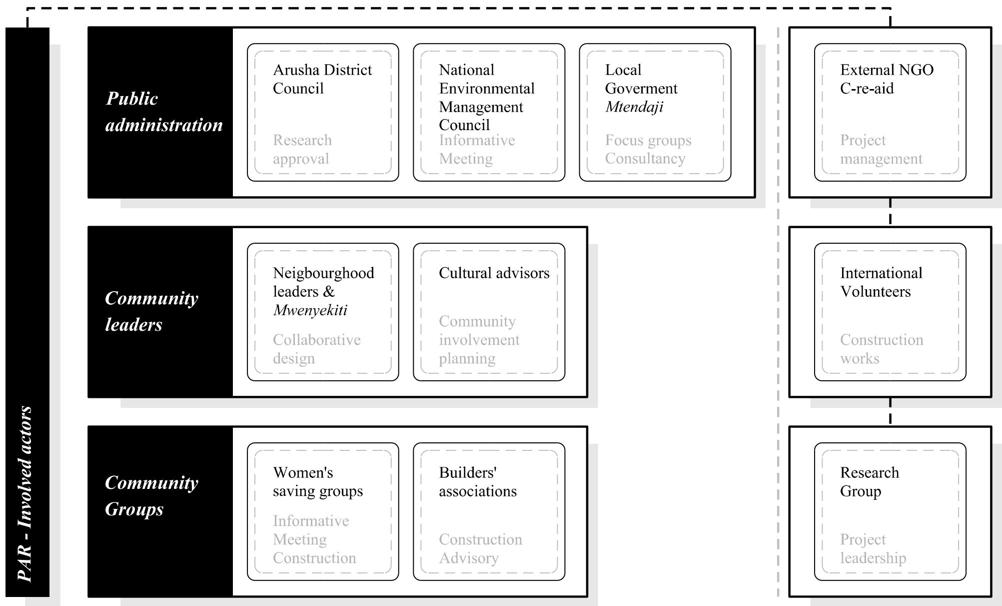
More importantly, the villagers' direct contact with the new building technique presents a unique opportunity to develop confidence and trust towards the



4.2 Participatory Action Research (PAR) framework. Own illustration

newly introduced material. Therefore, while part of the project's impact can be observed in the short term with the opening of the health centre's activity, the concrete objective of the action-oriented approach is future-directed (Small, 1995). The construction of the public facility has created a space to test the assimilation of an innovative building technique. This would be unlikely to happen without the active and direct involvement of community members. The progressive transformation of the built environment into a more innovative but sustainable system requires commitment and time. This active process involves context-related actions, that emphasise the relationship between people, the place they inhabit and the culture in which they are embedded, aiming to create long-term positive change as a result of the intervention. The specific details of the participatory-action engagement that was developed alongside the construction are explained in chapter 7.

As an architect engaged with the complex social reality of the built environment, I believe that the use of PAR within the methodology has encouraged processes that lead to empowerment and positive change. PAR not only creates valuable research knowledge due to the documentation and further assessment of the process, but it also promotes collaboration and builds trust towards the research objective. In this way, active engagement becomes an essential part of the action-research, enriching the design process whilst learning throughout. In addition, the use of this methodology in the context of a critical environmental issue has contributed to approaching the case as a top-down intervention, learning from local practices to propose an environmentally advanced solution.



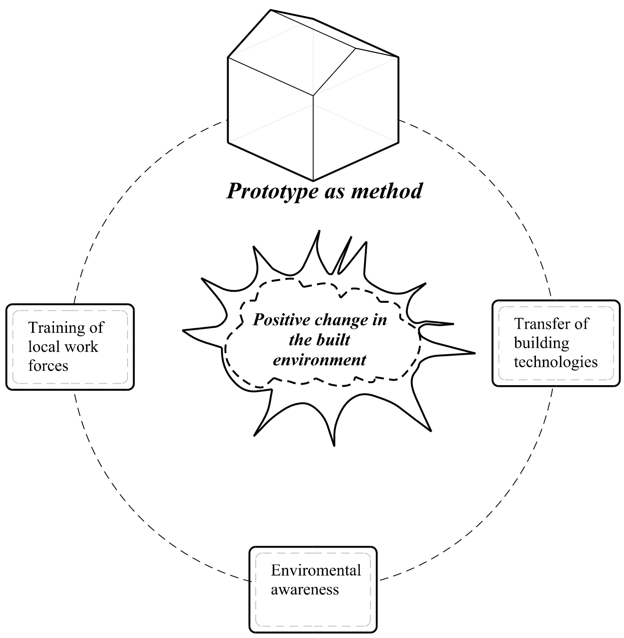
4.3 Main actors involved in the Participatory Action Research. Own illustration

4.4 PROTOTYPE DESIGN

In the recently published book ‘Prototyping for Architects’ (Burry, 2017), the authors justify the growing interest in this practice: firstly, it serves to prove the feasibility of specific designs, which leads to more flexible building solutions. This improves the architect’s awareness regarding the limits and opportunities of design, in terms of structure, aesthetics and technology. Secondly, they also stress why the final result of the project is not the point, as “prototyping is the revelatory process through which the designer gains insights” (2017:5).

However, the site of intervention needs to be approached with sensitivity and awareness to grasp local needs, which implies a large effort for in-depth analysis of the specific context. Unpacking spatial dynamics is key to avoiding processes that are detached from their socio-cultural context. The designer/researcher also needs to be open to changes and unexpected results, embracing the multiplicity of possibilities that the space and resources can offer.

Prototyping as part of the research methodology played a key role in the implementation of this project. As one of the primary objectives has been the transfer of building technologies, the most concrete and tangible way of showing the material's potential was through proposing a prototype project [fig. 4.4]. This option became feasible after the local government approached the organisation to commission the design of a local health centre. As such, the process of design and construction became the method in itself, and the prototype, an opportunity to transform theory into practice, leading to a transformative intervention. The design project sought to tackle the negative perception of the local community regarding construction techniques that use soil as the primary building material. After careful research into building techniques with the potential for adaptation to the local context, the use of Compressed Stabilised Earth Bricks was decided for the prototype buildings (specific details of the technique can be found in Chapter 6). Its relatively easy manufacture, easy access to the main material involved; soil, and the positive social, environmental and economic impact, made it a suitable choice to boost local communities' well-being. Involving the community in the process of production, construction and implementation of the new project sought to establish new building possibilities for local construction projects. The perception of earthen materials as poor and backwards can progressively change throughout contact, use, and experience of the material transformations,



4.4 Building prototype as method: framework. Own illustration together with attributes such as the strength, textures, colours, and spaces that this creates. This process demonstrates how both the physical material and the perception of materials are not static, but that through experience, concepts can be adjusted and ultimately shifted. Findings regarding the local community's perception after the finalisation of the project are shown in Book 3: Assessment.

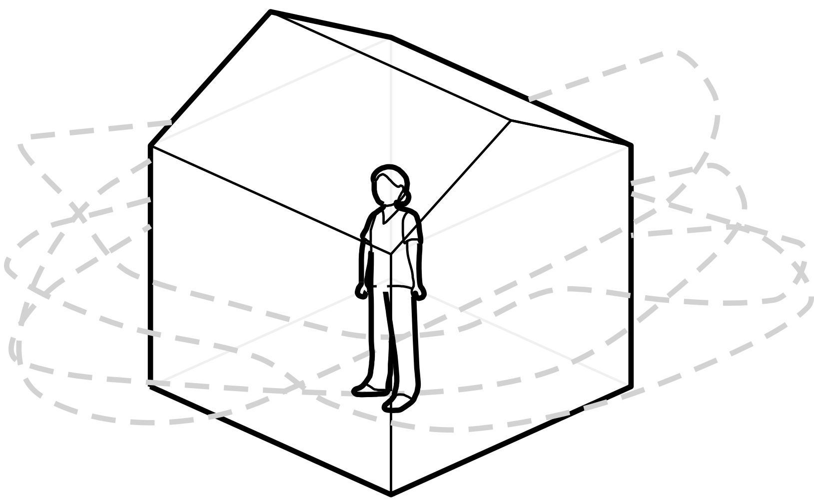
As has been stated before, community participation has been a key element in achieving the desired outcomes of the prototype. Unfortunately, architects have not usually been trained to take the knowledge of the project's recipients into account, which in this case was crucial to enable a just and inclusive transfer of building technologies into the building culture. Therefore, if knowledge is dominated by expertise and alternative views are systematically shut down, knowledge becomes a form of domination leading to disempowerment (Miraftab, 2004). In order to successfully implement the pilot project, such transfer needs to be conducted through a process in which the community leads, and the expert supports (Freire, 2000).

Considering the social and environmental challenges faced at the local level in the villages analysed, and after several years working and living with the Maasai community of Maji Moto, the act of building was to be necessarily seen as a trigger of positive social and environmental change. As such, the need to provide a public health centre - which will be discussed in the following sections - became an opportunity to draw attention to the social processes involved in the act of building, while demystifying the use of soil as a building material, showing the potential of environmentally sustainable building technologies such as the CSEB. Lastly, the assessment of the project, two years after completion, will provide valuable information on the possibilities and challenges for further implementation of similar prototype projects in other contexts.

4.5 BODILY EXPERIENCE: A CROSS-CUTTING METHODOLOGY

I have strategically chosen to include this section at the end of the methodology and before the analytical chapter. For a long time, I felt uncertain about the extent to which my bodily experience had influenced the research outcome. However, whilst it might be fraught to unpack exactly how this has impacted the thesis' findings, I am sure that in one way or another, my immersive experience in Maji Moto has strongly shaped the path of this research [Figure 4.5].

Lately, I have started to pay more attention to the subtle but nevertheless important bodily sensations that have been an essential part of my everyday life in the village, both at the Engagement and Assessment stages. This is in part because it would be absurd to research materiality without taking into account the physical and sensorial involvement of oneself within an environment where diverse materials are present. After all, the concrete expression of building materials is anything but detached and intangible. Experiencing homing practices through my own body for months has shaped my ideas of the Maasai indigenous house and the ongoing debate between tradition and modernity. Indeed, the opinion that I had back in 2016 when I visited the village for the first time has changed day by day as I have progressively experienced the mundane. Being woken up at night by the power of rain and wind hitting the corrugated metal sheets, and the worrying uncertainty of the roof's resistance to it; sitting in the house's living room at 2 pm in 36 degrees Celsius, attempting inventively to encourage better air ventilation; showering under the stars and with the presence of a couple of frogs every night; having a chat in the mornings after the rainy season with my elderly neighbour as she repairs the cracks of her



4.5 Bodily Engagement in Ethnographic Research. Own illustration

house's wattle & daub wall. These are just brief examples of some relevant bodily memories during my stay in Maji Moto. Some are easy to grasp and remember, some others are more subtle and have been forgotten, but humidity, temperature, texture, roughness, colour, smell, sound and so on, are integral in the ethnographic experience of a researcher researching perceptions in materiality, as Michael Jackson noted:

"By using one's body in the same way as others in the same environment, one finds oneself informed by an understanding which may then be interpreted according to one's own custom or bent, yet which remains grounded in a field of practical activity and thereby remains consonant with the experience of those among whom one has lived" (1989:135).

While interpretations are formed by personal understandings, the experiences collected through our bodily senses are spatially contextual, therefore the environment that is immersed in facilitates the researcher's ability to walk in other people's shoes. Participating in daily activities while sharing the same space sets a common ground for enabling further understanding of people's perception. Such a process bonds us together in the act of being grounded by place, which is central in ontology “as the structure giving sense to human experience” (Casey, 1993:16) In my case, Being in place has shown a lot of potential to build a much-needed contextual knowledge of local habitus. The two months that preceded the design process of the Maji Moto health centre were extremely useful in informing me of material qualities and spatial forms. However, my feeling is that the most ground-breaking side effect of my ethnographic immersion has actually been captured in the assessment stage. The embedded knowledge gained during the years that I spent living with a local family while following the project’s construction was extremely revelatory, enriching the data collection phase while prompting more detailed and meaningful conversations with interviewees. Also, the connections I made throughout the coding phase of the analysis (which follow in the next section 2.5) have indeed been shaped by these very tangible and intangible bodily experiences.

Other researchers have acknowledged the potential of ethnographic immersion to provide context and meaning to fieldwork research (Herbert, 2000; Fisher, 2014). Such contextual engagement, despite being time-consuming and sometimes overwhelming, provided me with valuable insights into the daily joys and challenges of the village. These have nurtured many reflections on people-environment dynamics that I would have been less eager or able to grasp otherwise (Mountz, 2010). Most importantly, however, by experiencing the local built environment with my own bodily senses, I have been able to theorise the reasons behind people’s choices of building materials.

5 — The Case Studies: An Analysis

This chapter aims to introduce the two settlements where the prototype buildings and subsequent ethnographic research were conducted within the context of Northern Tanzania. The objective is to provide the reader with a context of the history and the most relevant features of the two Maasai localities: Maji Moto and Mikocheni.

Firstly, section 5.1 presents Maji Moto, a very particular settlement where its inhabitants abandoned pastoralism and adapted to farming techniques as a consequence of the Villagisation Policy's approval. Relevant to note is that the prototype building conducted by C-re-aid NGO was in Maji Moto. Section 5.1.1 introduces the historical context of Maji Moto, which has been investigated through the oral history of dwellers. After that, section 5.1.2 is dedicated to introducing the spatial characteristics of the village.

Secondly, section 5.2 introduces Mikocheni, the second case study settlement where a prototype building was designed and constructed by the same NGO by using innovative building solutions. Likewise, it first introduces the historical context of the settlement, a pastoralist Maasai community that practices seasonal migrations but that settled in the area before Nyerere's Villagisation Plan. The last section, 5.2.2 introduces the particular spatial features of the area.

As such, this chapter wants to give an overview of the social and spatial organisation of both communities that are the subject of investigation of this thesis.

5.1 MAJI MOTO, THE CASE OF MAASAI FARMERS

5.1.1 THE FORMATION OF THE VILLAGE

Maji Moto is a village situated southern of the Arusha region. It falls under the management of the Nduruma ward and according to local authorities, there are around 2200 inhabitants [Figure 5.1]. The village was officially formed after 1975 with the implementation of Operation Imparnati in Maasailand, as part of the Ujamaa policy of 1967.

The majority of Maji Moto inhabitants belong to the Maasai ethnic. Surprisingly, when dwellers were specifically asked about their ethnicity, they would claim their belonging to the 'Warusha'. The Arusha people are a sub-group within the Maasai society that defers from pastoralist Maasai for being farmers. Their language, traditional practices and rituals share more similarities than differences (Spare and Nurse, 1992). The Arusha people became ideologically detached from the Maasai back in the 18th century when they started engaging with agriculturalist groups such as the Meru and the Chagga[1] (Butovskaya et al, 2016). After centuries of living in the areas around the Rift Valley in Kenia, Maasai groups migrated to Tanzania. Due to several internal conflicts, some Maasai groups living in the Kenyan border migrated to an area in the south of Mount Kilimanjaro called Arusha Chini, where they lived from the 18th Century. After being displaced from Arusha Chini by another sub-group

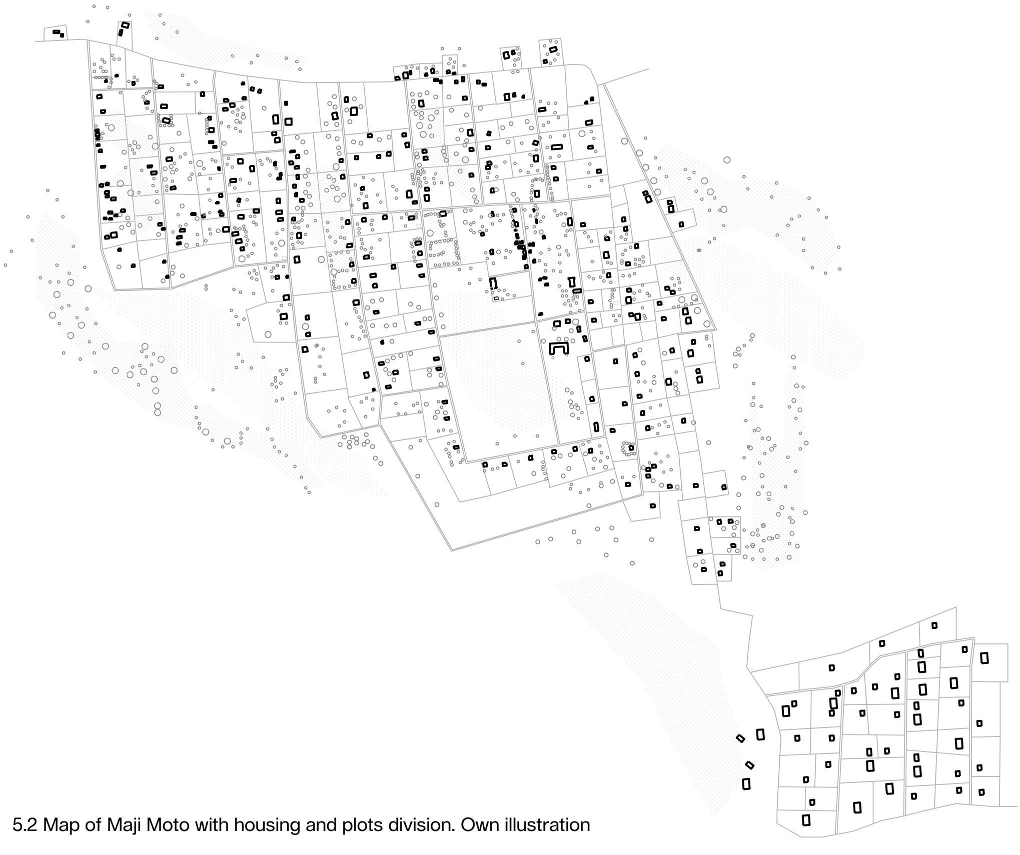
1- Meru and Chagga are two Bantu ethnic groups who live in the highland areas of northern Tanzania: Mount Kilimanjaro and Mount Meru. To know more details about the origins of the Arusha people and their relation with other ethnic groups, please see: Maasai Farmers : The Evolution of Arusha Agriculture Author (s): Thomas Spear and Derek Nurse Source: The International Journal of African Historical Studies, Vol.25, No.3(1992), pp.Stable URL: http://www.jstor

5.1 Situation map of Maji Moto and its surrounding environment. Own illustration (the Kisongo Maasai) they settled down in the surroundings of Mount Meru. At that point, Maasai coming from Arusha Chini got familiar with Highland Bantu Agricultural practices. Since then, they were considered to form a sub-group called Arusha and together with the Meru people, they formed what today is Arusha Town (Ibid.). While they had adopted agricultural practices, they did not fully refuse their livestock tradition, and when Arusha Town started to grow after independence, they decided to move to southern areas in search of less crowded space for their cattle. The Arusha people populated the areas of what today is the Nduruma Ward. After the application of Operation Imparnati, several villages were formed, being Maji Moto one of these. Thus, the pastoralist Maasai who did not want to be part of the Villagisation plan, kept moving south, while those who stayed became part of the different villages that are currently found in the area, such as Karangai, Nduruma or Mererani.

According to the oral history and after triangulating the different information given by elder leaders from Maji Moto, it is certain that the area was populated before the official formation of the village. A colonial settler of unknown nationality owned most of the lands, having coffee and banana plantations. The area was a dense forest populated by wild animals and several sources of water that had been installed by the settler owner of the lands. The characteristics of the land by that moment were advantageous for semi-nomadic communities in search of water sources and pasture. Around 1962 there was already a considerable number of families that populated the outskirts of the plantations. With the country's independence in 1964, the colonial settler was forced to leave the area due to misunderstandings with the new administration of the land. The territory kept receiving communities that were avoiding the crowd of cities until the Villagisation Plan was activated in the Arusha Region in 1975. Until that moment, families' compounds were scattered and far from each other. As the objective of the village's plan was to bring people closer to activate cooperation links among communities and to provide better access to infrastructures and security, regional administrators set up the official boundaries of the village. By 1977 the local authorities made a claim for people to join the village and subdivided the area into three types of land: The central area for community services, the three neighbours for family housing and the grazing area for livestock. The main road reaching Maji moto dictated such division; the village would develop into the south with perpendicular straight roads, and the north part would be kept un-built and communally owned to provide enough pasture for the resident's cattle. After that, the local government distributed the Maji Moto area into plots of 1 acre (70x70m) that were given to families free of cost [Figure 5.2]. The dimensions of the plots were considerably useful to enable a family to have plantations, a reduced amount of cattle and their house.

The new plan of villages was not convincing for many pastoralist communities who moved south refusing the government's mandate. In contrast, for many Maasai 'Arusha' who were already familiar with farming, the Ujamaa policy was seen as an advantage to provide a more decent life for their families. Baba Msafiri expressed it in this way:

"After moving around with cattle, we realised that it wasn't so good for us. We had been moving for a long time and at some point, we realised that we were going nowhere. That's why we decided to stop here. We were allocated a plot that the government was giving us for free. We decided to stay so that we could also cultivate crops. Now, we are no longer pastoralists; we are entrepreneurs and crop cultivators. [...] People say that we Maasai don't value education and don't bring our kids to school. I was a pure Maasai because I never went to school, but now we have to take our children to school, and we are grateful for that".



5.2 Map of Maji Moto with housing and plots division. Own illustration

Since 1977, many Maasai 'Arusha' people kept populating the area, along with other minority ethnic groups that valued the formation of social villages. Soon, primary schools, small shops and other services started to appear in Maji Moto as in other nearby formed villages.

It is widely said that the area was named after the settler's name, a questionable affirmation considering that Maji Moto means 'hot water' in Swahili. Some think that there was a source of hot water as the main reason for giving such a name to the area. Among the interviewed neighbours it was denied that the name had something to do with that. There are several hypotheses about the origins of the village's name, however, none of these seems to be relevant.

What seems clear is that the place was already commonly called Maji Moto before the formation of the village, which makes it possible that the name had a relation with the colonial settlers living in the area. Therefore, the specific reasons for the name formation are not clear, but is worth mentioning that there are many other settlements in Tanzania whose name is Maji Moto.

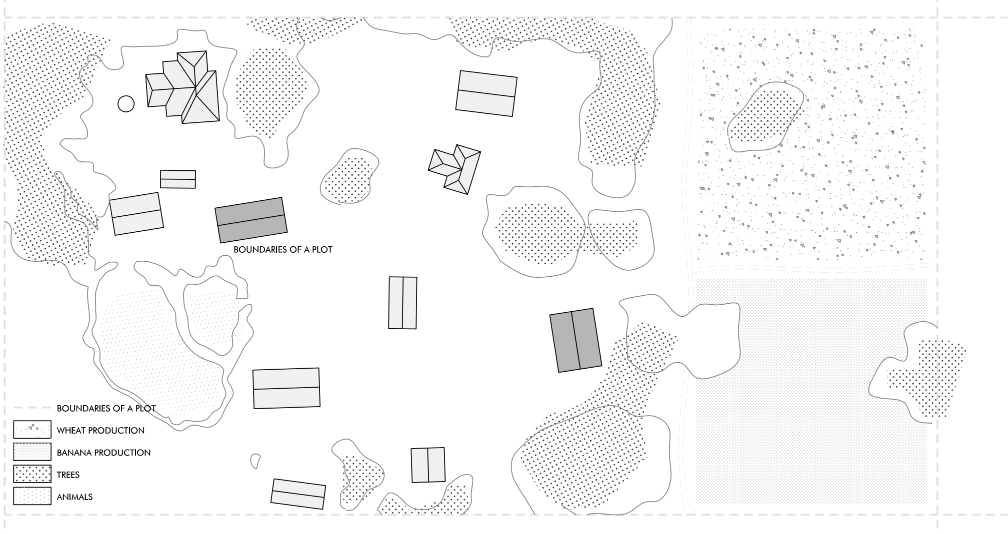
5.1.2 MAJI MOTO SETTLEMENT ORGANISATION

Maji Moto is subdivided into three areas - Msubbijini, Zaire and Kitongojini. Zaire is the central area where the public facilities are found: a primary school, a pharmacy, the local health centre prototyped in this research and the local government office. Besides that, several grocery shops and bars are confined within Zaire. The other two parts are mainly habitational. Maji Moto is mostly isolated and lacks public transport to reach the locality. It is limited by two seasonal rivers that leave the area inaccessible during heavy rainfalls. Secondary schools and bigger health centres are in nearby villages such as Marurani and Nduruma, however, the lack of public transport makes it difficult for the poorest residents to have access to such facilities, having to take a taxi motorbike or walk for long distances.

Regarding the layout of the village, the plots are allocated on the two sides of long straight roads that were designed with the formation of the village. In the latest years, an electrical installation has been brought to the village and many families have prepared the electrical layout of their houses to get connected to the main power system. Also, several public taps with potable water are distributed along the village to be accessible to all neighbours. The village does not have a sewage installation, and as such, toilets and kitchens are usually detached from the main houses occupying other smaller buildings in the plot. Again, the existing and missing infrastructures are relevant here to understand the accessibility and organisation of plots in the village.

In Maji Moto, there is a total of 298 privately owned plots. Many of these were allocated after the execution of the 1967 Villagisation Plan. As the village grew, new plots were given to the relatives of families that were already living in the area. Since plots were given to single families, the multi-household boma disappeared, giving rise to individual household plots.

The first generation of families living in Maji Moto were, as the Maasai tradition dictates, mainly polygamous. Thus, the dimension of the given plots was suitable for building the wives' houses of the main head of the house, reaching up to six or seven in some cases. As has been pointed out, due to the influence of the German and English colonies, Maasai communities became mingled with other ethnic groups that had converted to Christianism, and so the Maasai progressively did. The result of such syncretic religious practices led to a considerable loss of polygamous families, resulting in less crowded plots. As a consequence, married male children took the opportunity to build



5.3 Typical organisation of a family plot in Maji Moto. Own illustration

new houses in the same plots as their parents. The present spatial arrangement of plots is a result of all these cultural changes [Figure 5.3]. Currently, family plots enclose circa two or three houses belonging to the elder wives of the patriarch, and behind these, male children's houses are arranged. As shown in Figure 5.4 it is remarked the contrast between the materiality of mother's houses and their children's houses. The latest are built by single or engaged men before getting married, contrary to the Maasai tradition in which married women used to build their houses in the male's compound. When the space in the plot becomes limited, younger male children are allocated to nearby areas where they can build their houses and the future houses of their male children.

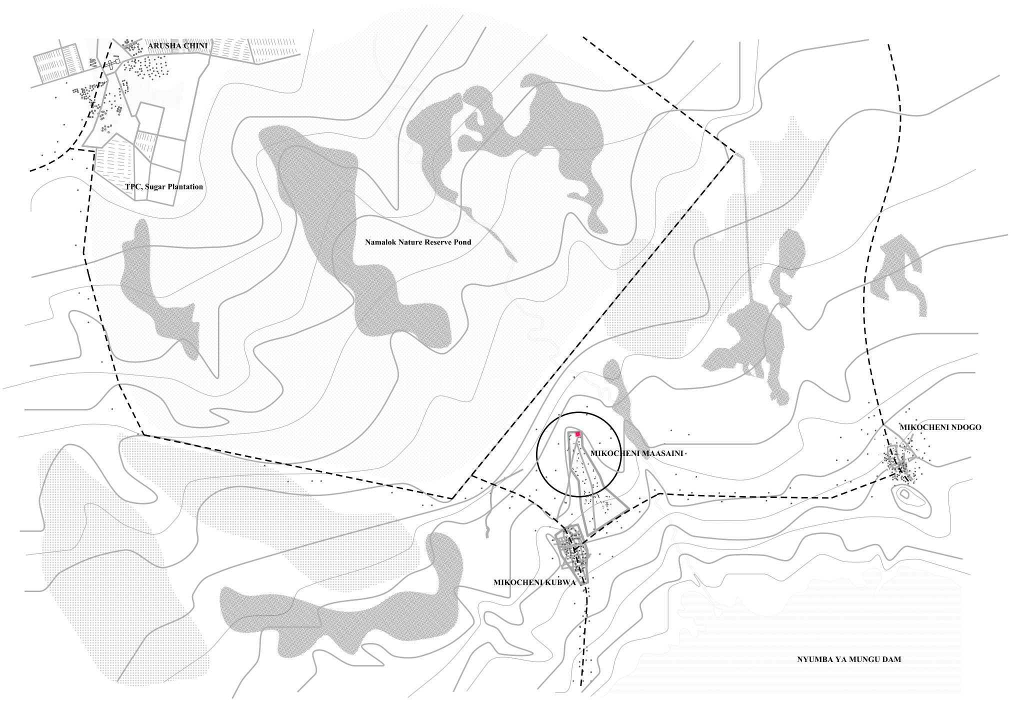
5.4 Mud house with thatched roof on the back and new house built with burnt bricks on the front in Maji Moto. Source: Own picture

5.2 MIKOCHENI: A PASTORALIST COMMUNITY

5.2.1 THE FORMATION OF THE VILLAGE

Mikocheni is a village located in the Moshi District in Kilimanjaro Region, northern Tanzania. The settlement is divided into two officially existing sections; Kubwa and Ndogo. The main sources of livelihood of the village are agriculture and fishery. Mikocheni is situated under the ward of Arusha Chini and around 15 km south of it, and it has an approximate number of 2000 inhabitants. The case under analysis is an unrecognised section of Mikocheni, commonly known as Mikocheni Maasaini, with around 700 inhabitants and where a Maasai community settled down in the early 1960s [Figure 5.5]. According to the oral history, the origins of Mikocheni Maasaini date back to 1965, when the Nyumba ya Mungu Reservoir was built by the Tanzanian Government [Figure 5.6]. The dam, the biggest man-made lake in the Kilimanjaro region (Denny, 2008), means ‘the house of god’ in Swahili, and it has an important spiritual meaning for the communities living around it.

Throughout the 19th century, the area surrounding Arusha Chini was well known for its proliferated cultivations that were a valuable source of livelihood for pastoral Maasai (Spear and Nurse, 1992). Its strategic location nestled between the river Pangani and other tributaries of Mount Kilimanjaro, made it an attractive hotspot for Maasai herders who had access to water and grasses while being provided with food supplies during droughts (ibid.). This privileged condition attracted more pastoralist communities who settled down in



5.5 Situation map of Mikocheni and its surrounding environment. Source: Own illustration

5.6 Aerial view of Mikocheni on the left side and the Nyumba Ya Mungu Dam. Source: Job de Graaf (Flickr)

the riversides surrounded by wetlands. In a conversation with Emanuel Shingombaya (a recognised elder from his Maasai age group in Mikocheni Maasaini) he explained how his grandfather arrived in the area from Monduli (in Arusha Region) in the beginning of the 20th century. Once settled in the areas of what is now the Nyumba ya Mungu dam, they drastically reduced their migrations, as they found all the needed livelihoods within the area. With the construction of the reservoir, they moved to its north side, where they have been living permanently since 1960. Contrary to what is usually thought about Maasai herders, whenever there were enough resources to feed the livestock, they would have semi-fixed settlements, though this was not very common in a semi-arid area. Women, kids and elders would permanently stay in the chosen area while young males would move to previously identified areas where to graze. Currently, the Maasai community living in Mikocheni Maasaini has access to three places where they move periodically with the cattle. The first one represents the permanent residence of Maasai communities, which in this case is Mikocheni. The second one is usually a rich area with pasture where the Murran (young warriors) move temporarily with animals during the dry season. Thirdly, they have a place called Alalili where the community keeps surplus grasses, which is used in case of emergency or to feed sick or fragile animals that are not able to travel long distances. With this system, pastoralist Maasai living in permanent villages can provide enough pasture for their livestock without having to migrate. The new system followed the rule introduced by the Nyerere government in which nomadic or semi-nomadic communities had to compulsory settle down. However, the Maasai inhabitants of Mikocheni Maasaini did not settle down permanently due to the launch of the villagisation policy. Needless to say, the infrastructure systems that were displayed across rural areas where villages were created, were indeed an incentive for the Maasai to stay in the area of Mikocheni.

Despite the arrangement that pastoralist Maasai have created to keep specific pasture areas for their livestock, there are increasing tensions between the Maasai inhabitants of Mikocheni with their 'swahili' neighbours, as there have been multiple claims of Maasai livestock destroying crop cultivations of neighbours from Mikocheni Kubwa. According to the mayor of the municipality, the Maasai community living in the area do not fully follow the rules of the areas that have been assigned to agricultural exploitation or natural reserves. Currently, the community has been in contact with the Arusha Chini ward to find a solution to the issue of land use for livestock.

Maasai communities are widely known for being 'pure pastoralists' and systemically rejecting any type of agricultural practices (Spear and Nurse, 1992). When asking to Mikocheni Maasaini dwellers about their ethnicity, many of them would proudly claim that they are real pastoralist Maasai because they do not rely on agriculture. However, the practice of 'pure pastoralism' is becoming increasingly hard for Maasai herders, due to unforeseen weather conditions that cause continuous periods of drought therefore reducing the extent of pasture lands. Emanuel Shingombaya put it this way:

"There is an increased population in the area and many people are being born. The economy is rising, and livestock will be reduced every time. Families will have some animals for themselves in their compound, like two or three. But people are seeing that there is not enough land and resources to keep the livestock, so it is about wealth. Pastoralists will stop keeping cows to avoid requiring going away looking for pastures, because of the scarcity of land and the rise of agriculture and other businesses"

It has been witnessed throughout interviewing the community that the wealthier families in the village do not only keep livestock, but they have set up other businesses or have cultivated lands near the Pangani River. Despite the maintenance of the traditional lifestyle and rituals, the community is undergoing a substantial change that is also captured in the built environment. The following section will unpack the specificities related to the Maasai lifestyle and the consequent effect on built forms.

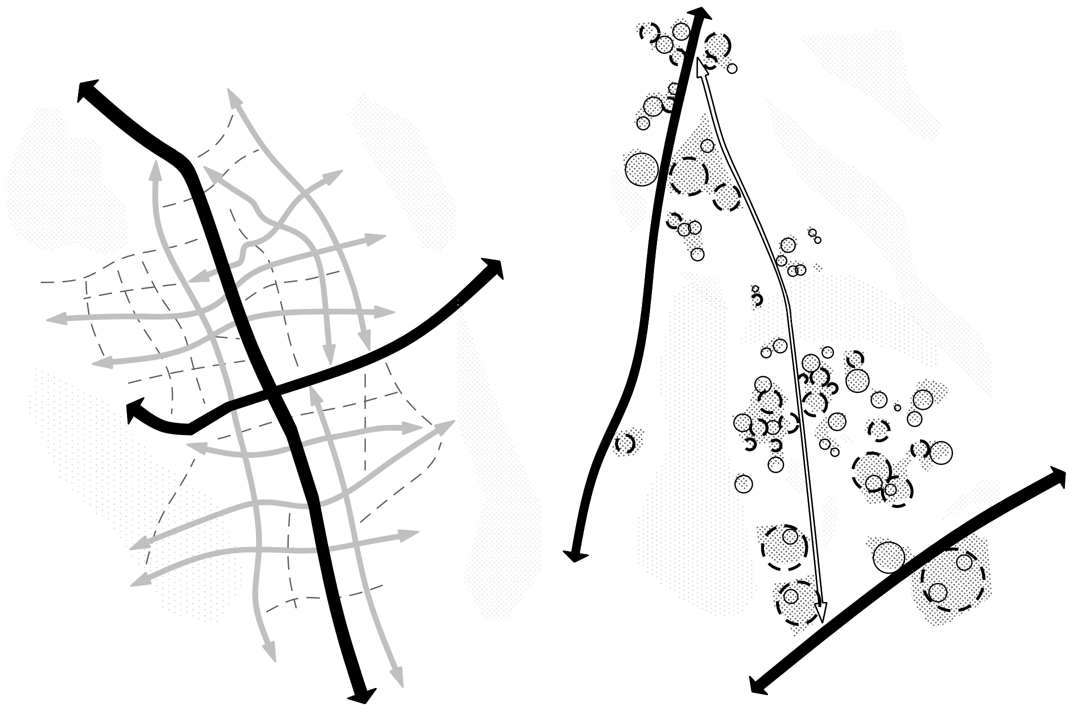
5.2.2 MIKOCHENI SETTLEMENT ORGANISATION

As explained earlier, Mikocheni is divided into three different areas - Mikocheni Kubwa (in Swahili, big), Mikocheni Ndogo (in Swahili, small), and Mikocheni Maasaini. The area is confined on both sides - east and west - by two rivers, in the south by the Nymba ya Mungu Reservour and in the north by the privately owned plantations of TPC[2]. In Mikocheni Maasaini there is a total of 66 bomas clustered around the main road crossing the village, while other 36 are scattered within the wider area of Mikocheni. Besides the main road that crosses up to the north end of the Maasai area, the land is not spatially organised and grows naturally from the formation of family bomas

2 - Situated in Northern Tanzania, about 50km south of Mount Kilimanjaro, TPC is one of the largest sugar estate in Tanzania with 8,000 ha under cane cultivation.

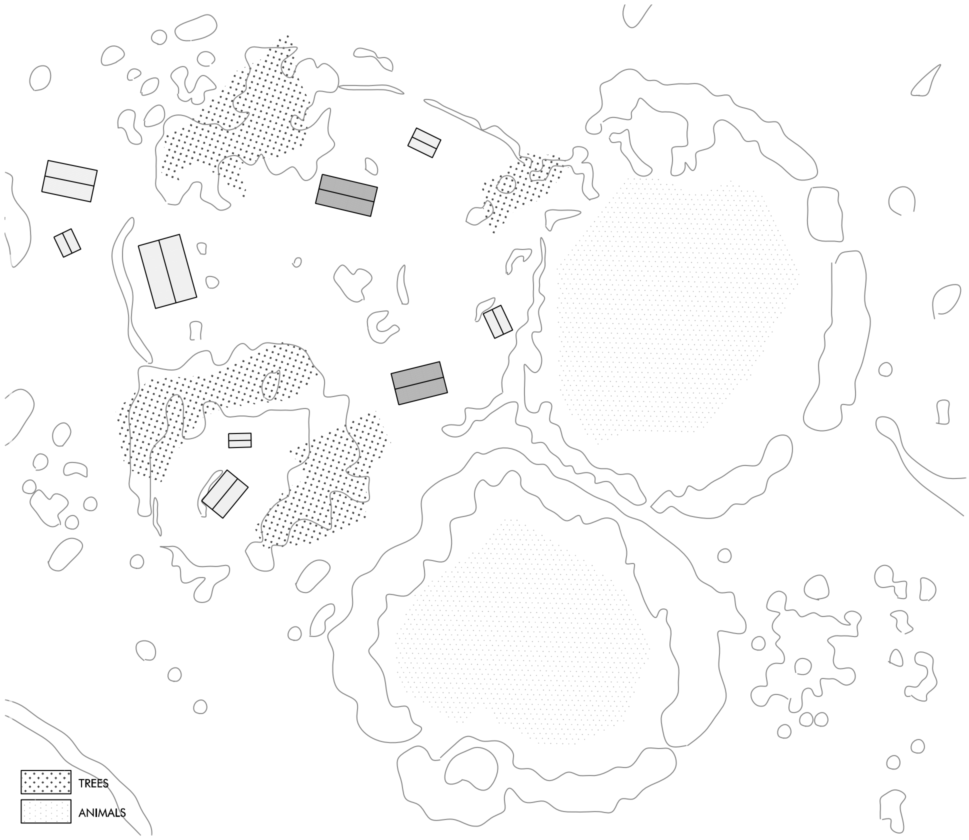
[Figure 5.7]. The Maasai settlement is found in proximity to Mikocheni Kubwa (around 500 metres), where most of the services and public facilities are located. The primary school and a small dispensary are found within the urban fabric of Mikocheni Kubwa, as well as public transport (dala dala). Due to the proximity of the Maasai settlement to its neighbour Swahili inhabitants, there is an increasing cultural exchange between the two communities. It is interesting to look at the comparison between the urban fabric of both areas as it can be observed in Figure 5.8. While Mikocheni Kubwa has some degree of spatial organisation

5.7 Spatial arrangement of Bomas and houses in Mikocheni Maasaini. Own illustration of roads, Mikocheni Maasaini lacks any type of spatial arrangement. Also, the main village has a more specifically dedicated area to services such as bars, pharmacies and shops. In addition, Mikocheni Kubwa has access to electricity. In contrast, Mikocheni Maasaini has access neither to electricity nor to sewage systems. Though, there are several public water taps spread across the village. This lack of infrastructure is crucial in understanding the organisation of Maasai compounds in Mikocheni.



5.8 Comparing the urban fabric of Mikocheni Maasaini (left) and Mikocheni Kubwa (right). Own illustration

The spatial organisation of bomas has slightly changed from the traditional organisation of bomas exposed in Book 1. In Mikocheni, a boma is usually delimitated by a circular fence made with thorned bushes or tree poles, inside which there are several houses of a single household. The difference in Mikocheni lies in the fact that the animal enclosures are no longer found within the boundaries of the family boma. As shown in Figure 5.9, the cattle are gated in nearby compounds made specially for them. This is probably due to the high number of livestock that each family owns, which makes it unhealthy to live close to them. For this reason, each boma occupies a large space, divided between the house's gates and the cattle ones. Each boma encloses between 3 and 10 houses, depending on the household size. However, the number of buildings within each compound is not representative as many of these are abandoned or used as kitchens, chicken coops or stores [Figure 5.10]. In conclusion, the typologies of Bomas existing in Mikocheni Maasaini



5.9 Traditional organisation of Maasai Bomas in Mikocheni, highlighting livestock fences and housing areas. Own illustration

have some commonalities with the traditional semi-nomadic boma spatial distribution but it has progressively adopted new forms due to the change in habits and social organisation of its Maasai inhabitants.


5.10 Neglected buildings in a family boma. Left side building is used as chicken coop and right building as kitchen. Own picture

6 — Environmental challenge: CSEB as Alternative

Following Tanzania's independence, the privatisation of lands due to the mentioned political strategies has contributed to diminishing indigenous traditions and livelihoods. These fundamental changes have profoundly impacted the resultant built environment of Maasai communities, transforming the landscape, building techniques and use of materials. Needless to say, the advancement of development in large cities of the country, has also widely influenced people's aspirations, who envision novel ways of living and socialising. Chapter 6.1 will introduce the changes and consequent environmental challenges that Maasai communities are facing, with a specific mention of a recently raised problem: the production of fired bricks (6.1.2). As a response to the environmental problem associated with unsustainable constructions, C-re-a.i.d. (6.2), a local NGO, has been working to find viable alternatives. Lastly, section 6.4 will expose the introduction of Compressed Stabilised Earth Bricks as an alternative building material.

6.1 ENDANGERED MAASAILAND

After centuries of practising semi-nomadic pastoralism, Maasai communities have undergone a significant shift in their lifestyle in recent years. As has been exposed in the previous chapter, ever since the colonisation of Tanganyika by German Colonies, private land ownership was incentivised at the expense of communally managed indigenous territories (Sambu, 2018). Furthermore, the historical Savannah lands occupied by Maasai communities such as Ngorongoro and Loliondo in the northern of the country, have now become conservation areas or national parks. Under the premise of conservation, many Maasai communities have been displaced from their traditionally owned regions, a trend that was reinforced with the application of the villagisation policy across the country (Coast, 2000). Such a popular plan implemented by Mwalimu Nyerere was a determining measure that mostly contributed to the shrinkage of pastoralist practices. The extent of Maasailand has experienced a massive reduction ever since, a problem that unfortunately has not yet found a fair resolution. In fact, during June 2022, Maasai communities were at the centre of attention as forced evictions were conducted in Ololosokwani village within the Ngorongoro Conservation Area. According to governmental authorities, the excessive number of humans living in the park is exacerbating environmental degradation and putting at risk the protection of wildlife (Aljazeera, 2022). In opposition to such affirmation, human rights activists and environmentalists have claimed that semi-nomadic Maasai communities and wildlife have coexisted in equilibrium for centuries and are convinced that such forced evictions are just an excuse to displace societies while gaining land to be used as "trophy hunting by luxury safari companies" (ibid.). The privatisation of lands and access to rangelands by pastoralist communities has contributed to the detriment of livestock and the rise of agricultural practices among Maasai communities and other pastoralist groups in Tanzania. One of the reasons leading the government to force Maasai communities to permanently settle in villages was to avoid the issue of land tenure with semi-nomadic pastoralist communities. However, far from being solved, the issue of land access is increasingly becoming relevant in the northern of the country, as many indigenous communities did not abandon their ancestral practices of pastoralism.

It has been witnessed in villages such as Mikocheni, how Maasai are in constant conflict with other settled communities that do not practice pastoralism. It seems evident that if a group of people has livestock as their only source of income and livelihood, access to grazing land is essential to ensure the survival of the group. If such access is denied while other income opportunities are not adopted by the group, it becomes in turn a reason for conflict and suffering, hampering the development of a decent life. In many cases, Maasai communities have been blamed for being misfit to the 'modern life' of the country, while the truth is that public institutions are doing little or nothing to ensure a smooth transfer with diverse opportunities to such communities. It has been observed that pastoralist families with large livestock holdings are using their extra income to invest in different businesses or acquire farming land. This is common among wealthy clans in Mikocheni, who envision the need to shift their pastoralist traditions. However, for most poor families is not possible to create other income-generating activities, which in turn, makes them more vulnerable. The limited access to grazing lands and the increasing difficulty in finding water sources are diminishing the livestock number and their healthy survival. Furthermore, with the visible effects of climate change, not only pastoralist communities are facing difficulties in maintaining their livestock. Also, many Maasai families that started cultivating during the past century are struggling to thrive as dry seasons have become longer which consequently increases fatal droughts for their crops. This is becoming a severe problem among the residents of Maji Moto, who during 2022 have not been able to collect their corn and pulses crops, which has provoked a severe food scarcity. At the same time, unexpected torrential rainfalls are causing irreparable damage to farming fields in the area. In turn, both the pastoralist Maasai community of Mikocheni and the farmer Maasai community of Maji Moto are seeing their livelihoods and income-generating activities threatened by environmental degradation.

6.2 THE CAUSE OF ENVIRONMENTAL STRUGGLE

At this stage, it is important to analyse the reasons that are putting at risk the survival of rural Maasai communities. First of all, despite the efforts of local authorities to ensure a successful implementation of the village's plan, many areas remained isolated and still today lack the proper infrastructures needed to maintain a decent lifestyle for its residents. While villages were supposedly planned to grow in proximity to accessible roads, most of these are still unreachable in periods of heavy rainfalls besides the lack of public transport connections. This is the case of both Mikocheni and Maji Moto. Such forced isolation prevents the community from accessing the services and livelihoods needed to overcome the breach of resources that they are experiencing. In addition, isolation further diminishes the chances of getting access to essential public infrastructures such as sanitation systems.

Secondly, the effects of climate change are being largely noticed among rural pastoralist and agriculturalist communities. The already fragile savanna environment is being further threatened by global warming. While periods of drought and rain are common weather events, these are being exacerbated by the effects of climate change. Unpredictable rainfalls and longer-than-usual periods of drought are endangering the survival of rural communities (Sarchi, 2015). While the scarcity of the typical savanna environment has been key in creating the conditions for Maasai communities to be resilient, the current climate crisis is putting at risk centuries of adaptative strategies.

Lastly, the increasing pressure of population growth in the surrounding environment is further threatening the natural territories in which villages have been located. Before the villagisation plan, indigenous communities were scattered and living in symbiosis with the environment they used to inhabit, fostering a sustainable management of the territory. The Maasai have protected their lands through the use of an indigenous knowledge that "is deeply embedded in the culture and history of traditional communities. It is an accumulation of centuries of testing, adjusting, negotiating and integrating a range of practices which have ensured the survival and resilience of these communities." (Fre, 2019: 35). With the fulfilment of the policy, scattered communities had to join together in a single village, resulting in a rapid and unnatural change of environment and lifestyle that threatened the survival of essential indigenous knowledge. As a consequence, forests and woodlands have been cleared for fuelwood, farming and building materials, leading to a dramatic impact on vegetation and wildlife (Kideghesho, 2015).

Historically, Maasai communities have used accessible natural resources for producing tools and conducting domestic activities. Likewise, these have been used for construction purposes. In turn, with the everyday more crowded rural and urban areas, environmental resources are being diminished by excessive use and lack of management. As habits have changed due to a forced sedentary lifestyle, the building culture has necessarily been adapted to the needs and practices of rural communities. As such, the indigenous temporary house that was built with sticks and mud has been replaced with more durable and resistant materials (García, 2017). Thus, an already limited number of resources in such a fragile environment is being threatened by new practices needed by rural communities to thrive. The issue of access and availability of building materials is becoming a rising concern among homeowners. Specifically, from a conversation with the local authorities of both areas in Maji Moto and Mikocheni, the identified environmental issues faced by the communities are:

Deforestation

In crowded rural areas such as Maji Moto, excessive felling is carried out mainly to use wood for producing charcoal, baking bricks and building temporary shelters for animals. Deforestation of woodlands is contributing to soil degradation, the reason why both droughts and flooding events become more evident [Figure 6.1] In fact, it has been banned by local authorities to cut trees from specific species, including those that are located in privately owned plots. These are Acacias (locally known as Mgunga) and Ficus Sycomorus (Mkuju in Swahili). As well, trees that are standing close to the river shore are protected against felling, as the river soil erosion is causing more frequent landslides and flooding events. In Maji Moto, the community has complained about increasingly dangerous winds in recent years, which have been destroying houses' roofs. According to the local government, this is due to the ongoing desertification process, as in the past, the surrounding forest would

6.1 Young Maasai man with his livestock in the typical. savanna landscape in Maji Moto. Source: Own picture.

protect the village against strong winds. As a stimulating measure, authorities are encouraging people to plant trees on their plots, with a minimum number of 5 trees in each plot. As well, through several initiatives from the local government, trees have been donated and planted in publicly owned buildings [Figure 6.2] According to the local community, the problem is that owners are not receiving any type of incentives or discounts for acquiring such trees. Furthermore, despite the ban on wood felling, it has been observed that several neighbours have cut ancient trees from their plots without receiving any type of punishment. The educational programme implemented by some villages has

6.2 Local government planting trees in Maji Moto. Source: Own picture proven to be the only effective measure with lasting impact. The programme aims to raise awareness among the community about the importance of trees and the risks associated with further increasing desertification in the area. The educational programme implemented by some villages has proven to be the only effective measure with lasting impact. The programme aims to raise awareness among the community about the importance of trees and the risks associated with further increasing desertification in the area.

Riverside erosion

Another issue that is affecting specifically the Mikocheni area relates to the use of thatch for roofing. The thatching technique has been used by the Maasai communities for centuries [Figure 6.3], however, the reeds needed for roofing that grow on the edges of the river have been banned from collection. The reason relates with issues of riverside soil erosion, which contributes to faster land filtering, and drying of the river as a consequence [Figure 6.4]. River reeds are essential in maintaining the proper levels of moisture and avoiding soil erosion. As such, the price of thatch rolls has increased to the extent that corrugated roof sheets are in some cases cheaper.

With this summary, the intention was to highlight the number of environmental challenges arising from the creation of rural villages and privatisation of lands with the Ujamaa Policy. Furthermore, the excessive use of natural resources and the lack of management and measures from the government, both at the local and regional levels, are putting at risk the continuity of rural dwellers' lifestyles. The following section will focus on a specific challenge that both communities are experiencing: the excessive use of firewood for producing fired bricks.

6.3 Thatched roof made from river reeds in Mikocheni. Source: Own picture

6.4 River where the community of Mikocheni collects reeds to make thatched roofs. Source: Own picture

6.5 Sun-dried or adobe bricks laying on the floor to dry after production. Source: Own picture

6.3 A LOCAL CHALLENGE: FIRED BRICKS

As has been exposed in Chapter 3, building traditions have experienced a radical change in recent years, widely influencing the choice of building materials used in construction. Most of the traditional techniques that have been supportive of indigenous communities for centuries are now disappearing. Techniques such as wattle and daub[1] as well as sun-dried earth bricks have been a reliable and sustainable walling choices in many countries of sub-Saharan Africa (Ahimbisibwe et al, 2016). Sun-dried bricks are easily produced with mud, straw and water, using a wooden formwork to make the desired brick shape [Figure 6.5]. However, these techniques have been replaced by fired clay bricks in the last decades, becoming one of the most widespread construction methods in Tanzania (Hashemi et al, 2015). Among others, one of the practical reasons that have contributed to the neglect of raw earth materials is their reduced waterproof resistance and the high maintenance required. Today, raw earth materials have become a secondary choice in construction since new materials are seen as more durable and a symbol of modernity, even in the most remote communities (Perez, 2009). Unfortunately, fired brick fabrication is endangering rangelands as large quantities of firewood are required to bake the bricks, generating important environmental damage (García, 2017). The excessive production of fired bricks “has negatively affected the local environment contributing to issues such as deforestation, desertification, air pollution, excessive soil extraction and fuel crisis” (Hashemi et al, 2015: 2; CRAterre, 2005).

1 - Wattle and daub is a composite building method used for making walls and buildings, in which a woven lattice of wooden strips is daubed with a sticky material usually made of some combination of wet soil, clay, sand, animal dung and straw.

The rise in the use of fired bricks is caused by two main drivers; on the one hand, the production of these bricks is almost free of cost, as the required materials are soil (which is easily collected from the building site), water and a wooden formwork. The challenging element becomes the biomass fuel needed for baking the bricks, which in rural areas is usually wood collected from tree felling. On the other hand, the easy production process makes it an accessible walling solution for inexperienced builders. The first step for the production of these bricks is the provision of a mix of mud and water. This mix is introduced in the rectangular formwork, to give it a brick's shape. Once the bricks have been made, they need to dry for a week under the sun [Figure 6.6].

After the blocks are completely dry, they are placed into a heap with the required space below to introduce the firewood, creating a handmade kiln. Once the kiln is ready, it is important to cover the surface with mud, water and cow dung to maintain the inner temperatures. Lastly, the firewood is inserted in the prepared holes where bricks will be burning for 48 hours [Figure 6.7]. Two days later, the bricks are ready to be collected and used in construction [Figure 6.8]. Despite the process of producing handmade fired bricks being

6.6 The three phases of producing fired bricks: moulded, drying and piled to be fired. Source: Own picture

6.7 Hand-made fired bricks' kiln baking for the second day in Maji Moto. Source: Own picture

6.8 Pile of fired bricks ready to be used in a family plot in Maji Moto. Source: Own picture

relatively easy, many homeowners in Mikocheni and Maji Moto are opting to buy the bricks from nearby artisans or to hire young workforces to make the bricks for them in their plots. The cost per brick varies depending on the size from 150 TSH TO 400 TSH (equivalent to €0.08 and €0.17). The cost can be increased if the homeowner does not have the strength or time to collect the wood, having to pay an additional cost for the wood collection, rising up to 200.000 TSH (equivalent to €87).

According to LafargeHolcim Foundation (2016), to build a 100-metre square house with fired bricks, 14 trees are required, used as biomass fuel to bake the bricks. The amount of firewood will vary depending on the type of wood and how moist it is. Despite the environmental consequences led by the production of this material, the use of fired bricks is the only affordable and slightly resistant option that homeowners and builders have to protect their houses against heavy flooding events. However, despite fired bricks being considered a durable and strong material by local communities, these often lack the required quality due to inefficient production. A good quality clay brick should be rectangular shaped, even and without cracks, and it should also have a copper colour. From the same production pile, bricks should have the same standardised dimension and a homogeneous surface. However, this is not usually the case and bricks have uneven strength properties, shapes and textures. As a result, walls have reduced resistance and require higher amounts of mortar to straighten the brick wall.

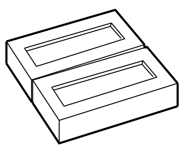
Low-quality bricks are commonly produced due to the unproportioned disposition of bricks in the kiln. In this way, the bricks that are piled close to the fire source are too burned and those positioned too far from the fire source remain unbacked, taking up to the 45% of the entire production. If the bricks are too close to the fire source, these can be excessively crystalised reducing the ultimate tensile strength. Instead, those bricks that are too close to the external surface or in cases in which the amount of firewood is reduced to save costs, are burnt at a very low temperature, resulting into bricks with a compressive strength that is usually lower than 2.5 N/mm2[2] (Mrema, 2005). The result of this uneven process of production are large amounts of material waste, a relevant challenge to overcome in the use of fired bricks.

2- According to the requirement for building low cost housing in Kenia and Tanzania, the minimum compressive strength for a fired brick should be 2.5 N/mm2. See: Low Cost Housing Technologies in Kenya. Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ) GmbH/GATE, German Appropriate Technology Exchange, P. O. Box 5180, D-65726 Eschborn, 1996.

Important to note is that the average energy consumptions by artisans and small-scale brick producers, is up to 5 times more than the average energy required for brick production in specialised factories (Ahimbisibwe et al, 2016). In rural areas artisans rarely use sustainable biomass fuels such as rice or coffee husks, agricultural waste or sawdust, that by contrast has been adapted to fuel larger industrial kilns. The reason is that most of the agricultural wastes are used to feed the livestock, to reduce the reliability in pastures. The environmental impact derived from the production of fired bricks is mostly linked to the burning phase[3], due to the high amount of CO2 emissions derived from the biomass fuel. As several research have pointed out, the embodied energy of producing a fired brick is 6122MJ/m3, depending on several factors such as transportation and dimension of the brick (Auroville Earth Institute, 2010). The average carbon emissions of the same brick wall are calculated to be 642,9 Kg CO2/ m3 as it can be observed in Figure 6.9. It has been demonstrated that with an efficient improvement of artisan kilns based on the ventilation systems, the amount of required fuel could be reduced, producing thus more sustainable bricks.

3 - Production processes, transportation and use of water are other factors contributing to environmental impact, but considering that in the case study villages bricks are produced locally by artisans, these are less relevant.

The lack of planning and policies to control the quality of building materials prompts small-scale producers to use available resources, which results in the unecological use of natural species, disrupting the flora and fauna of the natural Savannah environment. Local governments could play an important role in raising awareness among the population about the risks implied in the use of certain building practices. At the same time, existing policies to protect the environment should be accomplished while ensuring that vulnerable families are not left behind. Finally, promoting the use of alternative sustainable building techniques and incentivising their use through subsidising the provision of equipment must be at the core of planning policies. Educational programmes and policy implementation should be aligned with a reforestation plan that contributes to the mitigation of climate change effects if rural areas, fostering communities' resilience at a longer term.

Handmade fired brick		
	***Properties*** Embodied energy= 6.122,5 MJ/m^3 GWP= 642,9 kg CO_2/ m^3 Dimensions= 26,5 x 14 x 10 cm Density= 1.700-2.000 kg/m3 Cost= 0,08-0,17€/u / 150-400 TSH/u Compressive streght= 2,5 N/mm2	***Enviromental issues*** -Clay extraction -Deforestation -Firing -Excessive use of mortar

6.9 Table with material properties of fired bricks. Own illustration

6.4 C-RE-AID NGO

C-re-aid (Change-Research-Architecture-Innovation-Design) is an architectural NGO based in Moshi, Tanzania, which focuses on researching alternative building practices using locally sourced materials. The organisation was established in 2012 with the objective of promoting long-term socio-economic and environmental improvement in rural communities of northern Tanzania.

Through the different projects conducted, C-re-aid has explored multiple methods to ensure access to sustainable, ecological and affordable housing methods for the communities involved, understanding the potential of architecture beyond its aesthetical value. With the inclusion of responsible construction methods, the hope is to find viable building alternatives to trigger social, cultural, economic and environmental benefits to communities experiencing hardship.

The success of the initiatives carried out throughout the years has been possible only through close collaboration with village leaders, partner communities, and local organisations. Most importantly, the development of projects has been developed in collaboration with the direct beneficiaries, whether the owners of a private house or the members of a community group for public projects. Participatory processes have been key to ensuring the adaptation to the requirements and needs of the targeted groups. As part of the organisation's mission, it is believed that adequate projects cannot be executed without the involvement and commitment of the community itself. Furthermore, through thorough research on local materials and innovative building techniques, several pilot projects have been constructed not only to provide public infrastructures to the community but also to raise awareness about alternative ways of building sustainably.

C-re-aid's work on research and practice has been developed along three main directions:

Knowledge

Thanks to the collaboration with experienced local builders, architects and engineers, the organisation has acquired the know-how to translate ambitious designs into affordable, yet sustainable buildings. The methods and techniques tested successfully have been carefully documented to train young bricklayers interested in developing sustainable building constructions in their villages. As such, local craftsmen have acquired the knowledge of several methods that are currently being developed independently by themselves. Collaborative research and the transfer of knowledge are central in the work of C-re-aid, to ensure the smooth implementation of valuable building techniques.

Design

C-re-aid's search for innovative designs is concerned with excessive levels of creativity leading to useless design projects. In turn, the objective is to focus on the potential of simplicity to achieve efficient results. A simple design can be complex through the use of ecologically responsible materials while enhancing the natural simplicity of contextual building materials. At the same time, with the search for straightforward designs, the aim is to pursue design projects that contribute to the reduction/limitation of costs.

Building materials

With the rise of unsustainable industrialised building materials, C-re-aid is focusing on the development of building techniques that are developed from the use of locally available resources. Material research is mainly aiming to find solutions that reduce transportation costs, enhance the quality of indigenous building traditions and boost the local economy through the commercialisation of sustainable materials. As such, accessible materials can be popularised and become a 'modern' solution for local communities, while being respectful of the natural environment. To achieve a sustainable building culture, it is important to offer such qualities alongside thermal comfort, availability and affordability, to enable people with different backgrounds to have access to such materials.

C-re-aid NGO initiated its collaboration with the Maasai communities of Maji Moto and Mikocheni back in 2015. A community centre was built in Mikocheni to serve the local groups, as well as several housing renovations

6.10 Women meeting centre in Maji Moto, built as part of a volunteering programme with C-re-aid in 2016. Source: Own picture for local homeowners. In Maji Moto, I took part in the construction of a women's meeting centre in 2016, to be used by local saving groups [Figure 6.10]. Both projects were built by using manually produced fired bricks. After several months of looking for alternatives to the use of fired bricks, the organisation started to research the possibilities of building techniques that use raw soil. Several months of testing and adjusting resulted in the testing of techniques such as improved sun-dried earth bricks, rammed earth walls and compressed stabilised earth blocks (CSEB). Finally, in 2018 and in collaboration with C-re-aid NGO, the design of the first prototype using CSEB started: the dispensary of Maji Moto. In the same year, members of C-re-aid designed and built the bike shop project in Mikocheni, using as well CSEB as the main building material. Chapters 7 and 8 will be specifically focused on the development of these two prototype projects.

6.5 COMPRESSED STABILISED EARTH BLOCKS: THE ALTERNATIVE

The increasing demand for affordable housing in developing countries due to population growth is revealing the urgency of proposing appropriate building technologies. Continued innovation and sustained investment are required to meet the need for adequate shelter while ensuring a reduction of costs and environmental impact (UN-Habitat, 2009). The dramatic contribution of the building sector to global greenhouse gas emissions has put into perspective the need to rethink building technologies. As such, earth techniques have experienced a slight revival in the last decades (White, 2013) and will have an essential role in contributing to local adaptation to threatening climate conditions. Also, extensive use of sustainable building techniques such as forestry wood and earthen materials would be key in mitigating the effects of climate change at the global level. The detrimental environmental effects caused by the excessive felling of trees for fired brick production are endangering the local Maasai communities' object of this research. Consequently, it is acknowledged that there is a need for a substantial shift of building technologies that avoid the use of fired brick produced by artisan kilns. Contextual building techniques which make use of the local earth need therefore to be reconsidered and improved to meet the local demand without overlooking needs and desires. As an alternative to the extensive use of fired clay bricks in rural Maasai areas, after researching several earthen techniques, the use of Compressed Stabilised Earth blocks was implemented to build two prototype public facilities in Maji Moto and Mikocheni.

The first test of compressed bricks was made at the beginning of the 19th century by architect François Cointeraux, who cast small, rammed earth blocks[4] (UN-Habitat, 2009). He used hand-pressing tools to compress the soil mix into a wooden mould. The technique did not gain relevance until 1950

4 - Rammed earth is a worldwide used technique that has been produced since ancient types. Rammed earth construction entails the making of a mold into which the soil, inclusive of a weatherproofing agent, is compacted and left to dry. Subsequently, the mold is released and the earthen form remains. Relevant examples of constructions using rammed earth are: Buildings of the ancient city of Sanna (Yemen) or the Alhambra Palace in Granada (Spain).

6.11 Manual of use of the Cinva-Ram compressing machine in 1959, including bricks' production information. Source: Ibec Housing Corporattion.

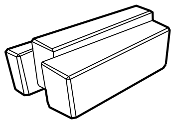
when the Chilean engineer Raúl Ramírez manufactured the first pressing machine named CINVA-RAM press [Figure 6.11]. The blocks were used as part of a housing research programme in Colombia, as an improvement of sun-dried bricks. The pressing machine was able to make regular blocks in terms of shape and size, and with several years of research and improvement, bricks became denser and stronger (Auroville Earth Institute, 2019). According to UN-Habitat (2009), since then, the methods for producing compressed brick have made enormous progress resulting in a wide variety of bricks and machines, alongside the creation of industrial-scale production units.

6.5.1 TECHNICAL FEATURES

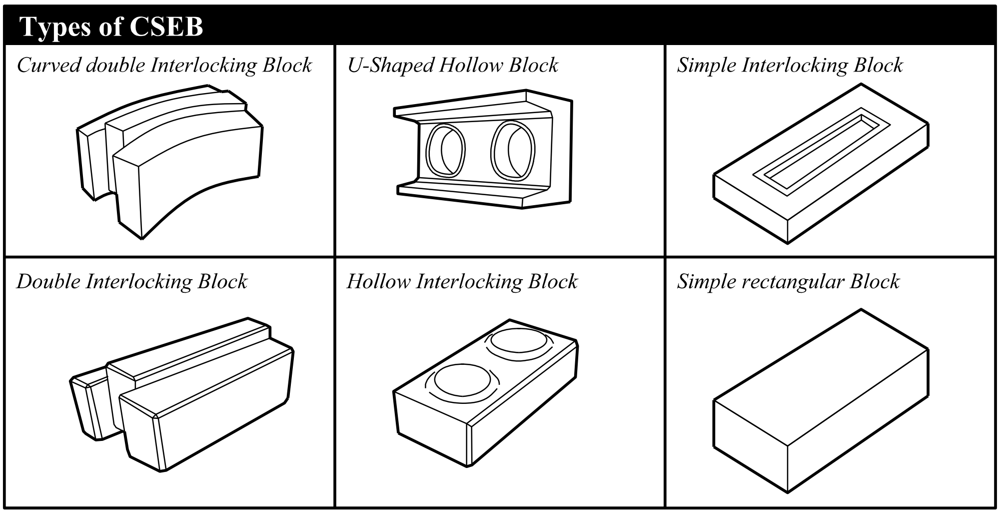
The first samples of Compressed Earth Blocks (CEB) were made with soil, sand and water. Due to its widespread use in low-cost housing, substantial strength improvements were needed. In a search for a more resistant material, the use of soil stabiliser gained relevance in its production. The use of CEB was tested with different proportions of cement or lime stabiliser[5]. As such, the stabilised CEB is commonly known as Compressed Stabilised Earth Block (CSEB). After the improvement of the block with the use of a stabiliser, it

5 - Stabiliser normally serves as a soil binding product for earthen building materials. Its use is also widespread for the construction of rammed earth walls. It is essential to make the brick stronger and more waterproof.

became much stronger and water resistant [see Figure 6.12 for details of the CSEB]. It also allowed the construction of higher buildings with thinner walls, reducing thus the amount of material used (Auroville Earth Institute, 2010).

Compressed Stabilised Earth Block	
	***Properties*** Embodied energy= 572,6 MJ/m^3 GWP= 51,5 kg CO_2/ m^3 Dimensions= 26 x 14 x 7 cm Density= 1.800 kg/m3 Material cost= 0,07/u / 162 TSH/u with labour 0,12/u / 300 TSH/u Compressive streght= 9 N/mm2

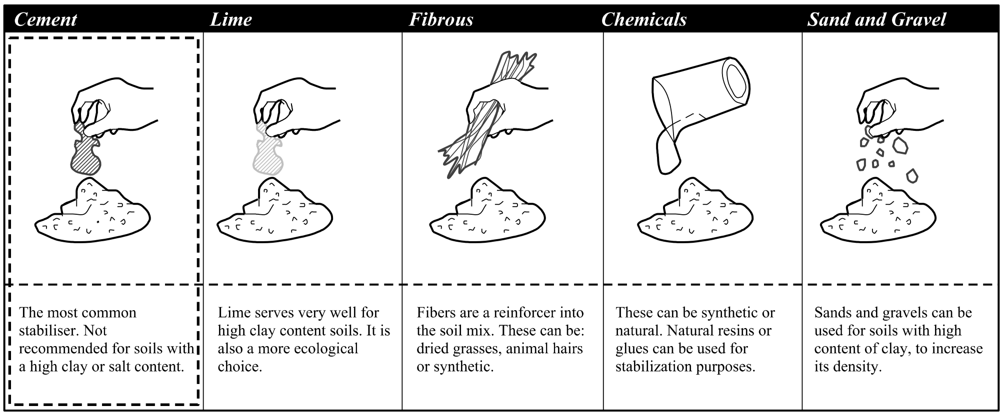
6.12 Table with material properties of Compressed Stabilised Earth Bricks. Own illustration



6.13 Bricks' shapes produced by a compressing machine, among others. Own illustration

Cseb technology uses different types of manual or motor-driven pressing machines to compress the block[6]. As shown in Figure 6.13, the compressing machine can produce a large number of different types of bricks and dimensions, from simple compact rectangular or curved bricks to hollow bricks and interlocking blocks. Before compressing the mix, an adequate amount of material needs to be prepared. In the composition of the brick, there is a mixture of soil, sand and a stabilizing agent. The amount of added sand will depend on the amount of sand existing in the original composition of the soil, which may also contain different proportions of clay, sand, silts and gravel. Also, the type and amount of stabiliser can defer, and depending on the quality of the soil, it will be better combined with cement or lime. There are also other type of stabilisers such as fibres, chemical stabilisers or gravel. However, the most commonly used is cement [see table 6.14]. It is important to remark that not all types of soil are suitable for CSEB production. Excavation topsoil and organic soils must be discarded to avoid deleterious materials and organic particles. It is recommended previously conduct specific soil tests to understand the

6 - UN-habitat strongly advises the use of manually used machines to reduce the machinery costs and to avoid constant and more complex reparations.



6.14 Type of stabiliser that can be added to the Compressed Stabilised Earth Bricks. Own illustration

composition of the selected soil. Intending to reduce the costs and emissions on transportation, the ideal is to use soil from the construction site and add the required missing materials. For example, cement stabiliser is advised to be used with sandy soils, while lime stabiliser will be more adapted to soils with a higher content of clay (Auroville Earth Institute, 2010). The amount of stabiliser varies between 3% and 10%, according to the type of soil. Once the type of soil has been identified, the final mix should be similar to the following depending on the type of soil: between 30-50% sand, between 20-35% clay and 15-20% silts (ibid.). Gravel can be added at a proportion of 15% max. to increase the density in the case of very clayed bricks [find the bricks' components and stabiliser in table 6.15]. Due to the remote access to rural villages in which the

Soil for cement stabilisation: it si more sandy than clayey	Gravel=15%	Sand=50%	Silt=15%	Clay=20%
Soil for lime stabilisation: it is more clayey than sandy	Gravel=15%	Sand=30%	Silt=20%	Clay=35%

The average stabilizer proportions is rather low

	Minimum	Average	Maximum
Cement stabilisation	3%	5%	No technical maximum
Lime stabilisation	2%	8%	10%

These low percentages are part of the cost effectiveness of CESB

6.15 Compressed Stabilised Earth Bricks' composition and proportions of stabiliser. Own illustration

CSEB Tests

- Soil: 100%
- Soil: 100% (sieved soil
- Soil: 97% Lime: 3%
- Soil: 95% Lime: 5%
- Soil: 85% Clay: 10% Lime:5%
- Soil: 97% Cement: 3%
- Soil: 85% Clay: 10% Cement: 5%
- Soil: 95% Straw particles: 5%
- Soil: 85% Clay: 10% Straw particles: 5%
- Soil: 92% Lime:3% Straw particles: 5%

6.16 Bricks' tests made to assess its qualities considering different compositions. Own Illustration.

use of CSEB has been employed, it is not always possible to make laboratory tests on the bricks. With that in mind, several composition and compressive strength tests can be conducted on-site with a series of sampled bricks, by using different compositions and amounts of stabiliser [Figure 6.16]. Once the several samples have been tested, the brick with the higher strength and most water-resistant qualities will be used for the construction.

6.17 Skilled workers using the compressing machine to produce CSEB on site. Source: Own picture

6.18 CSEB drying on construction site after production and ready to be cured before piling after 2 days. Source: own picture

When the different components have been well mixed with an addition of between 8-12 water to get a moist mixture, the mix can be introduced in the pressing machine [Figure 6.17]. The volume of one brick should 0,002548 m3 (0,14 x 0,07 x 0,26) after compression. Important to note is that the volume of the brick reduces by around the 30% after compression, so the initial amount of needed soil is 0,00364 m3 (C-re-aid, 2019). Once the mix has been well pressed, the bricks are stacked on top of a dry surface and covered [Figure 6.18]. In the case of having used cement or lime stabiliser, bricks need to be water-cured for 28 days until they acquire the proper compressive strength and waterproof resistance. In terms of production performance, a skilled team of 2/3 members, can produce around 500/600 blocks in a working day of eight hours (Pérez, 2009) with one manual pressing machine.

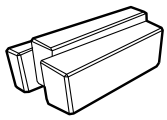
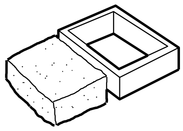
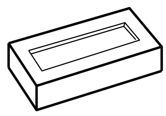
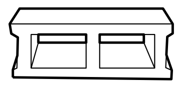
6.5.2 COMPARATIVE ANALYSIS: COST, STRENGTH AND EMISSIONS

The cost of producing CSEBs depends mainly on the pressing machine. A high-quality pressing machine of a recognised brand can cost around €1,500. Instead, if the machine is produced locally by an expert welder, the cost can be reduced by up to €1,000. Therefore, if the machine is owned by the brick producer, beyond the initial investment, the cost will be mostly related to the stabiliser agent. In Tanzania (in 2019) a 50 kg cement bag costs between 15,000 and 18,000 TSH (€7.5), while a 25 kg lime bag costs 12,000 TSH (€6). With one bag of cement, it is possible to produce up to 150 bricks with a proportion of 7% cement. Moreover, in the case of clayed soils, the addition of sand is required. A truck of sand (4,3 m3) usually costs 150,000 TSH (€65) including transportation, which serves 7 working days of bricks production. As can be observed from Figure 6.19, the material cost of a single CSEB brick is 162 TSH (€0.07). When the machine cannot be purchased, renting it plus two skilled workers cost additionally 150TSH per brick (€0.05). Therefore, the total cost for a single CSEB brick including workforces would be 300 TSH (€0.12). Looking at Figure 6.20, from a comparison of CSEBs with other walling solutions, a m2 of CSEBs costs 9,402 TSH (€4.03), while a m2 of concrete blocks costs 21,750 TSH (€9.32). The final price of a m2 of CSEB wall is similar to a fired clay brick wall, however,

Pressing Machine	*Cement*	*Sand*	*Production*	*TOTAL COST*
1.500€ / 0,07€/m^2	*2,5 €/m^2*	*1,456 €/m^2*	*2,8 €/m^2*	**6,83 €/m^2**
3.970.000 TSH / 250 TSH/m^2	*6.000 TSH/m^2*	*3.360 TSH/m^2*	*7.500 TSH/m^2*	***17.110 TSH/m^2***

**56 bricks / m^2*

6.19 Breakdown of cost for producing one meter square of CSEB's, which makes around 56 bricks. Own illustration

General info	*CSEB*	*ADOBE BRICK*	*FIRED BRICK*	*CONCRETE BLOCK*
Block Apperance				
Dimension	29 X 14 X 7 cm 26,5 X 14 X 10 cm	25 x 15 7 cm 40 x 20 15 cm	20 x 10 x 10 cm	40 x 20 x 20 cm
Weight (kg)	8 - 10 kg	8 - 18 kg	4 - 5 kg	12 - 14 kg
Texture	Smooth and flat	Rough and powdery	Rough and powdery	Coarse and flat
Blocks needed per m^2	35-56	10 to 30	30	10
Performance				
Compressive Strenght	1-4	0-5	0,5-6	0,7-5
Termal Insulation *(W/m C)*	0,8-1,4	0,4-0,8	0,71,3	1-1,7
Density (kg/m^3)	1.800	1.200-1.700	1.700-2.000	1.700-2.200

6.20 Comparative table of properties and attributes of different building materials due to the irregular shape of fired clay bricks, these would use larger amounts of mortar and plaster to render a neat finish. The cost of using CSEBs for walling solutions can be further reduced with mortar, which is usually much lower than compared to fired bricks, mostly if using interlocking compressed bricks [6.21]. Additionally, the use of CSEB does not require plastering as the material itself is waterproof, which further drastically reduces the final cost of construction. For that reason, it is claimed that in terms of affordability, CSEBs are more cost-effective per square meter by up to 40% compared with fired bricks due to cost savings related to the mentioned factors.

While concrete blocks cannot compete with the CSEB in terms of affordability, if comparing both compressive performances, these are slightly similar. One might think that a material that uses raw earth cannot reach high levels of strength. However, from the observation of Table 6.20, a stabilised earth brick can reach up to 8N/mm2 with up to 7% of cement stabiliser. The average compressive strength observed from C-re-aid tests made in the laboratory is 3.18N/mm2. If more stabiliser is added, CSEB blocks can achieve up to 10N/mm2. Despite concrete blocks can reach up to 12N/mm2, the compressive strength of CSEBs is acceptable for one-story houses with light roofing structures, which is the case for most developed projects in rural Tanzania. By contrast, while a properly manufactured fired clay brick could reach up to 6N/mm2, the unreliable quality of artisan-fired bricks due to different baking processes in the same batch, makes it risky to use them for structure purposes (UN-Habitat, 2009). The average strength of artisan-fired clay bricks is between 2.5 and 3N/mm2. For that reason, fired clay walling solutions are always complemented with a reinforced concrete structure of columns and beams, raising the final price of the construction considerably.

6.21 Compressing machine and CSEB just manufactured in Maji Moto. Source: C-re-aid website

Concerning the environmental damage that the production of these materials causes, the use of CSEB in comparison with fired bricks and concrete blocks is considerably lower. As shown in Table 4.20 the embodied carbon emissions related to the production of CSEBs is 51,5 kg CO2 per m3, and the embodied energy is 572,6 MJ/m3 while artisan-fired bricks can emit up to 649 kg CO2 per m3 [7] (Auroville Earth Institute, 2010). Instead, in the case of concrete blocks, the embodied carbon emissions are 130,56 kg CO2 per m3. The difference in emissions between these two is still relatively high compared to the CSEB. High amounts of cement used in concrete block production, added to the environmental damage caused by gravel and sand extraction, make this technological solution the most polluting one. Same for the fired bricks but more linked to the environmental damage caused by the energy-intensive firing that these need. Also, being CSEBs water-cured instead of fired helps in reducing the carbon emissions released by around 80% depending on the type of brick and mortar. As such, the use of CSEB results as an environmentally friendly alternative to fired clay bricks and cement blocks. In addition, the use of CSEBs at the local level avoids felling and sand and gravel extractions (Brown, 2019).

7 - Note that the production of fired bricks defers widely across locations. While if industrially produced their emissions' can be reduced up to 300 Kg of C02, its hand-made production in rural areas can raise drastically the emissions due to the loss of heat during the baking of the bricks and the use of illegal wood that contributes to deforestation

6.5.3 BENEFITS AND LIMITATIONS

There are numerous benefits derived from the production of CSEB technology to tackle both the environmental issue and housing crisis in rural and peri-urban areas. The use of building technologies that rely mostly on the availability of sustainable local materials is a crucial aspect that contributes to the protection of the environment. Thus, the impact of using CSEBs in construction ranges from environmental benefits to social, economic, educational and health advantages. A synthesis of the most relevant benefits identified by the use of CSEBs at the local level has been developed below:

Environmental

- The use of CSEB in participatory-led projects is a good opportunity to raise awareness about environmental issues such as desertification and its consequences. If the use of the technique is introduced alongside educational programmes, the local community can gain a valuable understanding of how to protect and enhance the environment while learning about the environmental impact of construction itself.

- Building materials such as CSEB have a direct impact on the reduction of environmental degradation at the local level. If a shift of building traditions is achieved and destructive materials are avoided, it is possible to restore natural ecosystems and the environmental value of rangelands, rivers and forests.

- CSEB production limits deforestation as its manufacture does not require a kiln for firing, reducing thus the wood demand and the embodied carbon emissions associated with its production. CSEBs are water-cured and use small amounts of cement and lime to activate their stabilising properties, providing a strong and waterproof material without contributing to the damage of fragile ecosystems.

- Good thermal performance of CSEBs as a walling solution, contributing to the natural proper temperatures of buildings, thus avoiding cooling systems that are highly energy demanding.

- The use of CSEB reduces the dependence on imported materials, their cost and the pollution caused by the transportation of materials coming from bigger urban centres.

- Little use of cement for mortar, as interlocking compressed bricks reduce by 75% its use. As well, due to the waterproof properties of the material, it is not required to plaster the walls. Studies show that up to 60% of the buildings that have used CSEB do not require plastering. Walls do not require plastering due to their waterproof nature and aesthetic features.

Economic aspects

- The relatively low-cost production of compressed bricks allows organisations and private owners to reduce the costs of construction, contributing to new possibilities for building public infrastructures such as schools, hospitals as well as housing.

- The possibility of creating local cooperatives contributing to the empowerment of community members. With the activation of local businesses and employment, as well as with the use of local materials, the production of CSEB could foster a sustainable circular economy. It also contributes to the rise of local businesses related to the material industry.

Technical performance

- CSEB is a technique that does not require high levels of expertise for walling constructions, as the technology does not differ much from other brick walling solutions. However, for its production, trained craftworkers are required to follow up on the quality control of the material. This point is relevant as the proportions of the mix and the water-curing process are key to ensuring high-quality bricks.

- Compressed stabilised earth bricks are highly performant regarding their compressive strength properties, its low conductivity and waterproof features.

- The final aspect of CSEB walls is aesthetically performant and in line with the local perception of industrialised building materials. The final rendering is neat without plastering, but it can be plastered and painted to have a similar result to the widely accepted fired brick walls.

Social aspects

- The CSEB technology is an affordable building technique valid for building low-cost housing as well as public facilities in remote areas. It can also be argued that the CSEB technology tackles poverty by providing business opportunities for local artisans, whether individually or as part of a community cooperative. Finally, it can also foster employment rates and training for un-skilled workers to gain an understanding of CSEB production.
- The contribution of the CSEB to mitigate the direct impacts of climate change at the local level enables communities to be more resilient, fostering their social fabric and the economic and environmental value of their land.

Limitations

Despite the apparent feasibility of achieving a fundamental change in the building industry of Tanzanian rural communities, the reality is that the challenge to eliminate or reduce the production of environment-degrading materials such as fired bricks, is still a hard endeavour. The use of fired bricks and concrete blocks is highly valued by homeowners and shows a certain degree of status among neighbours in comparison with those who still use traditional techniques. Recent studies show that the reasons to choose fired bricks are many: the wrong perception of affordability, the easy availability, competitive prices of fired bricks and high levels of acceptance by clients. Compared with the very popular fired bricks that in some cases are manufactured free of cost, it is acknowledged that the cost of CSEB production can be demanding and maybe restrictive for some, although overall cost is still accessible when compared to other techniques.

Another limitation comes from the long tradition of building with bricks by the local community. Builders are confident in building with fired brick techniques. The execution of CSEB walls requires specific training, mostly if interlocking bricks are used. As such, bricklayers tend to refuse the use of CSEB in the first instance. At this point is key to highlight the importance of having skilled workers to produce a quality product, which in some areas could be difficult to find.

As the number of organisations and private institutions using the compressed bricks technique is growing rapidly, UN-Habitat (2009) has stressed several times the need to improve communication and knowledge-sharing strategies about the use of sustainable materials such as CSEB. This will be required to quantify and verify real benefits, as well as to develop efficient approaches for the promotion and adoption of such building technology.

7 — Maji Moto Dispensary: First Built Prototype

The need to build a local health centre in Maji Moto presented an opportunity to tackle environmental issues through the building itself, finding thus a wider scope of application with the development of earthen building techniques. The design and technological decisions offered the chance to propose a prototyping approach that holistically engaged with skills, methods and materials that are contextual to the place while triggering positive change.

The objectives for proposing the specific design and implementation strategy were twofold: on the one side, the construction of a dispensary was an urgent need to provide access to healthcare services to the local community. On the other side, the proposed technology became an opportunity to both demystify earthen techniques and propose alternatives to the use of environmentally damaging building materials. The following chapter exposes how these objectives were achieved through the development of the prototype building project. Section 7.1 introduces the background of the project and its initial idea. After that, section 7.2 elucidates the role of community participation in the project. Section 7.3 will unpack the main features of the design projects, and finally, 7.4 will specifically focus on the construction process.

7.1 THE PROJECT ORIGIN: PREVIOUS WORK

In the summer of 2016, I spent three months in Tanzania with C-re-aid NGO as part of a volunteering programme named Groundwork Project. The initiative aimed at developing small-scale building or renovation projects in rural areas with the collaboration of two architecture students, one from Ardhi University in Dar es Salaam and one international. The volunteering programme was ground-breaking in many aspects. Firstly, because of the level of responsibility of the students alongside the constant support of C-re-aid members throughout the design and building process. Secondly, the bold decision of pairing students with diverse educational experiences for such a challenging three-month period proved to be extremely enriching. And lastly, because of the direct contact and collaboration of students with the local community and family to which the project results were directed. By the end of the programme, we had built a 25 m2 meeting centre to serve community-based saving groups[1] [Figure 7.1]. During the three months that I lived in Maji Moto, I had the chance to deepen my understanding of the community, learning from their traditions and lifestyle. That period was also a fruitful time for grasping the main local challenges and having meaningful conversations with community members.

1 - Community-based saving groups have been popular in Tanzania during the last decades. Due to the lack of financial support and access to loans, saving groups were stablished to enable access to micro-loans to community members. In Maji Moto, community saving groups are mainly joined by women.

After the opening of the meeting centre, it came to our knowledge that the local community were pressing the regional government to build a health centre in the village. From that very moment, a long process of research, crowdfunding and project development began. In February 2017 I visited again Tanzania

7.1 Women Meeting Centre during a training course to women on the opening day. Source: Own picture and had the chance to dig into community perceptions regarding building techniques, intending to measure the possibilities of success of the CSEB's use. We also had meetings with government leaders and visited the Arusha Regional Health Department to collect information about the functional and structural requirements of the future dispensary. The local climate conditions, availability of materials and the possible allocation of the future dispensary were analysed and discussed within the community of Maji Moto. Back in Ferrara, I was lucky to have been able to develop the prospective health centre project as part of my final MArch thesis at the School of Architecture, under the Laboratory of Technology. The process was also followed and supported by C-re-aid NGO, with the direct implication of several members. With the guidance of structural engineers, and experts in energetic efficiency and material research, I finally concluded the design project in July 2018.

7.2 COMMUNITY PARTICIPATION: DESIGN & CONSTRUCTION

After graduating from the School of Architecture of Ferrara, I joined the C-re-aid team in Moshi (Capital city of Kilimanjaro Region) and initiated the preparation process for the construction of the health centre in Maji Moto. Once in Maji Moto, several challenges were encountered. The assigned land had reassigned its use and therefore the building site had to be relocated to a new area, a plot owned by the local government in the main village centre. For that reason, some adjustments were necessary, and the opportunity was taken to revise some of the design aspects in loco. With the help of local

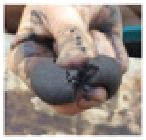
7.2 Visit to Karangai Dispensary, active since 2010 and 4 km away from Maji Moto. Source: Own picture

7.3 plans and sketches during the design of the new dispensary of Maji Moto. Source: Own picture

authorities from nearby villages, the team that included a group of international volunteers visited several dispensaries to gain a better understanding of the building functions and dynamics [Figure 7.2]. Thanks to the extra time spent in rethinking the design project, it was possible to propose a more adapted plan to the local conditions and requirements [Figure 7.3].

The new design was presented to the local authorities and regional engineers, who approved the design and construction plan. As well, several participatory workshops were held with community women's groups, to co-design the health centre to involve interested villagers in the construction process [Figure 7.4].

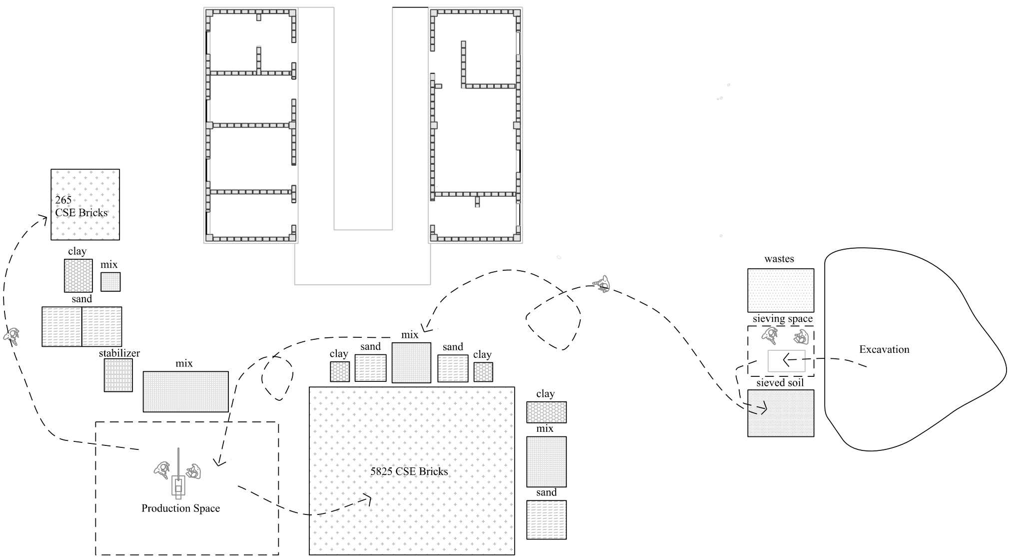
7.4 Participatory meeting to discuss the Women Centre's design with local women's groups. Source: Own picture

Consistency test	*Ribbon test*	*Shrinkage test*	*Sedimentation test*	*Snowball test*	*Smel test*
					
Moist earth is formed into a ball 2 to 3 cm. When not possible, then the sand content is too high and the clay content too low. If the ball can be crushed with a lot of force, the clay content is high.	Five samples should be taken and ribbon lengths measured at the point of rupture. If it breaks before 5cm, there is too much sand. If it breaks after 15cm, there is too much clay.	The soil is thrown in a mould of 4 x 4 x 40. This test will show the clay content. The mixture should shrink more than 1/10th of the whole length, so 4cm. If the mixture curves, the soil cannot be used for building.	The largest particles settle at the bottom, the smallest on top. This stratification allows the proportion of the constituents to be estimated.	Using a dry soil ball, the ball flattens only slightly and shows few or no cracks, it has a high binding force due to high clay content. If the ball breaks in many pieces, it has very low clay content.	Pure loam is odourless; If it acquires a musty smell, it might contain deteriorating humus or organic matter.

7.5 Standard soil tests to assess the composition and percentage of clay, sand and silts. Own illustration

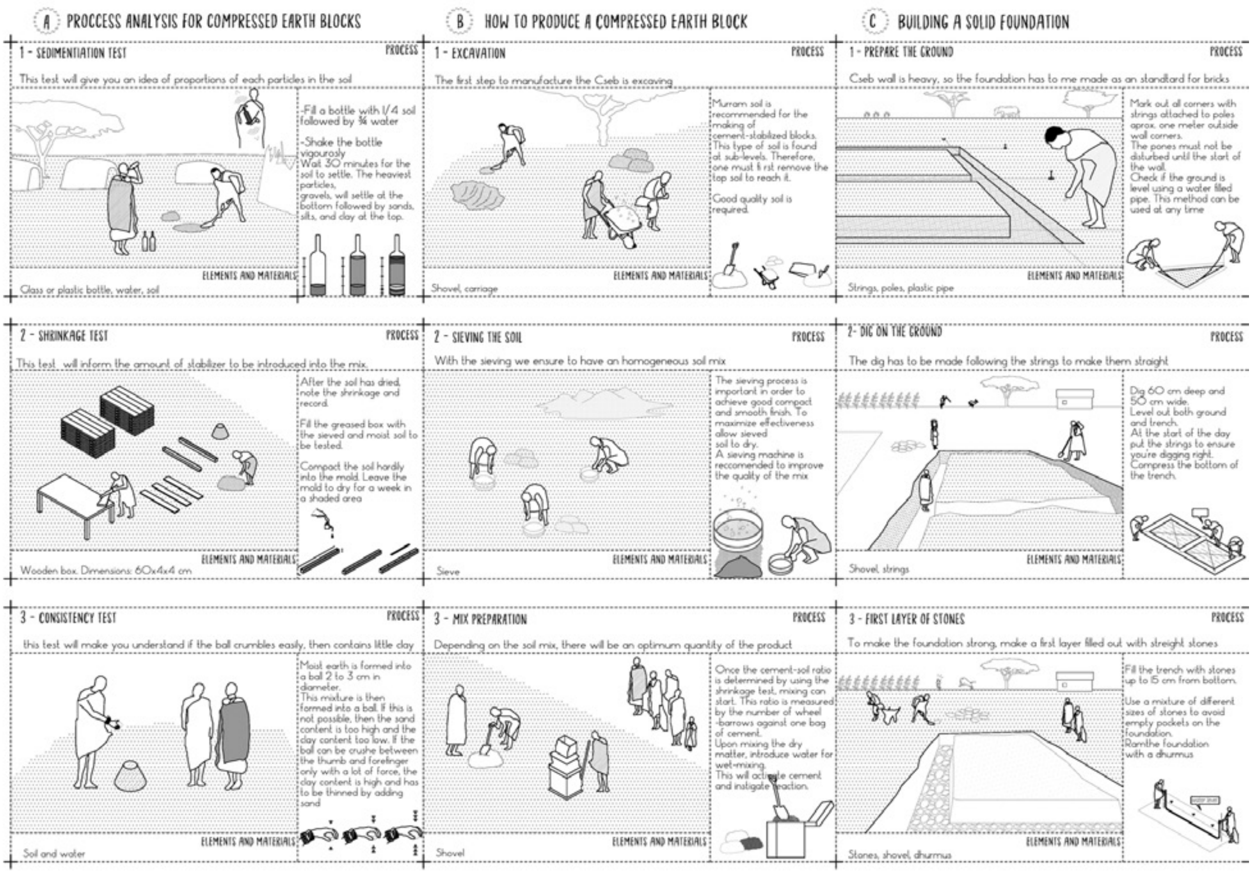
Contemporary, part of the team worked on the testing of CSEBs by producing different types of bricks in terms of soil composition and percentage of stabiliser. Soil from several areas of the plots was analysed following the standardised soil testing checks[2] [Figure 7.5]. Some of the tests that were conducted were the shrinkage, smell, sedimentation, consistency, snowball and ribbon tests. With the results of the test, the needed proportions of sand (62%) and cement (7%) were defined as the proper ones considering the soil composition. Another important phase previous to the CSEB production is the preparation of the site. The area needs to be cleaned and levelled, removing any disturbing elements such as construction waste and vegetation. Also, the materials needed for the CSEB production needed to be accessible on the construction site, to facilitate the craftsmen's work. If possible, the area of production should be covered to provide shade to workers while protecting the mixes [Figure 7.6].

2 - These tests are advised in case of inability to execute a proper soil test in a near-by laboratory. The results of such tests are only illustrative and cannot exactly elucidate the material proportions of theanalysed soil.



7.6 Planned arrangement for the extraction and production of CSEB on site. Own illustration

Due to the interest that the building technique had raised among the community, several activities were organised. In line with the objective of using an innovative technique that is easy to replicate, several meetings took part with community representatives and leaders, to discuss the viability of the use of the compressed blocks. Besides that, several workshops were held at the previously built meeting centre to raise awareness amongst the neighbours about the reasoning behind the use of CSEB. The issue of climate change and desertification impacts were presented while informing how the newly introduced technique can tackle the problem. As part of these activities, a manual of production and use of CSEBs was made to facilitate the transmission of knowledge, which is paramount for the achievement of the project aims. As shown in Figure 7.7, the manual included instructions for; 1) analysis and



7.7 Manual produced in 2018 to be distributed amongst local communities with basic instructions on the production and use of CSEB. Own illustration

previous soil tests; 2) production of the compressed bricks; 3) building a solid foundation and 4) CSEB walling technique. Luckily, two local masonry workers had been trained in the production of the CSEB previously to our project. As such, they provided the team with extensive experience while being able to successfully train a total of 10 young workforces in the production and walling techniques. Once trained, they took part in the construction of the project and have been since then working in other construction sites using CSEB as a main walling technique.

Actively involving the community in the construction has always been at the centre of the project, since our hope was for the innovative techniques involved to be assimilated into the local knowledge. The technological advantages, based on a policy of environmental sustainability, simplicity of construction and affordability are the main features that could contribute to fostering the replicability of the model that is being proposed. Building a public facility with local materials where many actors of the community can participate enables the promotion of a more sustainable building culture. Fostering thus, social and environmental justice comes alongside the vernacular knowledge of the territory combined with appropriate and contextual building technologies.

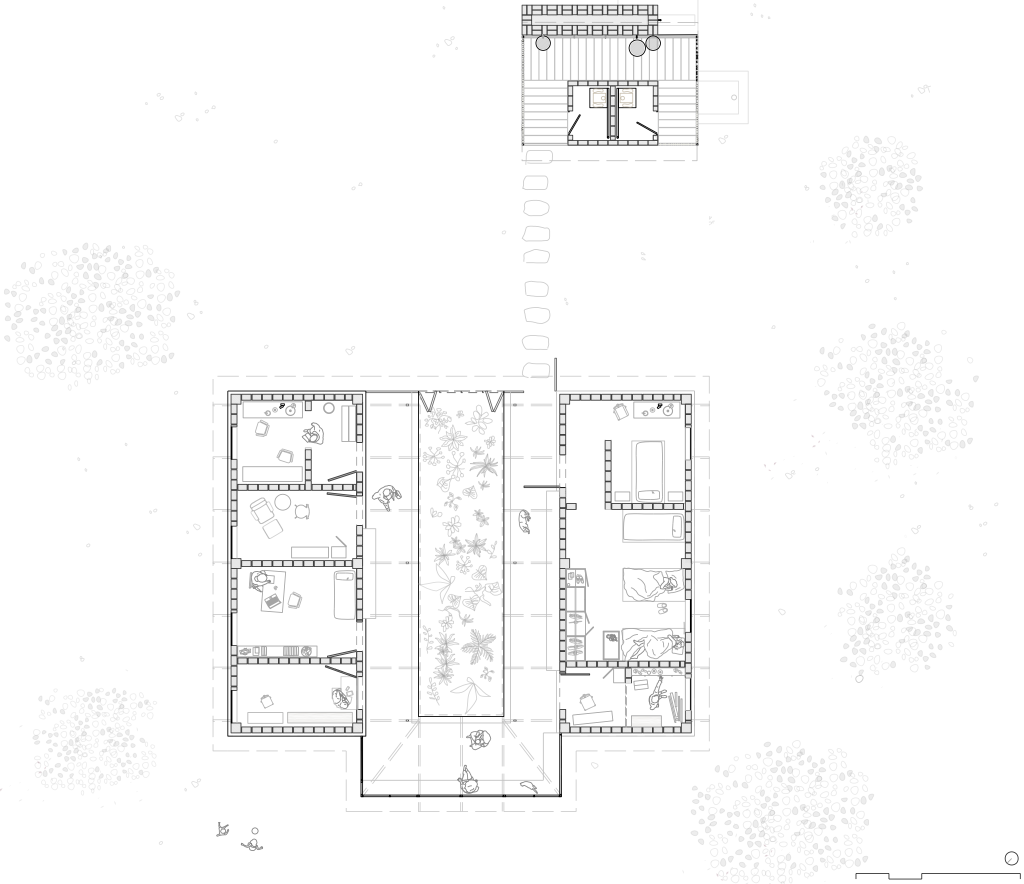
7.3 THE DESIGN PROJECT

Providing access to healthcare at the local level has been at the hotspot of the Maji Moto political agenda during the last few years. Before the opening of the Maji Moto dispensary, villagers had to travel by motorbike taxi, commonly known as piki piki. The absence of ambulances and cars would complicate the health situation of many people who could not afford the transport cost or simply could not travel on a motorbike. Most pregnant women in Maji Moto are still assisted at home by relative women with experience in births. These challenges put into perspective the urgent need to have access to healthcare services.

After years of preliminary research, the final design of the health centre was not just my Master's thesis project. Most importantly, the adjustments made on-site through communication with different community groups were key in providing a design that was adapted to the local context. Furthermore, with the inputs of the regional health officer and the regional engineer in Arusha, we further complemented the design to fulfil the government requirements. As such, the final proposed design was a complex process of actor's involvement, adjustments and requirements that gave shape to the functional programme proposed for the Maji Moto Dispensary.

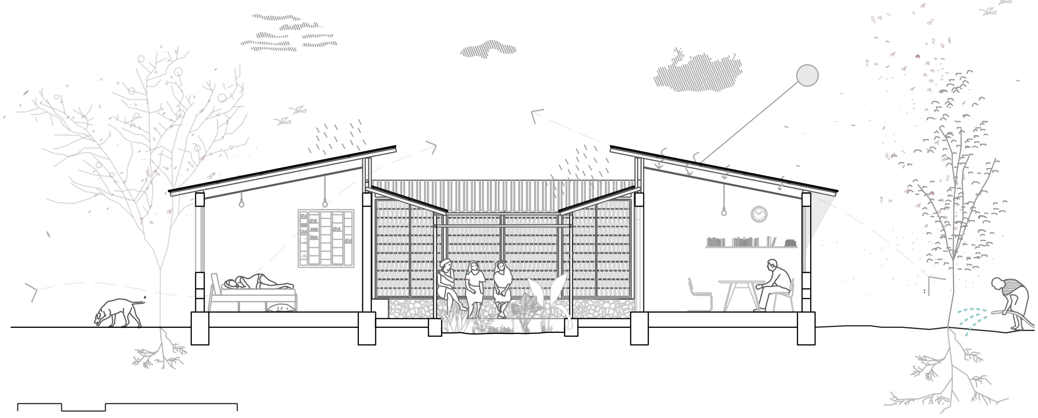
Programmatic design

With a total of 120m2 built, the functional programme divides the building into two different blocks of 48m2 each, creating an intermediate shaded space. As observed in the floor plan [Figure 7.8] the block located in the right site (4x12m) contains the general ward of the dispensary. On the side of the entrance, there is the registration room taking admissions for new patients. Next to it, there is the doctor's consultation room, and besides that, there is the injection room and laboratory. The four rooms have direct access from the central courtyard and windows facing the east and have an average dimension of 8m3, which is in line with the guidelines for rural dispensaries. The block located on the opposite side of the courtyard is specifically dedicated to the maternity ward. One of the primary needs of rural dispensaries is assisting children, who are usually



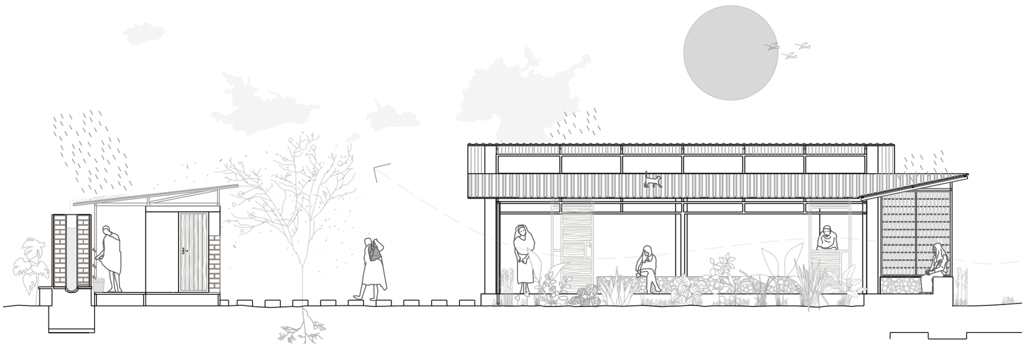
7.8 Floor plan of the designed project for the Maji Moto's Dispensary. Own illustration

the most vulnerable, and mothers. The maternity ward wanted to offer also the possibility of having a delivery room and a post-birth care room. The latter is the biggest space in the dispensary, having 18m2 and can accommodate three women in post-partum care. In the same block but closer to the main entrance there is the pharmacy to which patients will access to collect their medicines before leaving the compound.



7.9 Transversal section of the designed project for the Maji Moto's Dispensary. Own illustration

The central courtyard is the distinctive element of the dispensary design. The external covered space is the dispensary's waiting area and circulation space [Figure 7.9]. Due to its centrality between the two blocks, is the most transited part of the building. Considering the dimensions of the shaded area, the space enables the inclusion of seats where patients can wait to be visited. Besides that, the central garden provides shade and coolness, as can be observed in the longitudinal section [Figure 7.10]. The inclusion of a series of bamboo frames further contributes to the privacy of the interior courtyard while ensuring a regular flow of fresh air. As such, this space connects people who are sharing a moment of privacy, providing a relaxing atmosphere where they can feel safe



7.10 Longitudinal section showing the connection between the dispensary and the toilet block. Source: Own picture

7.11 Dispensary's front wall, entrance and main courtyard, which highlights the bamboo lattice work. Source: Own picture

7.12 External view of the building, where the entrance and bamboo shading can be seen. Source: Own picture

and comfortable. The warm colours of the walls, and the trees of the garden in addition to the natural touch of the bamboo frames, foster quietness and aesthetical beauty [Figure 7.11 and 7.12].

7.12 External view of the building, where the entrance and bamboo shading can be seen. Source: Own picture

7.15 Details of the toilet block, wooden floor, bamboo mosquito net and paint. Source: Own picture

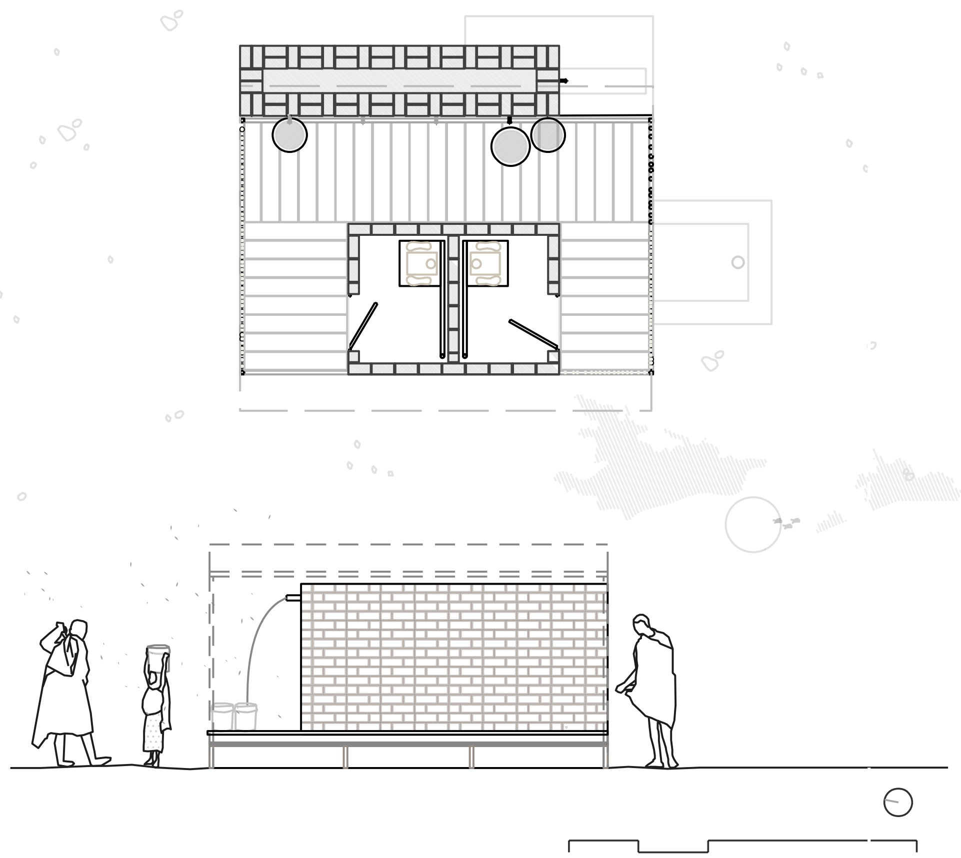
7.14 Dispensary's toilet block from the front and right side. See the water tank which collects rainwater. Source: Own picture

7.14 Dispensary's toilet block from the front and right side. See the water tank which collects rainwater. Source: Own picture

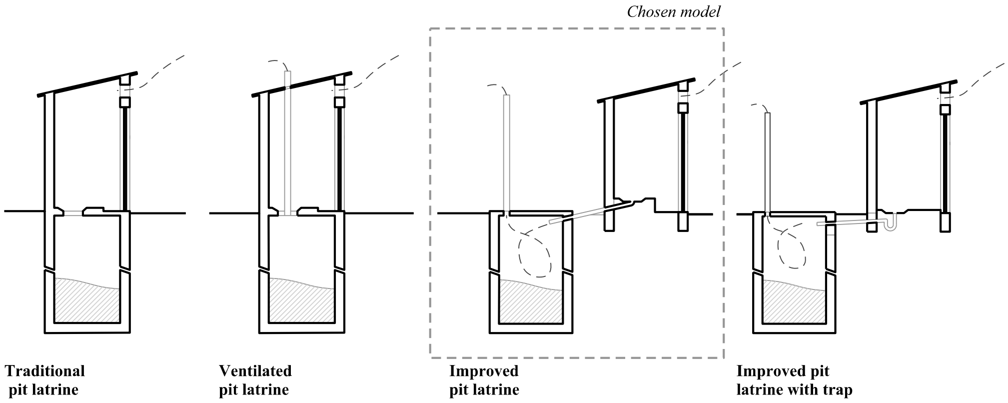
7.13 Traditional pit latrine in Maji Moto, close to a pile of fired bricks. Source: Own picture

Improved Pit Latrine

External to the building, the need for a toilet block was also an opportunity to tackle the precarious condition of pit latrines around the village. Access to adequate sanitation systems is of great concern in rural areas of many African countries, including Tanzania. Due to the lack of sanitation systems, private toilets are unsafe and unhygienic [Figure 7.13]. Furthermore, traditional pit latrines are unsustainable due to their limited lifespan. Whenever the pit is fully covered with waste, another toilet is built, abandoning the old construction on top of the slab. Also, the pit can be in some cases subjected to overflowing or failure during the rainy season. Children may also be discouraged from using the pit latrine if the slab is not designed with their size in mind. Due to these issues, we found the possibility of taking advantage of the need for a dispensary's toilet block to propose an additional prototype building. Through small but essential changes it was possible to build an improved pit latrine [Figure 7.14 and 7.15] to reverse the poor condition of traditional toilets. The new design avoids smells and insects while providing clean water. It also reduces children's risk of falling into the deep pit, which has become an urgent issue to tackle in rural areas. Being the budget and the skills required to build the improved version similar to the construction of a common toilet, the design is easily replicable and affordable for the local community [Figure 7.16]. The main improvements carried out relate to the

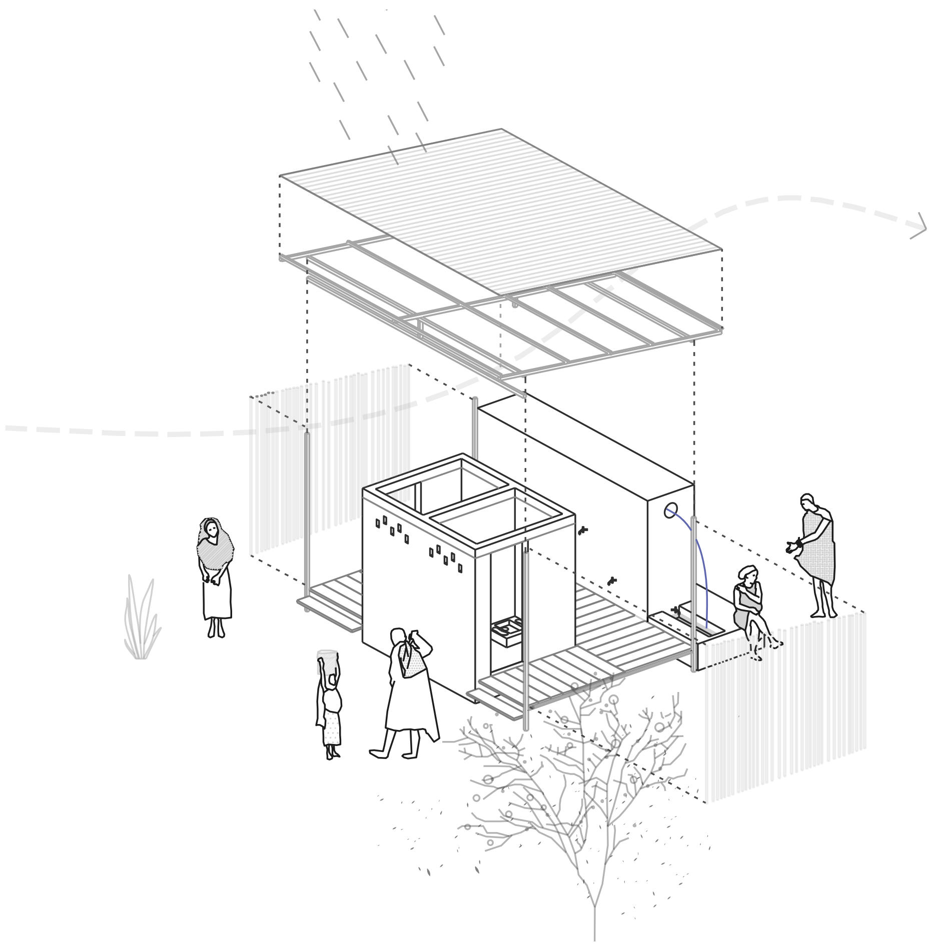


7.16 Floor plan and back prospect (water tank) of the toilet block. Own illustration

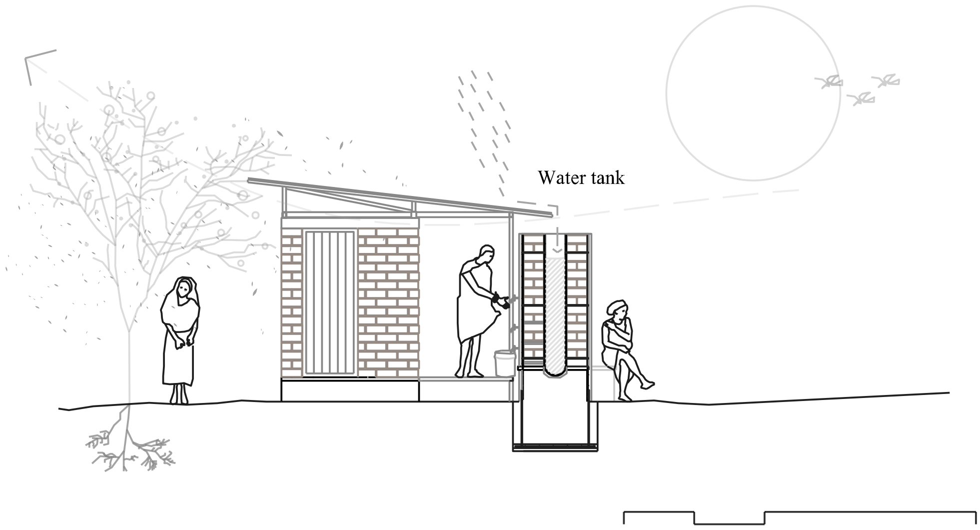


7.17 Comparative drawing that shows the traditional pit latrine and the possible improvements. Own illustration

piping systems and the position of the pit. Traditional pits are usually around 10 metres deep and are covered with a concrete slab in which the person stands, which increases the risk of falling in case the slab is unstable. The comparative drawing 7.17 shows the differences between traditional pit latrines and the feasible improvements. As can be observed, in this case, the pit was placed aside instead of below the toilet to increase the safety of the slab and to provide an easier system to clean and empty the septic tank. Another innovation that the



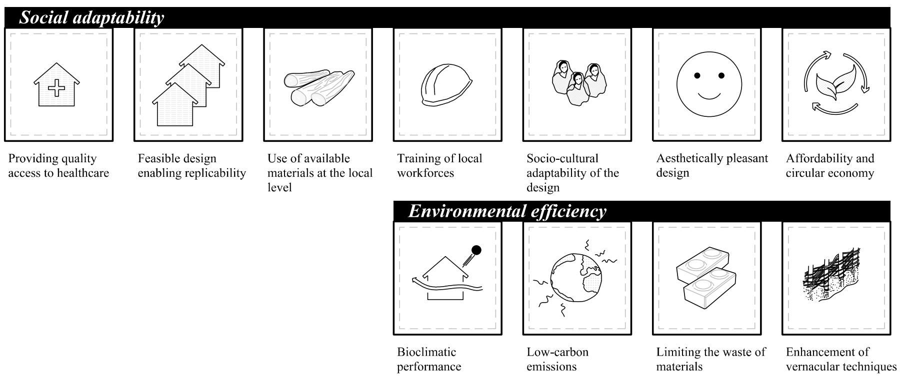
7.18 Axonometric view of main elements of the toilet block. Own illustration design of the toilet block has included is the inclusion of a water collection system to be directly used in the public toilet, which further contributes to compliance with the health standards [Figure 7.18]. The toilet block's roof conducts the water to an external water tank [Figure 7.19] that was built in proximity to the building, ensuring the continuous availability of fresh water to flush the toilets.



7.19 Side section of the toilet block, which highlights the structure of the water tank. Own illustration

Design Criteria

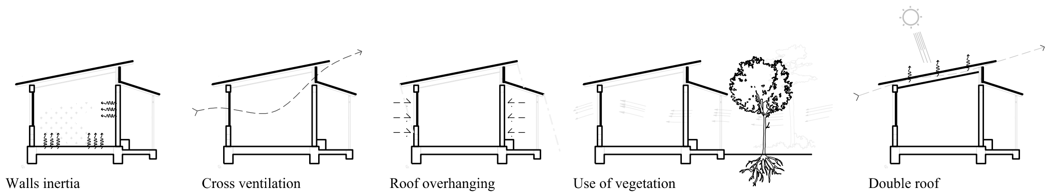
The final design and functional programme of the project were chosen based on unmovable design criteria needed to secure the sustainability and adaptability of the project. As shown in Figure 7.20, the fundamental design guidelines look at two main aspects: the ones looking at social adaptability and those at environmental efficiency. The specific guidelines relating to the former are 1) providing quality access to healthcare; 2) feasible design enabling replicability; 3) use of available materials at the local level; 4) training of local workforces;



7.20 Design criteria of the dispensary prototype divided into social adaptability and environmental efficiency. Own illustration

5) socio-cultural adaptability of the design; 6) aesthetically pleasant design; 7) affordability and circular economy. Instead, the guidelines that relate to the latter are 8) bioclimatic performance; 9) low-carbon emissions; 10) limiting the waste of materials; and 11) enhancement of vernacular techniques.

While some of the specific guidelines have been highlighted earlier as part of the process and origin of the project, for some others it feels relevant to give further details. To propose a feasible design while easy to replicate (2) by the community, the building technologies used should not be unknown to the community. While the production of bricks implies a certain level of knowledge, the laying of bricks and walling technique is similar to other walling solutions. On another level, when looking at the socio-cultural adaptability (6) of the design, it is required to look at social dynamics within the local traditions. For example, the central courtyard takes into account the need for privacy for those who are in the dispensary, while promoting the exchange of conversations among women in a relaxing and safe space.

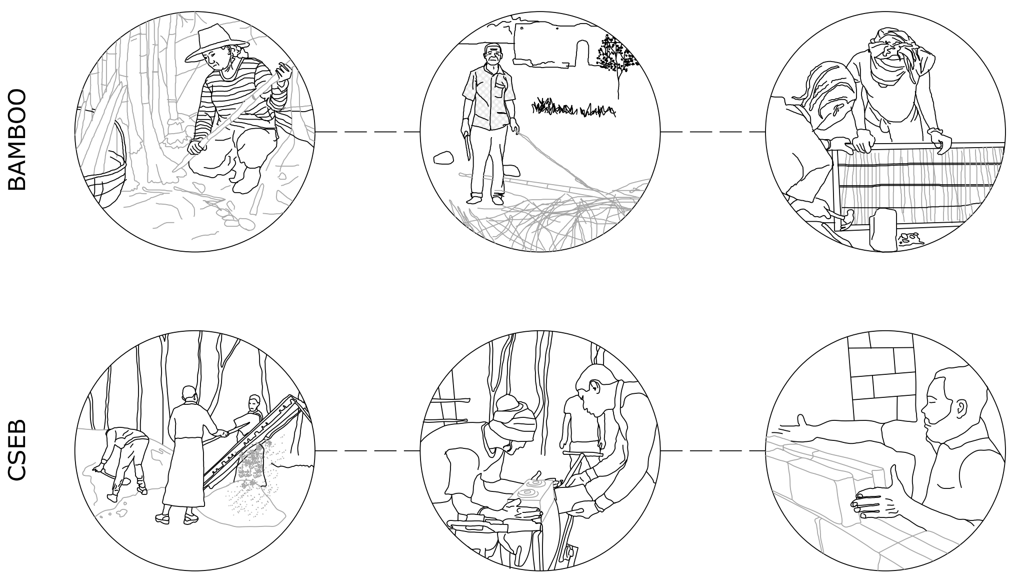


7.21 Sketches showing the main elements considered to achieve thermal comfort through passive cooling strategies. Own illustration

Environmental efficiency was the greatest challenge faced by the design of the project. Bioclimatic architecture (8) is an approach to design which focuses on the analysis of the local climate conditions to propose an adapted solution (Watson, 2013). Bioclimatic architecture aims to reduce the reliance on active cooling systems, thus ensuring thermal comfort using natural resources and passive building strategies. To achieve that, five elements have been key [figure 7.21]. Firstly, the earthen walls use thermal mass to protect the inner spaces against the sun's heat during the day, while releasing the heat into the rooms at night when the temperatures outside are cooled down. Secondly, the central courtyard improves cross-ventilation, together with the double-sided openings of the rooms which further enable natural ventilation throughout the day to reduce the inner temperatures. Thirdly, the roof has been designed to overhang on both sides, providing shade to the building walls, while the central courtyard has an independent roof structure to further provide shading areas. Fourthly, the building's central courtyard is populated with trees to regulate temperatures and humidity. Lastly, the roofing system has been designed to protect the building against the solar radiation absorbed by the corrugated roof sheets. To achieve it, a modular ceiling was placed with an intermediate air gap. Moving to another guideline, carbon emissions (9) have been reduced by using the CSEB technique, replacing fired bricks, which are environmentally damaging due to their need to be baked; and concrete blocks, which use high amounts of cement in their composition. In addition, by using local materials, the emissions associated with material transportation have been drastically cut. To conclude, it is important to highlight the crucial role of vernacular techniques (12) in the development of the project. The use of raw earth in the indigenous building tradition has been an interesting inspiration for the project. As well, the bamboo frames that enclose the central courtyard have been inspired by the traditional wattle and daub technique of an intersecting wooden frame to create separations or walls.

7.4 THE PROCESS OF CONSTRUCTION

Concerning the construction decisions taken as part of the dispensary project, the environmental aspect as well as the knowledge transfer were at the core. Economically, it was also important to propose a technology that was affordable considering the project budget, but due to the large amount of local materials that were used, the cost was considerably reduced. The use of CSEBs as the main walling solution responds to the three aspects mentioned above, as it is an affordable solution, environmentally sustainable and similar in use to the commonly known fired/concrete brick. In a first attempt, the CSEB wall was designed as a load-bearing wall with the objective of replacing a concrete structure with the compressed brick wall itself. While the idea was tempting and represented the epitome of a sustainable walling and structural solution, it implied several uncertainties. Not knowing the compressive strength of the bricks in advance represented a risk for the design project. However, even if brick strength was the required, the lack of experience in building structures



7.22 Strategic use of locally sourced materials such as bamboo and earth for producing the CSEB. Own illustration.

with such technology generated a worrying feeling among the team members. Also, building a load-bearing wall implied a thicker brick wall for stability purposes, which would have significantly increased the workload and use of materials. Such a decision would have implied an uncertain building process that could have impacted the self-confidence of workers and architects. Thus, to avoid overcomplications and unclear decisions, it was determined to use the CSEBs only as a walling solution by building an additional concrete structure in which the roof would be laying. In this way, the walling technology was executed in the form of a building envelope and internal partitions. Needless to say, is that the qualities of the compressed earth brick in terms of inertia and water resistance were still valuable characteristics for a non-structural wall [fig. 7.22].

Construction process and detailing

The following breakdown of the building components, explain in detail every step followed during the construction of the Maji Moto dispensary, followed by an enlarged technological section of the building:

Site cleaning + foundation layout

After having selected the plot in which the project was developed, the foundation layout was marked, thus the cleaning of the area and surroundings was conducted [Figure 7.23]. Several bushes were removed, while trees were respected. The site area was cleared of stones and soil humps while ensuring enough appropriate space for the materials and bricks' storage. This step is crucial to ensure the security and free movement of workers on the construction site. Site cleaning and foundation layout were made within a couple of days with a group of 4 workers.

7.23 Construction site after cleaning and measuring the foundations before digging. Source: Own picture

7.24 Form works containing the concrete structure of the over foundation. Source: Own picture

7.25 Finished over foundations and casting of the concrete pillars of block 1. Source: Own picture

Foundations + over foundations

The construction of the foundation was a lengthy process due to the limited resources available on-site to do concrete work. The lack of a concrete mixer and pipe was a consequence, making every concrete work extremely slow. This is one of the main issues encountered after deciding to build a concrete structure, requiring large numbers of workforces at specific moments.

The foundation was designed with pad footings for the building columns. Each column is at a distance of 5,6 metres. In total, 6 isolated footings per block were dug, then armed with 14mm diameter armatures. Due to the slightly seismic area in which we were building, the isolated footings were braced by a reinforced concrete foundation beam that would also serve as support for the CSEB wall [Figure 7.24]. While the pad footings were 50x50cm and 1 metre deep, the braced foundation beam was made digging 50cm deep trenches on the ground. A cleansing 10cm layer of concrete was poured before laying the reinforcing steel bars (4 bars of 10mm diameter). The space in between the two blocks, the actual entrance and waiting area was joined to both of the blocks' foundations to increase stability. In addition, due to the increasingly strong flooding events in which water can reach up to 20cm high, the foundations were added an over foundation of 30cm high. The reason was twofold: on the one side, it would prevent the water from entering the building in case of floods, while on the other side protect the CSEB wall, as it could be damaged by large quantities of water. The over foundation was also reinforced concrete, which implied the use of casting wood to make the containing formwork. Upon conclusion of the foundations, the steel bars that would join the column structure were left visible until the concrete structure was executed [Figure 7.25]. In total, the construction of the foundation + over foundations took one month for both blocks, with 4 expert workers, 5 additional workers and 15 volunteers.

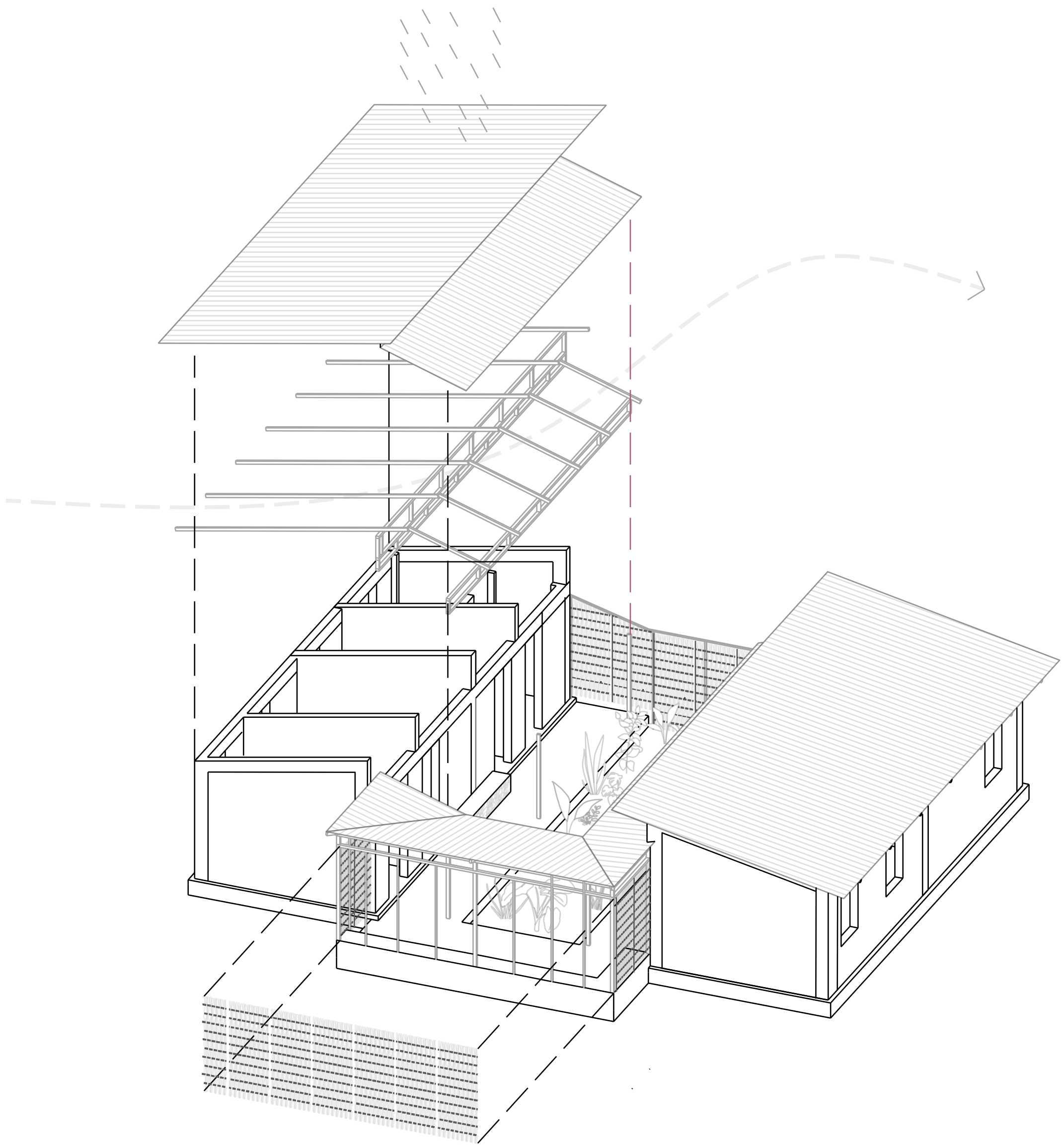
7.26 Volunteers sieving the excavated soil from the site before using it for producing the CSEB. Source: Own picture

7.27 Construction workers producing CSEB on the site of the dispensary. Source: Own picture

Compressed Stabilised Earth Bricks Production

Contemporary to the initiation of the first block foundation, a group of skilled workers started producing of CSEBs. For that, a big hole of 10x5 metres was dug to collect the soil required for the mixing. After the top layer of soil was removed, quality soil was sieved twice before being piled [Figure 7.26], where it would be ready to use. The other mixing components, sand and cement were orderly placed to ease the work of production. With that, two skilled workers produced around 500 bricks per day [Figure 7.27], and after that, bricks were stacked and watered for two weeks before being ready to use. Due to the large number of bricks needed for the building envelope, the process was lengthy and happened contemporaneously with the foundation and concrete structure execution. This phase was mainly made by two/three skilled persons that were exchanging roles, to enable the transfer of the technique knowledge.

7.28 Dispensary's block one with concrete structure completed, both columns and beams. Source: own picture

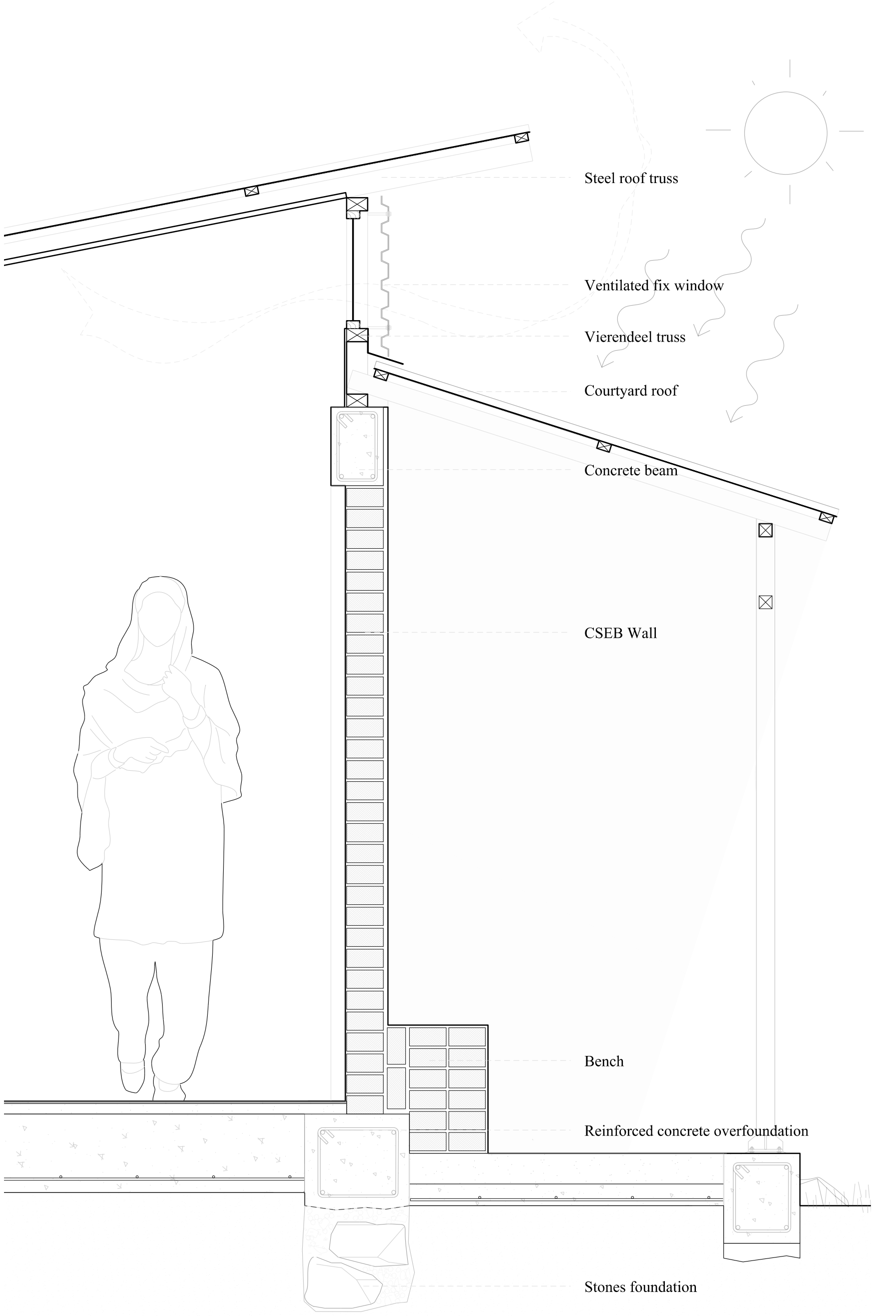


7.29 Axonometric view of the dispensary building, which highlights the roof structure and the bamboo lattice work.
Own illustration

Concrete structure

As explained earlier, the concrete structure was included in the design due to the uncertainty of the bricks' structural quality in advance of the construction beginning. A concrete structure ensured the required strength and resistance. The structure consisted of a structural framework of columns and beams [Figure 7.28]. The columns of 30x30 cm were made of reinforced concrete, with two different heights: 2,70m and 3,8m. The columns at the internal site of the blocks in the rectangle's end have been designed higher to hold the Vierendeel metallic truss that gives shape to the clerestory roof[2]. For clarifications regarding the details, please check the axonometric view in Figure 7.29 and the technological section in Figure 7.30 . After the columns were raised, the formworks for the beams' construction were placed. The reinforced beams have a dimension of

2 - A clerestory roof is a roof with a vertical wall which sits between the two sloping sides, which features a row of windows (or one long, continuous window). The clerestory roof can be symmetrical, with a hipped or gable-type design, or else it can be asymmetrical, resembling something closer to a skillion roof.



7.30 Constructive section of a typical wall: concrete foundation, floor, CSEB wall, concrete beam and steel roof. Own illustration

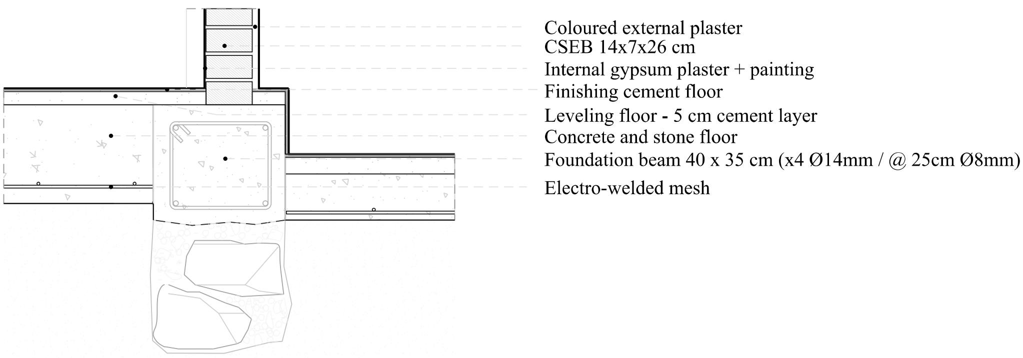
40x20 cm. A rectangular reinforced steel skeleton of 14mm steel bars was placed inside the concrete beam. The longitudinal 12-metre beams followed a straight line while the transversal 4-metre beams at the external sides had a shape of 10% following the roof inclination.

However, after reviewing the massive efforts carried out to finalise the concrete structure of both blocks, it was concluded that concrete structures in rural areas are often too difficult to achieve successfully. Several difficulties related to the mixing and pouring of concrete, plus the final look of concrete beams due to the use of inappropriate casting wood were among the disadvantages of this technique. A wooden or steel structure, or as it was said before, a CSEB load-bearing wall, would have resulted in a more efficient and uncomplicated building solution.

7.31 Team working on the filling of the floor slab with local stones, before pouring concrete on block 2. Source: Own picture

Floor

When the concrete structure was finalised, the team jointly worked on the floor's filler, which due to the over-foundation height was almost acting as a concrete slab [Figure 7.31]. The 30cm deep over-foundation was filled with stones of different dimensions until completion. After that, a layer of concrete was poured on top of the stones, together with a welded mesh to reinforce the concrete. The external layer of the floor was left unfinished to continue with the work of walling and roofing. The levelling cement layer plus the final layer of finishing cement were conducted once the internal partitions and walls were built, avoiding thus damaging the final floor layer. See figure 7.32 to find the construction detail of the floor.



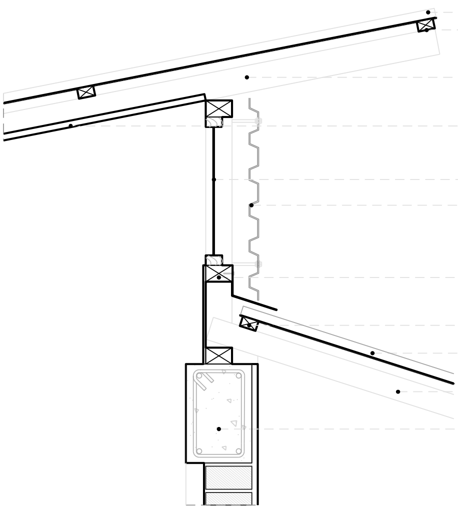
7.32 Constructive detail of the cement floors and its different layers. Own illustration

Envelope + partitions

The envelope and internal partitions were the solutions for which the CSEBs were mostly used. The two building blocks were added to a CSEB closing wall under the concrete structure [Figure 7.33]. For the internal partitions, an additional beam was built with reinforced concrete for stability purposes and to join the main structure to the partitions. The external wall was laying on top of the over-foundation, including a plastic layer that was placed between the concrete and the bricks to avoid moisture. A group of between 5 to 7 workers raised the walls with the compressed bricks. Normally, between 5 and 6 lines of bricks were laid on a single day, having to wait one day to secure the execution of the walling part. The use of interlocking bricks helped to improve the execution of the walls, making them quicker and cleaner. Due to the interlocked part of the bricks, these can be joined without the need for cement [Figure 7.34]. According to interlocking experts, cement mortar has to be added in 1 of every 5 bricks' lines, which considerably reduces the cost of cement and the environmental impact.

7.33 Team working on the construction of the closing CSEB wall after completion of the concrete structure. Source: Own picture.

7.34 Volunteer working on the CSEB construction of the toilet's water tank. Source: Own picture.



7.35 Constructive detail of the Vierendeel steel truss and closure. Own illustration

Roof structure

As observed in the axonometric view of Figure 4.49, the roof structure is a double skillion roof which divides the rooms' covering and the porched courtyard roof. In the two blocks, the roof structure is formed by 12 metres long Vierendeel truss, made out of 8x5 cm square pipes (8 mm thickness), and 10x5 cm steel trusses (square) transversal to the building [Figure 7.35]. The steel trusses are both welded at the Vierendeel truss on the one side and to a steel anchor placed on top of the concrete beam on the other side. Above these, there are rectangular

7.36 Night view of the reception room and open courtyard, with visible closing of the Vierendeel truss. Source: own picture steel rafters (5x3 cm and 4mm thickness) to which the corrugated roof sheets are joined. To cover the courtyard porch, rectangular steel trusses of the same dimensions are joined from the Vierendeel to another smaller reticular truss that closes the porch structure. The U-shape porch is completed with 7 rectangular steel columns (10x8cm and 8mm thickness) that support the porch roof structure [Figure 7.36].

Plaster

Despite a CSEB wall does not need plaster if is properly protected from the rain with hanging rooves and over foundations, the community has since the beginning shown a special interest in plastering the building. As such, we looked for the best possibility to avoid plastic paints that are widely known for being pollutant and environmentally damaging (Pucino et al, 2021). Therefore, it was decided to use cement and sand plaster with an addition of natural pigments, to get an aesthetically pleasant colour but avoid having three layers of plaster, including gypsum coating and painting. The final colour was a mix of yellow and red, that was bought in a local shop in Moshi. See figure 7.37 for the finishing look of the coloured plaster.

In the case of the dispensary's rooms, due to cleaning and health requirements, surfaces needed to be neat and smooth. Therefore, a first layer of cement plaster was applied on top of the CSEB bricks, as well as a gypsum layer and a final white painting colour. To render the space more attractive and to avoid damaging the rooms' white walls, a half-painted wall in blue colour was added with a resistant plastic paint [figure 7.38].

7.37 Internal courtyard and waiting area at sunset time, reflecting the light game of the bamboo lattice work and the colour of the walls.
Source: Own picture

7.38 Delivery room showing the internal coloured walls of the building. Source: Own picture

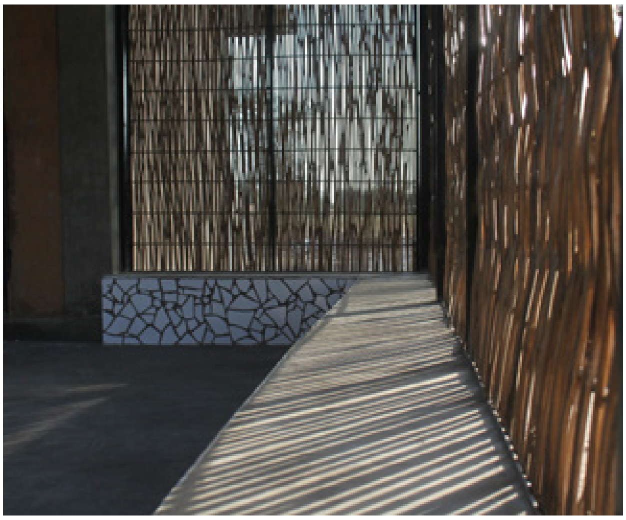
7.39 Reception room and observation room. To note the timber of the doors re-used from casting. Source: Own picture

Windows and doors

A main entrance door directed to the internal courtyard and waiting area was made out of a steel frame and bamboo. Once in the entrance hall, the general block has four rooms with a door and a window in each, while the maternity block has two doors and three windows. The doors' structure were manufactured by a local welder, while the door itself was made by using the leftover casting wood after being treated and cleaned [Figure 7.39]. The top part of the doors has been designed to enable a constant flow of air by making bamboo frames, promoting cross-ventilation. In addition, the Vierendeel truss closing detail uses a polycarbonate layer with a small separation from the steel truss that further enables a constant flow of air in the rooms. The windows were designed by the team and manufactured by the same local welder, while the window glasses were placed by another local craftsman.

Finishing details

Other finishing details relevant to the final aesthetical look of the building are the hand-made benches of the waiting area. These were built with compressed bricks leftovers and with a final layer of broken tiles that were given for free from a local shop [Figure 7.40 and 7.41]. Another important detail in the courtyard is the bamboo lattice work that encloses the central open area. Its warm colour and creative design were very well welcomed by the community who demonstrated their enthusiasm for the technique [Figure 7.42]. Furthermore, while ensuring privacy in the waiting area, it has enough space to enable ventilation in the courtyard. On another level, an interesting detail that was complicated to execute was the ceiling. The ceiling became an essential component to reduce the roof's solar heat. Plastic ceiling boards were chosen due to their practical and easy-cleanable surface, beyond providing a neat white colour to the rooms. Finally, the plants and trees added in the central garden additionally foster constant cool temperatures in the public space.



7.40 Final detail of the bench in the waiting area.
Source: Own picture

7.41 A volunteer working on the finishing detail of the bench, using re-used broken tiles. Source: Own picture

Actors involved

The construction process was carried out in two different periods of between three and six months each. The first construction phase was initiated in July 2018 and was continuously active until December 2019. The second and last phase was conducted from July to October 2019. In total, the dispensary was built within 9 months. This was possible due to the large number of people involved in the construction process. The first period of six months involved the recruitment of 22 local bricklayers who took part in the construction of the structure and the building's masonry. Besides that, 16 international volunteers were involved from July to September in the construction process, as well as a group of 20 building engineering students from Belgium from October to November. Volunteer groups, mostly composed of architecture students

7.42 Crowded bench receiving community members on the opening day. Source: Own picture or architects, worked in several construction activities. Among others, they collaborated on the digging and sieving of the soil needed for the production of bricks, fabrication of the reinforced steel bars to be used for the concrete structures and helping local bricklayers in the laying of the walls. During the second period of three months, with the walling works and roofing finished, a reduced group of 10 international volunteers was involved in the detailing and finishing of the building. Among others, they collaborated in the making of the courtyard benches, the bamboo frames, painting the walls, and cleaning up the site and building.

7.43 Women working on the construction of the bamboo windows.
Source: Own picture

7.44 Women working on the colour plastering of the toilet block.
Source: Own picture

An important aspect of the construction process was the involvement of women's groups in specific parts of the project [Figure 7.43 and 7.44]. While skilled workers were hired for most of the activities related to structure, walling, welding and roofing, women were key in the manufacturing of the bamboo frames and applying the coloured plaster to the external walls, both in the toilet block and the dispensary building. The chance to involve women's groups in the construction process was indeed a valuable contribution and a source of empowerment for them as construction work is usually associated with males. Their determination to work on the construction site was also moved by a desire and genuine interest in the project and the positive impact that their involvement would have on the community itself. As such, they were part of decision-making activities regarding aesthetical details such as the colour painting, the windows design and the vegetation included in the courtyard [Figure 7.45]. Due to the fragile economic situation of Maasai women, the temporary job in the dispensary construction helped them to boost their financial capacity as well as their self-confidence.

Relying on local experts and workers was probably one of the most important actions taken by the organisational team of C-re-aid. The two construction managers who followed the project's steps are from Maji Moto and part of the directive team of C-re-aid. Their deep knowledge of local dynamics, challenges and people has been an essential factor to ensure the smooth execution of the construction phase. Therefore, I believe in the value of relying on local experts if an international development project wants to be successfully implemented, considering the lack of local knowledge of the 'technical team' of architects and engineers. Also, relevant to the project achievements were the groups of skilled workers that contributed to the shaping of the project since the beginning. As said before, a group of 22 local bricklayers took part in the different construction phases. Out of these, 7 were fundis[3] (construction experts in Swahili). Fundis usually lead the execution of foundations, structures and walling of buildings. Besides that, 10 were labourers usually helping in the mixing of concrete and other non-skilled activities on construction site. Regarding the bricks' production, two professional CSEB producers worked and trained our local fundis on the production of the CSEBs. Other three workers were hired to help in specific actions such as pouring concrete, filling the water tanks or preparing wooden casts. During the second project phase in 2019, the number of fundis was reduced to three, who mainly worked on plastering inside/outside walls and the finishing of floors. Other specific skilled men were required. One local electrician and two of his labourers, three expert welders that came from Arusha worked on the roof structure, while the other two local welders were commissioned the steel window frames. The roof finishing was conducted by the team of welders from Arusha while the ceiling was installed by some volunteers. In addition, a team of local carpenters worked on the cleaning of casting wood that was used to make the steel framed doors. In total, a group of 18 workers, counting three labourers, were part of the team during the second phase. Ultimately, the continuous effort and support given by all community members who were involved in the dispensary project was key to enabling a successfully implemented project. Each single contribution became paramount at every stage of the project development. As well, advice, opinions and critiques became a challenging and rewarding source of improvement.

3 - A fundi is a local expert in any specific subject. In construction, fundis undertake a three years course in a training school, which enables them to have a role similar to a construction site manager.

7.45 Women's group participating in the decision of the external colour for the dispensary walls. Source: Own picture

8 — Mikocheni Bike Shop: Second-Built Prototype

This chapter introduces the second built prototype that has been analysed as part of this research, which is located in Mikocheni (Kilimanjaro Region). C-re-aid NGO has been working in the Mikocheni area since 2015. Firstly, through a project commissioned by an international organisation, the team of C-re-aid designed and executed the construction of a community centre in the Maasai area of Mikocheni. After that, the first bike shop was built in Msitu Wa Tembo, a village nearby where other Maasai communities live.

The search for innovation in building techniques can be witnessed when looking at the different projects that were carried out in the area. The community centre was built with fired bricks, while the first bike shop was an experimental project in which the main walls were built with a stone's gabion box. In 2018, Following the results of the Compressed Earth Blocks research that was carried out by team members of C-re-aid, Germany's Rotary Club and Global Bike organisation entrusted to C-re-aid the design and construction of the Mikocheni bike shop. The acquired knowledge on compressed block production was an opportunity to tackle the material scarcity that the area has been experiencing in the last decade. Finally, by the end of 2018, the bike shop of Mikocheni was built. The two sub-chapters below will expand on the details of the second prototype built with Compressed Stabilised Earth Bricks (CSEB).

8.1 HOW THE PROJECT WAS BORN

Mikocheni is located in an isolated area, resulting in a community that lacks public transport and alternative transportation means for its inhabitants. Is for that reason that Global Bike NGO supported by Rotary decided to set up a bike shop in the area. The objective of Global Bike is to harness the benefits of bicycles as a tool for better mobility, social impact, economic development and women's empowerment (Global Bike, 2019). The organisation works in rural areas of Tanzania providing women with training and equipment to run bike businesses [Figure 8.0], improving their transportation needs and propelling women into sustainable careers. The lack of electricity and access to drinking water forces women to travel long distances to have food and other essential supplies. As such, with the construction of the Mikocheni bike shop, women can use bikes to carry out their daily activities. Considering that domestic tasks such as the supplying of essential goods for the household are mainly carried out by women, the establishment of Global Bike's initiative entails a significant relief for local women. According to Global Bike (2019), a woman can save up to 65% of her time if using a bike instead of walking in search of livelihood. This contributes thus to the quality of women's lives and enables them to spend their time focusing on more relevant activities, such as their families or businesses. With that in mind, the built project wanted to provide a space for women where they could store and fix bicycles, for themselves and to be rented to community members. As part of the programme, women are

8.0 Women working on a workshop to fix bikes. Source: Global Bike NGO website trained to repair bicycles and to run the cooperative business. Through Global Bike, women are provided with the financial capacity to self-run their shops. As well, they receive donated bicycles, tools and equipment for the first year, and the organisation contributes to their self-sustainability through constant collaboration and provision of additional resources.

Community involvement

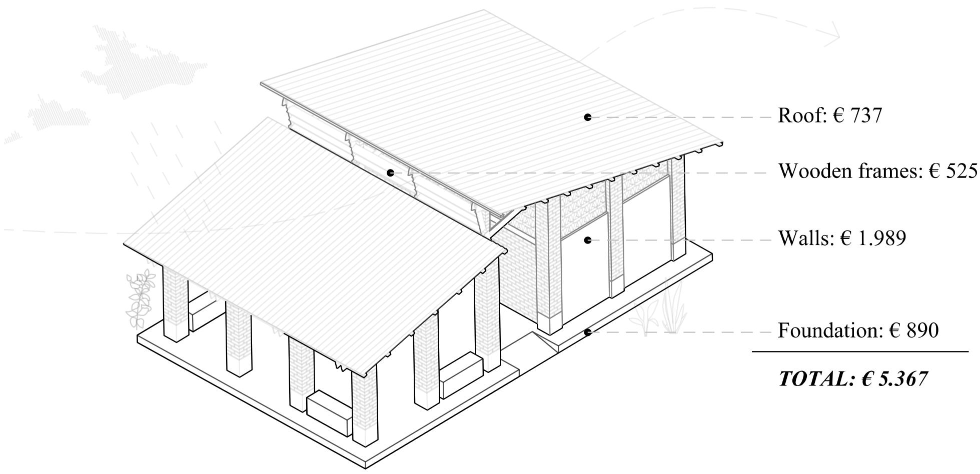
To assess the local needs and to recruit the group of women that would be part of the cooperative biking shop, Global Bike organised several meetings with community groups that had demonstrated an interest towards the initiative. After that and building upon preliminary meetings between the client and the architect's team of C-re-aid to set up the project objectives, women's groups took part in a series of participatory-led design workshops. These aimed to think collectively about the project's development, women's involvement and design implications. While the specificities requested regarding the functional programme will be exposed in the next section, it is interesting to note some of the women's suggestions as part of the mentioned activities. Among others, women were concerned with the type of building material that would be used for the construction. They suggested using cement blocks as the main building material, but due to the search for sustainable alternatives part of C-re-aid's philosophy, the CSEB technique was introduced to women, as a similar in strength but less environmentally damaging technique. After discussing the technical and water-resistance properties of the newly introduced technique, women showed interest, but they advised lifting the over-foundations enough to avoid the bricks' erosion, as well as to plaster the building to further protect the walls against the rain. Their contextual knowledge regarding the local conditions was essential to propose a building technique that respects natural resources while offering comfort and adaptability to the context. Besides that, they advised on roofing types that can be dangerous due to strong winds. For example, they have witnessed how single-slop rooves can be blown away by the wind while gable or hip rooves offer more stability. Such advice influenced the final design of the skillion double-sloped roof. Other requirements made by women's groups involved the construction of a free-standing toilet block that they could access easily while working in the bike shop. Also, the installation of solar panels was advised to have access to lighting at night for security reasons and electricity to use some repairing tools. Lastly, a public water tap was requested in the surrounding areas of the bike shop to enable tree plantations and access to water for other domestic purposes.

After having collected women's opinions and suggestions, the C-re-aid team travelled to Mikocheni at every phase of the design development to inform the involved community as well as to receive feedback for improvements (Figure 8.1). Such a process happened over four months in which the team developed both material research and the project design and technical details before the beginning of the construction in September 2018.

8.1 C-re-aid team discussing the design of the bike shop with women's groups. Source: C-re-aid website

Budget

In this case, Global Bike and Rotary provided the costs of construction of the shop, plus the managerial costs and equipment for the first years. It is expected that over time, the local cooperative can run independently. The initial budget devoted to the project was €6,900 to cover labour, transportation, building materials, logistics and the C-re-aid design fee, which included material research, design and construction management. With this in mind, it was expected that the project would cost around €125/m2, a reasonably reduced amount considering the average cost of other projects developed by the organisation in the same village. Considering that the building has a surface of 42m2 and that the final cost of the construction project was €5,367 (excluding the C-re-aid design fee), the cost per m2 was €124/m2. The detailed cost regarding the different parts of the building (foundation, walls, roof, doors & windows and logistics) can be seen in the axonometric view of Figure 8.2. Apart from these, other costs such as logistics, transport and food for workers and the team on site were €1,057.



8.2 Axonometric view of the Bike Shop project with breakdown of costs. Source: own illustration adapted from C-re-aid team.

CSEB as technological solution

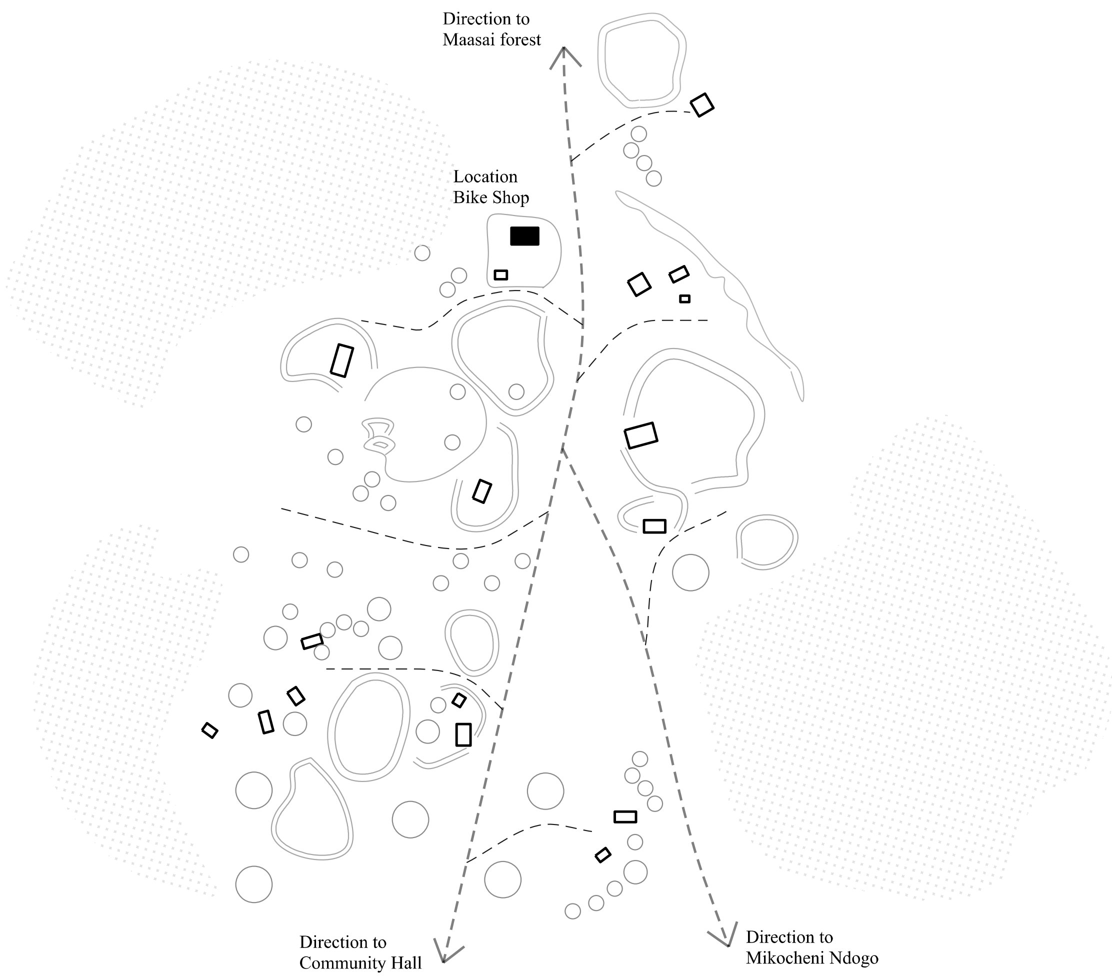
Considering the local struggle in the search for adaptative building techniques, the action of building becomes the trigger of a community business supporting and improving the neighbour's quality of life. The opportunity for promoting an alternative building technology as a substitute for fired bricks and mud constructions was proved to further revitalise an area where the scarcity of resources and population growth are hindering local sustainable development. The loss of traditional building knowledge in Mikocheni has been exposed throughout Chapter 5.2, though environmental decline is also having a huge impact on the use of building techniques. With increasing periods of droughts, desertification is reducing the tree cover of the already semi-dry savanna area. With it, the main building technique used in the area (pole and mud walls) is in some cases difficult to build. As well, the alkaline condition of the local soil prevents the manufacture of fired bricks in the village, having to rely upon long-distance transportation to have access to these materials. Currently, the use of concrete blocks is gaining popularity among the local community, who perceive the material as the strongest option available. Besides being the most expensive building material accessible at the local level, its damaging environmental consequences due to the production of cement were an incentive to look for other alternatives. Furthermore, due to the irreversible chemical reaction of cement, the material is not reusable or degradable. As such, proposing CSEB as a viable and environmentally friendly alternative has presented a new opportunity to tackle the issue of access to building materials for the Maasai communities living in Mikocheni. Due to the composition of the local soil which contains aggressive minerals, its use in building materials can cause structural damage. This issue has been observed among the buildings existing in the area. The problem with salty soils is that when salt particles

8.3 Testing the strength of the interlocking compressed bricks.

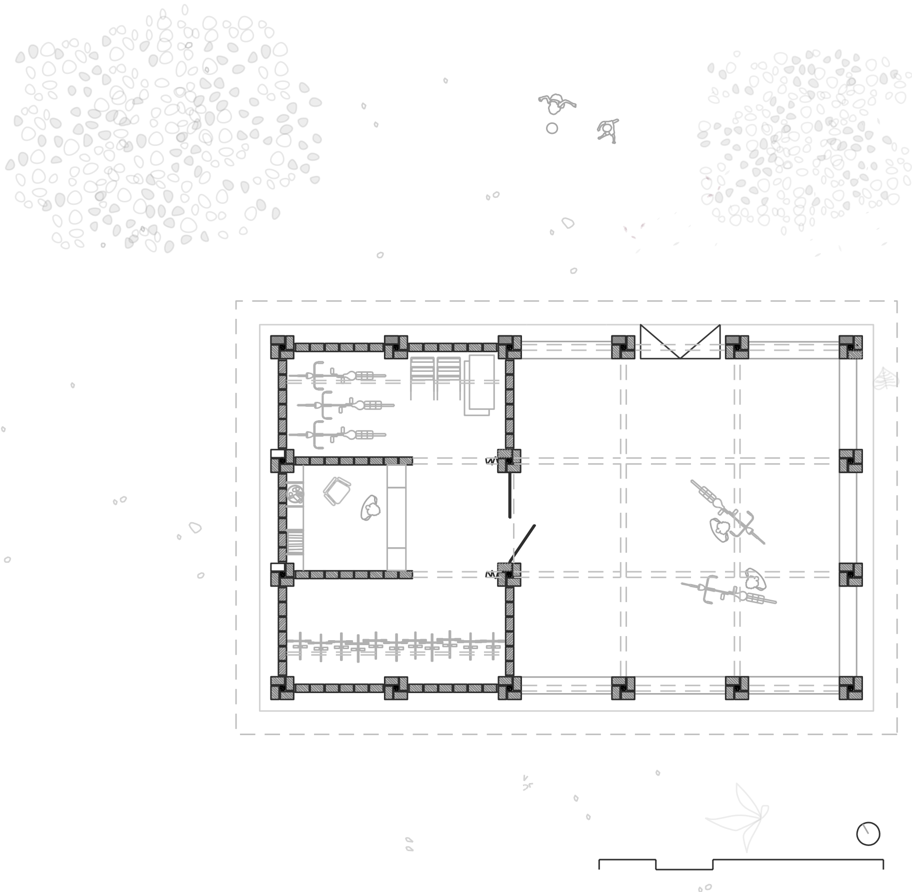
crystalise after having been in contact with water or moisture, the material gets expanded, creating pressure in the structure and ultimately damaging the building (C-re-aid, 2017). Considering this situation, the challenge was to find a solution to overcome the alkaline condition of the soil. Thus, after conducting several CSEB tests with different types of stabilisers, it was established that the lime stabiliser had a better reaction with the local soil to reduce the impact of the soil's alkaline condition. Lime usually binds properly with clayed soils, creating a strong waterproof reaction that protects the brick against crystallisation. Different tests were conducted to test the strength of the samples before sending these to the [Figure 8.3]

8.2 THE DESIGN PROJECT

The location of the bike shop was chosen by the C-re-aid team after a careful analysis of traffic flows and community interactions. By taking into account these dynamics, the building was positioned at a strategic point that could foster the communal use of the space. As shown in Figure 8.4, the building was



8.4 Situation plan of the bike shop, that was thought in relation to pedestrian traffic paths. Source: Own illustration adapted from C-re-aid team



8.5 Main floor plan of the bike shop, separating the indoor shop space and the open common space. Source: Own illustration adapted from C-re-aid team

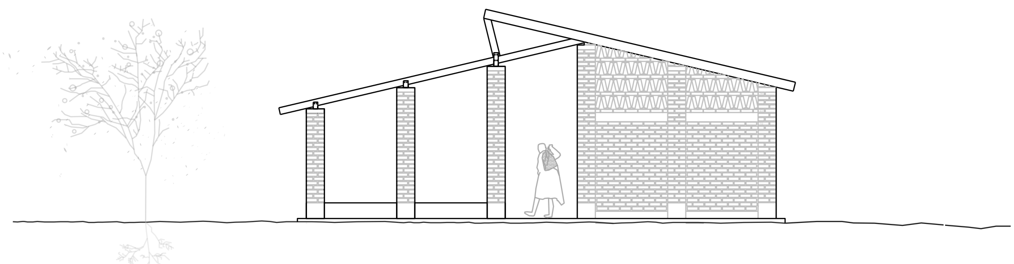
8.6 Side picture of the bike shop after completion. Source: C-re-aid website oriented towards the usual path that neighbours usually cross, opening itself into the space and promoting its public character. Its position also creates a sort of meeting point along the traffic path in which public meetings and other community events can be held. Considering its communal character, the building was designed as a flexible space in which other activities beyond bike-related could occur. For this reason, the covered open space gains relevance as the

8.7 Detail of the bricks' lattice work that ventilates and illuminates the indoor shop. Picture before completing the floor. Source: C-re-aid website

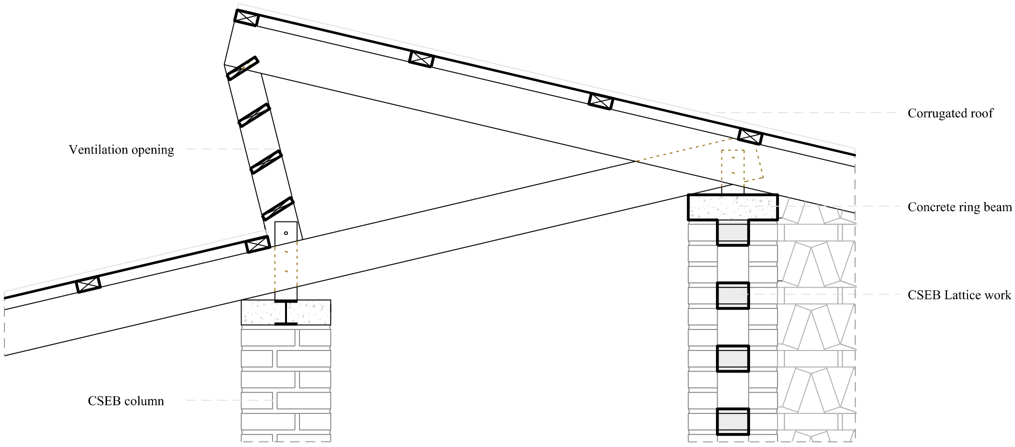
8.8 Women fixing bikes on the open space of the bike shop.
Source: C-re-aid Facebook page

8.9 The bike shop during a local meeting involving women's groups.
Source: Own picture

main area in which training and fixing bikes can be carried out alongside other meetings or celebrations. The primary purpose of the outdoor covered space is to allow women to work and meet while being protected against the sun and rain. Instead, the closed space has reduced dimensions and is divided to serve specifically as a storage and small shop [see figure 8.5]. These three spaces are designed to provide interaction among them, being accessed and connected by the open space. The only entrance to the enclosed spaces by the veranda serves to facilitate the control of people's flow during the day [Figure 8.6 and 8.7].

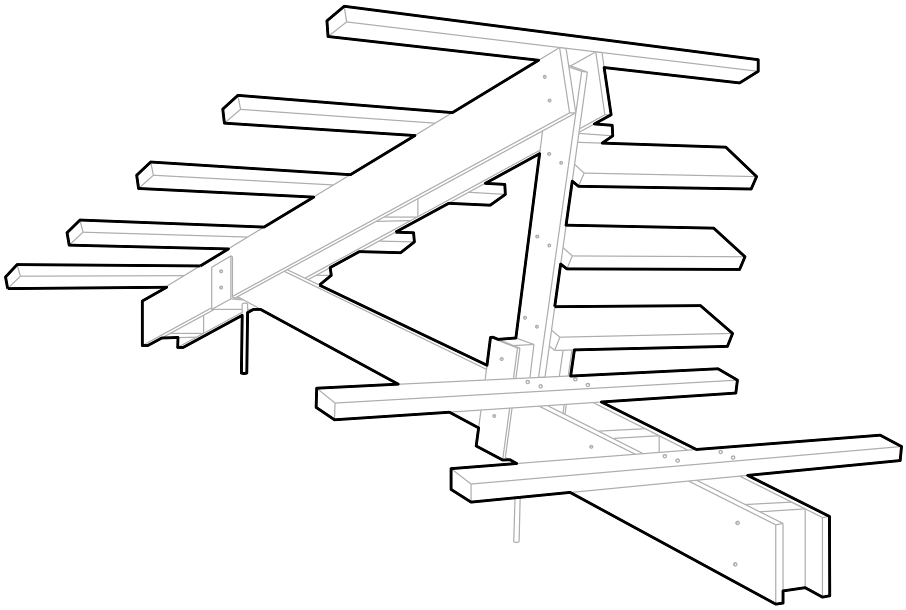


8.10 Main section of the designed bike shop. Source: Own illustration adapted from C-re-aid team

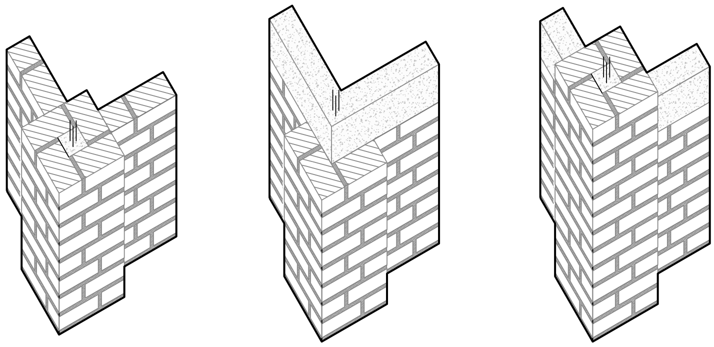


8.11 Constructive detail of the clerestory roof that gives ventilation and light to the courtyard. Source: Own illustration adapted from C-re-aid team

As it has been mentioned earlier, the veranda space is central to the design of the building. With an area of 36 m2, the open and multi-purpose space allows training to women around bikes, and community workshops on biking while providing a clear space where to fix 30 bikes at a time [Figure 8.8]. Contemporaneously, the low wall that delimits the veranda acts as an expanded bench that invites visitors and neighbours to sit down and learn about the importance of bikes in isolated communities like Mikocheni [Figure 8.9]. As such, the open space becomes a sort of scenery where the different activities carried out can be observed. See



8.12 Axonometric view of the structural beam made with timber, highlighting the window. Source: own illustration adapted from C-re-aid team



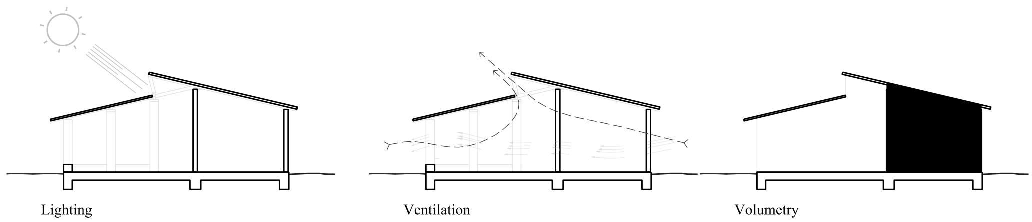
8.13 Constructive detail of the CSEB columns and the concrete ring beam. Source: Own illustration adapted from C-re-aid team

the main section in Figure 8.10 and detail in Figure 8.11, where the clerestory roof form enables the entrance of light and flow of ventilation while being protected from the rain. The vertical space existing between the two sloping sides of the roof has been intentionally left open to increase cross-ventilation and reduce inner temperatures. This is of paramount importance considering the radiation absorption of the corrugated roof sheets. A wooden structure of beams gives shape to the roof. In the technological detail of Figure 8.12 you can observe how the beam is made of two timber trusses joined together with a separation of 15 cm in between. These beams are anchored to the CSEB structural columns with steel profiles, to which the beams are joined with bolts.

These structural CSEB columns where the beams' anchors are laying are reinforced with 12mm steel bars [Figure 8.13]. The columns populate the

8.14 The shop under construction that highlights the CSEB lattice work.
Source: C-re-aid website

8.15 The shop after official opening, run by local women.
Source: C-re-aid facebook



8.16 Sketches showing the design strategy of the project. Source: Own illustration

perimeter of the building, being enclosed by a CSEB wall that creates the inner space of the shop and storage. The upper part of the wall includes a dynamic latticework of thinner compressed bricks that allows continuous ventilation while giving a playful touch to the building's design [Figure 8.14]. The walls and columns are held by a concrete ring beam that unifies the whole structure of the building. Inside the closed space, the shop area displays the different bikes that can be rented/sold, with a counter facing the entrance door where the woman in charge will be managing the building [Figure 8.15]. With a total area of 24 m2, the shop and warehouse area should allow for storage of materials, bikes and tools. In total, around 25 bikes can be stored, but using specific hooks that were produced specifically for the bike shop. The project was developed around several key points that are essential to allow a flexible and uncomplicated design. As shown in the table 8.16, the main points of the conceptual design have been:

Orientation

The building was designed to be strategically located on the side of the main road where pedestrians walk along. The building is positioned with a massive presence from the behind wall, becoming visible to the community. The main entrance was turned on the opposite side of the path, to give a higher degree of privacy to the open veranda. In this way, the building remains visible to the neighbours while ensuring quietness. Activities can be carried out more privately, avoiding distractions and unwanted interactions. As well, the orientation has been thought to face the Kilimanjaro views and has been decided after a careful analysis of the prevailing winds, that come from east to west. This ensures the building's protection against rain and strong winds, which is further protected by the shape of the roof to evacuate rainwater.

Ventilation

A constant flow of air has been paramount to the design's features. One example is the clerestory roof shape that leaves a vertical space where the air can enter to lower the inner temperatures of the shop/store and the veranda space. This is extremely important due to the high temperatures that the corrugated roof sheets can reach. The other example is the latticework made with thinner CSEB bricks around the building walls to improve cross-ventilation.

Lighting

Due to activities such as fixing bikes and selling tools and spare pieces, it is important for the building to be properly illuminated. The lack of electricity in the villages makes it essential to rely on daylight as much as possible. As such, the opening in the garbled roof enables enough light to illuminate the veranda space, which due to its dimensions requires extra lighting. As well, the latticework inside the shop and store enables its lighting while avoiding having big windows that would reduce the level of security of the building.

Volumetry

Volumetrically, the building can be understood as having two main volumes: the empty one or veranda, and the closed one where the shop and store are allocated. These two volumes play with each other and give support to the activities that happen in both. During the day, tools and materials are taken to the veranda space where fixing and renting bikes can happen, while inviting clients to enter the space. Contrary, at night, the enclosed space stores the materials and bikes that need to be locked in for security reasons. The veranda space with its openness, enhances the public activities of the building and provides shadow and protection from the heat to neighbours. Its solid and rhythmic columns create a sense of a comfortable space of quietness while the shop and store are supportive to keep materials in a safe space. In terms of circulation, the only door placed in the wall between the veranda and the shop further protects the building and allows continuous surveillance from the women who work in the bike shop.

9 — Conclusions on Prototype Design

This chapter discusses the impact of the two built prototypes after the official opening of the public buildings. As this book, Engagement, has focused on the development of the two prototypes, the aim is to provide a final reflection that considers the challenges and further steps that follow the completion of the Maji Moto Dispensary and the Mikocheni Bike Shop.

The first part of Chapter (9.1) gives an account of the current state of both projects, after a visit carried out in March-April 2021. The achievements, changes and challenges faced by the community to run the public facilities are described within the chapter. After that, Chapter 9.2 offers a review of the project's impact at the local level, putting into perspective the transfer of knowledge on building technologies and the implementation of the building innovations.

Finally, the Chapter concludes with the limitations encountered and the areas of improvement for future interventions where prototype buildings can trigger a positive impact.

9.1 OPERATING PROTOTYPES - THREE YEARS AFTER

Maji Moto Dispensary

After its completion in September 2019, the community of Maji Moto had to wait for more than a year until the dispensary opened to the public in December 2020. The main challenge for activating this project was that while the design and construction were carried out by an independent NGO and funded through fundraising, the responsibility to make it run was that of the Arusha Regional Government. As such, its activation was left beyond reach, depending on public funding to be officially opened. In this way, several issues difficulted the preparations to start running the health centre, a very much needed facility by inhabitants and other neighbour villages. First of all, a lack of financial resources from the regional government diverted the responsibilities of the future dispensary to the central government, prolonging the bureaucratic process for receiving the required approval. As part of a vaccination campaign for children, the centre opened during spare days at the beginning of 2020, where several doctors participated while assessing the needed medicines and equipment. After this symbolic activation, local authorities began a periodic follow-up of the situation, until the Health Ministry from the central government finally committed to give the required approval that would activate the search for doctors and medicines. After a while, one doctor, two nurses and an auxiliary doctor settled in the doctor's houses that had been built in the same compound. Also, due to the lack of financial resources aimed at providing the required furniture, sanitary equipment and medicines, the local government initiated a campaign to which every family had to economically contribute a small donation. Eventually, the local government finally managed to provide the required elements to start running the dispensary. The Health Ministry provided the medical staff and sanitary equipment, while the local government managed to fund the rest.

Currently, the health centre has been open for around two years, and despite several financial difficulties, this new public facility is highly contributing to monitoring mostly children and pregnant women, one of the biggest health deficiencies that the locality was struggling to overcome. Unfortunately, the delivery room and day-care space are not active yet due to a lack of resources, so once pregnant women are close to their birth date, they are sent to a regional hospital in Arusha where they will be looked after.

The state of the building, which was visited in March 2021, was surprisingly good despite having been closed for more than a year after construction. The left-side wing is mostly in use, including the reception, doctor's room, observation room and vaccination room, while in the right-side wing, only the medicine dispensary is open. In the waiting area, both the tiled benches and the bamboo lattice works are in exceptional conditions [Figures 9.2 and 9.2], and in the courtyard, the trees that were planted have grown, providing shade and fresh air to the building [Figure 9.3]. Also, the toilet block that was opened sometime later than the

9.1 View of the health centre's waiting area, with tiled bench and its characteristic closing filter made with local bamboo. Source: Own picture

9.2 Steel structure for joining the bamboo lattice work on the back door. Source: Own picture

9.3 Central view of the courtyard and waiting area, where grown trees can be observed. Source: Own picture

dispensary is properly working, and the water tank that was made to provide running water to the toilet users' has successfully stored water during the rainy season that now can be used by patients and visitors [Figure 9.4].

Some little changes have been carried out since the dispensary was open to the public, such as two of new windows in some rooms. Due to changes in the building regulations of health centres, the delivery room and post-delivery recovery room needed one more opening each [Figure 9.5]. This suggests that the project was properly handed to the community and through a growing sense of belonging, they are adapting the spaces as it better suits the needs of the health centre [Figure 9.6].

Overall, the project seems to have been successfully implemented in Maji Moto, providing an essential facility for the community and neighbouring villages. The simple fact of being active in the area and providing visits for neighbours, helps in the prevention of serious illness, as in case of critical cases, doctors direct the patients to the hospital in Arusha. However, the work is not finished yet, as the local government is still pushing to activate the day-care area for mothers and children, especially the delivery room. Also, a space that was set to be a laboratory has not been opened due to a lack of equipment. While this project is still a work in progress, is a success seeing the space being used by community members, especially those who need it more, children, mums and the elderly.

Mikocheni Bike shop

The opening and activation of the bike shop happened smoothly right after the completion of the construction. Due to the direct involvement of Rotary, bicycles, equipment and tools were provided to the group of women in charge of the shop space. In this way, after receiving the required training on fixing and maintenance of bikes, the group of local managers opened the bike shop.

9.4 View of the current state of the toilet block and its water tank. Source: Own picture

9.5 Back view of the health centre with the new additional window on the left-wing. Source: Own picture

9.6 Women attending a vaccination day in the Maji Moto health centre. Source: Own picture

Since then, the space has been a focal point in the community, where Maasai neighbours have progressively felt confident in renting a bike, being able to reduce the distances they go through daily to run their errands. From youngsters to elders, many of Mikocheni's neighbours periodically visit the bike shop to rent or fix a bike. In addition, the bike shop has become a frequent gathering space for women's groups, prompted by the many women who already work there. Weekly meetings of different women's saving groups are carried out in the shop's open area, but also community meetings are held in this space [Figure 9.7]. The activation of the bike shop has provided permanent part-time jobs to six women from the community, contributing also to the financial well-being of many families in Mikocheni.

Upon a visit organised in April 2021, I had the opportunity to talk with the group of women who manage the bike shop. The idea was to understand how the building was supporting their activities while serving its purpose at different levels, from functional to thermal comfort. In general, the building is fulfilling the needed requirements, and the inner space of the shop has been populated with repairing tools and bikes, which are stored mostly at night when the shop is closed [Figure 9.8]. Temperatures within the inner space were comfortable, moving from 19 to 23 C degrees, and cross-ventilation created from the CSEB's latticework further provides fresh air inside the shop. The beautiful latticework illuminates the shop, contributing to filtering sunlight comfortably and pleasantly. The purpose of keeping the closed space as small as possible to reduce building costs has not affected the working dynamics in the shop, as during the day, most of the work is done in the covered courtyard. As such, the internal desk is open at times but generally, the shop works in the external space. One issue that was mentioned by the shop managers was the

9.7 Women's saving group on a meeting in the covered courtyard of the bike shop. Source: Own picture

9.8 Bike tires hanging on a timber beam in the bike shop.
Source: Own picture

9.9 Detail of the open space created by the clerestory roof.
Source: Own picture

open space left between the two sides of the clerestory roof [Figure 9.9]. Built initially to enable ventilation and sunlight to the external courtyard, it has been reported to be an issue during the rainy season, as rain enters through the space preventing the staff from working or meeting in this space. During events of strong wind, the rain is pushed crosswise in a way that penetrates this space. Local managers propose to cover the roof space with timber or polycarbonate sheets, as the latter prevent the rain from entering while enabling the entrance of light. Apart from this, which they expect to fix with the support of Rotary, there have been some modifications in the building during these years. The most striking change is observed in the façade. The CSEB columns and lattice work where the bricks were left uncovered on purpose have been filled with cement plaster on all its surfaces [Figure 9.10]. This solution was doable as the columns were standing on top of a raised foundation, avoiding thus the direct contact of the earthen bricks with the ground to avoid moisture. Likewise, the upper latticework made with the same earthen bricks was covered by an overhanging roof, that protects the surface of the walls [Figure 9.11]. However, locals have claimed that the compressed bricks have been progressively deteriorating for several reasons. On the one side, the windy rains have damaged the surface of the bricks, while also the alkaline condition of the local soil has contributed to damaging the blocks. As such, the dynamic and beautiful façade made on purpose to show the innovative building technique has been completely covered by cement plaster, unlike the original wall's plaster that was made with lime and red sand.

The new look of the building has lessened the natural touch of the material colour, while cement plaster has hindered the transpiration capacity of the walls, avoiding humidity regulation; however, community members are now more confident regarding the preservation of the building, which is at the foremost. Overall, the managing local groups have shown a strong sense of ownership of the place, taking care of the building and making the needed repairs to maintain it in good condition, which denotes the success of the project and the impact on the community of Mikocheni.

9.10 New look of the bike shop walls after the application of the cement plaster. Source: Own picture

9.11 Front view of the bike shop where the newly plastered columns can be observed. Source: Own picture

9.2 ASSESSING THE PROTOTYPES' IMPACT

The main objective of the built pilot projects was that of transferring the knowledge of climate-adapted building techniques, besides providing access to public facilities, such as healthcare in Maji Moto and access to bicycles in Mikocheni. As an essential step of this research, it is necessary to evaluate the impact of both completed projects after a few years. Only by analysing the processes and dynamics that have been triggered through the construction of the prototypes, it is possible to assess the success or failure of the development of such projects. Important to note is that one of the reasons that drove me to include the Bike Shop project in this research was to be able to comparatively look at the different steps and the final impact in both communities, unfolding more accurate conclusions. As such, a series of conversations with community members and users were conducted to elucidate the ways in which the project has impacted the habits and the local building culture of dwellers.

In the case of Maji Moto, the project was conceived since the beginning as an opportunity to prototype the use of CSEB providing an alternative to fired bricks, that were contributing to the degradation of the local environment since its widespread some decades ago. Since the beginning, I have been determined to use the prototype as a catalyst to implement the CSEB technique. But not only; the continuous presence of more than 40 volunteers coming from all around the world throughout several months contributed to standing out and spreading the voice of the construction process. Additionally, the ongoing collaboration between C-re-aid NGO and the local government helped to pursue a much-needed community project. Not surprisingly, during the visit in 2021, every neighbour of the village knew the project and could properly describe the building materials used in its construction. This denotes at least, that the construction development raised interest amongst neighbours.

Instead, in the case of Mikocheni Bike Shop, the team of architects from C-re-aid developed the project for an external client and executed the construction independently, without specifically wanting to measure the impact of the project. As shown in the previous chapter, the recipient women groups were involved in the decision-making process of the design and construction, but the rest of the community members were unaware of the project development. Upon the visit to Mikocheni some years after, around half of the interviewed neighbours did not know much about the project, despite an awareness of the existence of the bike shop. This could also be because the use of the bike shop is more specifically addressed to a specific group while the health centre targets the community as a whole, becoming an integral part of the public facilities available for the community. In conclusion, both the mechanisms employed during the design phase and the construction process as well as the level of use by communities after its opening are relevant in measuring the impact and shift in perception of the community. The following section will carefully present this research's findings regarding the elements that are crucial to creating a positive impact within the local built and social fabric.

9.2.1 CONSTRUCTION PHASE: IMPACT

The following assessed elements are believed to set the basis for promoting the successful implementation of prototype projects throughout the construction phase:

Support from local authorities

Compressed Stabilised Earth Bricks are not legally included in the building regulations of Tanzania. As such, specific approval from the regional engineering board needs to be requested. In our case, as the dispensary project was a public building, such approval had to go through previous agreements with the local authorities. Due to a long-term collaboration with C-re-aid NGO, the local government agreed on the use of CSEB after several meetings in which the reasons and outcomes of the material choice were discussed. Having the support of local authorities facilitated the different phases of the project, as they organised several initiatives to inform the community and raise awareness about environmental issues.

Instead, in the case of the Mikocheni bike shop, decision-making regarding the materiality of the building did not have to be discussed with the local authorities as it was a private initiative promoted by an external organisation, impacting a specific group of people. In any case, the proactive involvement of local authorities has shown to be core if a real impact wants to be triggered, as it promotes further opportunities to build locally using innovative building techniques.

Community involvement

The active involvement of the community is essential to enable the transfer of building technologies. Through participation in the construction site, neighbours learn new ways of using locally available materials while creating a sense of belonging with the building, promoting also the further keep up of the facilities. In this sense, the development of the dispensary project was carried out with the presence of community groups, both at the design stage and the construction stage. Especially during construction, skilled workers were hired to work on the different phases of the project, while non-skilled youngsters and women groups were periodically hired to help with some specific actions. This also contributed to the economic well-being of the village, increasing the financial capacity of workers and owners of construction shops. Plumbers, electricians, bricklayers, blacksmiths, carpenters and helpers in general, were part of the construction process, witnessing the qualities of the building technique and progressively shifting their perception regarding a building material that has been neglected during the last decades.

In the case of Mikocheni, a group of skilled workers that usually collaborated with C-re-aid in different localities led the construction of the bike shop. While some local youngsters were hired as workforces to help in the construction, most of the bricklayers were not from the village. But also, local women were hired as helpers to support in specific moments of the construction.

Training of workforces

In the case of the Maji Moto dispensary, the group of workers devoted to the production of the CSEB's were neighbours of the village. This increased the trust in the newly introduced technology as they were known by the community. Also, construction students from a nearby training school were introduced to the technique during the first weeks of bricks' production, giving them the appropriate foundations to continue working with this building technology in the future. Being qualified to produce CSEB further allows them to create independent businesses where this specific knowledge can be an asset. After the completion of the dispensary, other public and private projects were carried out, where these newly trained workers were hired to produce the bricks, which confirmed the successful assimilation of the technique by local workforces.

Knowledge dissemination

Considering the local perception of earthen building techniques and the massive widespread of environmentally damaging materials such as hand-made fired bricks, knowledge dissemination is essential to enable an impactful transformation of the built environment. Also, in the case of a prototype building aiming to create a positive impact, it is essential to inform the communities involved about the decisions taken and the reasoning behind these, so that neighbours are aware that material choices are not arbitrary. With this in mind, a series of meetings were organised in Maji Moto with the community and councillors to discuss the opportunities offered by sustainable building techniques such as de CSEB. These meetings involved critical discussions with members who were sceptical of the technique's potential. After several demonstrations and long conversations, every member of the meeting committee agreed to test the innovative technique for the construction of the health centre. However, beyond the meetings with local leaders, the implementation of the project lacked a more engaged action with the rest of the Maji Moto neighbours. At some point, we tried to arrange a conference where to invite climate activists and regional authorities that were specifically working on the environment sector, but the initiative never raised too much interest and was in the end, cancelled. As such, it is acknowledged that the project fell short in terms of creating awareness about the choice of the technological solution and tackling the environmental issue faced at the local level. A similar case was experienced in Mikocheni, though a series of meetings with the women's group involved was useful in transmitting the reasons behind the choice of CSEB as a technological solution.

9.2.2 POST-CONSTRUCTION

The construction phase is not the only opportunity to promote the integration of building technologies into the local building culture. After the construction, other factors can contribute to the assimilation of technologies such as the CSEB:

Facilitate access to building technologies

This is a determinant aspect in terms of ensuring the smooth transfer of the building technique. Upon previous assessment, a specific building technique can be considered appropriate to contribute to the sustainable transition of the built environment. Such assessment has to ensure that potential issues preventing its proper use are identified, by verifying access to the required equipment, skilled workers and building materials. In the case of Maji Moto, the introduction of the CSEB laid on a solid foundation: local skilled workers and access to the required materials: soil, sand, cement or lime and water. The only missing element was the compressing machine, essential in the production of the CSEB. Given this, part of the project budget was devoted to acquiring a machine that would be left in the community centre, enabling its use by potential villagers. Unfortunately, during the construction of the health centre, the machine, that was manufactured in Arusha, got broken several times. After several trials, the machine was brought back to the factory where it was produced, and the team rented another machine to a local company. Despite the intention of buying another machine to be kept in the village, the lack of funding to finish the project prevented us from acquiring it. At the same time, the cost of the machine complicates the chances of local neighbours to acquire a new one. Of course, in the case of a potential business for producing the CSEB, someone could buy it individually, but it would not benefit the entire community. In the case of Mikocheni, the interviewed dwellers were not very convinced of hypothetically using these building techniques for their own houses. Also, in the case of Mikocheni, the machine was rented and given back to its owner after the construction, leaving no option for local communities to keep implementing the technique. This can be considered a deficiency hindering the opportunity to transfer the building technique. Several dwellers in Maji Moto mentioned that they would build their houses with CSEB in case they had access to the machine or if someone would set up a local business and sell these. It has been demonstrated therefore, that prototype buildings need to be planned to have these constraints in account, as not considering the required equipment may defeat the purpose of the prototypes themselves in isolated and vulnerable contexts. Due to this, the team has lately been working to secure funding to buy a machine and promote the set-up of a local building cooperative in Maji Moto that would enable homeowners to produce and/or by CSEBs for their own constructions.

Users’ bodily experience

The experience of users within the building environment is by no means, a determining aspect that contributes to changing the perception of some building materials. In both villages, buildings that have been constructed with earthen materials are considered dirty, dark, uncomfortable and hot. Instead, the experience of being in a building such as the Maji Moto health centre suddenly feels opposite to the vernacular memories of the mud house, as the amount of light, cleanness and fresh air can be felt upon arrival at the building. Besides that, finishing details such as the internal plaster, the tiled benches and the roof’s ceiling, contribute to demystifying the poorly achieved details of earthen buildings. Of course, the cost and labour involved in the construction of these prototype buildings are way more intensive than for the typical earthen constructions. But considering the efforts made by local communities to build following the modern trend, the finishing details of building with CSEB are not much different.

Another key aspect that many neighbours in Maji Moto have pointed out, is their surprise to see the strength and resistance of the building three years after its construction. The community has shown an unexpected enthusiasm for the final look of the building. At the beginning of construction, comments revolved around issues of durability, and community members did not trust the use of the compressed bricks. After the involvement of many neighbours and the widespread voice of the strength of bricks, many are surprised to see the building standing in such good condition. As such, this research demonstrates how the execution of well-built prototypes overturns false beliefs, demystifying the aura of poverty that surrounds earthen building materials.

The crucial aspect here remains the capacity of the prototype buildings to shift the perception that homeowners have about earthen materials. Thus, listening community’s concerns and highlighting the areas where the material perception is at its lowest, increases the possibility of a prototype building to catch communities’ attention and promote its integration in the local built environment.

Affordable alternative

Last but not least, this research has observed how the implementation of a building technology will be effectively transferred if the alternative proposed is an affordable option. If the innovative technique proposed is in comparison more cost-effective than other building solutions, local artisans and self-builders might quickly adopt a new strategy. It has been observed how fired bricks have been quickly adopted in Maji Moto, as once the producer knows how to bake them, there is almost no cost. Contrary, in the case of Mikocheni, due to the impossibility of using the local soil because of its alkaline properties, dwellers cannot afford to buy the bricks and transport them from other areas. Specifically, the shift would be more welcomed if there is a further reduction in labour costs, in case of a production process that can be done by oneself. In this case, specific training needs to be given to the CSEB producer, as the building technique requires a closed check of the material's quality control. Therefore, its adoption becomes more challenging as extra costs for hiring skilled workers raise the total price of the material. In this case, the challenge lies in reducing the cost of the CSEB production, considering the amount of expenses implied, such as the rent or purchase of the machine and the additional acquisition of cement or lime. Therefore, reducing the cost of the CSEB to match the production of fired bricks would be complicated, but if compared to the concrete block, the CSEB equates its quality but reduces its cost.

9.3 CONCLUSIONS: AREAS OF IMPROVEMENT

The conclusive chapter of this book, Engagement, has aimed to provide a detailed account of the strategies that have contributed to increasing or reducing the positive impact of the prototype projects developed in Maji Moto and Mikocheni. At a glance, it can be concluded that both pilot projects have provided a doable and alternative building solution that tackles the environmental challenge posed by the use of damaging building materials such as fired bricks. Besides the benefits provided by the provision of public building facilities in both cases, the material choice was also directed at shifting communities' perceptions regarding earthen building technologies. In this way, the projects have presented an opportunity to demystify the use of a locally sourced and ecological building material, which reconnects Maasai communities with their environment and traditions. But in doing so, the technological solutions have taken special care of construction details to create buildings that were aesthetically pleasant for community members. This has been possible by listening to the suggestion of neighbours, as in the case of Maji Moto, where many have explicitly requested the walls to be plastered, while others repeatedly asked for coloured roof sheets. In this case, meeting the community's expectations was key, which increased the level of acceptance of a technique that was badly perceived in the beginning. It also fostered the community's sense of belonging, reducing thus the possibilities of negative perceptions around the building technique. By contrast, parts of the walls of the bike shop in Mikocheni were not plastered following the aesthetical sense of the architects, which in turn created a negative opinion regarding the building technique. Sometime after the opening, the group of women managing the shop decided to plaster the parts where the brick was visible, arguing that the material was getting eroded. Whether this was true or not, it contributed to setting a precedence for doubting the material qualities, which was eventually widespread across the community. Not surprisingly, when asking about the built prototype to local dwellers, many claimed that the material was not trustable as it had to be plastered as a consequence of its low durability. This example puts into perspective the need to advance technological innovations by using traditional and locally available building materials. A strategy that has always been at the core of this research, has been that of pursuing vernacular knowledge and local materials alongside technological innovation in the context of rural indigenous communities. In the case of the prototypes presented, it has been demonstrated how the combination of locally sourced building materials and technological advances improves the chances for real implementation. Both for availability purposes and to achieve socio-cultural acceptance, these two strategies need to come hand-by-hand. Communities' will of development and new building trends need to be listened to and included in the building strategy if a pilot project is to create an impact in a specific context.

These pilot projects were born out of a necessity to tackle the excessive reliance on the local woodlands as biomass to burn fired bricks. As such, providing evidence to local communities about the existence of suitable alternatives should be a first step to tackling the local vulnerability to climate change collaboratively. In this sense, I believe that a pilot project within a local community sets the first milestone to introduce sustainable technologies such as the CSEB. Though, the implementation of a pilot project cannot happen for its own sake, it is just the starting point of a longer process of adaptation. The introduction of innovative building techniques such as the CSEB still needs years of research and implementation, and it would become a doable solution only after having been approved as a regulated building technique by governments. Only after that, technical schools could equip future construction workers with the necessary tools to propose and develop sustainable building technologies such as the CSEB.

There is indeed a potential for similar low-carbon building techniques to contribute to the adaptation and risk reduction of climate change hazards, promoting environmental protection and awareness for local communities. Furthermore, the introduction of such building techniques can be an opportunity to boost local economies while promoting circularity and sustainability. For example, the CSEB technique has been proven in other countries to be a fruitful chance for creating cooperatives that are managed at the local level by small entrepreneurs or even by women's groups, as in the case of Community Impact Nepal. This cooperative trains women from rural communities to build resilient income by equipping them with construction training specifically on CSEB production, which further contributes to the creation of safe housing strategies.

Lastly, a pilot project cannot be successful in the absence of a strong commitment between local governments, civil society and community-driven groups. It is acknowledged that building techniques such as the CSEB, are low-carbon-footprint technologies with the potential of providing a sustainable response to the rapid urbanisation happening in Tanzania. However, its implementation will not be accomplished unless it happens alongside an adapted programme that points to the responsibility of the building industry and its commitment to local communities. Therefore, beyond the activation of effective prototype buildings, further actions should be directed at tackling the contextualisation, research, monitoring and promotion of specific policies to create ecologically driven building solutions and decent housing for all.

Assessment

Book — 3

Book 3 presents the last part of this PhD thesis, the Assessment Stage. The book is divided into five chapters that explore communities' perceptions of their built environment and its materiality. To elucidate decision-making dynamics behind material choice, the book begins by introducing the methodological approach that has been developed throughout this phase. This is followed by a comparative case analysis driven by the premises of grounded theory. After the analytical exploration, the first chapter of findings is presented, building upon the ethnographic, qualitative research conducted. The chapter explores the processes that have given meaning to the contemporary Maasai dwelling. After that, one of the most relevant chapters of this research unfolds, elucidating the driving forces behind communities' choices of building materials. Lastly, Chapter 14 presents the final conclusions of the book and a final reflection on this research project.

BOOK 3.
ASSESSMENT

Content

10 — Methodology: Assessment Stage

The previous methodological chapter (4) presented in Book 2, Engagement, gave an account of the methods that have been key to understanding the scope of the participator-led built prototypes. This chapter introduces the second integral part of the research fieldwork: the research findings that provide an overview of the prototype buildings's impact. This stage brings about a shift in the role of the researcher. While during the engagement stage, I was leading the development of the co-designed dispensary project in Maji Moto, this second phase focused on the subsequent ethnographic analysis and impact assessment. This stage presents the second part of the research methodology that was carried out two years after the end of the Engagement Stage. In 2019 the dispensary building was completed, taking another year to open to the public. The phase described here started in February 2021 and spanned across an entire year: three months were devoted to data collection fieldwork (sections 10.2, 10.2 and 10.3), while another nine months were required to work on the interview's transcripts and analysis of the data compiled in the NVivo software platform (this part will be looked at in section 10.4). As such, the following chapter will expand on the chosen methodologies [Fig. 10.1], constraints and other practicalities of this stage. While it might seem that too much relevance has been given to the methodological assessment of this research, I believe that examining my experience as an architect delving into the space of social science might be useful for other practitioners engaging in the manifold complexities of assessing the impact of participatory-led design projects.

10.1 COMPARATIVE CASE STUDY

The assessment stage of this research has involved the inclusion of another case study project, which enriched the overall analysis of the built prototype in Maji Moto. Due to my continuous involvement with C-re-aid NGO, I had the opportunity to approach the designers of a bike shop that had been built in Mikocheni in 2018, a little Maasai village in Kilimanjaro Region. I was also introduced to community leaders there and was able to receive official approval for conducting research fieldwork in the area (for more details, see the following section 10.3). Analysing the bike shop project was invaluable to my research for several reasons. Firstly, the bike shop was a public building serving the needs of a Maasai community that was there for several centuries. Secondly, through an approach to sustainable construction, the project used the same building technique as the Maji Moto case study and lastly, because the design and construction were developed with a certain degree of community participation. All the previous conditions prompted me to analyse the two cases comparatively. When this became a viable opportunity, I was initially reluctant to include it as it would have involved a much longer period of fieldwork and further analysis. Also, I was not familiar with qualitative data analysis and even less with comparative research. However, despite the challenge posed by the use of comparative research, it offered a greater opportunity to measure the local impact of the participatory building project that I had co-led.

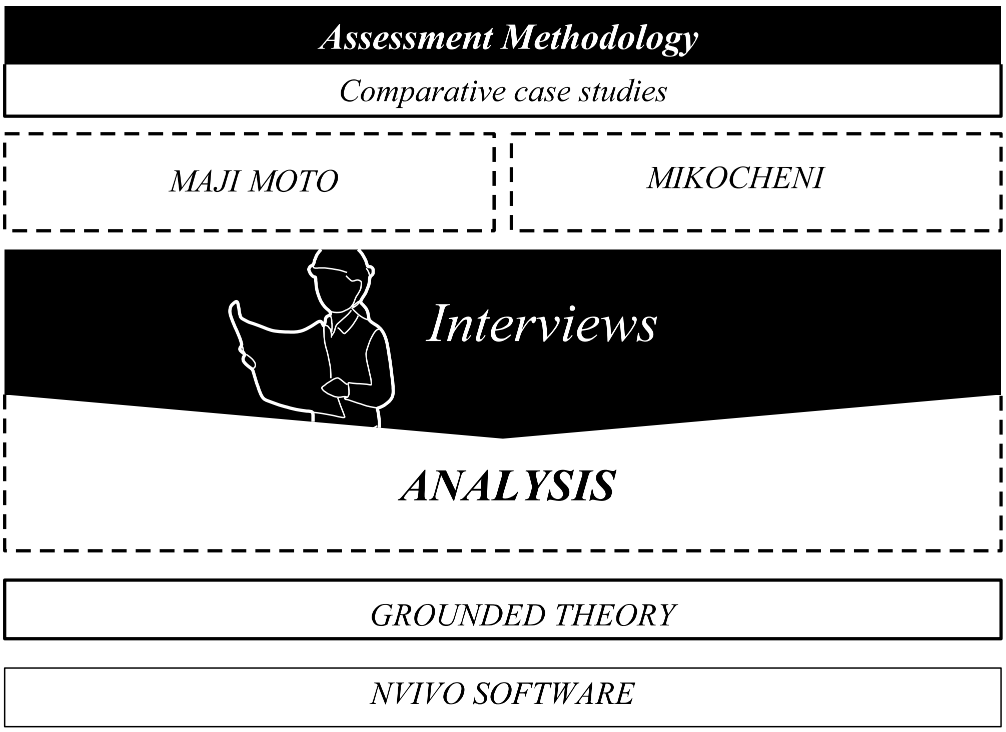


Figure 10.1 Framework of the methodology employed for the assessment stage. Own illustration

Building from Comparative Urbanism (Robinson, 2022), this methodology looks at co-designed projects by working comparatively across different contexts. With the use of comparative design as an epistemological instance, the aim is to highlight the processes involved in the development of architectural projects rather than the specificities of built forms, opening up other imaginaries and questioning mainstream architectural practices. This methodology advocates for a radical and experimental approach in which diverse cases can be compared. To do so helps prompt newer theoretical framings (Schmid et al, 2018) to enable the recalibration of equally valuable factors such as everyday life, the symbolic and the knowledge embedded in indigenous building practices.

The objective of using a comparative strategy was twofold. On the one hand, comparative analysis was an opportunity for assessing more critically the prototyping process of the dispensary, through looking beyond the project itself and finding commonalities and differences across the two cases. This opened up new possibilities for developing methodologies of engagement that are both meaningful and effective. On the other hand, due to the project's aim of promoting the inclusion of novel building techniques into the local built culture, the use of such methodological analysis enabled me to assess the viability of the proposed building technique and the level of impact amongst community members. However, comparative analysis demands researchers "to adopt a shared methodological and theoretical perspective, to probe and test new concepts, and grasp the contours of a collaboratively defined problematic" (Schmid et al, 2018:28). As such, due to the similarities between the developed prototypes, both cases were analysed building upon Ingold's ecological approach and based on a process-oriented epistemology. The use of comparative analysis has been an asset in critically analysing the two prototype projects throughout their design, construction and activation, positively contributing to the richness and depth of the research's findings. Eventually, the inclusion of comparative research in the realm of architecture should prompt meaningful debates and exchanges on the role of the buildings we design, and the impact it has on the ecological systems of our built environment.

10.2 NEGOTIATING ACCESS AND CONSENT

Doing ethnographic research with rural communities in Tanzania required a series of negotiations at different levels. I was required to officially request research approval as part of a bureaucratic process with the District Councils of both regions. Due to the comparative component of the research, which was conducted in two different areas, I had to go through the approval process twice. I also needed to receive individual consent from all interviewed actors.

As part of the data collection fieldwork carried out in 2021, I had to provide a series of introductory letters to be submitted to the Arusha District Council (for Maji Moto) and Kilimanjaro District Council (for Mikocheni).

Due to my previous involvement in C-re-aid and relying on a locally registered institution to carry out my research, I worked with the director of the organisation to prepare the required material. The official letter included information regarding the case study location, the aims of my research, the main issue under investigation and the scope for doing ethnographic fieldwork in both villages. I also had to give specific details of the methodology that I was going to employ for data collection, as well as the required length of my stay for conducting such activities. In total, this process took around 4 weeks before I got the final approval for conducting research with local communities. Once approval was gained, I had to plan a date on which local authorities of both villages would receive me, where I delivered the signed letters to the local mayor, Mwenyekiti, and the regional government's councillor or Mtendaji[1]. After that, I would be introduced to the rest of the local government, including councillors and local groups.

1 - In Tanzania, each municipality conforms a local government which is represented by both the *Mwenyekiti*, that is chosen by the local community, and the Mtendaji, a figure that is appointed by the regional government and that has parallel responsibilities with the *Mwenyekiti*.

Besides the legal approval for doing research in both localities, I had to undergo a process of negotiation with local authorities in both villages. These were tackled differently due to my long-term involvement in Maji Moto. Despite both prototype projects being promoted by C-re-aid, I was specifically involved in Maji Moto, and therefore, local authorities in Mikocheni were less confident in my abilities. As a result, I had to devote a great amount of time introducing myself, discussing the objective of conducting fieldwork in the area and the terms of the data collection. First I had a meeting with Mikocheni's Mtendaji, who was reticent and asked for many more details than the approved letter had included. After his approval, I attended another meeting with the Mwenyekiti of the Maasai subdivision, who already knew about C-re-aid and the projects that the organisation had built in the area. As such, agreeing on the terms of data collection with the Mwenyekiti was quite straightforward. They showed interest in the research outcomes and supported the fieldwork activities. As I had been working with local authorities and community groups in Maji Moto since 2016, this eased the formal approval process at the local level. The Mwenyekiti, who already knew about my research, introduced me to the regional Mtendayi, to whom I presented the research proposals. Due to the active involvement of the local authority and our long-term cooperation, they proposed to organise some focus groups regarding the impact of the prototype building with the government's councillors and two community women's groups, which was very insightful as an early exploration of the fieldwork I had to carry out.

Once local authorities were fully aware of my research plan, I needed to introduce myself and the assisting team to those community members I would interview throughout the data collection process. In Mikocheni, the community leader of the Maasai area where I was conducting the research approached local groups to inform them about my upcoming data collection process. In Maji Moto, I had the chance to get to know many of the community members across my years of involvement, but some of them just knew me as the 'mzungu who built the health centre'. In any case, I had to prepare a consent form that all interviewees had to read before starting any conversation. The document contained details regarding the safety of their personal data and the main objectives of the research, both in English and in Swahili. It was very important to communicate to participants that their involvement was upon continuous agreement and that they were free to end the conversation at any point.

Throughout the ethnographic data collection, I always tried to be open and self-aware of my privileged position as a researcher and its implications when working with vulnerable communities. Patai (1991) claims that the race, nationality and educational background of the researcher may expose participants to exploitation. With this in mind, the research team always clearly stated the reasons for conducting research to all participants, alongside honest conversations about the aims of the ethnographic data collection. Also, respect for participant's privacy was always at the core of any action undertaken, valuing their time and commitment during the data collection and meeting them at moments that were convenient for them. However, Murphy & Dingwall (2001) also noted that in some cases, participants might try to get a personal benefit out of the research. For example, several community members who took part in the ethnographic account suggested that their willingness to be interviewed revolved around their chance to ask for support from the organisation to build a new house. These common responses made more evident the need to be especially clear when introducing the objective and outcomes of the research's data collection, reminding participants that the research's aim would not be to benefit individual members of the community.

10.3 INTERVIEWS

In the context of research that has been developed across a long time span, some researchers have claimed that interviews cannot easily be differentiated from other forms of conversation (Atkinson, 2001). This thesis has undoubtedly been influenced by the direct involvement of community members throughout the development of the case study projects, as well as by conversations with key actors. However, while there is much truth in Atkinson's claim, this methodological stage has specifically required the execution of a series of semi-structured interviews, addressing the research key questions and assessing the impact of the prototype buildings.

Interviews arranged with homeowners were conducted in their own houses, ensuring a private and comfortable space where they could feel at their ease. Initially, we would propose to sit down in an open space within the family's compound, usually under a tree or close to the house's roof [Fig. 10.2],] avoiding invading their private spaces inside the house. However, many of them invited us into their living rooms, showing trust and confidence. Before starting, we asked for the respondent's individual consent to conduct the interviews, as stated in the previous section. The research team introduced themselves to the

Figure 10.2 Interviewing a homeowner in Mikocheni in March 2021. Source: Own picture

individual or family to be interviewed. After that, the research objectives and the purpose of interviewing community members were clearly stated, to avoid misunderstanding or undesired expectations. Such information was collected in a document that the respondent could read, however, due to the inability of some of them to read, these details were also explained orally.

Most of the interviews were conducted in Swahili, relying on a research assistant to help with communication. In some rare cases, elderly respondents did not know Swahili as they only spoke Maa language, therefore requiring the help of a younger family member to translate the research assistant's questions. While I can understand basic Swahili, I was not able to conduct the interviews in Swahili by myself. As such, the research assistant would start asking some general questions that were designed to prompt open conversations that then would be adapted according to the respondent's interests. Due to my ability to grasp the topic of the conversation, I would ask the research assistant to ask more specific questions related to the interviewee's response. If a response was not clear to me, I would ask the research assistant to ask for clarification. Usually, respondents would be engaged in the conversation in a relaxed and informal manner, allowing us to explore the respondent's opinions in most cases. In order to avoid any information being lost, all interviews were recorded with the consent of the respondent, to be subsequently transcribed directly into English with the help of the research assistant.

In total, we conducted 31 in-depth interviews in the two villages. In Maji Moto, 13 interviews were arranged with homeowners, three with members of the local authorities and two with local bricklayers. In Mikocheni, 10 of these were with homeowners, two with community leaders and the last one with an elder whose house was built as part of a C-re-aid's groundwork project. Aside from these, another two interviews were conducted with members of the Regional Environmental Committee and with the director of environmental organisations, both of which were in Arusha [see table 10.3 for more details]. The selection of key actors to be interviewed was planned ahead of the data collection period. With the help of a C-re-aid member in the case of Maji Moto and a community leader in the case of Mikocheni, the idea was to choose a series of community members that were diverse in terms of age, gender, marital status and financial income. Considering the diversity of respondents is crucial to grasping the existing complexities at the local level. As Rigon claims "A focus on diversity is not only important in terms of offering different options that recognise the diversity of needs and aspirations, and for working towards a fair distribution of benefits. It is also fundamental in the management of the intervention to ensure the representation of different groups of residents in their design and implementation" (2022:2). While it was difficult to ensure such diversity, we managed to get a representative cross-section of key actors, with gender balance being the most challenging due to the unlikeliness of finding men at home during working hours.

One limitation of the process of conducting interviews is the risk of the researcher's presence influencing the response of interviewees. Other researchers have recognised this risk before, such as Fisher (2015:30) "Because of the limited opportunity to engage ethnographically with household survey participants and the tendency to be perceived as 'white,' I was aware that my presence may have made some residents feel uncomfortable or likely to modify their responses to my questions". Mostly in the case of Maji Moto, most of the dwellers that were interviewed knew me and my interest in the topic of building materials, therefore they might have responded what they knew I wanted to hear. As such, it is important to acknowledge that my unavoidable participation in the conversations might have shaped the outcome of the research to a certain extent.

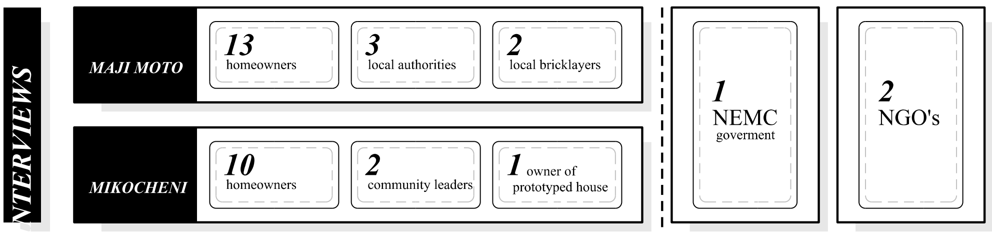


Figure 10.3 Summary of the interviews conducted during the assessment stage. Own illustration

10.4 ANALYSIS

This final section of the methodological chapter looks at the analysis of the data collected throughout the engagement and assessment stages. This does not mean that the analysis is a detached process that happens only at an advanced stage of the research. Instead, as Atkinson suggests (2001), ethnographic analysis should be an iterative mechanism that enables continuous engagement with the collected data, allowing for new insights to emerge and to refine the research questions. In this way, the analysis can inform subsequent data collection, which leads to a deeper understanding of the phenomenon under investigation. Also, due to my previous long-term involvement within one of the two analysed case studies, I have opted for an inductive approach, which allows relevant patterns and themes to emerge rather than imposing preconceived categories onto the analysis. Grounded theory, which will be introduced in the section below (10.4.1), provides an approach that allows such analysis to happen in a dialogical manner with data collection. The last section (10.4.2) presents the development of the study's qualitative data analysis through the use of the NVivo qualitative data software, and how it has been useful in establishing key findings.

10.4.1 GROUNDED THEORY: AN APPROACH FOR DATA COLLECTION & ANALYSIS

Before conducting the data collection fieldwork in 2021, I had an established understanding of how the prototype building would impact the community and how learnings from this might be brought forward. Indeed, continuous conversations with community members and stakeholders provided me with a preconceived idea of how the process of co-creation had worked out during the construction of the Maji Moto health centre. In order to prepare for the interviews and other relevant fieldwork, I was determined to work on a set of pre-established hypotheses[2] to be explored. The choice of pre-established structured interviews linked to the variables I wanted to build upon would have produced responses that affirmed my preconceptions. However, upon reflecting on such a rigid structure, I was uncertain that these variables would cover the aspects that were relevant to addressing the research questions. Likewise, I could not be certain that my biases were not affecting the research outcome. Therefore, I researched diverse methodologies that could address the lack of open exploration. Grounded theory has provided the appropriate tools for rethinking my approach to the data collection and analysis phases, enriching the research findings while preventing limiting the extent of these.

2- Pre-established hypotheses are statements or predictions about the expected relationship between variables in a research study. These hypotheses are developed based on existing theories, previous research, or logical reasoning. They guide the research process and provide a framework for data analysis and interpretation.

Grounded theory is a method proposed by Glaser and Strauss (1967) to analyse research data, but also to propose the way forward for structuring ethnographic fieldwork. According to Rigon (2012), the use of Grounded Theory can be used to discover social processes and transform concepts into substantive theories. The involved methods enable the inductive construction of themes that can be integrated into a research framework (Charmaz & Mitchel, 2001), becoming a powerful analytical tool to discover less visible categories that are essential to understanding undergoing social processes. Glaser (1998), later stressed the importance of flexibility within the use of Grounded Theory to facilitate the unfolding of data findings. Openness towards the direction of the research happens through the use of the memoing technique, which consists of a constant use of notes to define the potential themes whilst in the field, continuously re-thinking new possible directions for data findings (Russell, 2006). This iterative process helps the researcher to become “more and more grounded in the data” (2006:492).

The reason behind adopting the principles of Grounded Theory in my fieldwork and analysis relates to the capacity of the method to avoid pre-conceived analytical categories. This allows the emergence of more abstract concepts that are progressively built upon through the creation of connections between different themes. This is especially interesting for researchers who have been engaging for a long time with the study area, and who wish to obtain a more open approach to the data collected (Rigon, 2012). As such, this research uses Grounded Theory as a method to get in-depth data from fieldwork, avoiding limitations in the scope of the research due to biases or pre-established ideas. To make this possible, open-ended conversations with members of the community were employed, gathering meaningful data that could not be attained by the imposition of strict questions following a specific pattern. In this way, fieldwork becomes a “dialogical process which is structured by the researcher and the participants" (England, 1994:80).

Following an interpretivist epistemology, I acknowledge that the context I analyse is constructed by my own experience and that is subjected to my perception. As an architect engaging in a context with a specific social reality, I believe that the field of architecture should be more open to reconnecting with the lived aspects of the spaces we design. The use of grounded theory as a way forward to engage with fieldwork data is a radical act where “the researcher seeks to be open to the phenomenon and to allow it to show itself in its fullness and complexity through her direct involvement and understanding” (Seamon, 2000:163). Therefore, this method embraces empiricism and positivism as equal factors in the production of the built environment, instead of relying on solely positivist approaches which focus on the technical aspects of buildings. In looking at people-environment relationships, I believe that the implementation of grounded theory methodologies courageously emphasises the lived experience of users within their physical spaces, helping the researcher to explore meaning and perceptions within the framework of the material world.

10.4.2 QUALITATIVE DATA ANALYSIS WITH NVIVO SOFTWARE

Since the beginning of the Assessment fieldwork, Grounded Theory proved useful in narrowing down the most relevant topics of research. I adopted an open approach to conducting interviews, which enabled me to start working on the data analysis at an early stage, identifying potential themes. To assist with this, I decided to use a software to support the data analysis of the interviews: NVivo software.

NVivo is a powerful tool for qualitative data analysis, and its use can greatly benefit researchers conducting fieldwork guided by the premises of Grounded Theory. In architectural research, the use of data analysis software such as NVivo is rare, as usually there is a lack of training and awareness of such tools. Despite my initial fear of using software that I was not familiar with, the use of NVivo software proved to be very useful in facilitating the analysis of interviewees' data. In my case, NVivo helped manage the large sets of interview data, in turn assisting in identifying patterns and themes and generating meaningful insights to support the research objectives through its clear layout.

The first stage of the analysis took place whilst I was working on the interview transcripts. Because I was transcribing regularly in between undertaking fieldwork in the villages, I would start adjusting the interview questions at an early stage. By analysing the direction of the open-ended questions, I managed to detect inconsistencies and figure out how to direct the conversations with respondents towards the themes that started to show theoretical potential through wider triangulation. As part of the three months that I spent conducting fieldwork data collection, I worked on some initial coding[3], which helped me to be able to guide the fieldwork direction more meaningfully. Also, the progressive inclusion of data into this initial coding enabled me to identify gaps and new relevant topics. As such, coding became a flexible tool to explore emerging themes during fieldwork, whilst facilitating the identification of contradictions that needed further examination. NVivo proved very useful in organising all the data into one file, which helped to reduce the overwhelming feeling of having to deal with some hundred pages of transcripts. NVivo's easy and flexible interface helped me to start linking concepts, which were in turn used to create the main body of codes.

3 - Coding in qualitative research refers to the process of analysing and categorising data to identify themes, patterns, and meaningful units of information. It is a crucial step in organizing and making sense of qualitative data, such as interview transcripts, field notes, or textual documents.

Once most of the data collection fieldwork was concluded and imported to NVivo, I was able to visualise some of the initial core themes. To do so, I imported all interview transcripts into NVivo, creating a different case for each respondent (both dwellers and local stakeholders). There were 31 in total. Each case was assigned a series of relevant attributes such as age, gender, marital status, profession, income, and so on. All these attributes helped to find common patterns of response among interviewees. Once I had categorised all the cases, I started reading the transcripts and coding relevant 'quotes' to be added to general tree nodes. Sometimes I would find other new topics, therefore creating new nodes. A second complete reading of the transcripts was essential in confirming the appropriateness of some nodes or discarding others that were becoming less relevant. As Di Gregorio suggests (2000), I placed representative extracts of conversations in specific nodes, which were extremely useful in assisting with the writing process. In the end, I had a total of 53 nodes under 14 main tree nodes. Some of these nodes were singular, while others would have sub-nodes and so on. See Figure 10.4 to visualise a structure of my NVivo analysis of nodes once the coding was finalised.

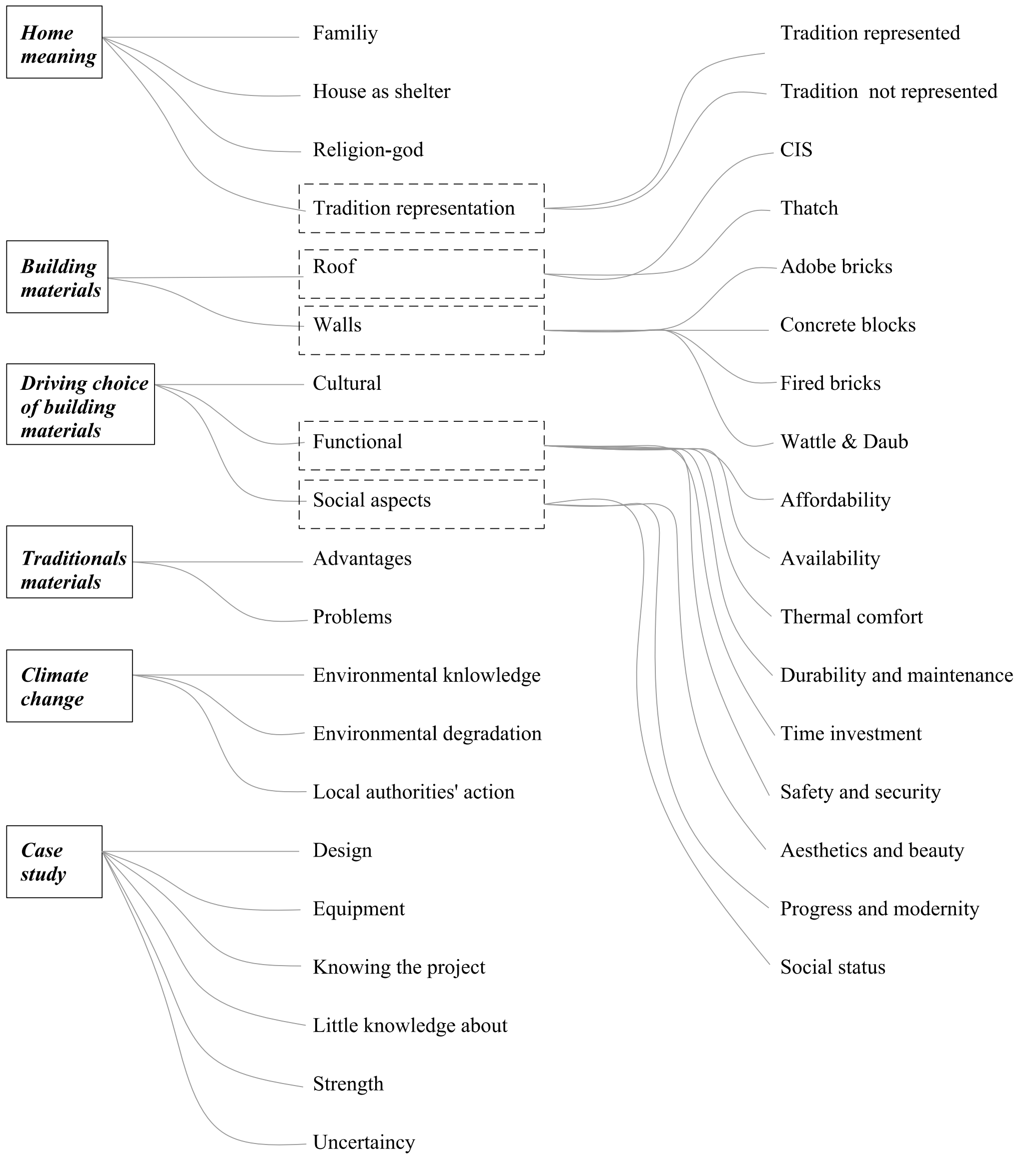


Figure 10.4 Overview of the research project's main coded themes with NVivo. Own illustration

Having concluded with the coding phase (which took almost three months), I was surprised to find that the main nodes were somehow defining the chapters and topics I believed as essential for my thesis. These nodes were progressively strengthening my analysis and their exploration became a rewarding and educational part of the analysis of qualitative data, vital for an architect with no previous experience in qualitative research.

To conclude, NVivo proved to be a very powerful tool for enabling a flexible and crafted-oriented approach to analysing data. Whilst some may claim that the limitations of using such software reside in its rigidity, I believe that its comprehensive but easy functionality enabled me to think beyond the data itself, finding connections between different nodes and information and being able to deliver a complex yet straightforward presentation of my findings.

11 — Housing Analysis: Maji Moto and Mikocheni

The following analysis chapter wants to give an account of the specific housing conditions of the case study villages - Mikocheni and Maji Moto. To do that, both villages were visited during three months of fieldwork, following three years of intermittent periods during the construction of the two built prototypes. Once there, several families were selected following different patterns such as building type and income. In Mikocheni, a total of 10 families were interviewed, together with a site visit to their houses. In Maji Moto, 13 families were interviewed and visited at their houses. Besides the dwelling families, focus groups, government members' interviews and focus groups with elder villagers were conducted. To know more details about the methodology adopted to conduct the interviews and further analysis, see the previous Chapter 10.

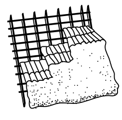
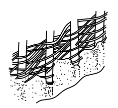
The reasoning for interviewing the families owning the sampled houses had a specific objective. The idea was to analyse the spatial and material quality of buildings while learning about their experiences within their houses. Responses revolved around their opinions, frustrations, tastes, dreams, requirements, social practices, attachments to tradition and so on. Also, getting to know the family composition, income, ages, ethnicity, and so on, was crucial to enable further data analysis and the connections between household features and responses. The objective of such dual data collection was to search for family attributes and elucidate how spatial forms and material choices were or not resulting from such aspects. The result of the analysis will be exposed in the following chapters (12 and 13). Meanwhile, this section will describe the social, spatial and material features of the sampled houses in both villages.

11.1 MAJI MOTO: HOUSING SAMPLING

For simplicity purposes, this section has been sub-divided into groupings of dwellings that share spatial and material aspects. Among the total of 13 families that were selected In Maji Moto [Figure 11.1], the different housing samples are represented and analysed below in three different groups.

11.1 Map of Maji Moto indicating the location of the sampled households. Own illustration

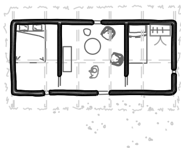
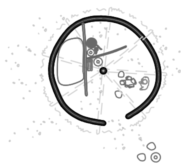
Group 1: mud walls - thatch roof

GROUP 1 - MAJI MOTO	Building techniques	Price	% of buildings
		2,5x4 m rolls 15.000TSH €6,5	21% of houses
		Rigid wooden poles 500 TSH €0,20	2% of houses

The first sub-group is the less common among dwelling types in Maji Moto. Contrary to Mikocheni, the shift to an agriculturalist lifestyle and the proximity to Arusha, a large urban centre, has contributed to higher levels of development in this Maasai community. For this reason, the type of house built with poles and cow dung and roofed with thatched ceased to be built a long time ago. This type of building was common among pastoralist communities that settled down between the 60's and 70's, due to external influences and the early application of the villagisation policy.

After analysing all dwelling types in Maji Moto, it was confirmed that the two houses under this group are the only examples in the village where someone lives. There are some other round-shaped houses, however these are currently neglected. The average cost of building this type of house is 330.000 TSH (€140). However, this number is not indicative as the house of the informant (21) was built by himself and was free of cost. Informant (23) did not build the house structure by herself, so most of the cost relates to labour and the wooden poles needed to build the roof structure.

The following summary table 11.3 exposes some of the main features. It is followed by a description of remarkable aspects:

GROUP 1 - MAJI MOTO		PERSONAL INFORMATION	HOUSE INFORMATION
 021MM		92 years old	3 members of the family
		Male	Two buildings in the plot
		Married	Owner
		No formal education	Free of cost
		Farming. Old parent taken care by his wife who farms.	Three rooms
		No salary	Built with a thatched roof and wattle & daub walls
 023MM		76 years old	2 members of the family
		Female	Four buildings in the plot
		Widow	Owner
		No formal education	680.000TSH
		Mainly farming plus livestock keeping	Three rooms
		Salary under 50.000TSH	Built with a thatched roof and wattle & daub walls

11.3 Group 1: classification of households in Maji Moto. Own illustration

Family unit

The first attribute to highlight considering the owner's features is their age. Informant (21) is a 92-year-old male while informant (23) is a widow 76-year-old woman. The fact that elders own a type of house that hasn't been built in the last 30 years is not a coincidence. In both cases, they have claimed to have lost the strength to build a better house, as they used their resources to raise their children. The income of both is very low, under 50,000 TSH per month (€21) and depending on the season, they do not have income at all. In the case of informant (21), he claimed to be self-sufficient and making a living from the crops his wife collects. Meanwhile, informant (23) owns two cows which enable her to sell milk occasionally.

Elders are among the most vulnerable groups in the village, being forced to rely on their children's help to move forward. Is for this reason that both hoped that their children or grandchildren would build a new house for them, as they consider that their houses are out-dated and not reaching the standards of a decent quality of life. In the case of informant (23), she has managed to save for a long time so that now, with the help of her family, she is building a small house using fired bricks. Her house was built in 1970 when the neighbours were also building in the same style. In the case of informant (20), he built his house in the late 60's.

Spatial features

Considering that both houses were built more than 50 years ago, the structures were found in surprisingly good condition. These types of houses require however high levels of maintenance and probably the mud plaster and thatch have been replaced several times. From inside, the roof beams were covered with a black layer due to smoke, as they used to cook inside the house in the past. After understanding the harmful effects of smoke inside the house, they built a smaller building close by that was especially thought to cook.

The absence of windows informs about the period in which the houses were built. Despite the informant (20) built his house with adobe bricks, which can easily enable the construction of openings, windows were not common when it was built. As a consequence, the inner space of the houses is very dark and dusty, increased by the lack of a paved floor.

In terms of distribution, the round house presents a very interesting layout that is developed around a central large wooden trunk. Around it, a half circle is closed with a divisionary wall made with horizontal poles plastered with mud, enclosing two bedrooms. The other half-circle is left open and used as storage and a space where to sit down. By contrast, the informant's (20) house is arranged as the typical rectangular houses that were built after villagisation - two bedrooms on the sides and a central space with chairs.

An interesting feature is the overhanging roof that was built in the case of the rectangular house, which is not common and usefully protects the wall from being hit directly by rain. This reduces the number of repairs that the external plaster will need. During a conversation with informant (20) he explained a traumatic experience he had when during a heavy rainfall, water entered his house through a hole in the wall, forcing the family to escape in the middle of the night.

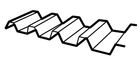
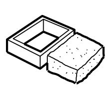
Materiality

The building techniques used in both houses are not something which owners seemed to be proud of. They constantly pointed out the fact that their neighbours have been telling them to build a new house as this one does not follow the features of modern houses. In both cases, the dream is to have a house built with fired bricks and roofed with Corrugated Iron Sheets (CIS). They do not expect to have a big house with many bedrooms and coloured plaster, but they just want the minimum required to build with good materials and live decently.

Regarding the thatched roof, they claimed that the inner temperatures of the house are comfortable even during very hot days. This is the only advantage that the roofing technique had, according to them. For the rest, the constant maintenance required by the thatch roof would make it very difficult to cope with. They are too old to do it by themselves and the type of grass they used to roof (dry grass from rice fields) is not available anymore in the area.

The walling technique used in both dwellings is different. In the case of informant (20), the house was built with adobe bricks, the reason why he managed to build it in a rectangular shape. In the case of informant (23) the walls' structure was made with poles by her son and she filled the inside with cow dung and mud. For the roof structure, she hired a worker to place the wood beams and the thatch.

Group 2: earth walling materials - CIS

	Building techniques	Price	% of buildings
GROUP 2 - MAJI MOTO		Sheets of 3 x 0,85m TSH 15,000, €6	70% of houses
		Casting wood one off TSH 5000 €1,86	18% of houses

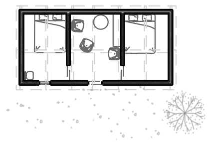
The type of housing presented in this section was quite widespread in Maji Moto several years ago, however, the gain in the popularity of fired bricks has played to the detriment of raw techniques such as adobe bricks or poles and mud.

Despite the neglect of construction using raw materials such as adobe bricks, there are still many families living in these, accounting for around 18% of dwellings in Maji Moto. Usually, dwellers with adobe brick houses collect savings while buying or producing fired bricks in small batches to build a new house with fired bricks. Is very common to find a construction site in plots, where families are building with this trendy technique.

Once families have managed to build a new house, the old one built with adobe bricks and Corrugated Iron Sheets (CIS) is used as an extra room to be used by extended family members or grandchildren. Also, it has been noticed how elders tend to live in their mud dwellings, but they spend most of the time at their son's houses which are bigger and more comfortable. We will see these types of houses in the next section.

The average cost of a house built with adobe bricks and CIS is 750,000 TSH (€320), varying in some cases depending on the external labour requested.

The remarkable characteristics of this sub-group [figure 11.5] are:

GROUP 2 - MAJI MOTO		PERSONAL INFORMATION	HOUSE INFORMATION
		72 years old	6 members of the family
		Female	Three buildings in the plot
		Widow	Owner
		No formal education	500.000TSH
		Farming	Three rooms
		Salary under 50.000TSH	Built with CIS and un-burnt bricks
		50 years old	5 members of the family
		Female	Three buildings in the plot
		Married	Owner
		Primary education	1.000.000TSH
		Mainly livestock keeping plus farming	Three rooms
		Salary under 50.000TSH	Built with CIS and un-burnt bricks

11.5 Group 2: classification of households in Maji Moto. Own illustration

Family unit

Similar to the previous case, the families owning these types of houses are usually elders or vulnerable families with a large household. In the case of informant (14) the owner is a 72-year-old widow living with 4 grandchildren and a daughter. In the case of informant (15) a 50-year-old female living with her husband and three grandchildren. Both families have a monthly income which does not exceed 50,000 TSH (€21) per month. The main economic activities are livestock and farming, generating a quite fluctuant income depending on the season.

It was claimed by both informants that the support of their kids was essential to build their houses. In the case of informant (14), after the death of her husband, her children supported her economically to build a new house with a CIS roof. While for the informant (15), her son manufactured the adobe bricks that were then used by skilled bricklayer to build the house.

Spatial features

In terms of spatial forms, this type of dwelling is quite widespread across Maji Moto. The rectangular shape of the walls was one of the first formal implementations applied to the indigenous Maasai house. Both sampled houses were built with un-burnt bricks. In the case of the informant (14), the house was built following the typical rectangular layout built with mud; two bedrooms at the sides and a central shared space. By contrast, informant (15) applied an innovative design that has been quite common lately. Instead of building walls in a rectangular shape, the house was designed in an L-shape, placing the two bedrooms on the long side and a more spacious living room on the entrance area.

Due to the shape of the walls, the typical gabled roof that is usually built with CIS was substituted by a shed roof. The family is concerned about this type of roof because during windstorms it might be lifted by strong winds.

Despite the use of adobe bricks, none of the families built large openings. One of the houses has two little windows in the bedrooms, while the other house did not build windows but just some little openings to allow ventilation, resulting in very dark inner spaces.

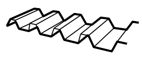
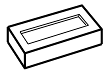
In both cases, the families have not managed to afford an electric installation, so they just rely on a few solar panels that are installed in the roof.

Materiality

For these two families, having been able to upgrade the quality of their houses by building a proper roof with CIS is a big achievement for which they feel very proud. Now, families feel relieved as they will not have water leaks in the roof. However, informant (14) states that with a CIS roof, the house became very noisy when it rains, despite being protected from the rain. Informant (15) explained that they sold two cows to build a new house after changing their thatch roof periodically to avoid infiltrations.

Concerning walling materials, informant (14) seemed quite frustrated with the fact that she has to live in a mud house while her neighbours are all building with fired bricks. For this reason, she hired a mason to produce fired bricks that she intends to use shortly to build a new house. In the case of the L-shaped house, the owner's children produced the bricks, and a skilled bricklayer built the foundation, walls and roof. A relevant part of the cost in both cases was the wooden beam structure to lay the CIS.

Group 3: fired bricks - CIS

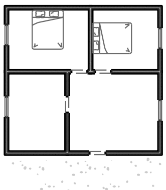
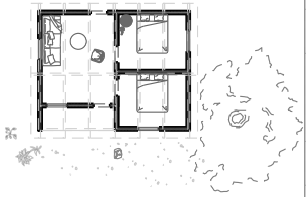
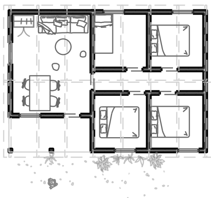
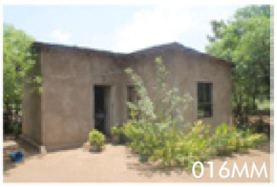
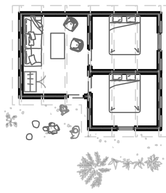
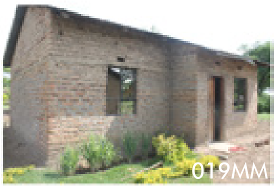
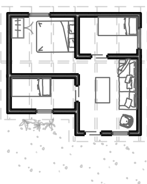
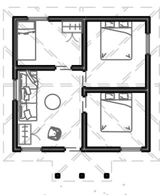
	Building techniques	Price	% of buildings
GROUP 3 -MAJI MOTO		Sheets of 3 x 0,85m TSH 15,000, €6	70% of houses
		TSH 300-500 € 0,11-0,19	80% of houses

The seven houses grouped under this section represent the most widespread The seven houses grouped under this section represent the most widespread type of building in Maji Moto, accounting for 75% of the total number of houses. The increased number of families that have learnt about the production of fired bricks has resulted in a transformed built environment far from the traditional Maasai settlement. This has been in part also due to the rise of CIS, which has enhanced the need to build more durable and stable walls. High levels of permanence have been translated in diverse designs as well as in an increased sense of identity that is shown throughout the dwelling forms.

Most of the dwellings falling under the characteristics of this housing type have been built after 2010, apart from the house of informant (12), a 33-year-old orphan male, whose house was built in 2005 by Dorcas, an NGO providing support to vulnerable individuals. A common feature among the totality of the houses is the intense time invested in building the house. For example, informant (20) took five years to complete the construction, being able to buy materials in batches and keep them aside until he was capable of paying for the workforce. Another example is the case of informant (22) whose house was started in 2016 and is not yet finished, as they still need to apply paint to the walls and install the ceiling boards and the floor tiles. In the case of informant (11), they moved into the new house despite it was not completed and the roof was just lying on the walls with a temporary solution.

The average cost of the type of house built with plastered fired bricks and a roof structure with CIS is 5,800,000 TSH (€2,500). Again, the average total cost is not to be considered as indicative, as some informants' houses like (13) have a much higher cost compared with the rest. This is due to the number of details included inside, such as the electrical installation or the bathing toilet. Specific housing costs can be viewed in the table below.

The following summary table [Figure 11.7] exposes some of the main features. It is followed by a description of remarkable aspects:

GROUP 3 -MAJI MOTO		PERSONAL INFORMATION	HOUSE INFORMATION
		51 years old Male Married No formal education Mainly farming plus livestock keeping Salary betwen 101.000/500.000TSH	8 members of the family Four buildings in the plot Owner 1.900.000TSH Four rooms Built with CIS and fired bricks
		33 years old Male Married Primary education Mainly farming plus livestock keeping Salary betwen 101.000/500.000TSH	4 members of the family Two buildings in the plot Owner 850.000TSH Three rooms Built with CIS and fired bricks
		30 years old Female Married College education, Teacher's college Goverment employee Salary betwen 101.000/500.000TSH	8 members of the family Three buildings in the plot Owner 20.000.000THS Five rooms Built with CIS and fired bricks
		36 years old Female Widow Primary education Mainly farming plus livestock keeping Salary under 50.000TSH	3 members of the family Three buildings in the plot Owner 1.600.000THS Three rooms Built with CIS and fired bricks
		78 years old Female Widow No formal education Mainly farming plus livestock keeping Salary under 50.000TSH	4 members of the family Two buildings in the plot Owner 3.000.000TSH Four rooms Built with CIS and fired bricks
		74 years old Male Married Secondary education, class 8 Mainly farming plus livestock keeping Salary betwen 50.000/100.000TSH	6 members of the family Three buildings in the plot Owner 8.200.000THS Four rooms Built with CIS and fired bricks
		19 years old Female Married Primary education Mainly farming plus livestock keeping Salary betwen 101.000/500.000TSH	3 members of the family Two buildings in the plot Owner 5.000.000THS Four rooms Built with CIS and fired bricks

11.7 Group 3: classification of households in Maji Moto. Own illustration

Family unit

The owners of these heterogeneous dwelling types are normally young couples, apart from the cases of informants (19) and (20). This is due to the recent rise of young men migrating to bigger towns in search of job opportunities to contribute to the payment of the house. As shown in the table, most of the families have a relatively higher income compared to the owners of previous dwelling types. Average monthly incomes are between 100,000 and 300,000 TSH (€42-126). In the case of the elder owners in this sub-group, (19) has received the help of her son, while (20) had been a government employer in the past.

The main economic activity carried out by owners is farming and livestock keeping, making farming more relevant to their financial situation. In the case of informant (13), who owns one of the most expensive houses in the village, she is a government employee working as a teacher in the primary school of Maji Moto.

Spatial features

The several houses belonging to this sub-group are quite diverse among each other. These have been built for the last 10-15 years and the costs are quite variable across the houses. However, these seven houses share one common thing: the use of fired bricks as a walling technique that has allowed diverse designs in terms of shape and finishing. With a growing group of skilled constructors building with fired bricks, there has been an increased knowledge of the technique, executing more sophisticated designs as can be seen mostly in the cases of houses (12), (13), (20) and (21). These four houses have been designed with large porched areas with columns. As it was explained before, the use of porches has risen among settled dwellers as longer periods are spent at home. In addition, having CIS makes houses warmer, making it even more necessary to have an open space protected from the sun. The variety of new design options is also visible in other houses, by using the L-shape described before or by building the roof structure with intersecting hipped forms. This type of building is lately becoming very popular, as its raised roof prevents direct sun radiation from entering the house.

The programmatic layout has also varied with the inclusion of internal partitions to create more rooms. Most of the houses have three bedrooms and a larger living room, with a distributional corridor in some cases. Moreover, it has been observed in the house of the informant (13), the inclusion of a toilet inside the house. Despite the house not having running water or a sewage system, they have provided a toilet with a shower for future installation. In terms of electrical installation, four out of the seven houses have been afforded to connect to the new public electric system of the village.

Differently from previous cases, all these houses have been planned with at least one big window in each room, providing daylight and proper ventilation in the inner space. In addition to windows, houses have been provided with ventilation blocks in the higher part of the walls. This has become an essential requirement due to the high temperatures experienced inside as a side effect of using CIS as a roofing system.

Lastly, it can be observed how decorations in the houses have been carefully considered, reflecting a higher level of permanence and attachment to homes. Furniture, pictures, carefully chosen coloured plaster, plants in the surroundings and so on are a clear sign of pride. Most of the interviewed dwellers have claimed to be happy with their houses as they are looked after.

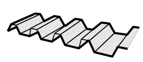
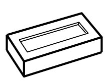
Materiality

The first thing that most of the informant dwellers claim is a sense of pride for the houses they have managed to build. They talked passionately about the strong, durable and permanent houses that they have. This is mostly due to the improvement of walling material from raw clay to fired bricks. In addition, most of the houses are plastered with cement, which increases the strength of the walls. The totality of the houses are paved with concrete and a final cement layer.

Structurally, the walls have been built on top of foundations made with concrete and stones, and with an upper structural concrete ring beam to reinforce the walls. Some families (13, 20) have also afforded to install ceiling boards on top of the ring beam.

Looking at the plot, it can be observed that some of the older buildings were also built with fired bricks or adobe bricks, which means that many have already built a new house despite the former being considered strong for the owners. However, despite the quality that owners have managed to achieve, most of them still want to build a new house. Only informants (19) and (21) do not expect to move. The rest, whether for dimension purposes or to have a trendier roof, are firm in their intention to build a new house in their plots.

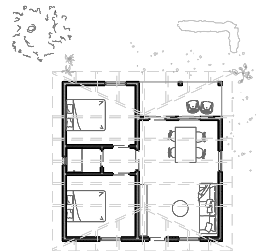
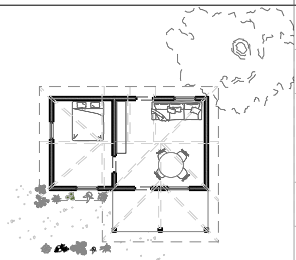
Group 4: (improved) fired bricks - coloured CIS

GROUP 4 - MAJI MOTO	Building techniques	Price	% of buildings
		Sheets of 3 x 0,85m TSH 22.500, €8	9% of houses
		TSH 300-500 € 0,11-0,19	80% of houses

There are just two buildings representing this typology of dwelling in Maji Moto. This is because these are comparatively much more expensive, as these only represent the 10%. What is certain is that this typology of a house is the one to which most of the villagers aspire to have.

The average total cost of this type of house is 17 million TSH (€7200), an amount that only those neighbours owning businesses or living in bigger towns can afford. Nevertheless, due to the appealing look of these houses, many dwellers are making great efforts to be able to build similarly in the near future. This is a direct indicator of the increasing level of development of this Maasai village.

The following summary table [figure 11.9] exposes some of the main features. It is followed by a description of remarkable aspects:

GROUP 4 - MAJI MOTO		PERSONAL INFORMATION	HOUSE INFORMATION
		23 years old	3 members of the family
		Female	Five buildings in the plot
		Married	Owner
		Secondary education	25.000.000TSH
		Mainly farming plus livestock keeping	Four rooms
		Salary under 50.000TSH	Built with coloured CIS and fired brick
		32 years old	5 members of the family
		Male	Five buildings in the plot
		Married	Owner
		Primary education	9.000.000TSH
		Owns a shop	Two rooms
		Prefer not to say	Built with coloured CIS and fired brick

11.9 Group 4: classification of households in Maji Moto. Own illustration

Family unit

Following the results of the previous case, the owners of this type of housing are very young individuals. Also, it can be observed that families who afford to build a house like this, have a smaller number of children than the village average. Informant (17) has only one kid, while informant (18) has three.

Despite being considered Maasai, they do not practice polygamy, which also increases the number of resources that the couple has access to. In this way, both husband and wife can commit to a single objective for improving their living conditions.

On average, the cost of building this type of house is 17 million TSH (€7,200). In both cases, families have been able to build their houses through the earnings of their businesses. In the case of informant (17), she claimed that her monthly income is below 50,000 TSH (€21) mostly due to farming and the small number of livestock that she owns. Nevertheless, she stated that they afforded such a house as her husband works in the mining industry, which means that whenever he would find minerals (Tanzanite[1]), they would build a part of the house. In the case of informant (18) he preferred not to say his average monthly income,

1 - Tanzanite mines are very common in this region of Tanzania. Many young people sporadically work in these mines with the objective of finding the mineral. In some cases, they work months for free until they eventually get some payment out of finding the mineral. Close to Maji Moto there is a huge mine, in Mererani.

however, he is renowned in the village for owning the only bar and the biggest shop, apart from having a transport business.

Spatial features

The two housing units that belong to this group are quite homogeneous in shape and materiality. It is observed the level of complexity of its forms compared to the previous cases, which gives the constructors the required space to experiment with new designs. A common feature of this type of house is the consolidation of the porch as one of the most important spaces where the family members will spend their time. An indicator of this is the number of plants existing in the porched area and surroundings, denoting dedication and care towards the house environment. Also, several trees and a bushes garden contribute to having a cool outdoor space that is not common in the Maasai culture.

Another element that becomes visible at first sight is the roof. Its shape is not any more gabled or flat but is intentionally raised in a hip and valley shape. The reasons are twofold: on the one side, raising the roof, if combined with a ceiling, contributes to dissipating the solar gain, reducing the temperatures inside the house. On the other side, the imponent roof structure is a sign of wealth and power, accentuated by the use of coloured roof sheets, commonly known as South-African 'bati', which are the latest trend in construction.

All these features, combined with the use of wall paintings and glassed windows, are a clear indicator of a modern house. Is for this reason that the two families belonging to this sub-group stated that they are not expecting to build a new house, as the one they have fulfilled all their requirements. This is quite remarkable, as they are the only young owners who are not thinking of building a better house, which is a clear sign of satisfaction. Only informant (18) noted that he would like to build an extension of his house as it only has one bedroom and a living room. In the case of the informant (17), they only have one kid and a house with three bedrooms, a bathroom and a large living room.

Materiality

As well as the external look of the house, the inner space is highly detailed compared to the rest of the houses analysed. Both houses are paved with trendy tiles, walls are plastered and painted and living rooms are fully furnished with sofas, tables, shelves, and so on.

The walling solution adopted was fired bricks. They claimed that concrete blocks would have been a stronger solution, however, the long distances needed to buy this material would have made it too expensive. In any case, they affirmed to be satisfied with the walling material chosen.

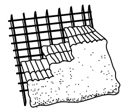
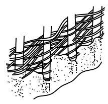
The choice of coloured CIS to roof the house is not arbitrary, due to the success of this material as almost 100% of the families would like it for their houses. Technically it does not have a better quality, however, it is possible to find them with several thicknesses, which can result in more durable roof sheets. The price for a normal metallic CIS of 3m x 0,85m is 15,500 TSH (€6,55), while the price for a single-coloured sheet of the same dimension is 22,500 TSH (€9,50), both with 2mm thickness.

11.2 MIKOCHENI: HOUSING SAMPLING

Equally to the previous section of Maji Moto, this section has been sub-divided into groupings of dwellings that share spatial and material aspects. Among the total of 10 families that were selected In Mikocheni [Figure 11.10], the different housing samples are represented and analysed below in three different groups.

11.10 Map of Mikocheni Maasaini indicating the location of the sampled households. Own illustration

Group 1: wattle and daub - thatch

	Building techniques	Price	% of buildings
GROUP 1 - MIKOCHENI		2,5x4 m rolls 15.000TSH €6,5	40% of houses
		Rigid wooden poles 500 TSH €0,20	80% of houses

As it was stated in previous chapters, the indigenous oval-shaped enkaji roofed with a layer of mud plaster has been neglected by current pastoralist communities in Tanzania. For that reason, most of the buildings that are found in Mikocheni follow the reasoning of the houses that were promoted after the application of the Ujamaa Policy: square or rectangular buildings with a thatched roof. Interestingly, it has been witnessed that some youth describe the indigenous Maasai hut as being characterised by a thatched roof, while this technique was adopted after the sedentarisation of Maasai communities due to the influence of other ethnic communities.

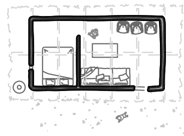
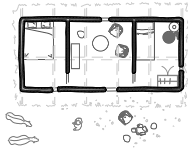
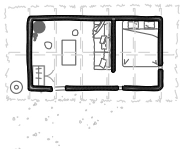
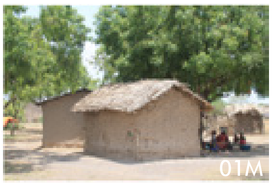
This type of house is the most widespread in the community of Mikocheni. Due to its proximity to more developed villages and the consequent rise of houses roofed with CIS, this type of dwelling is outdated and barely anyone is still building a house with such features. The average cost of building this type of house is 320.000 TSH (€135).

It is a common pattern to find scattered houses in each boma that are built with poles/mud and a thatched roof. However, in some cases where the families have managed to build more durable houses, these buildings have been transformed into kitchens or rooms for the elders. In this case, the interest was to interview and visit those families who were living permanently in houses built with poles/ mud and thatch. Following the summary shown in Figure 11.12, some remarkable common features are:

Family unit

A common feature among the four families is their vulnerable position. As the 3.30 table shows, informant (03) is a widow taking care of two grandchildren. Informant (04) is an 87-year-old male living with his wife and other three grandchildren. Informant (09) is a widow living with her son. The case of informant (01) defers from the rest as they are a young couple, however, have four kids. It was remarked by the four families that they plan to build a better house shortly, but due to several difficulties, they have not managed yet. Interestingly, in the case of informant (01), the homeowner claimed to be staying in this house while saving to build a larger house where his big family could live better.

The main economic activity of the four families relates to keeping livestock, which gives them around 50,000 TSH (€21) per month. Informant (09) also

GROUP 1 - MIKOCHENI		PERSONAL INFORMATION	HOUSE INFORMATION
		52 years old	3 members of the family
		Female	Four buildings in the plot
		Widow	Owner
		No formal education	100.000TSH
		Livestock keeping	Two rooms
		Salary under 50.000TSH	Built with a thatched roof and wattle & daub walls
		87 years old	5 members of the family
		Male	Three buildings in the plot
		Married	Owner
		Class 8	140.000TSH
		Livestock keeping	Three rooms
		Get money from his children	Built with a thatched roof and wattle & daub walls
		33 years old	2 members of the family
		Female	Three buildings in the plot
		Widow	Owner
		Primary education	700.000THS
		Livestock keeping	Three rooms
		Salary betwen 50.000/100.000TSH	Built with a thatched roof and wattle & daub walls
		35 years old	6 members of the family
		Male	Four buildings in the plot
		Married	Owner
		Secondary education	320.000THS
		Livestock keeping	Two rooms
		Salary betwen 50.000/100.000TSH	Built with a thatched roof and wattle & daub walls

11.12 Group 1: classification of households in Mikocheni. Own illustration

works temporarily in a pharmacy as she needs such extra income to pay for his son's expenses. Informant (01) is the chief of the Maasai section of the village, which helps him with some extra income reaching up to 100,000 TSH (€42) in some months.

Spatial features

Despite the 'modern' forms to which Ndagala (1982) referred when describing rectangular-shaped dwellings, the four houses under this group are somehow related to the indigenous enkaji. The walls have no openings or in some cases, very few windows. This influences the insalubrity of dwellings' interiors, creating dark, dusty and unventilated spaces. In fact, all the informants have complained especially about the lack of ventilation due to the absence of windows. Also, the fact that floors are not paved further increases dirt and the general feeling of unliveable spaces.

The basic rectangular form that the walling technique enables does not allow the design of other spaces beyond the typical plan with two rooms at the sides and a central communal space. This becomes limiting especially for families with many members, as for the cases of informants (01) and (03), with up to 6 people living in a two-bedroom house.

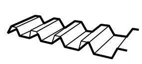
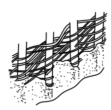
Materiality

In general, informants have expressed resignation and unhappiness when talking about the thatched roof. They claim to be living in constant fear of seeing their roof flying away or dripping during heavy rainfalls. Moreover, grasses along the river are becoming scarce and thatch needs to be replaced every two years, which increases the long-term cost. Despite they are aware of the insulation properties of thatch that maintain cool temperatures inside, they would rather prefer to change their thatch by CIS.

Due to the persistence of traditional walling techniques, women are still able to build these by themselves, as they used to do for the indigenous enjaki. In the case of informants (03) and (04), women built the walls and hired workers from a nearby village to build the roof, in the 'Swahili way' (referring to a thatching technique that has been borrowed from neighbours). Informant (09) did not manage to build her house by herself, so she had to hire workers, which considerably increased the cost of the house compared to others. Same case for informant (01) who highlighted the fact that currently, women do not build anymore because men are the ones with financial capacity, so they buy materials and hire workers to build their houses.

It has been a common pattern to find out that the four informants have plans to build newer houses. They all had a clear idea of the type of house they wanted; built with fired bricks and CIS. In the case of informant (09) she stated to have the capacity to buy CIS for her roof, however, she did not consider the cost of the processed timber she needed to build the roof structure. Informant (01) is already building a new house with poles/mud and CIS, which means that he is already thinking of the next house he will build after the one that is currently under construction.

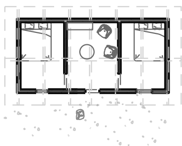
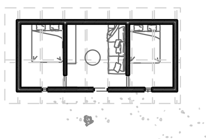
Group 2: wattle and daub - CIS

	Building techniques	Price	% of buildings
GROUP 2 - MIKOCHENI		Sheets of 3 x 0,85m TSH 15,000, €6	60% of houses
		Rigid wooden poles 500 TSH €0,20	80% of houses

The second group of houses relates to the dwelling type that is currently raising faster among the community. The availability of CIS in near-by towns, easiness of its transportation and assembling makes this material highly requested in Mikocheni. By contrast, the difficulty of transporting fired bricks from other places has hindered the improvement of walls and the community still uses their traditional walling technique. On average, the cost of building this type of house is 870,000TSH (€365). The raise of price is mostly due to the cost for the roofing structure and the hiring of builders, in detriment of the indigenous custom in which women used to build their houses.

The raise of the new roofing technique has impacted in almost all the bomas of the area. Usually, there is at least one building in each boma that is has been roofed with CIS, usually being the house of the wealthier son of the boma's patriarch.

The summary table [Figure 11.14] shows the features of the houses built with poles/mud and with CIS roof, that represent the XX% of the total number of buildings in Mikocheni. The remarkable characteristics of this group are:

GROUP 2 - MIKOCHENI		PERSONAL INFORMATION	HOUSE INFORMATION
		45 years old	5 members of the family
		Female	Four buildings in the plot
		Married	Owner
		Primary education	900.000TSH
		Livestock keeping	Two rooms
		Salary under 50.000TSH	Built with CIS and wattle & daub walls
		40 years old	7 members of the family
		Female	Three buildings in the plot
		Married	Owner
		Primary education	1.000.000TSH
		Housewife	Two rooms
		The husband is a bussiness man with fluctuating income	Built with CIS and wattle & daub walls
		63 years old	7 members of the family
		Male	Three buildings in the plot
		Married	Owner
		Several trainings, teaching, army, heathcare	700.000THS
		Farming and Livestock keeping	Three rooms
		Salary betwen 101.000/500.000TSH	Built with CIS and wattle & daub walls

11.14 Group 2: classification of households in Mikocheni. Own illustration

Family unit

As it can be observed, families that have managed to replace thatch by CIS have a slightly higher income than families belonging to the previous group. In most cases, these are mid-age families in which the father has migrated to bigger towns to provide an extra-income in addition to the one from livestock. In the case of informant (02) she had to first build a house with a thatched roof until she managed to save enough to build a bigger house for her, the husband and three children, despite she is in the low-income range. It is common to find families making big efforts to save for long time to be able to improve their houses.

Also, because a house with CIS roof tends to be bigger and needs a specific execution of the higher part of the wall to support the roof structure, it falls outside women's building knowledge and these houses tend to be entirely built by skilled workers. This gives men the primary role of deciding upon their houses as they have more financial capability. However, it has been observed that despite women contribute in part to the construction of their walls, they claim that the houses have been built entirely by bricklayers.

Spatial features

In this type of houses, walls tend to be built more stable even if these have been built by using the same type of local materials. Better walls lead to build larger windows; however, these cannot be built as big as the families would like and they still complain about the lack of ventilation. The combination of a CIS roof and small windows has increasingly become a concern due to the high temperatures experienced inside the house.

Interestingly, once a family manages to upgrade their house with a CIS roof, new problematics and desires usually emerge - they want to add a paved floor, specific furniture for the living room and they think about a newer house with more rooms. As it can be seen, the informant (05) house has been placed with a gutter to collect water, and in the house of informant (07) they have added steel bars to the window frame to increase security.

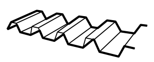
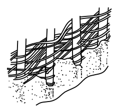
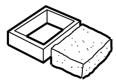
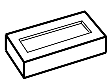
Materials

Thatched rooves are a common struggle among Maasai dwellers in Mikocheni. For this reason, families that have managed to build wit CIS found released in many ways, but mostly because of the cease of water leaks during the rainy season. The cost of CIS is quite higher than thatch [see again Figure 3.31], however at the long term these can help in saving a lot of resources and time. As stated by informants, a thatched roof needs to be replaced every two years, while CIS can last more than 20 years. For this reason, CIS have become the most requested new building material in rural areas as its installation is seen as a long-term investment.

Despite their housing upgrading with a more durable roof, families are still unhappy about their walling solution. They claim that the alkaline soil of the area destroys the walls, so they expect to move to a house built with fired bricks. Besides the limitations of poles/mud walls in terms of durability and strength, this building techniques does not give many possibilities to increase the size of the house. This further prevents dwellers to provide a higher number of rooms on the house, limiting it to the traditional setting of two rooms and a central living room.

Group 3: mixed walling techniques - CIS

GROUP 3 - MIKOCHENI

Building techniques	Price	% of buildings
	Sheets of 3 x 0,85m TSH 15,000, €6	60% of houses
	Rigid wooden poles 500 TSH €0,20	80% of houses
	Casting wood one off TSH 5000 €1,86	15% of houses
	TSH 300-500 € 0,11-0,19	5% of houses

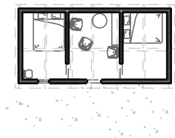
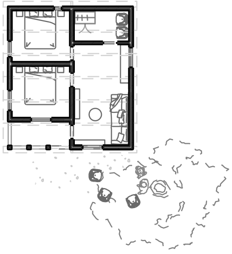
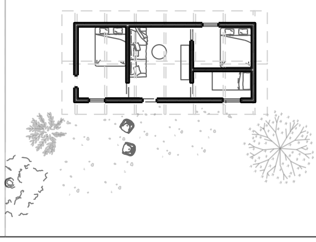
The last group of dwelling types is the most heterogeneous one regarding walling techniques, yet the three houses share an important feature; these have been built to resemble concrete blocks. This type of house is less common among dwellings in Mikocheni, representing less than 10% of the houses. However, taking into account the fast pace at which families are improving their dwellings, it can be assumed that in the following years, many young families with increasing financial capacity will follow the style of this group. At present, these three houses are the only ones that have managed to focus on construction and finishing details to improve their house, but it is visible that some other houses built with concrete blocks are currently under construction.

On average, the cost of building this type of house is 11 million TSH (€4,650). This price is unaffordable for most of the Maasai neighbours of Mikocheni. The average monthly income of these three families is, as observed be seen in the table [Figure 11.16], way higher than that of any other informants. The remarkable features of this group are:

Family unit

As pointed out before, something that is remarkable regarding these families is their monthly salary. In the case of informant (08), whose fluctuating income reaches up to 1 million TSH (€420[2]) per month, his family has the highest number of livestock in the village, counting with more than 2,000 cows. The other two informants (06) and (10) stated that the family man runs businesses in nearby towns or are working for big companies such as TPC, one of the biggest sugar cane estates in the country. According to informant (08), these houses are an example for the rest of the community, and a sign that the Maasai people are developing.

2 - In Tanzania, the average income salary per month was 362,400TSH (€160) in 2016, which is less than double of the monthly income of informant 8. This is, for a rural dweller an absolutely unusual financial capability.

GROUP 3 - MIKOCHENI		PERSONAL INFORMATION	HOUSE INFORMATION
		49 years old	7 members of the family
		Male	Five buildings in the plot
		Married	Owner
		Primary education	3.000.000TSH
		Livestock keeping	Three rooms
		Salary betwen 101.000/500.000TSH	Built with CIS and un-burnt bricks
		49 years old	6 members of the family
		Male	Three buildings in the plot
		Married	Owner
		Primary education	29.000.000TSH
		Livestock keeping	Four rooms
		Salary betwen 501.000/1.000.000TSH	Built with CIS and fired brick
		23 years old	6 members of the family
		Female	Two buildings in the plot
		Married	Owner
		Primary education	2.500.000THS
		Livestock keeping	Four rooms
		Salary betwen 101.000/500.000TSH	Built with CIS and wattle & daub walls

11.16 Group 3: classification of households in Mikocheni. Own illustration

These houses are clustered inside a boma with a group of houses. The higher quality of the house's materials in comparison to others of the same compound, enables a larger number of people living inside. On average, 6 people live in each of these houses. This includes children and single siblings of the main parents in the house.

Spatial features

Despite each house being built with a different walling solution, all of the owners have managed to build straight walls covered with cement plaster. This has allowed them to be distinguished among the community, as some of them pointed out, are wealthy people.

Strong walls have also given space to propose a more complex design, allowing the inclusion of new rooms and moving away from the traditional, two-rooms and a central living room. In fact, the three houses have at least three bedrooms each. The case of informant (08) is the most remarkable: the house is comprised of 5 rooms, consisting of three bedrooms, a store and a living room. To highlight is also the inclusion of a porch, where the family spends most of their time. This is the only house in Mikocheni that has a covered open space.

Beyond the built forms, is interesting to note the number of smaller details that are included in the design. The three houses have installed a visible TV aerial close to the main door, exhibiting their access to television. These three houses have also installed solar panels to provide lighting and electricity. There are other minor details to note; for example, the three houses have blue paintings in some parts and over-foundations. Inside the house, the roof is covered by ceiling boards in two of the three houses, and other decorative details such as posters are framed on the walls.

Materiality

Due to the use of industrialised building materials, houses have been entirely built by skilled workers. As exposed in the table [see again Figure 3.33], the house of informant (06) was built with adobe bricks but covered with cement plaster. Because both materials do not work collaboratively, they are having serious issues with the plaster which is cracking very often. The house of informant (10) was built with a poles' structure, however, was filled with stones rather than with mud and cow dung, and later a cement plaster was applied. The same issue of cracked plaster is happening in this house. The house of informant (08) is the only one that has been built with fired bricks, the desired material by almost every dweller that was interviewed. The problem is that because of the alkaline condition of the local soil, fired bricks cannot be produced in Mikocheni, which means that high costs for transportation were added to that of bricks.

These are also the only houses that were visited where there is a paved floor, with two of them made with concrete and a final layer of cement, and one with tiles. All the informants expressed their willingness to put tiles on the floor.

Considering the level of detailing of these houses, it was interesting to note how once they have reached a certain level of quality, they value other minor things. Similarly to Maji Moto, they pointed out their taste for coloured CIS, commonly known as 'South African roof sheets'. They also want to include gutters to collect the water and metallic frames for doors and windows.

The total cost of the houses, mostly for the case of informant (08), which was 29 million TSH (€12,200) was excessively high in comparison due to the level of detail of the inner space. Ceiling boards and their structure, tiled floors, fired bricks, doors and windows with glass, etc, inevitably increase the total cost of the building.

11.3 CONCLUSIVE REMARKS

The previous section has been dedicated to analysing the several dwelling typologies existing in the case study villages of Mikocheni and Maji Moto. The careful examination of building techniques and materials has contributed to understanding the socio-cultural evolution of the settlements throughout their built environment. Below, some remarkable conclusions will be exposed.

Upon first glance, it is evident that the two villages are at different stages of development. While Mikocheni has still conserved many of the defining features of a traditional Maasai settlement such as the household clustering in bomas, the livestock keeping as a main source of income or the social organisation of houses, Maji Moto may appear as a rural settlement with apparently no similarity with the Maasai traditions. Indeed, having the Maasai community from Maji Moto adapted to farming since the first generation of settlers, their lifestyle has changed considerably. As well, the proximity to Arusha town has contributed to promoting higher levels of modernisation and adaptation. Generally, these factors have positively influenced the income of families, enabling them to afford better-quality housing. Nevertheless, despite the difference in traditional practices and their resulting dwelling types, it can be claimed that the constant push for development and modernisation is inherent in both communities. Undoubtedly, the built environment in Mikocheni will progressively look more similar to the one of Maji Moto, as the one of Maji Moto will always keep adapting to the latest building trends in Arusha.

The study of the material and spatial qualities of the sampled housing analysed above sets the foundations for introducing the following chapters. Chapter 12 will dig into the meaning of home through the analysis of the presented dwelling types and the experience of their owners, while Chapter 13 will disclose the driving choice of building materials of the interviewed dwellers, considering the intertwined relation existing between them, their houses and the environment.

12 — On Dwelling: Processes and Forms

Building on the analysis of the housing cases previously exposed, this chapter wants to look at the meaning of home, with the objective of unpacking the processes by which Maasai people establish connections with their homes and how they transform their everyday relations with their living spaces. By analysing how buildings are conceived, designed and lived is possible to shed light on symbolic meanings that are essential in shaping the forms and materiality of one's home.

This chapter will unpack the meaning of home for the Maasai communities under analysis and the processes by which they create and transform such significant experiences as dwellers. The first part (12.1) will look at relevant literature that has tackled theories and approaches towards understanding the meaning of home and the differences between the house as an object and the home as an experiential device (12.1.1). It will follow an account of the ethnographic research conducted in Maji Moto and Mikocheni. The analysis of the ethnographic data is divided into three main sections, each of which focuses on crucial concepts giving meaning to the Maasai home: shelter (12.2), family (12.3) and identity and representation (12.4). This research will provide the basis for assessing the progressive loss of traditional technologies within the two communities and the drivers of the emergent idea of modernity and progress reflected in the built environment. A critical examination of such concepts will lead to the following chapters to unpack global and local forces influencing the choice of building materials by local dwellers.

12.1 CONCEPTUALISING HOME: POINTS OF VIEW

In architectural theory, many architects have been interested in analysing the house, usually tending to stress the physical forms of buildings, rather than looking more deeply into symbolic significance (Sixsmith, 1986). Despite the tendency of architecture theorists to remain on the tangible surface of buildings, some have attempted to unveil symbolic nuances, for example Polikoff (1969), and more lately Memmott (2015) and Vellinga (2011).

As stated by Vellinga, this has been a more regarded topic in the field of anthropology, which in the late 30 years has seen a growing interest in the study of architecture, yielding an interesting body of literature about the cultural embodiment of built forms (e.g. Moore, 1986; Waterston, 1990). He continued by affirming that "if anthropology is to fully understand the cultural significance of architecture, serious attention needs to be paid to its material as well as to its social and symbolical aspects, and to the way in which all three dialectically interrelate" (Vellinga, 2007: 757).

These studies have reaffirmed the role of architecture as being a central element in any given culture. If the anthropological field has witnessed the potential of architecture to unpack socio-cultural behaviours, so too architecture theorists must regard with genuine interest the meaning of the built environment beyond its forms and aesthetics. In avoiding so, architecture is denying the potential of the house to communicate social, political and cosmological relationships through its spatial forms (Cunningham, 1964).

There is a valuable amount of encoded meaning existing in the identification of each of us with the houses we dwell in, as well as in the portrayal of our origins. Fox (1993:23) has noted that in our societies the house can be viewed as "a theatre of memories". The indigenous Maasai house is an example of it, as its design is the translation into forms of a lifestyle and a set of cosmologies. For example, for nomadic Maasai women, the process of assembly and construction of their houses was part of a community ritual that would strengthen ties among other women of the same age group. These types of practices are still common for many ethnic groups (Vellinga, 2011), and represent the vitality that the house might have by itself, being sometimes considered as an "animate entity" (Waterson, 1990). Despite these types of ceremonies are progressively disappearing in Maasailand, the contemporary house built by rural Maasai is somehow genuine and rooted, insofar that its physical representation is the translation of an understanding of the current world and their everyday life activities. Thus, the house becomes the living expression of those who inhabit it throughout time and space.

Conceptualising the house as a living entity can be traced alongside the typological evolution of the Maasai house portrayed in Chapter 5. The replacement of rituals, practices and as a consequence, the material forms of the house, are nothing but the representation of the Maasai society's transformation and identity adaptation. The house loses its meaning as a static and finite object, to rather become a process of constant transformation. As Waterston noted while studying the Southeast-Asian house, “throughout its life history, from its ‘birth’ to its ‘death,’ the vitality of a house is inter-dependently linked to the well-being, health, and success of its owners and inhabitants” (Waterson, 1990; in Vellinga, 2011:758).

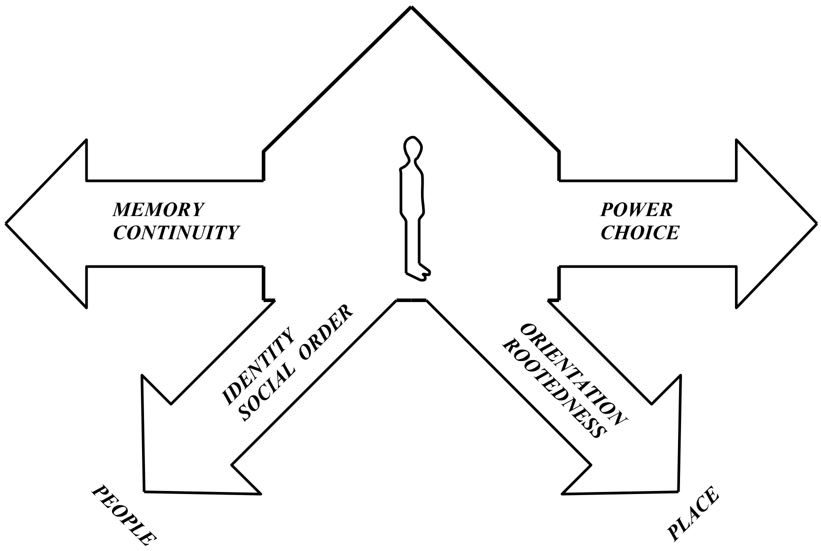
12.1.1 HOME: A THEORETICAL DIVERGENCE

As mentioned earlier, it has been common in the field of architecture to regard the house concerning its physical forms and its understanding as a static object. Such understanding needs to be reformulated to embrace more dynamic concepts of it. However, due to the etymological associations of the word ‘house’ with the aforesaid concept, it is important to theoretically clarify the divergent meaning to which this research refers. The purpose of the subsequent analysis is to look at dwellings from the point of view of the word ‘home’, which significance is understood as a fluid relationship and experienced meaning (Dovey, 1985). The difference might seem subtle; however, it is important to not confuse both concepts. To avoid that, Dovey exemplified it with the sentence ‘I don’t have a home’, which can have two different meanings: either someone that does not have access to a dwelling please or that someone does not feel that their dwelling carries the meaning and experience of home (ibid.). The latter experiential meaning is that of this research’s interest.

While the house may seem to lack alternative dimensions beyond that of the physical space, researchers have usually claimed that home is a multi-dimensional phenomenon (Cieraad, 2010), and as such, the house would be just one aspect of those layers. It is important to clarify here that the spatial quality of the house is ultimately relevant in this research, but it cannot reveal much data by itself. Instead, looking at less visible layers such as the socio-cultural aspects can enlighten meaningful information that eventually encodes people’s material and spatial driving choices. In other words, to propose ‘supportive designs’ (Rapoport, 1983) and contextual building techniques is essential to look at the experiences that create and transform these built forms. Many authors have argued that the physical aspects of home such as location, spatial organisation, materiality and size, are largely influential in people’s relationships and habits. In this sense, both the resultant physical dwelling space and the activities carried out, shape each other (Cieraad, 2010).

Rapport and Dawnson (1998: 8) argued that “home brings together memory and longing, the ideational, the affective and the physical, the spatial and the temporal, the local and the global, the positively evaluated and the negatively”. Therefore, it can be claimed that in looking at dwellings as encoded experiential devices, personal behaviours, cultural norms and desires can be elucidated [Figure 12.1].

For the purpose of this chapter, the house’s physical building is understood as an experiential device encoding relevant information. Such information talks about relations existing between people, their dwellings and the surrounding environment (Rapoport, 1983). In an attempt to find the response to dwellers’



12.1 Framework for analysing home and its connections. Own illustration adapted from Dovey (1985:9)

1- Environmental behavior studies investigate how individuals and groups interact with and respond to the natural and built environment. These studies aim to understand the psychological, social, and cultural factors that influence people's attitudes, beliefs, and actions towards the environment. Amos Rapoport was one of the Pioneer theorists introducing the concept of EBS.

experience within their home environments, this analysis has taken its influence from Material Ecologies and Environmental Behaviour Studies[1]. The impossibility of measuring the meaning of home and the intangible nature of such a concept (Dovey, 1985), has been crucial for determining the use of the ecological approach presented in Chapter 3. Together with this theoretical perspective, the analysis is a result of an ethnographical research that started in 2018. Participated observation and informal interviews with dwellers have been crucial in gaining an understanding of people's meaning of home. More specific information about the methodology applied can be found in Chapter 10.

Several researchers have pointed out that dwellers' personal and social experiences widely influence desires and choice of house designs (Mallett, 2004). In line with this, this analysis has been narrowed down, finding four main aspects of interest: the social, the cultural, the domestic and the representational. These four aspects are defined below:

The social

Social relations are grounded in the physical space in which these happen. In rural settings that usually lack public infrastructures and places for social exchange, the house tends to be the place where many of these interactions occur. The spatial organisation of the house is in many cases determined by social ties, and therefore, home can be viewed as a 'socio-spatial system' in a fusion of the physical house and the social unit (Saunders and Williams, 1988). At the same time, the spatial features of the house (location, size, aesthetical aspect, design) will determine the type of social relations that will be tailored (ibid.), allowing and delimiting different relationships and behavioural patterns. By having this in mind, it can be claimed that both the dwelling space and the relations happening within it will shape each other throughout time.

As for any given society, the social organisation of the Maasai and its resulting relationships are central to the perpetuation of its culture. For this reason, analysing the defining patterns of the home in relation to its social relevance is essential to have a holistic understanding of it.

The cultural

Rapoport (1983) defined ‘culture-specific design’ as an approach that takes into account the cultural norms and beliefs of a group of people. According to him, giving the right value to cultural variables is critical in “defining the nature of relevant groups, describe their lifestyles and preferences and hence help define the nature of ‘good’ or ‘better’ environments for them” (1983: 254). If the objective of design is to create ‘better’ spaces, then one needs to be able to define which are the most important elements of any given culture. He called these ‘core elements’, which should be essential for the identity’s continuity. The core elements of the Maasai culture are of interest here, in attempting to understand how home gives support to these, and eventually, how can such elements be transformed throughout the evolution of traditions.

In the case of the Maasai, is also noteworthy to look at the cultural past, including traditions and rituals, to elucidate how these “illuminate and transform the present” (Hooks, 1991: 147, Massey, 1992: 14). The attachment to culture can be transformative regarding the spatial qualities of the home, whether as a way of reclaiming a nostalgic past or as a form of rejection.

The everyday life

The everyday life of dwellers in their homes is intrinsically related to the socio-cultural norms and values specific to a social group, as well as to the individual cosmologies and understandings of the world. The type of domestic activities carried out at home can be enlightening in itself, providing a deeper understanding of how people dwell. As well, the spatial distribution, inner temperatures and size of a given house can widely impact the development of domestic activities, to the benefit or detriment of people’s well-being.

The typological evolution of the Maasai house exposed throughout Chapter 3 has shown how dwellings have transformed alongside their spatial and material qualities, as well as concerning the activities conducted in the inner and outer home spaces. The changes in the domestic sphere associated with socio-cultural activities and their connections with the environment that dwellers are surrounded by (Ingold, 2000) are central to analysing the adaptability of home spaces and their chances to be transformed over time.

Representation and Identity

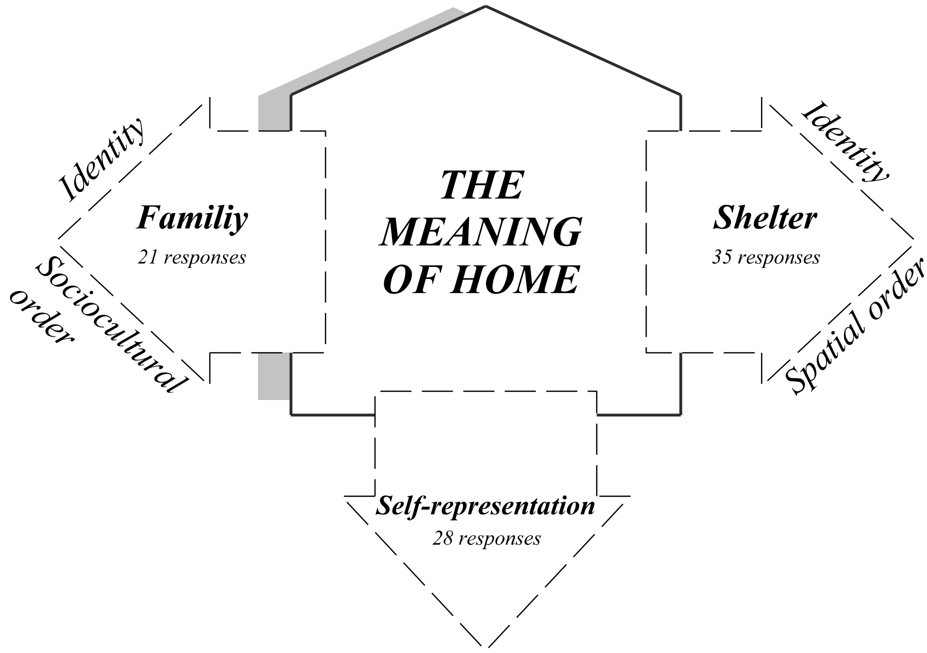
Many have stressed the existing connection between our childhood experience of home and the attitudes and preferences expressed during our adult life (Dovey, 1985, Seamon, 1979). This can be translated into an identarian label that is shown through the forms of our dwellings. Individual identity needs to be formed and constantly negotiated; hence, the qualities of home tend to be transformed parallelly (Mallett, 2004). However, the influence of the past in the formation of identity can be reflected in many different ways, which do not always result in spatial implications. In the present built environment of rural Maasai settlements, identity is shown as a syncretic combination of the traditional Maasai culture and the present development pressures. If identity is constantly reproduced, cultural change and external influences have a crucial role in the shape of people's identity.

The appearance of dwellings is also a result of an identity that wants to be portrayed by the dweller through the use of symbols, materials and forms. Whether intentionally or unselfconscious, the house becomes a screen in which everyone's identity is represented to others. Labels of wealth, power, social status or pride are socially exposed to self-represent certain types of identity.

12.2 THE MEANING OF HOME IN MAASAI CULTURE

The Maasai built environment reflects an ongoing process of cultural linkages between the past and the present of dwellers (Cieraad, 2010). It also reflects social and traditional aspects of the community's lifestyle. Under this mechanism, the reinvention of built forms and behaviours will keep transforming, presumably at an even more rapid pace. As such, cultural hybridisation allows for new spaces to project the future homes, which will be key in determining the ecological implications of the built environment. Taking this into account, beyond the four aspects mentioned above (social, cultural, everyday life and identity), the interest of this chapter is to unpack the current pressures that will give shape to spatial forms and the rise of new building techniques in the near future. In an attempt to find sustainable pathways to solve the housing deficit of the country, it is imperative to pursue a deeper understanding of how dwellings will be transformed, looking at current socio-political and environmental pressures and cultural aspects. The impact of all those forces shapes the 'ideal of home', and unavoidably, these need to be carefully observed and analysed. Therefore, architects, urban planners, engineers, politicians, social scientists and developers should have an active role in including the many implications at the time of designing, to promote appropriate and acceptable living spaces (Chapman and Hockey, 1995).

The following sections will unfold the findings related to the two Maasai case studies analysed in the previous chapter; Maji Moto and Mikocheni. As stated in Chapter 10, a total of 23 households were analysed, while the respective homeowners were interviewed in their houses. Building on these interviews, this chapter is divided into three main categorised meanings of home: shelter, family and representation [Figure 12.2]. Through a dialectical association between homeowners' experiences, opinions and built forms, these sections will unpack the reasons behind the creation and transformation of home meanings.



12.2 The meaning of home for local dwellers has resulted in three key findings: shelter, family and self-representation. Own illustration

12.3 BACK TO THE ORIGINS: HOME AS SHELL(TER)

12.3.1 THE LEGACY OF THE INDIGENOUS MAASAI HUT

For the Maasai, the meaning of haven has evolved throughout time and has taken the shape of a conventional house with foundations only in the last 40 years. Before, shelter would be just a temporary structure to protect people against wild animals and bad weather. Such structures were extremely simple in terms of spatial distribution, as these had neither separatory spaces nor furniture or decorations. The shelter was a refuge in its more rooted meaning. For this reason, the sense of home for the Maasai is very dynamic and fluid and has a strong relation with the surrounding environment, a place where they might spend much more time than inside the hut, which was designed just as a means of protection.

Home is the intimate space where we project our understanding of the world. In contrast to the extensive natural environment that appears to change under its own rules, we are active agents in the making and transformation of the house. The conditions of such making will vary depending on the relationship between people and the environment.

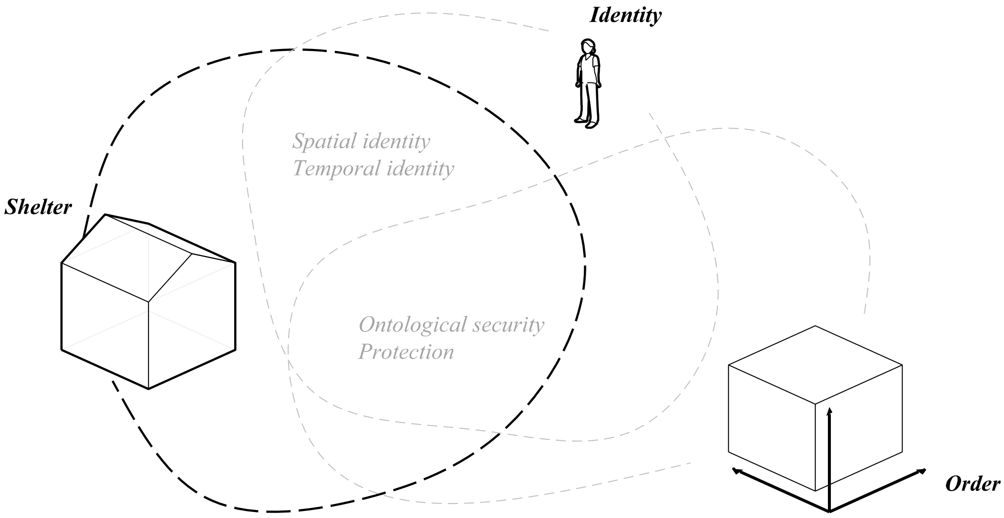
When looking at the spatial layout of the traditional Maasai hut, is remarkable how the walls appear as an impenetrable boundary with almost no openings as a response to the untouched and hostile (outside) environment. The environmental conditions of the Savannah in which the enkaji was originally developed, required such closeness for different reasons. On the one side, extreme weather conditions such as high temperatures during the day, increased by a lack of shaded areas, were incentives to reduce the number of openings inside the hut. In addition, during the rainy season, heavy rainfalls increased by strong winds may penetrate the inner spaces through windows and doors. The enkaji usually has very low walls, which further reduces the height of the doors leaving less space for windows, which in any case were rare due to the dusty nature of semi-arid environments plus a lack of materials with which to build the lintel [Figure 12.3]. Due to its temporary nature and its sheltering purposes, it would not be necessary to create large openings to enable sunlight and fresh air inside. On the other side, the savannah environment is well known for its wildlife. Thus, maintaining the shelter as closed as possible and with a smaller number of openings would help to have a safer and more secure inner space. Such determining factors were not a limitation in itself if we look at the functional reasoning of the Maasai hut. It is only recently that the temporary shelter has become permanent[1]. For this reason, I would argue that the constituent attached meanings of home to many Maasai dwellers are yet to be formed and evolved. This has happened since in the absence of more symbolic or mnemonic meanings, people relate their homes to the idea of fundamental shelter.

1- After the approval of the Villagisation Policy implemented by Former Tanzanian President Julius Nyerere, the temporary nature of shelter shifted, requiring more permanent houses adapted to sedentary lifestyle

Home has been defined by many as "a place where to stay inside". Nowadays, Maasai families spend longer time inside their homes, as their daily practices have fundamentally changed with the shift to a sedentary lifestyle. This condition has created the necessity for a house with a functional layout that enables different activities to be carried out. However, as such process of becoming sedentary started only 40 years back, the attached meaning of home is still very rooted in a primary sense of refuge.

12.3 Traditional thatched round house in Maji Moto, in a plot with other constructions that show different building types. Source: Own picture.

The following sections analyse the importance of shelter within the emergent meaning of home in a dialogical manner that sheds light on the findings of both Maasai communities. Building on Dovey's framework, the Maasai shelter will be analysed concerning Identity and Order [Figure 12.4]



12.4 Framework for analysing shelter in the case of Maasai housing, focusing on order and identity. Own illustration

12.3.2 SHELTER AS IDENTITY

While the existing relationship between groups of people and the place they inhabit can be underestimated, it is never fortuitous, and it requires centuries of adaptation and adjustments in the process of communities' identity formation. Throughout history, societies have adapted their dwellings according to the weather, the available resources, the group's skills and so on. As has been described above, the Maasai are not an exception. The enkaji or nomadic hut is, together with the traditional clothing and the famous dancing ritual Adumu[2], one of the strongest identarian labels of 'being Maasai'. Its shape, materials and aesthetics are deeply connected with the pastoralist lifestyle and the surrounding environment.

2 - The Adumu is a traditional dance performed by the Maasai people of East Africa.It is an iconic and highly energetic dance that holds cultural and ceremonial significance within the Maasai community. The Adumu dance is primarily performed by the young Maasai warriors, known as morans, during special occasions and rites of passage ceremonies.

It has been stated earlier that differently from house, the concept of home means to be identified with the place we dwell. That means that one should be able to see themselves as mirrored by the story of their home, whether with nostalgia, sorrow, relief or happiness. Such strong bonding between people and places has a twofold response: on the one hand, people take their identity from the place in which they live, as well as the place is identified with the dwellers that inhabit it (Dovey, 1985). According to this, not only do Maasai people automatically relate to their traditional hut but likewise, the Savanna landscape in Tanzania and Kenia is merged to the existence of the Maasai.

Such connectedness between these two is both sentimental and affective but also rooted in daily practices. Thus, to understand people's identity projected in their houses, the responses should encompass ideas of 'how' people dwell and 'who' they express to be through the patterns of their dwellings (ibid.). By relying on the theoretical division of home identity as both spatial and temporal, the interviewed dwellers' idea of shelter will be analysed in an attempt to unfold the complexities of Maasai syncretic identity.

Spatial Identity: How we are at home

It is not a difficult exercise to identify ethnic groups and categorise them by their dwelling type and forms. For example, if thinking about nomadic communities inhabiting the Central Asian Steppes, like the Kazakhs or the herder Mongols, we can rapidly connect their landscape to the presence of the traditional Yurt[3]. Such an immediate connection between people, their dwelling and their landscape can be often problematic if just seen as a symbolic label. By no means, indigenous housing types have been a fundamental element in the configuration of the natural environment, mostly because of their direct relation with the sustainable management of the territory. This further nurtures communities' identities by mirroring themselves in the place they call home. However, in the present, the identity of once-nomadic communities is way more complex due to intertwined connections with other groups, the change in lifestyle and the living impacts of colonisation among others. Since the entry into force of the Tanzanian Villagisation Policy in 1970 mentioned earlier, the traditional enkaji has been progressively adjusting its forms and features to suit a sedentary lifestyle. Identity is never static, and it is essential to recognise how the Maasai identity has been transformed to accommodate the new changes in the built environment, with which the community can easily relate. Such adjustments have happened naturally, as the original purpose of sheltering animals and family members at night and against weather events was not supportive enough of the newest lifestyle. For this reason, during the last 50 years, the essential round hut with barely internal divisions has been transformed into a permanent squared house of normally three to four rooms, including a living room. These changes are a result of a shift in the daily activities implicit in a sedentary lifestyle. For example, women and children spend most of their time at home, and as a result, the typical low roof has been lifted to enable the required comfort to move inside. This change in the roof height has forced the whole structure of the house to be modified, having to build more stable brick walls to support the roof structure of timber and Corrugated roof sheets. Also, the absence of openings has been replaced with big windows that need to provide ventilation and daylight in each room of the house. Inside, decorative elements have become common in an attempt to give a distinctive touch of taste, specifically with the inclusion of furniture such as sofas, shelves and tables. Externally, the front wall has been set back creating an open and shaded space, the porch[4]. The space of the porch is usually populated by a set of plants and nearby trees, to provide a further sense of a cool and comfortable space.

3 - The traditional Mongolian yurt, also known as a ger, is a portable and sturdy dwelling that has been used by nomadic Mongolian herders for centuries. It is an iconic symbol of Mongolian culture and a practical structure suited to the nomadic lifestyle of the Mongolian people.

4 - The porch as a form in houses has a colonial legacy that can be traced back to the architectural practices and influences of European colonial powers in Tanzania. Also, traditional Swahili architecture incorporated a porch which as been absorbed by modern forms in the country.

All these rapid changes in family homes have transformed the appearance of the villages' built environment, creating a new sense of identity between dwellers and their houses. It is important to specify here that such a shift in building patterns is more visible in Maji Moto than in Mikocheni, due to the proximity to the city of Arusha and the adaptation of the community to agriculture as the primary means of livelihood. In Mikocheni, where the community is still mostly pastoralist, only around 3% of the families have upgraded their thatched and earthen houses to brick construction with CIS roofs. However, most of the interviewed dwellers are planning to build a new house following the characteristics of the new permanent type of house. Due to the above-mentioned shift in the building traditions, most of the Maasai inhabitants do not identify with the traditional mud house. In fact, amongst the interviewed dwellers, 90% in Maji Moto and 58% in Mikocheni, stated that their homes have nothing to do with the indigenous Maasai hut. Beyond this, the actual Maasai enkaji built with poles and mud and roofed with thatch is seen as poor and backward. "Home as temporal order is not dependent on aesthetic attraction; it may be more accurate to say that the homes of our past set the ground for our very perceptions of attractiveness and ugliness." (Dovey, 1985) According to this statement, some connections can be drawn with the actual rejection of the traditional "Maasai hut" or enkaji, which reminds of the nomadic condition that has been widely neglected by governmental policies, and lately by themselves, by viewing sedentarisation as the only move to a stable, prosperous and comfortable life. The indigenous hut seems to be carried by Maasai communities as an unhealed trauma, creating a sense of rejection from both communities towards the traditional building type. In fact, some dwellers have pointed a sense of pressure from their neighbours to build a new house that is adapted to the current situation:

"I have decided to build a new house. The style of my house does not match the current trend anymore. If you look around, you will see that nobody has this type of round house with thatch and a column in the middle. All my neighbours have changed to build new houses with glass windows. That's why they keep asking me why I have not changed my old house yet. I had to tell them that I needed to concentrate on raising and educating my children so I could not afford to build a new house".

Nayore is a 76-year-old widow who has lived in her thatched house since the early 70s. She feels very proud of finally having afforded to build a house with fired bricks and a roof covered with CIS [Figure 12.5]. With the new building, she will not have problems with water leaking during the rainy season, but also, she will be able to show the growing shared identity of the community. She also expressed her disappointment with her house, for which she is not happy, but she has stayed in this house for long because it has sheltered her. Most of the dwellers who have not managed to upgrade their houses by integrating more durable building materials have described their homes as mere shelters, only useful to protect them at night. In those statements, there is in part resignation, but also hope of a better home in the future. Likewise, when asking wealthy homeowners what they think about the traditional Maasai hut, they understand

12.5 Nayore's grandchildren playing in front of her thatched round house, where the new house with fired bricks that she is building can be observed. Source: Own picture

that people living in these mud houses just need to overcome a temporary period until they can move to a 'modern house':

"I used to live in a mud house when I was a child. But now, look at my beautiful house. I think mud buildings are needed because they shelter people before they can afford to build a new house".

In this way, the traditional enkaji is seen as a supportive structure for some community members to have a shelter where to be protected from external threats, but it is intended to be transitory, and therefore, to disappear. When looking at the ethnographic data, one realises that do not only those living in mud houses still relate their home identities to a sense of refuge, but also most of the dwellers who have improved their houses do. Jhon, a 74-year-old male living in a three-bedroom house built with care and much effort [Figure 12.6], puts it like this:

"My house means a lot to me. Since I live here, I haven't had any problems because now my house gives shelter to me and my family. In the end, a house is a place to shelter someone, because if you don't have a house is like having nothing".

During the interview, which was conducted on a large, shaded porch with many ornaments, he talked about the nice yellow colour of the walls, the space of the living room and the interesting view of the green surroundings from the windows. Jhon's house was nurturing his life far beyond the fact that it was sheltering him and his family, yet because the experience of home is usually unselfconscious (Dovey, 1985), all those nuances might have gone unnoticed. Processes of identity formation require time and repetition over generations,

12.6 Side view of Jhon's house and floor plan, where the external porch and vegetation can be observed. Source: Own picture

mostly in cases in which your immediate elder generation, or even oneself, has not experienced home as a permanent element before. Home grows in a place by the impact of multiple forces, both personal, circumstantial and social. Also, the place itself and its environmental conditions influence how a house becomes a home. Therefore, home is place-based, and the surroundings are also a key element in the formation of dwellers' identity.

As the data analysis revealed, despite the unequal variety of buildings that dwellers were inhabiting, almost all of them referred directly or indirectly to home as an important element of refuge. Yet as a conclusion I may claim that the relatively short period since when dwellers settled permanently leaves very little space to fully grasp the lived experience with their homes beyond the very meaning that the traditional hut had for their nomad ancestors: a shelter. Home as a permanent experiential device is being explored just recently, and so the possible spaces, forms, uses and ultimately identities, are yet to be discovered and transformed.

Temporal Identity "Who we are and where do we come from"

"Growth of identity is more than a search for a form that reflects a static self-image; it is dynamic and may indeed actively resist equilibrium" (Allport, 1955; In Dovey, 1985)

The identity of the Maasai dwellers analysed in this research, and most probably that of other indigenous groups in the country, is in a continuous process of evolving and becoming. The reason is the recent lifestyle alteration to which many communities are still struggling to adapt, in a flux of tensions between the adoption of new practices and the refusal of others. This can be witnessed when looking at the Maasai youth who dress up with jeans during the day and with the traditional Maasai clothes in the evening and for special events. Also, high levels of syncretism bring into light how throughout religious practices, males marry only one person following the directions of Christianity but can marry as many women as they can afford[5] by the Maasai tradition. Likewise, the evolution of the Maasai hut into modern housing forms is a tangible example of this process of becoming.

5 - In Maasai tradition, the number of wives a man has is often associated with his wealth and financial status. Polygamy, a common practice among the Maasai, allows men to have multiple wives. The ability to support multiple wives is considered a sign of prosperity and social standing within the community.

6 - Due to the nature of the materials used to build the huts, the remaining of those natural materials would again become part of the landscape, being disintegrated by the rain, remaining no sign of these.

To understand this, it is important to look at the changes that have happened in the last 50 years. Before the 70s, sheltering structures were built with the available material resources and within a few days. After some months and following seasonal changes, these huts were abandoned[6] by pastoralist families, who had to move to other places in search of pasture and water for the livestock. Such continuous changes of shelter and the natural environment have influenced the temporal identity that the elderly have attached to their homes. For those who have recently moved to houses built with concrete blocks, cement and CIS, their memories can only be connected through a resemblance with the landscape. Thus, the natural environment remains the mnemonic anchor in an active seek to connect past memories and the present environmental experience (Dovey, 1985). In fact, many elder have expressed how they continuously keep their traditional culture alive by taking part in Maasai ceremonies and with the use of storytelling. It can be claimed, therefore, that the modern houses that are built in the present by many neighbours of both villages do not encapsulate the memories of their nomadic past as such. By contrast, it can be hypothesised that in the near future, young generations that have grown up in the same house will have attached such temporal identity of their homes to the future projection of their lives.

If we understand memory as a vital element in the shaping of the built environment, it is revealing to witness how the memories of an un-wanted past, have given form to the actual built environment. In other words, the rejection of the image (rather than the essence) of the nomadic hut, has had an active role in protecting the taste and dreams of a community that believes that pastoralism is outdated and counterproductive. Many interviewees have expressed their concerns about their lifestyle. When asking Koixane, a 19-year-old male from Mikocheni, whether his house (squared, concrete blocks, blue painting, and CIS roof) represented or not the Maasai tradition [Figure 12.7], he answered:

"My modern house actually represents a lot. The Maasai are developing. Maybe it does not represent the traditions itself, but it shows that having a house like this is a form of development for our community. We, the Maasai, want to move from our formal traditions and nomadic lifestyle to the use of modern practices".

12.7 Koixane's house stands out amongst other houses in Mikocheni, as it has been built with the most trendy technologies and materials. In picture, back front. Source: own picture

With this statement, he wants to highlight that it does not matter if his home mirrors or not a state of 'being Maasai'. What is important is that his new house shows a desire to take distances with the representation of their traditional identity throughout the built environment. Here it is crucial to clarify that this reasoning does not mean a rejection of the Maasai traditions. Being Maasai is a reason for which to be proud and the community keeps bringing it to the fore through other mechanisms such as their age groups, rituals, traditions and family structures [Figure 12.8]. Social relationships are essentially connected to the Maasai tradition. During the collection of the ethnographic data, it was witnessed how this thought was commonly widespread in the community:

"My house does not represent the culture of the Maasai people because I have built it with fired bricks, and it has a tall roof and lots of windows. However, I can say that I am the one continuing my culture. I usually take part in the rituals, by singing and dancing. The house is not the culture. I'm the one who has the culture, and my traditions".

Together with cultural practices, many of the daily activities carried out by settled Maasai are still deeply rooted in the pastoralist lifestyle, such as their diet and their main source of income, associated with the number of livestock owned.

Sensorial memories of a childhood surrounded by smoke, dust and darkness have been key in pushing to a non-return point regarding the forms and identity of the built environment. Throughout interviews with homeowners, it has been highlighted the importance of some elements such as windows, paved floors and building kitchens outside the main house. As well, the shift to a sedentary lifestyle has put into perspective the benefits of settling down:

"My parents used to move from one place to another because of their cattle. They did not give value to owning land, they just valued cattle. Then I came to Maji Moto and started growing my family. I thought about moving around like my parents, but I realised how important is to be in one place for the stability of my family. So, I decided to settle in a plot that the government had offered to me. Since then, I understand the value of having owned land".

Such a statement puts into perspective the importance of land ownership for the villagers of Maji Moto and Mikocheni. Nomadism implies a sense of insecurity and poverty from which families have struggled to detach with endless efforts. Maasai community's past is just a nostalgic memory of a time that they do not desire to go back into but which resulting culture is truly valuable.

As a conclusion, it has been put into perspective how the built environment is transforming together with its inhabitants to match their new needs and desires following a profound disruption of the community's pastoralist lifestyle. Following Allport's theory of personality (1955), identity is not a finished product, but rather a transitive process. While it can be grounded on solid attributes, it can never be static. For this reason, home as a temporal identity cannot be limited to the understanding of the past or its connection with the present. In fact, when asking to homeowners if they were considering building a new house, 80% would reply yes. Such a response unfolds a desire for progress and the projection of people's lives into the future. In this sense, home is also an essential element of this connection of people with their future. Home centres homeowners and their lives to project a stable future by adapting to new situations and life views.

12.8 Cattle is taken out in the morning for grazing in Koixane's boma. Source: own picture

12.3.3 SHELTER AS SPATIAL ORDER

One of the main features defining spatial order is the existing dialectic between horizontal/vertical and inside/outside. The experience of home implies both of these, as it is spatially constructed by vertical walls in a horizontal land, serving as a separation from the outside, the unknown, the danger, and the otherness. Such a barrier between both worlds gives the concept of shelter the primary aim of being a secure place (Rainwater, 1966). To be safe from unpredictable external threats, a very simple construction that physically protects you against such threats can suffice. Thus, shelter is the primary manifestation of the house. A dweller might take a long time to create a place to be called home, to adapt their taste and needed comfort to a new place, but a basic walls-roof hut will serve as a shelter from its very construction. The traditional Maasai hut has been serving this purpose for thousands of years. Its very simple spatial arrangement, with barely internal divisions and windows, creates a specific sense of refuge in which the walls are the separation between the safe manageable space and the vastness of the world. Such difference between the inside and the outside gives order to our lifeworld and create borders and differences (Dovey, 2005). The sense of shelter enclosing one's property boundaries shapes the domesticity of in-wards spaces, both within the external fence of the house and the building itself [Figure 12.9]. This dialectic dynamic stimulates the idea of otherness in our built environments. The fear of entering the unknown defines the boundaries between inside/outside, safety/danger, familiar/strange, private/public, home/journey and self/other (ibid).

If we look at the dweller's experience within their homes and built environments, the notion of home as being 'inside' in contrast to the 'out there' environment

12.9 Front area of a family compound in Maji Moto, denoting appropriation and intentioned creation of comfortable spaces. Source: Own picture has been widely highlighted. In both communities, people feel that home is a safe place where to arrive when they are carrying out outdoor activities such as working, travelling or socialising. Gabriel, the chief of Mikocheni, puts it this way:

"My house is very important to me, because is the place where I reach when I'm outside. I plan my life inside and get out to go for work.
For me, home is the place where I loosen up myself. When I come and night and get inside, I sleep and rest with my children and wife".

For Gabriel, home represents the unmovable reference of his life, but beyond this, it seems that home is the only calm and safe space that enables him to visualise and organise the 'outside's life'. When he talks about home as a place where he can 'loosen up himself' he is referring to a sense of freedom and privacy that serves as the needed filter between himself and his social life. Such dichotomy reinforces the essential meaning of shelter not only as a protective roof-wall construction but as a place from which we tailor social relationships as well as our own identity. Another interviewee said:

"My house has a big meaning, because is my resting place at the end of the day. In my house I can sleep in peace with my family".

The house is a supportive device needed to carry out daily activities. If essential physical needs like sleeping or resting cannot happen in a safe comfortable place, how will the family thrive and be able to work and accomplish essential daily activities? Therefore, home is a vital element in the development of our life, both inside and also as a preparation for the external environmental experience. As Bachelar stated, "A house is imagined as a concentrated being. It appeals to our consciousness of centrality" (Bachelard 1969: 4). Home becomes the centre of life, the place where to always come back, reinforcing the importance of an own peaceful space that keeps people rooted to a specific environmental experience.

Shelter = ontological security of ownership

"My house is a place where I sleep inside with my children, so I don't have to go to someone's else to sleep. I really like that I can live inside. Because if I go to someone's else house and they chase me, where would I go?".

For Kalija, whose house was built by herself 20 years ago, the ownership of her place is a crucial element, as the only way of ensuring that she and her grandchild would have a place where they can safely live. She continues highlighting with fear the possibility of having to beg for a roof where to sleep. In rural areas, it is common for dwellers to have ownership of their houses[7], alongside agricultural lands owned by the family's clan. However, women can sometimes be subjected to a lack of house ownership. As explained in earlier chapters, in the Maasai culture, only male children inherit a plot in the family's compound, where they can build their houses. This cultural practice puts women in a weak position when for example they have been widowed while living in their husband's compound. Magdalena, a widow who had to strive to build her place where she

7 - These were initially built with very scarce resources but in the latest years they have been able to slowly implement these whenever they have the financial capacity.

could be at her ease tells us the following:

"I'm happy because I'm in my own place and I don't get any type of disturbance. I once got into trouble because I was living at my in-laws, but we were constantly arguing so I decided to stay far from them. They started to sell my animals and I was not at peace. So, I came to build here and now I am happy with my house".

Another widow interviewee, who conceives her home as the anchored place where to peacefully live and grow her family, said:

"My house represents me, because if I didn't have it, where would I live with my family? In the way I see it, having a house means having shelter for me and my family".

Without a secure ontological centre, as the refuge of home is, the journey of raising a family becomes obscured and threatened. Most of the rest interviewed families, both in Maji Moto and Mikocheni, have expressed an instinctive feeling of being protected and sheltered by their homes. Here is important to clarify that the sense of shelter attached to people's houses does not mean that all of them are happy with the conditions of their houses. Many have reinforced the idea of 'home as shelter' with resignation, as the only positive argument they could make about their houses:

"I don't like anything about my house. I just built it so I can sleep inside, which means that I don't have to sleep outside".

Elisabeth, who lives in a wattle and daub house with a thatched roof, could not mention anything she liked about her house, apart from recognising that ownership gives her the security of sleeping under a roof. Again, here it is highlighted how basic needs such as sleeping in a safe place are sometimes the only pushing force to build a house that will not be as one wishes. Another interviewee said:

"I live inside, I stay sitting inside, and also sleep here. Me in my room and my wife in her room. When she wakes up in the morning, she cleans the house, prepares tea and then we sit to drink it. I just like the fact that I'm living inside. If it's bad or dirty, I can't do anything. I just have to live with what I have".

Moses, the eldest interviewee in Maji Moto, gave up a long time ago when he realised that his children would not build a new house for him. His words express the necessity of a daily life routine, essential to creating bonds with the place that he inhabits. Here is interesting the reiterative importance of 'living inside', although he might not be happy with his house, it is still an owned protective shell against the unsettling feeling of the external environment. Thus, creating a home becomes a "process of establishing the sense of home as a 'calm and stable centre' which keeps the forces of chaos at bay" (Dovey, 2005).

Shelter = protection from external threats

Another factor influencing people's attached meaning of shelter to their homes is the climate condition of the area. Heavy rainfalls that usually happen between mid-May and June force the community to get prepared and equipped to protect their houses against leaks and floods. Due to the lack of water collection systems such as wastewater pipelines or gutters, several flooding events are happening in both communities. Especially in Maji Moto, in addition to the lack of public infrastructures, the rapid desertification of the land is increasing the number of river overflows that further affect the populated areas. In the dry season, by contrast, high temperatures during the day reaching up to 32°C force people to stay at home during the hottest hours of the day. Also, due to its proximity to Mount Meru and the surrounding rainforest, nights can get very cold, up to 11°C from June to September. Such climatic factors increase the need to provide proper shelter for the community. The aforesaid weather threats are key elements in determining the material and spatial arrangements of the house. Martha, who recently built a house changing the thatched roof with corrugated iron sheets (CIS), said during an interview:

"I feel in peace in my house and I can sleep in a good place. Since I have the new CIS roof, rain is not dripping on me anymore".

She explained that before having a CIS roof, she might be awakened at night by water leaks. The thatched roof house in which she was living before was very comfortable during the dry season, as temperatures inside her house were optimal compared to the current house with a CIS roof. However, her point was clear; how can you feel safe at home if you are scared whenever the rain comes? This is probably the reason why many dwellers raised a point regarding the sheltering purpose of their houses. Another interviewee said:

"I like the peace of my house. If I am here, I would not have a problem of lacking shelter, which means I don't get rain at night and I have good ventilation. Also, now I don't have mosquitos at home".

Home as a refuge must protect against weather inclemency to its inhabitants. It is interesting to note how both interviewees mentioned the word 'peace' when referring to the feeling they have at home when outside is raining. They feel at peace because they have a safe space protecting them from what happens outside the walls of their houses. Here, the dialectics between inside/outside reinforces the idea of home as a device separating bodily experiences from the surrounding world. In Dovey's words (1967) "the underlying structure of home as a spatial order lies in its role as a centre of our spatial world with a sense of verticality and horizontal access". If we cannot trust the centre of our spatial world due to lacking a minimum condition of safety and comfort, the only feeling that a dweller can have to its dwelling becomes fear and rejection, as another interviewee puts it:

"I've not completed the construction of my house yet, but even when it rains now is better and I can sleep in peace with my family. Before, our house was giving us trouble. The rain might come, and the family might be forced to run to the forest, because the building would be falling, becoming thus a danger for the people living inside".

In general, most of the interviewee dwellers who still live in houses with wattle & daub walls and thatched roofs, have claimed to feel unsettled in their houses. The lack of trust and safety implies having an insecure spatial centre that is translated into uncertainty in other aspects of people's lives. Thus, the primary cognitive tie to home, before further enabling attachments to memories or belonging, it is represented by the concept of refuge. A house cannot be called home if such essential conditions are not met, as seen in the examples in Figure 12.10. In recent years, most of the community members have managed to improve their houses to meet those requirements, whether by changing the roofing materials or by building stronger walls. I believe that this is the reason why almost all the dwellers have expressed a feeling of refuge in their houses. Once essential conditions have been met people can partially become conscious of other body-space feelings attached to their places in the process of 'becoming of homes'.

12.10 Due to the lack of continuous maintenance, mud houses built with the wattle and daub technique fall apart in Mikocheni. Source: Own picture

12.4 A FAMILY CAPSULE, HOME

12.4.1 HISTORIC RELATIONSHIPS BETWEEN HOME AND FAMILY IN THE MAASAI CONTEXT

Literature about home has usually been associated with family and kinship. Many researchers have noted this relationship throughout history (Mallet, 2004; Bowlby et al., 1997; Memmot, 2015). The home space is the 'first universe' in which newborns create their understanding of the world (Bachelard, 1969). This meaningful first contact is in many cases responsible for shaping people's behaviours and needs, and thus, the family house(s) becomes the symbolic reference where children are nurtured and grown up until they can depart and live independently (Jones, 2000). The case of Maasai children resonates with this idea, though extending the home space to the boma or compound surroundings. The strong ties existing among different households of the same family create a sense of security that allows children to be constantly moving around relative's houses, especially their grandmothers', where they spend long periods. Throughout childhood, they learn the family codes of respect and domestic responsibilities, and they are introduced to traditional practices and rituals that mostly happen in the family compound.

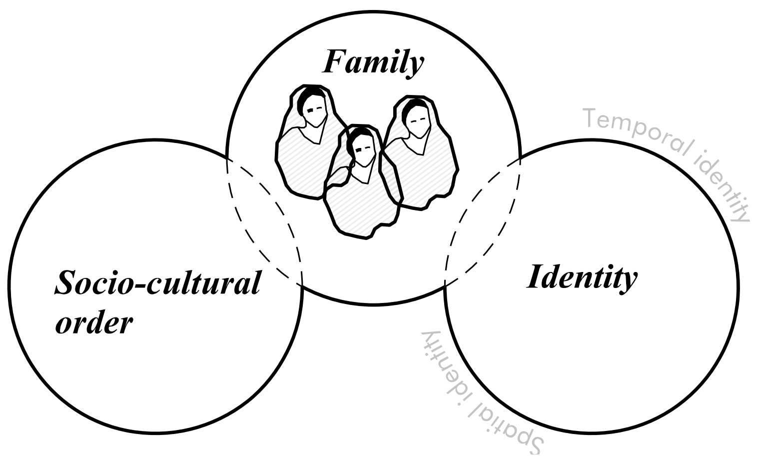
According to the Maasai tradition of age sets, boys who conclude their period as Murran (Warriors) and become elders, should ideally get married (Coast, 2000). However, their ability to marry depends on their economic capacity, as they need to establish an independent household and own livestock. At that point, the just-married wife would leave her natal home to live in the husband's boma (ibid.). Normally, women would spend a long time building their own houses, and therefore, they might spend up to two years at the house of their mother-in-law. In fact, in Maasai tradition, the house represents a matrifocal unit in which women are the heads of houses (Talle, 1987).

As was stated in Chapter 3, the role of women as the main builders of their houses has progressively been neglected, and nowadays are young Maasai males the ones in charge of providing the means for masons to build their houses. In fact, it has been witnessed a rising competition among young males to build the most attractive houses as a step forward to finding a wife[8]. Such a dynamic has increased the families' pressure on unmarried males to complete their house, which will give them more possibilities to find a girl to marry with. This tendency has been more evident in Maji Moto, where most of the houses have already been built by bricklayers with the husband's savings. Young boys are usually given a space to build their own house in the family plot, behind their mum's house, and in case there is not enough space, they will be allocated in plots near the family compound. For most Maasai men, building a house and to an extent a family, is a reason for pride which allows them to elevate their social status amongst the local community. This is particularly effective if the man has built a house which looks 'modern' by using industrial materials such as cement blocks and coloured roof sheets. By contrast, is important to note that moving to a new house is not always a reason of happiness for women, who in some cases are forced to go away from their parental house without their consent. Women are not legally owners of their houses; however, they have most of the domestic responsibilities of the house (Eisenstein, 1984). Despite women are usually the ones shaping the home spaces, "they often lack both authority and a space of their own within this realm" (Munro and Madigan, 1999; in Mallet, 2004: 75). Thus, the new family house may become a site of oppression dedicated to reproductive and domestic labour (Eisenstein, 1984).

8 - The rate of Maasai men who marry more than one women has been drastically reduced, becoming an uncommon practice among young Maasai, despite their parents' practicing of polygamy. This is due to hybridisation and absorption of modern practices.

The process of building a home, whether following the traditional ritual of builder women or by young males, highlights the importance of having a house as the first step to creating an 'own' life outside the family house. The process of marrying and moving to the new house means creating new family norms and having the freedom that is lacking in the natal home. There are some cases in which couples have their first newborn before owning their house, but this is a rare case. Thus, home becomes a new life cycle in which the family will raise their children until they leave to start a new one. This is probably the reason why most of the dwellers in Mikocheni and Maji Moto have related their homes with family during the conducted interviews.

The significant relation of home with family for Maasai dwellers also represents and reproduces the heterosexual family stereotype; whether traditionally polygamous or nuclear in the present. The materiality and symbolism of the Maasai house encode gender roles and specific relationships that not everyone necessarily feels comfortable following. This has created a sense of pressure on Maasai youth in search of pursuing higher education or with the desire to find a better quality of life elsewhere. Migration to urban areas is becoming increasingly common among Maasai men (Coast, 2004) who migrate to urban areas in search of better-paid jobs. Also, since Tanzania became a popular tourist destination around the 80s (Anderson, 2013), many Maasai have migrated to areas such as Zanzibar and Dar es Salaam. An ethnographic account made by Hooli (2017) concluded that more than one thousand Maasai men seasonally migrate to Zanzibar searching for better opportunities. This rate keeps increasing, affecting also women who can find the opportunity to study or work elsewhere. The current migration flow in Maasai communities and the yearning for development is changing the traditionalist pattern of family structures, becoming considerably irrelevant (Wardgaugh, 1999). Hence, it is suggested that the attached meaning of family to home might be losing its strength as many youths might form other types of households equally pertinent. At the same time, the importance of family might be essential to the lived experience of home for many dwellers, but for others might be less powerful. The following findings that relate home with family have been divided again into two parts: Identity and socio-cultural order [Figure 12.11]



12.11 Framework for analysing family as one of the key findings of home's meaning (identity and socio-cultural order). Own illustration

12.4.2 FAMILY AS IDENTITY

It is widely known that our childhood and the place in which we live while we are growing up, somehow defines who we are in the world (Dovey, 1983). The natal home embodies the symbols and worldviews that will shape our identity. Within this process of identity formation, the family plays an important role during childhood and adolescence. The Maasai dwellers at whom we are looking have pointed out the intimate relation existing with the dwellings they inhabit and their families. Of the total number of interviewed homeowners (23), 12 of them have pointed out a family in one way or another when asking about their homes and what it represents to them. Out of the 10, 5 people were from Mikocheni and 7 from Maji Moto. Most of them were married family men or women with an age above 35 years old, whose households were composed of between 4 and 8 family members.

Temporal Identity

The relation between family and home was noticed at the very beginning of the ethnographic data collection, when homeowners were asked: How would you describe your house? and around half of them replied: Do you mean to describe my family? The first time it felt that the question was not formulated properly, or that they were not used to that kind of question. Indeed they were not. However, the 'problem' comes with the word itself. If we make a quick search for the meaning of home in English, the issue would be easily clarified. These are some of the meanings of home given by the Oxford English Dictionary (2022):

> 1- the house or flat that you live in, especially with your family
> 2- the town, district, country, etc. that you come from, or where you are living and that you feel you belong to
> 3- a house or flat, etc., when you think of it as property that can be bought and sold
> 4- used to refer to a family living together, and the way it behaves

The first definition contains the word 'family', but the fourth definition creates a strong connection between home and family. This connects to dwellers' response concerning family when asking about home, denoting that it is not fortuitous. Although, as exposed in the methodology section in Chapter 10, the interviews were conducted in Swahili using the word nyumba (house) in the abovementioned question. After several interviews in which the question had to be reframed or further explained, the word nyumba had to be exchanged by jengo, (building). To our surprise, even after reframing the question to: How would you describe the building in which you live? many dwellers directly related it with an explanation about their family. For some authors, the existing connection between home and family is almost indivisible (Crown 1989; Bernardes, 1987). More explicitly, they claim that when the meaning of the two is overlapped, home usually symbolises the birth of the family. The following transcript is the beginning of an interview with Jesse, a 43-year-old family man from Mikocheni who was asked to describe his house:

12.12 Within Jesse's plot, the house on the left side is being built with concrete blocks, where the family will move after completion. Source: Own picture

"I started building my house in 1996, before I got married. I was still young, and I was struggling because I had no money. I used the little resources that I had to make big sacrifices to build my house. I did it step by step and slowly, until 1998 when I managed to roof. In November 1998 I got married. I built it with mud because my income could not allow me to build with normal bricks. I started my family in this house. So here I am with my wife and 5 children. Now I am building a bigger house with concrete blocks where I will be able to relax with my family because I saw that this is not enough".

From the description, it can be appreciated how the story of Yesse's life, and the construction process of his house are emotionally bonded and for so, detaching one from another would erase its meaning. For him, getting married was only possible after affording to build the roof, and finalising his house was the starting point of a family formation. The house symbolises the temporal identity of its owner, through the memories of struggle and success, and the pride of a family that due to its size needs to be upgraded [Figure 12.12]. In looking at the difference between the two houses, one might think that these are a mirror of people's history and identity. It has been identified that the relationship between home and family identity is widely evoked by connections with the past and the present. Another interesting finding is that many dwellers refer to their homes as the place where 'they have started life' as if the period previous to marriage was not relevant. This understanding can be the result of the Maasai tradition, which prioritises marriage and the formation of a family over other lifestyles. In fact, male social status is deeply connected to the number of children that one has, and therefore people feel that they are only 'settled' when they raise their own family. Additionally, it could also be because permanent housing is a relatively recent phenomenon which does not allow connections of their homes with childhood memories.

The memories of people within their house environments are crucial in defining the experience of home, and those experiences are continuously revised and made alive. But memories are not always positive events. Also, past traumas can widely impact the perception of home and safety, which can lead to the refusal of their dwelling. The feeling of unsafety and rejection regarding the home environment was very present in Moses' words, who claimed the need for a newer house where he could forget about a traumatic experience that put his family at risk. Moses lives in one of the first houses that were built in Maji Moto after the community settled down in the 70's. It was built with adobe bricks and it still stands with a very thick thatched roof [figure 12.13]. He stated that when he looks at his house, the only thing he can see is his failure because while others have improved their houses, he still lives in a building that can be harmful to him and his family. In the impossibility of improving what once was dangerous for him, he continuously revives that traumatic moment that will always be part of his memories and is imprinted on his identity.

Home as temporal identity is not only linked to memories of the past but is also connected with the future. If identities are in continuous transformation, then the freedom of acting upon our home environment and changing it enables the continuity of one self-identity and representation. When a dweller can think about adaptability strategies to fit such identity transformation, there is a feeling of freedom and continuity. According to Dovey (1987: 8) "the growth of identity requires a certain freedom of interaction between present and future, between our experiences and dreams. Knowing that we have the power to remain in a place and change it permits us to act upon and build our dreams".

12.13 Moses's house side view and plan. To note the low height of the door and roof, due to the requirements of the thatch structure. Source: Own picture

This resonates with Beatrice's hopeful statement:

"I am happy in my house because I don't owe a rent and I can be in my place. Also because even if I don't have the house I wish, I am thankful because god gave me children and my man is alive to date. I am not successful yet, but I am on my way because I have my family by my side".

Despite she has not been able to improve the material and spatial quality of her house, she thinks of a future in which, together with her family, she will be able to make the changes she desires, such as plastering the walls with cement or paving the dusty floor of her house. Here, the family support is the moving mechanism that allows Beatrice to keep dreaming of a better house. However, because the dynamism of identity goes beyond built forms that reflect a 'static self-image' (Allport, 1955), future expectations might change according to an evolving identity, thus resisting equilibrium.

Spatial Identity

The representation of identity through built forms stems partly from the social structure of a given group. Not surprisingly, the Maasai population is structured within family clans[9] and kinship relations are key in defining Maasai social structures. As it has been noted earlier, the social status of a man depends on the number of children that he might have. Despite its progressive decline, even the number of wives is a sign of social status, as the wealthier men are, the more women they can afford to marry. As such, the spatial forms of the Maasai dwellings in Maji Moto and Mikocheni depict the ideal of family in its forms and arrangement. For many dwellers, owning a house where they can feel safe and protect their family members is the ultimate sense of pride that they can feel. In line with this, home means security and continuity for the household, a meaning that is embodied in the spatial forms of the building and which gives homeowners a sense of identity. Martha, a 49-year-old woman from Mikocheni, puts it this way:

9 - Clan is a group of people who recognise descent from the same ancestor. Amongst the Maasai, clans are patrilineal; a child belongs to the clan of his father and remains a member for life. Membership of Maasai clans is possible for non-Maasai through ritual incorporation. The Maasai clan system is complex and incompletely understood by external authors. (Coast, 2000)

"My house represents me with respect because my family can sleep well at night and if I get visitors they do not get burnt by the sun. During the rainy season, the rain will not leak on my kids, so for that reason my house gives me a bit of respect".

Many other dwellers from both communities have stressed the importance of having the house that any family would deserve, where to be comfortable and protected. The indigenous past of these neighbours' villages is deeply present in today's perception of homes and affording a house where to be protected from the outside weather is viewed as a sign of respect. This feeling is mostly shown by homeowners with corrugated roof sheets and walls that have not been built with traditional earthen techniques. The place where people dwell embodies the strength and capacity of the head of the house to provide appropriate shelter to their families. This is translated in a sense of pressure and anxiety for homeowners, both to ensure the actual comfort of the family but also because of the status that they will portray in society. Such pressure becomes increasingly evident for mid-age adults that beyond having to ensure their children's comfort, have to take care of their elder parents who do not have the economic capacity to renovate their houses. Most of the elders in both villages are widowed and/or do not have any income, so they become fully dependent on their children. Benjamin, an 89-year-old man from Mikocheni, pointed out how his children helped him to build a new house:

"I used to have a small house and it got destroyed after heavy rains. At that point, my children decided to build a new house for me. All my family contributed to buying the materials. It was built with timber and then roofed with thatch. We moved into the house after filling and plastering the walls with mud and cow dung".

For Benjamin, the meaning of his house has a powerful relation with the gratitude of his family for helping him to have a new house. Despite he would have liked to roof with corrugated iron sheets, he claimed to be used to his thatched house that keeps very good temperatures inside. It is common to find the eldest neighbours in both villages living in houses that do not make use of industrialised materials [Figure 12.14]. However, elders play a crucial role in the support of their children, as they usually take care of the grandchildren during periods in which parents are working intensively. This is the case of Benjamin, who lives with his wife and three grandchildren in a two-bedroom house.

Differently, other elders who were interviewed and who live in old-thatched houses usually pointed at the investment in their children's education as one of the reasons why they could not move forward and afford a better house. Nayore and Moses (76 and 92 years old respectively) put it this way:

12.14 House of Benjamin surrounded by his children's houses, some of them improved and built with CIS. Source: Own picture.

"I'm expecting to get a better place, but children can finish with all your wealth. If someone does not have children, can save to have a better economy. But in my case, I have children who even went to university. How could I afford to build something better? So, I decided to bring them to school, hoping that they would manage to come back and build something better for me because I don't have the capability and I depend on them right now". (Moses, Maji Moto)

"My elder son built the house structure and after that, I filled the poles with mud. We called someone to roof the house with thatch. It was 1970 and I was just having my third baby born. I could have upgraded my old house before but staying here helped me a lot to raise my children. Now I am happy that they are building a new house for me with fired bricks". (Nayore, Maji Moto)

Both of them are the last neighbours of Maji Moto still living in a thatched house. Fortunately, Nayore's young daughter is now giving back her help by building the house that she has always dreamt of. Is interesting to note how for both, the factor that impeded them from building a newer house was their choice of using their income in educating their children. Especially for Nayore, who mentioned that 'the house helped her'. Her house almost seems a supporting structure in the upbringing and development of her family. It is not surprising that their identity is somehow shaped by family constraints and their house is the mirror in which they constantly remember that. Identity finds its roots in the environmental experience of home, and despite this experience having been transformed throughout time, the family struggle has been key in defining the spatial and material quality of the house, and therefore, it is part of the identity and meaning of their homes.

12.15 Bushes enclosing a family boma in Mikocheni after rainy season. Source: Own picture

12.16 Traditional fence enclosing a family compound, made with locally sourced poles in Mikocheni. Source: Own picture

12.4.3 FAMILY AS SOCIO-CULTURAL ORDER

Earlier in this chapter, the difference between the concepts of house and home was discussed and unfolded. While the house tends to refer to the actual building, home is a relational experience that defers from place to place, in every culture and within each family. The latest is probably one of the most crucial aspects influencing the spatial quality and uses of the house, which in turn, are informed by socio-cultural specificities. Some researchers have claimed that without the family, a home is nothing more than a house (Gilman, 1980; Leonard, 1980). As such, home becomes the shelter of family dreams and provides the members with a sense of stability and order (Mallett, 2004). Family norms and behaviours are impressed in the layout of the house environment, which is shaped by cultural beliefs and social activities (Dovey, 1985a). In addition, the type of environmental setting including weather, landscape, external threats, etc, are key in framing socio-cultural practices within the familiar sphere.

According to Dovey (2005), the spatial order of dwellings is mainly socio-cultural. Historically, the home has been the place in which families have thrived and created their own set of rules. As was already explained in Chapter 3 about the Maasai traditional organisation around bomas, houses are arranged at the right or left side of the cattle fence according to the number of wives of the patriarch. Since families have been allocated with individual plots, like in the case of Maji Moto, the boundaries of each plot are made visible through wood fences or trees [Figures 12.15 and 12.16]. However, through kinship norms, relatives living in other plots are allowed to cross by in case they need to. Thus, the external boundary remains such for externals but does not have value for

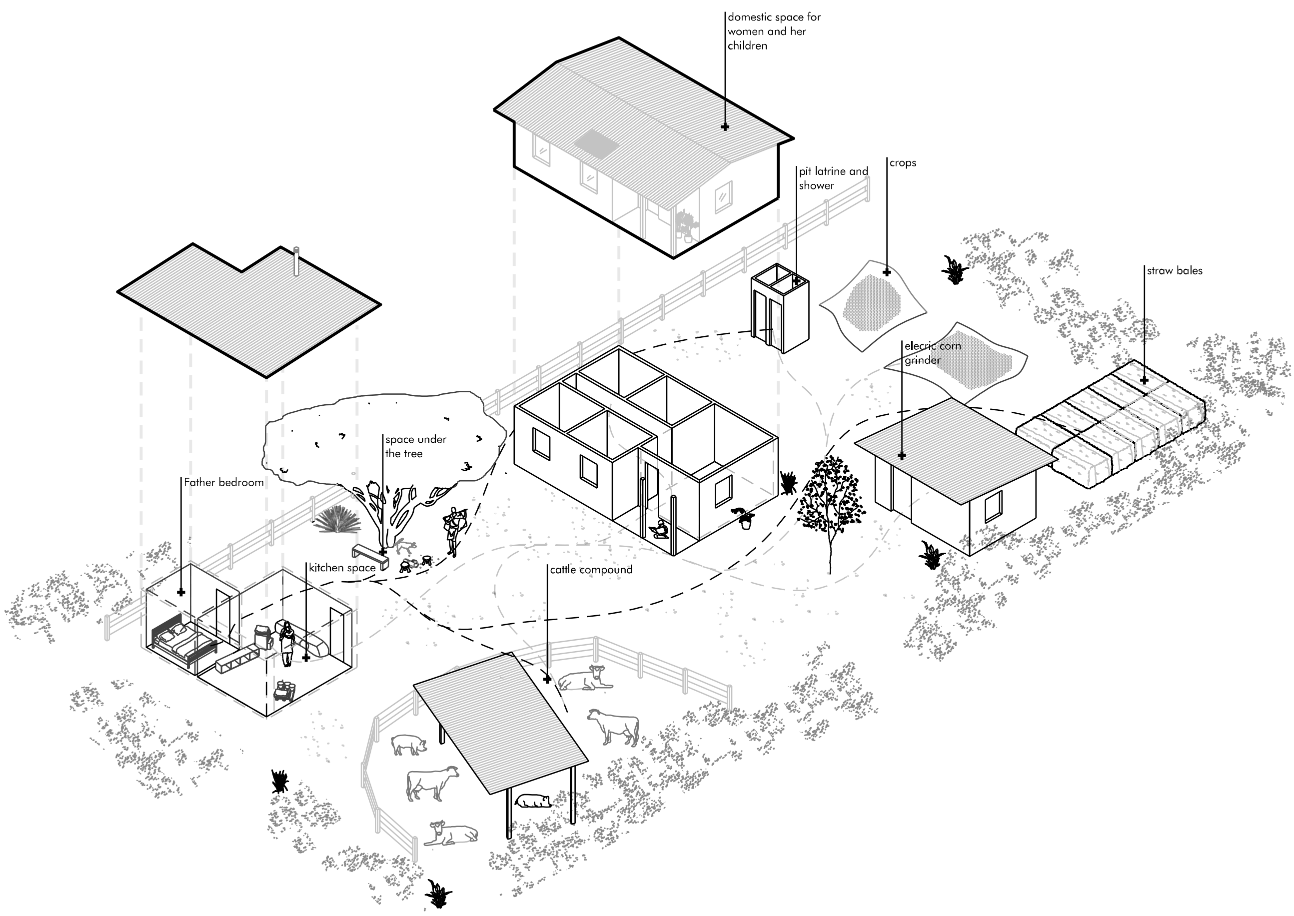
12.17 Traditional Maasai dance performed by an age group in a traditional ceremony in Maji Moto. Source: Own picture

members of the extended family. Whenever the main patriarch plot does not have enough space for all male children to build their houses, they are allocated to nearby pieces of land. Likewise, the restricted space in which kids can move around is also enlarged to the wider family plots. This set of rules stimulates certain types of relations with relatives, such as inviting them to sit down for a while or to have food if they are passing by at the moment in which the family is cooking. Is a sign of respect and good manners towards family individuals, even if these are not direct relatives.

Within a family plot, whether in the indigenous boma setting or the given piece of land, there are a series of traditional norms that are always followed by the Maasai members of a community. Those codes are usually determined by cultural beliefs and traditional practices. For example, social organisation around circumcision ceremonies, marriages, funerals and passage rituals to another age set[10] follow a set of gender-related rules. During the celebration of the mentioned events, women usually occupy the house space, mostly the living room, to receive visitors or to prepare the bride before a wedding. Eisenstein (1984) has noted a tendency for women to be usually the ones occupying domestic space, which defines an invisible boundary between women and men. They might also allocate a fire in the back of the house if cooking is involved, where all women would contribute to preparing the event. Meanwhile, men usually sit down in the plot surroundings around a tree, where they discuss community issues. If the ritual involves the traditional Maasai dancing Adumu, men will use the central space of the plot to dance in circles [Figure 12.17]. These divisions of roles and the use of the spatial layout help to strengthen ties between women, who are usually relatives and who may find a necessary and unconditional support from each other.

10 - These specific ceremonies happen for men. The first step is to become a Murran, when males feel ready. After that, they will have the passage ritual to adults, where they are expected to marry and create their own household. Finally, the last age group is joined when they become elders.

In the current setting of nuclear families living in plots assigned by the local government, the spatial arrangement has considerably changed. Due to traditional Maasai norms, when the mother gives birth to the firstborn, the father will move his bedroom to a free-standing small building of just one room in the same compound. From this moment, the house remains mostly the domestic space for women and their children. If the bigger child is a male, he would be moved to the larger bedroom in the house. If is a girl, she may stay for a longer period in the same room with the smaller siblings or would go to stay at her grandmother's house if there is a lack of space. The mum usually sleeps with the smallest children until they are independent, at around 10-12 years old. The mum may only sporadically sleep in his husband's room outside the house. As part of the plot, there are other free-standing buildings, such as the kitchen space and the pit latrine and shower [Figure 12.18].



12.18 Axonometric view representing the every-day life of a family living in a private compound in Maji Moto. Own illustration

Within the house space, new valued activities are shaping the quality and layout of spaces. For example, in the traditional setting, the 'living room' would be just a space to sit down and cook, being barely decorated [figure 12.19].

12.19 Barely decorated living room inside a house built with adobe bricks in Maji Moto. Source: Own picture

12.20 Uncommon living room decorated with modern motives and well-furnished in Maji Moto. Source: Own picture

Families usually spend their time in the living room relaxed or animatedly chatting. Most of the middle-aged family parents that were interviewed referred to the value of having a quiet space at home where to spend time with their families. However, what is interesting to note is that the living room is mostly occupied by the mum and her children, while the father spends more time listening to the radio or talking with his age-group males outside, generally under a tree. Trees are an important element of family gathering mostly during the day, when is usually too hot to stay inside the houses. They usually have several chairs or benches under the tree, where throughout the day, the family might spend time having food or taking a nap [Figure 12.21].

12.21 Family compound in Mikocheni with tree in the middle, the space where families usually spend their time during the hottest hours of the day. Source: Own picture

For many families, the biggest tree becomes the central space of the plot, fostering the life quality of the dwellers.

This section aimed at highlighting both the spatial and temporal identity of dwellers and the relation that family dynamics have with home. At the same time, getting an understanding of the socio-cultural order by which the environmental and spatial quality of a house is arranged, gives a deeper understanding of the uses and resultant spaces of the home. The characteristics associated with family dynamics are relevant to unfolding material and spatial implications of the dwellings, which will defer from place to place due to cultural and environmental specificity. That is the reason why a close examination of socio-cultural patterns and place-based features is key in proposing adapted designs for the members of a household.

12.5 HOME: A REPRESENTATIONAL DEVICE

"We make our homes. Not necessarily by constructing them, although some people do that. We build the intimate shell of our lives by the organization and furnishing of the space in which we live. How we function as persons is linked to how we make ourselves at home. [...] Our residence is where we live, but our home is how we live." (Ginsberg, 2020)

Previously in this chapter, it has been exposed how both the notion of shelter and family are inherent in the physical forms and the meaning of home for dwellers living in Maji Moto and Mikocheni. These given meanings arise due to a series of social relations and cultural forces that are part of individuals' identity and their experience of dwelling. Besides that, the self-consciousness of our being in relation to the surrounding environments, and specifically our homes, carves out a meaningful relationship. According to Dovey (1985) "The home is both a 'statement' and a 'mirror', developing both socially and individually, reflecting both collective ideology and authentic personal experience". This relates to the Heideggerian notion of 'being-in-the-world', which shapes people's identity and can be represented in a physical or figurative home. Within environmental-behaviour studies, several authors have referred to the idea of home (with its physical space) as an expression or symbol of the self (Mallett, 2004). For example, Tucker (1994) claimed that home is an unerasable source of identity. Also, according to Déspres (1991) the spatial forms of the house, together with the interior decorations and functional arrangements, are a mirror of dweller's being and personality. Individual's status and wealth have been historically reflected in built forms, following diverse strategies to make visible and represent one's identity. However, the need for personal identification in relation to dwelling places is becoming progressively relevant with the emergence of cultural differences and the societies' race for development. The built environment becomes thus the theatre in which we produce and perform our identities, in a continuous search for 'ontological security' (Giddens, 1990).

The Maasai communities under analysis are not a different case in this regard. The representation of people's identity and status through built forms is in some cases unselfconscious, however is gaining relevance as part of people's design and materials' choice. Self-representation has been manifested in some cases in the form of social pressure and anxiety for portraying an unachievable self-image. For others, is a pride to show their wealth and status through built forms and the materiality of their homes. In addition, some dwellers understand home as the only transcendent element of their beings, with the capacity to remember one's identity even after death.

12.5.1 HOME, SELF AND BEINGNESS

In the conceptualisation of home, the building can be understood as an extension of the body, encoding or reaffirming our existence and capable of informing about people's personalities. Just as the way we dress or the hobbies we have, one can somehow deduce the identity of dwellers by looking at home details. More importantly, the sense of homelessness can be experienced not only in the absence of home but also if the dwelling place does not convey the needs and functions of its inhabitants. The feeling of living in a place where one does not feel mirrored can trigger a sense of emptiness and anxiety. Philosopher Kuang-Ming Wu (1993) referred to the home as an intersubjective relation that elevates the self, person or I into being, understanding the home as essential to exist. According to Wu, such conceptualisation does not necessarily occur only with the physical home, however, the interest here is in the cases of dwellers for whom their physical home is inherently tied to being.

It was surprising to discover that the pressure for representation of self-identity through the house was more accentuated in Maji Moto in comparison with Mikocheni. In the former, most of the dwellers claimed that their homes were not adapted to 'current times' and that their aspect was backwards compared to their neighbours' houses, the reason why they would not feel comfortable receiving visitors in their compound. They felt that the image conveyed by their houses was a representation of their poverty and lack of honour. The reason for feeling such pressure is probably due to higher levels of modernisation of the local architecture combined with the proximity to Arusha, bringing Maji Moto residents closer to the experience of the developed city. In this regard, self-identity is also constructed through comparison to neighbours, accentuating otherness (Staszak, 2008). What oneself is, can only be rendered visible through the conception of what others are, and is only through differentiation that a sense of inferiority is triggered in the case of vulnerable dwellers. Through the built environment, communities have tended to create a divide between those owners capable of portraying respectability and wealth and those others who look at the formers, triggering feelings of shame and weakness. Otherness and identity are undetachable concepts as identity can only exist within the self and against or concerning the other. What has been stated above is rendered visible through the words of an elder neighbour of Maji Moto:

"There is nothing in my house that I can like. When I look at it, I see how other people are living in good houses while I'm still suffering in this thatched house. This shows my fragility, which has prevented me from building a better house because I don't have the economic condition to improve it".

He intentionally wanted to stress the idea of the thatched house as a place to be ashamed of. He did not explain the reason why his thatched roof was a problem for him, and he also stated that his thatched house was very cool inside while people living in houses roofed with corrugated iron sheets struggle with high inner temperatures. His concern was about otherness, as 'other people' are living in 'good houses'. While differentiation is implicit in the diverse types of roofing material, otherness goes beyond mere differences and is created around a discourse of inferiority. After that, he continued by stating:

"I don't mind if it will be hotter in a new house built with corrugated roof sheets. I will just stay there. The only thing I want is a good house so even if I die, people will find me dead in a nice house".

The last sentence, which is at the same time moving and compassionate, stresses the important role of spatial identity performed through built forms. The search for self-representation is shown to go beyond the boundary of life, in an attempt to leave a transcendental sign when oneself will not be there anymore. Such a response seems to have a twofold trigger; on the one side, it is deeply personal, connected to the profound need to demonstrate to himself that he did not fail in life. On the other side, since most Maji Moto dwellers live in houses built with industrialised materials, his response has a strong social component. He wants to resemble his peer neighbours by reaching the 'standard' level of quality housing in the village while displaying his status and achievements to others. Temporal identity gains importance here as well, as the interest of this elder is to leave a mark not only in the present but also for the future, so he would be proud of people remembering him when seeing his newer house. The relevance of temporal identity has also been identified by a conversation with another dweller in Maji Moto, Suzana, a 36-year-old widow woman:

"My house represents me, because if I didn't have it, where would I live with my family? Even when I'm not around, you will be told that this is my place. For example, now that my husband has passed away, when you ask for his place, they will still bring you here. But if I did not have a house, it's like my life is 'zero'".

Two interesting statements come to the fore; as a widow, the dwelling place is the only stable and visible landmark that keeps alive the memories of those who are not here anymore. While people move and change, the household of her husband will remain as a totem that represents and reproduces the identity of her husband. The statement stresses again the intimate relation existing between being and home, and how one nurtures the other and vice versa. On the other side, the statement "if I don't have a house, it's like my life is zero" explains the need of dwellers to show their identity through their homes, in an attempt to link personal development and status with the owned house which embodies the ultimate achievement of the homeowner. The choice of building materials as well as the final look of a house seems to gain relevance as the meaning of home and the representation of its household is intimately linked to it. Is probably for this reason that dwellers incrementally feel the pressure of building upgraded houses that will represent them more meaningfully. In fact, dwellers who have afforded to replace their thatched rooves or to build new houses with what is known as 'modern' shapes, have expressed their feelings of pride towards their houses. Both in Maji Moto and in Mikocheni, neighbours understand their physical homes as the representation of them as hard workers, the reason why they keep making efforts in an endless nonconformity with the quality of their dwellings [Figure 12.22]. Achieving the respect of community members about the type of house that one owns has increasingly triggered the classification of dwellers according to their income.

In the specific case of Mikocheni, it has been interesting to note that such behaviour has less relevance among homeowners. The more isolated location of this community and their attachment to the Maasai pastoralist tradition has prevented higher levels of development and only very few inhabitants' houses stand out in the dry environment of bomas [figure 12.23]. Of the 10 analysed households, only two of them mentioned a sense of pride regarding their built houses. These two homeowners follow the pattern of young males with high incomes due to a relevant number of livestock and other businesses. Both of them referred to their houses as the representation of them as being successful neighbours, constantly comparing the materiality of their dwelling places with the rest of the buildings in the village. In addition, one of them claimed that he

12.22 Flashy porch and entrance in Maji Moto, decorated with gypsum columns and well-maintained coloured plaster. Source: Own picture

12.23 Maasai boma in Mikocheni, surrounded by the typical dry savannah landscape. Source: Own picture intentionally did his house differently to actively differentiate himself from the rest. Such discourse glimpses an awareness of alterity that puts other neighbours at the centre of the pressure to demonstrate the ability to improve their homes. As such, self-representation is re-created and preserved by homeowners as a sign of endurance. To a lesser extent, it has been noticed how the dwellers in Mikocheni who have afforded to replace thatch reducing thus the possibility of having water leaks, feel more comfortable inviting friends and relatives into their homes. They feel that their renovated houses are a sign of respectability and reputation towards their neighbour inhabitants.

Likewise, it has been noticed among interviewed women from Mikocheni that their homes are a representation of themselves as Maasai members. This is because in Mikocheni is still common to find women who are in charge of building their own houses. In the indigenous Maasai tradition, building women's homes cooperatively was part of a ritual that lasted for centuries. The fact that in recent years this practice has been increasingly neglected, creates a sense of representation among builder women connecting those who still carry this traditional practice. As such, home is part of a self-representation system that acts as a mirror of the inherent belonging to the Maasai society. This idea will be further developed in the next chapter, as the progressive shift of such building tradition has largely influenced the choice of building materials among Maasai dwellers.

12. 6 CONCLUSIVE REMARKS

This chapter has provided an in-depth analysis of the dynamic meaning of home for Maasai dwellers in Maji Moto and Mikocheni. In the attempt to understand the connections between the significance of self-builders' spatial and material choices, the chapter ought to grasp these new concepts that arise from the abrupt changes that communities have experienced. Undoubtedly, a sedentary lifestyle has triggered new ways of dwelling and as a consequence, new building types are gaining popularity amongst settled communities. Beyond that, land ownership, proximity to urban centres, the erase of traditional practice and a more stable economic situation have also impacted in the perception that communities have regarding their homes.

As it has been unfolded throughout the chapter, home is for some a 'protective cocoon', a way of seeing that encapsulates our comfort zone, providing a scale without which we would not find a point of reference (Giddens, 1990). For others, it is the essential element needed to create a sense of family, a place where to always come back, rooted to memories of the past. For others is a start, a white blanket, a diary to write, which represents beginnings, and therefore an opportunity to guarantee the continuity of life.

Lastly, from the ethnographic account of this research, it has been observed how self-representation takes a relevant role in the definition of home for Maasai dwellers. Considering the collective sense of life of Maasai nomadic settlements, the process of sedentarisation has prioritised individual identities, gaining weight against collective identity. Individual needs and representation seem to be a consequence of globalisation and modernity, as suggested by Dovey (2005), considering how the everyday life experience has been transformed from local tensions into global aspirations. As such, the search for development has directly impacted the design and aspect of local dwellings, which has led to newer individual and collective experiences of owners within their dwellings.

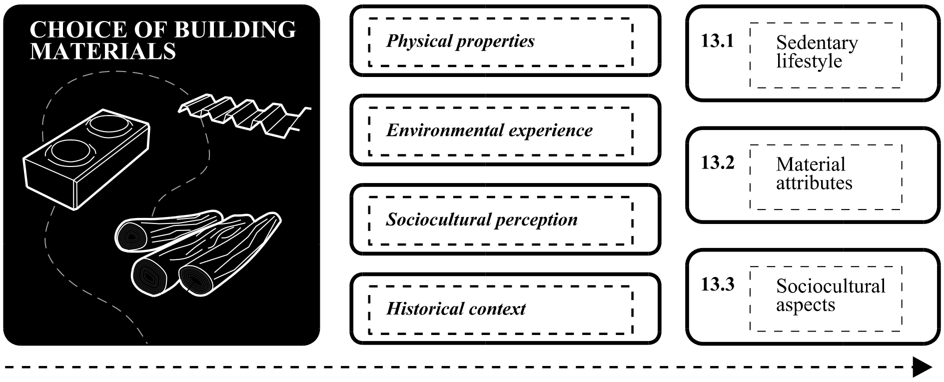
Therefore, the question posed here is: Is the Maasai house a Maasai house?, but also: What is then a Maasai house? The Maasai house does not exist, but the Maasai house is also all the houses inhabited by Maasai dwellers. Elucidating this question from looking at the material and spatial aspects of people's houses would be misleading as it would imply that the passing of time, progress, aspirations and lifestyle changes are detached from the natural development of human beings in their environment, being shaped by the forces of the society. In any case, when making this question to dwellers, the response was not surprising after all. Most of Mikocheni's neighbours, living in wattle and daub houses, stated that their homes encoded in a way the identarian symbols of the Maasai traditions, despite their rooves were not built like the traditional hut. Many also pointed out that their houses had been built by women with their own hands represented their traditions, as new houses are built by skilled workers paid by men. Also to notice is that dwellers living in traditional houses built with locally available materials were the least happy with the image that their houses conveyed. By contrast, most of the dwellers in Maji Moto who own houses built with fired bricks and corrugated sheets, categorically denied the representation of their houses with the Maasai tradition. As they pointed out "our houses represent the will of our community to embrace change and development". But the question raised here is: Does the will to progress as a social group and individuals erase the fact that these houses have been built by Maasai dwellers in a contemporary context? Maybe the problem is the question itself. When asking if a Maasai house is a Maasai house, a double-sided world has been already created. Instead, the reality beyond categorisations is that of a group of dwellers who built their own homes, engaging in the development of their everyday life, in a continuous involvement with their environment and their people. Maybe, as Ingold argued, "building cannot be understood as a simple process of transcription, of a pre-existing design of the final product onto a raw material substrate". (2000:186). Also, Mallet (2004) reminds us that analysing the meaning of home needs to happen alongside an acknowledgement of the uncertainties implied, as it can be too wide and abstract, so the risk is to remain subjective and imprecise.

Conclusively, this research argues that in the case of self-sufficient communities, building is inevitably an ongoing process of people contextually engaging in a specific setting. Thus, the purpose of this chapter was not to analyse a finished artefact, but to grasp the forces that shape the fleeting moment in which spatial and material decisions are taken to match a human purpose. In the attempt to gain an understanding of these material and social forces flourishing from everyday life, this research may enlighten ways to pursue more conscious and adapted designs promoting the emancipation of vulnerable communities.

13 — On Matter: Driving Choice of Building Materials

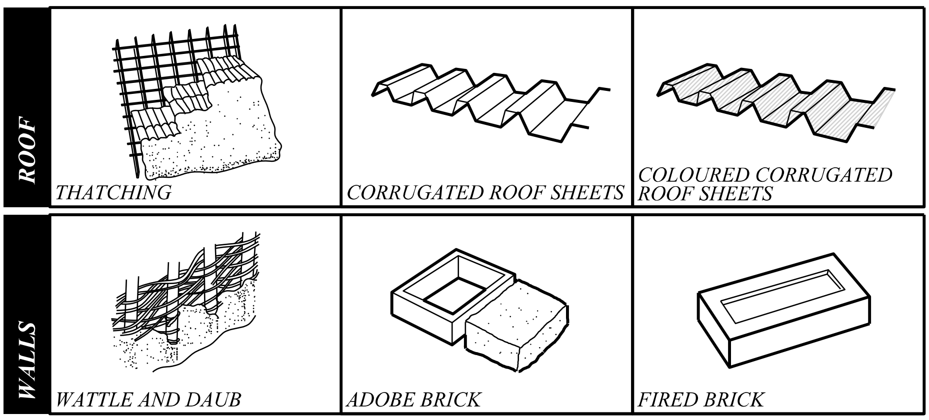
"Our decrying of the inauthenticity of places and things is all too often a pedantic effort to lend our lives a surface effect of authenticity while a deeper disconnectedness from the place which we inhabit remains unchallenged".
(Kimberly Dovey, 1985)

The last chapter of this thesis' findings explores the determining elements that influence the choice of building materials in the context of self-built Maasai settlements. Considering environmental features, indigenous traditions and social processes, the chapter aims to deepen the perception of materials and how it impacts decision-making dynamics in the local building culture. The overall objective of this chapter is to enlighten those often-hidden drivers that prompt the use of specific building materials, proposing a practical framework for architects working in contexts of material scarcity or where unsustainable practices require the proposition of alternative building solutions.



13.1 Framework for analysing building materials' choice in the case study settlements according to the four main aspects. Own illustration

The first sub-chapter (13.1) explores how the sedentarisation process has impacted indigenous building traditions. Moreover, it sheds light on how the adoption of a sedentary lifestyle has fastened a process of cultural syncretism that triggered the emergence of new building patterns and materials by the communities in Maji Moto and Mikocheni. The second part of the chapter (13.2) wants to look at the most tangible experience of building materials within homesettings and their impact on dwellers' everyday lives. In looking beyond that, this chapter unfolds the reasons behind the often rejection of locally sourced and natural materials by local communities, in the attempt to predict innovative ways for adapting sustainable building materials. Factors such as durability, maintenance, affordability and so on are analysed alongside the dwellers' experiences that have pushed them to justify the importance of these essential elements. The last sub-chapter (13.3) explores how social structures and cultural beliefs in the Maasai society impact the resultant built forms and materials used. Determining factors such as social status, progress, respectability and so on, are analysed by finding common patterns within dwellers' experiences. This section has grouped both social and cultural factors, due to the impossibility of separating both elements, as these are always connected and shaping one another. Due to the use of grounded theory, this chapter's findings have naturally emerged from the data analysis of dwellers' interviews. This means that the three sub-sections exposed below do not respond to a preestablished analytical structure used to prompt responses from interviews. Instead, these three themes have progressively been enlightened by data, composing a body of experiences that justify the highlighted core drivers of building materials' choice [Figure 13.1 and 13.2].



13.2 Division of building materials used at the local level according to its use in walls or roof. Own illustration

13.1 SEDENTARY LIFESTYLE

The progressive loss of nomadic pastoralist practices in Northern Tanzania has impacted the Maasai lifestyle in many ways. Longer periods are spent in a specific location, which has accelerated systemic changes in the provision of livelihoods, income needs, access to public facilities and so on. Needless to say, this shift has also profoundly affected the built environment, both in form and material requirements. The temporary shelter that was supportive for transhumance groups, does not comply with their needs anymore. This has required a series of implementations to adapt their buildings to the new lifestyle, which in most cases has happened through hybridisation of building practices absorbed by learning from nearby communities. Assimilating building techniques has been an ongoing process for centuries, achieved by mixing with other communities, however the abrupt influence of the German and British colonies accelerated such change. Bhabha (1994) named this phenomenon as 'cultures in-between'. By understanding culture as a construction of different influences without a specific delimited area, Bhabha's theories explore the blurriness of cultural boundaries and view them as active and alive rather than passive and static. This term fits with Anderson's definition of indigenous cultures as 'dynamic societies, in a continual process of adaptation, global impacts and changes of tradition at an unusually large choice, and constraint' (Anderson, 2010:83). Interestingly, the rapid change undergone in the last decades has raised an awareness from local communities about the aspects of their built environment that have been absorbed from other groups. For example, Benjamin, an elder man from Mikocheni, justifies the adoption of improved building strategies learnt from neighbour communities:

"Throughout our migratory journey, we've lived with many tribes. After we saw the Swahili houses[1]*, we thought: how can we live in a house that is like a chicken coop? When you are inside you just bend, not being able to stand straight, so is not comfortable".*

1 - Swahili architecture is a traditional architectural style that developed along the East African coast, particularly in Kenya, Tanzania, and Mozambique. Swahili houses have distinct characteristics that reflect the region's history, climate, and cultural influences. One notable feature of Swahili houses is their courtyard lay-out, the use of coral stones and carved wood for beams, windows and doors.

This claim shows how through a highly selective synthesis process, Maasai have retained some aspects of their traditional culture, but have also incorporated new technologies inherited from other ethnic groups and by the influence of nearby cities. To discover how the building culture has changed, which are the replaced patterns and those absorbed, these processes of synthesis and the reasons behind them need to be unfolded. The result of this process will appear as a form of 'cultural syncretism' (Rapoport, 1983:255). In Mikocheni Maasaini, due to the transitioning stage in which they are and their proximity to the other areas of the settlement where coastal tribes moved, they are quickly implementing the use of more stable wooden roof structures and stronger walling solutions. Martha, a neighbour from the area told us:

"We've seen what others are doing with their buildings, we're also doing the same. Before, we used to build with small poles, to later move to bigger poles that our neighbours use to make their rooves. I also really like their bricks, so that's why now we're using those bricks in the same way they do".

These types of responses were largely encountered in the case of Mikocheni, as their semi-nomadic practices, even if in the process of disappearance, have contributed to maintaining many aspects of the indigenous Maasai house. As such, due to higher levels of sedentarisation and direct contact with other neighbouring areas of Mikocheni, they have witnessed such change in recent years. The inclusion of these techniques is not to be misled with a 'loss' of traditional knowledge, as knowledge should always be relational to contextual needs. The sedentary lifestyle has transformed such needs. Therefore, in contrast to arguments discussing the progressive loss of traditional building techniques, which in many cases is associated with the encroaching influence of modernity, what is explored here is a notion of hybridity: far from cultural identity disappearing, it is constantly being reconstructed and redefined (Kellner, 1995). This is in part because both continuity and change play an important role in syncretic processes. On the one hand, cultures ensure the preservation of traditions and living heritage, on the other, external influences enable the arrival of new patterns, techniques and activities (Hauser and Banse, 2011). Thus, new cultural practices arise and become gradually integrated into everyday life practices, influencing the emergence of hybridised building types. Surprisingly, several dwellers from Mikocheni have claimed that their building types do not currently share commonalities with the traditional Maasai house. However, such an assertion does not exactly match the actual building situation, as their dwellings, despite the inclusion of several features such as the roof structure and the use of fired bricks for walling, still maintain similar functions of the Maasai house, with one or two rooms and without a porch or courtyard as the Swahili houses [Figure 13.3]. Another remarkable example of building hybridisation is the use of cement plaster to cover the vernacular walling technique, hiding the structure made with adobe bricks or wattle & daub [Figure 13.4].

13.3 Traditional Swahili house with porch in Zanzibar.
Source: Dominique Hazard

13.4 Yesse's house in Mikocheni, with visible cement plaster that is peeling off from the adobe bricks' wall. Source: Own picture

Despite most dwellers being aware that irregular mud walls and cement do not bind together, they still prefer to cover their traditional walls with a plaster that often causes cracking, in the cases of families that cannot afford to build their houses with a brick wall.

In a more nuanced way, inhabitants from Maji Moto have stressed the impact of sedentarisation in their building practices, embodying change as a series of adaptations that have occurred over a longer time. This phenomenon can be explored by looking at the time-space nature of built forms. The adoption of farming in the transition towards a more stable source of income has consolidated the sedentary shift. Rukwaro (1997) identified the different socio-cultural variables that have most influenced transformative changes in Maasai settlements, such as the removal of communal land ownership in favour of individual ownership; improved access to education; diversification of occupations; the adoption of new religions taken from the colonial legacy and changing familiar structures. These variables have triggered a shift in cultural values, with many implications at the settlement level. Currently, the need to have a permanent house has become one of the main individual aspirations, being equated with the importance of accessing public education for children. These houses have been progressively growing in size, adding new rooms for guests or a living room, requiring also building materials that are adapted to those bigger dimensions.

The consequences of a sedentary lifestyle in the built environment are also experienced if we consider the resources offered by the surrounding landscapes. The reduction of seasonal migrations for cattle plus the threatening effects of climate change such as draughts, have reduced the extent of grasses, for pasture but also roofing. As such, an overly available resource in the nomadic context as thatch has been drastically reduced, preventing its use for covering the houses' rooves, as a dweller from Maji Moto points out:

"That was available because we were moving around abundant grass areas, but now as we don't move our animals eat most of it, and the grasses diminish. Maybe in other communities as the Tindiga tribe, is still possible to use the thatching roof, as they plant rice. But now, even when they plant, it is only enough to feed the animals even more since draughts are becoming common".

In any case, the use of vernacular materials that are locally sourced is being drastically reduced for many other reasons. The next section will deepen the practical limitations that have hindered the use of natural materials such as thatch and mud, though understanding such a process requires a careful analysis of the impact that has resulted in the change of lifestyle. Otherwise, claims of indigenous knowledge loss remain superficial, tending to mislead the real reasons behind such disruptive transformation[2]. The use of modern materials has been mostly received with hope by these communities, who rightly think that the move to permanent housing is non-reversible:

2 - The stress on the concept of "indigenous knowledge loss" is necessary as lately, both in architecture and anthropology, theorists have explored the impact of modernisation and urbanisation on traditional building practices but not the argumentations and constraints behind it.

"Initially we were using mud, cow dung and poles to build our houses. Then we started to roof with corrugated iron sheets when we decided to stop moving.

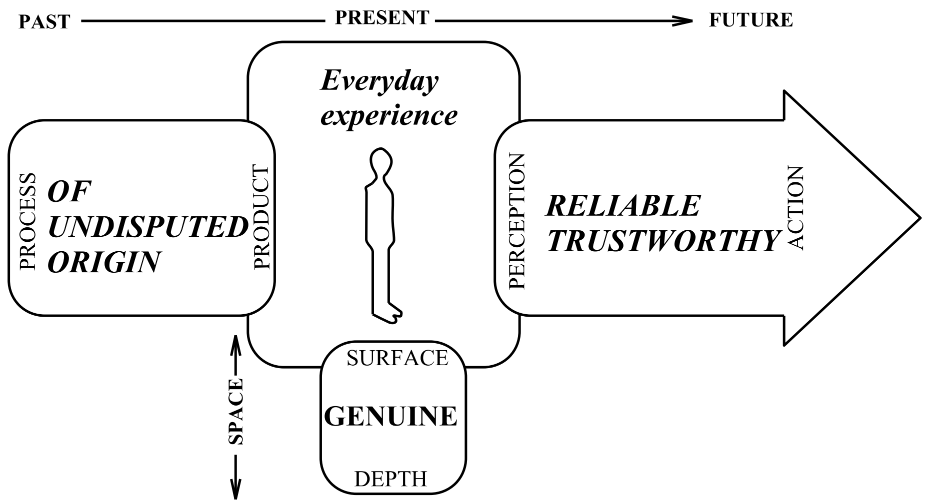
Now, we think is the moment to build a new permanent house with bricks".

In this case, Katrina from Maji Moto shows how the need for permanency is enabled by the possibility of accessing durable materials, an asset that recently settled communities highly value. In fact, new requirements such as durability have gained an importance that goes beyond any traditional representation. Local dwellers recognise that their current buildings do not comply with the features of the vernacular Maasai hut, however, they insistently remark that the transformation of their architecture does not represent a loss of indigenous practices, as these are still present, despite not having conserved specifically traditional building practices. This statement confirms how we wrongly assume the meaning of indigenous architecture as if it could remain static despite the changes happening around it. This resonates with Vellinga's (2007) statement about vernacular forms, who claims a need to remove categorising boundaries, to understand our built environment as part of a dynamic endless process of change, mistake, repair and remake. Therefore, if societies evolve and cultures can only be conceptualised concerning their surrounding environments and traditional practices, the resultant built forms are part of this entangled process of mutation and adaptation.

The analysis of dwellers' emphasis on the impact of sedentarisation in their lifestyle and building practices has served as a prologue to introduce the following sections in which practical, functional and socio-cultural aspects of people's choice of building materials will be unpacked. Eventually, analysing the past from which communities come, is essential in grasping the current needs of societies within their built environment, as is such a process that enlightens the possibilities for the present and future of their practices.

13.2 MATERIAL & ENVIRONMENTAL ATTRIBUTES

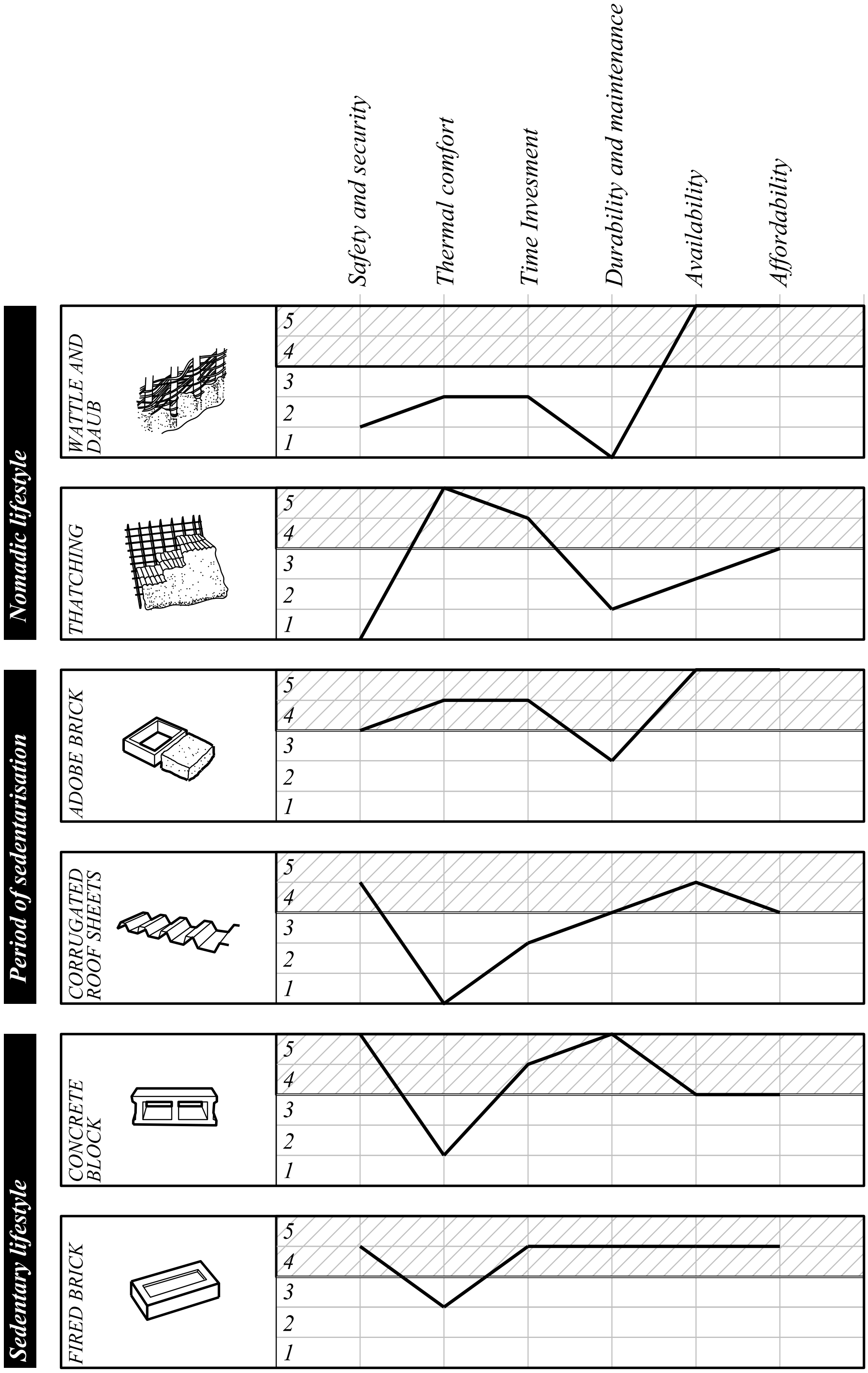
This section presents one of the most pragmatic yet obscured aspects that are key to understanding the current state of the Maasai built environment. Endless claims regarding the dramatic loss of indigenous building tradition have failed to address the real constraints implied in such a transformation of building materials use. Western discourses on indigeneity and change seem to blame communities for falling into the trap of modernity (Latour, 1993), without realising that the argumentations fall into the trap of false authenticity. I have witnessed, within the humanitarian sector of architecture, how the failure to introduce sustainable and natural materials in vulnerable contexts seems to be the user's responsibility. One after another, the success of these projects is subjected to the willingness of local communities to accept the proposed material and form of aesthetics, creating a hopeless feeling of frustration in the project's designers. But as Kimberley Dovey (1985b) suggests, as long as the search is not conducted by looking at everyday-life practices but at the 'exotic' and the nostalgic past, such practices will bring frustration and even destruction. Meanings in the built environment cannot be resurrected if daily practices and environmental constraints are not considered when proposing a given design or building technique. Dovey, whose research has been centred around authenticity and spatial practices [Figure 13.5] argues that "The fundamental paradox and the source of the greatest ambiguity is that inauthenticity emerges out of our very attempts to find and recreate a lost authenticity, a lost world of meanings […] Authentic places and things are born from authentic dwelling practices in everyday life. Their order flows bottom up rather than top down." (1985b: 47)



13.5 Framework for looking at authenticity in the built environment. Source: own illustration adapted from Dovey (1985)

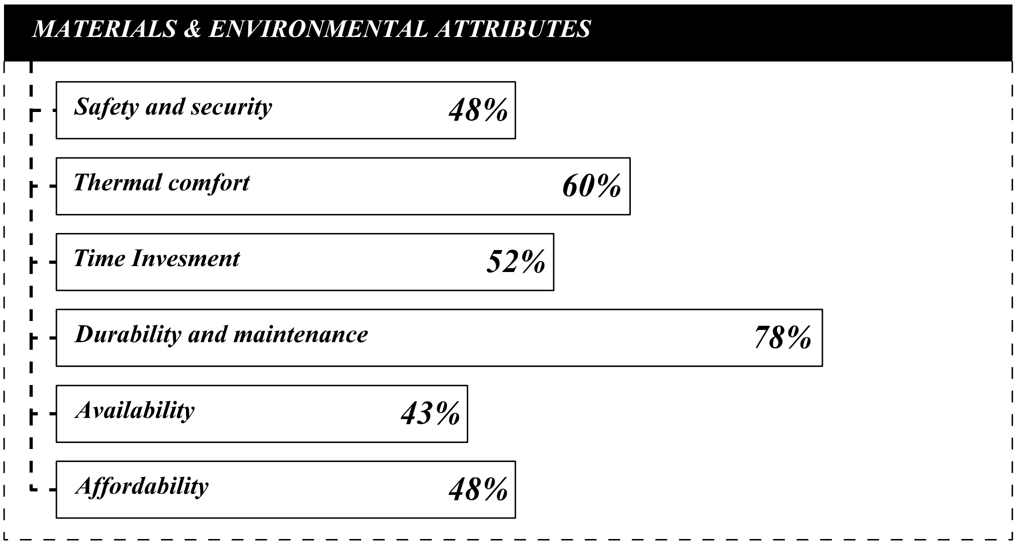
This section does not aim to justify the use of industrialised materials in Maasai settlements. What I aim to highlight with this discussion is the connection between the ecology of person-environment and how, through understanding the evolution of Maasai built forms and the pressures that have motivated it, this has unfolded in the present use of 'non-indigenous' building materials. I believe, therefore, that the focus needs to be on looking at the meaningful processes by which those materials have been progressively included in the building tradition of a certain group. The abrupt change into a sedentary lifestyle in the analysed Maasai communities has unavoidably led to the creation of different needs, which directly impacts the qualities that their supportive buildings have to convey. Only by understanding such processes of techniques' adaptation and the reasons behind the use of these materials, can we envision a future in which the inclusion of newer, efficient and more environmentally adapted building materials can successfully happen.

For the reasons presented before, the following discussion has been devoted to analysing the material attributes that the researched communities have expressed as essential components of their dwellings, hoping that the chapter will shed light on the reasons behind the neglect and absorption of building materials [find the specific average of response regarding each of the material attributes in table 13.6 and the correlation of responses between materials and attributes in table 13.7]. Materials are supportive to them through the physical, environmental and most pragmatical experiences of their everyday life.



13.6 Analysis of material and environmental attributes that dwellers have attached to the different building techniques existing at the local level. Own illustration

This shows the power of material properties, and how what materials are made of can define our experience with them (Ingold, 2007), finding the border zone between ourselves and everything that surrounds us.



13.7 Average of interviewees concerned with the material and environmental attributes of existing building techniques.
Own illustration

13.2.1 SAFETY AND SECURITY

The issue of safety with interviewees has pretty much focused on the performance of the two main traditional techniques that are in detriment in Maasai rural areas; wattle and daub and thatch. Dwellers' claims regarding the lack of safety of these techniques have been reinforced by justifying the use of concrete blocks, fired bricks and CIS for roofing. The experiences, feelings and concerns explained by dwellers represent a powerful and tangible testimony that somehow elucidates the reasons that motivate the refusal of using vernacular techniques. In my opinion, this is a clear indicator of what has prompted such a rapid transition towards the use of industrialised materials in indigenous communities. Below, a dialogical discussion between the two main building materials and communities' testimonies is exposed.

Thatch

Thatched rooves have been removed from almost 60% of houses in Mikocheni and 95% in Maji Moto. The refusal of thatch has happened alongside a reduced availability of river reeds in the areas. Regarding what concerns this section, most of the dwellers have expressed a fear of living (and with special emphasis, sleeping) under a thatched roof for several reasons. A homeowner from Mikocheni who has changed the thatched roof recently, express it as follows:

"In this new house, we don't get water leaks inside compared to that thatched house. I remember during long periods of rain if it didn't stop for two weeks, water would start dropping on us while we were sleeping inside. Despite our thatched roof being quite thick, when it got humid due to non-stop rain, is very difficult to avoid leaks at some point".

Some other neighbours have remarked the good inner temperatures of thatched Some other neighbours have remarked on the good inner temperatures of thatched houses compared to the newly built houses with CIS. However, the inability to ensure a 100% waterproof roof makes homeowners feel hesitant when having to repair their thatch roof after the rainy seasons, being eventually more convenient to make an extra effort to change the roof structure to accommodate CIS [Figure 13.8].

Wattle and Daub

In the specific case of Mikocheni, the vernacular technique of wattle and daub is still widely used. 80% of the interviewed dwellers live in houses built with this technique. This is because of the inaccessibility of the place, together with the presence of an alkaline soil that prevents locally produced fired bricks. Also, Maasais from Mikocheni are still very much connected to the indigenous practices of the ethnic group, and therefore, the loss of traditional techniques is happening at a slower pace than in Maji Moto. Lydia, a neighbour from Mikocheni whose house is built with this technique and will be soon replaced, states:

"First, when the wind comes the house can get broken because mud is very fragile and does not have proper foundations. But also, the walls harvest insects because sometimes you will find cracks and insects will enter inside".

13.8 Family compound in Maji Moto with thatched building on the left used as kitchen and house roofed with CIS on the right, main house.
Source: Own picture

Several dwellers have pointed out the issue of insects, specifically scorpions, as well as the presence of snakes that hide within the wall's cracks, turning thus dangerous for users. This story from Moses, a 92-year-old elder living in a wattle and daub house in Maji Moto, does not need explanations:

"When it rains, the walls get eroded. There was a time when there were heavy rains. The water made holes in the wall and my wife had given birth to our child only one month before. The water was very high. Fortunately, we were sleeping in high beds, as we're no longer sleeping in the typical Maasai beds. There was so much water that I could not come out to help my wife. Then I found a snake called 'saton'. I was so scared, and I had to make a hole in the wall, so the snake went away with the water".

Also, dwellers who have been able to upgrade their walls' technique have expressed their relief for not having to deal anymore with the fear of finding their houses destroyed by floods or strong winds. The experiences told by dwellers provide valuable information that can help designers and material engineers to think about ways in which vernacular techniques and sustainable building materials could comply with the community's building needs. These very specific testimonies that talk about fears related to textures, strength, form, durability and so on, put into perspective how those who promote vernacular techniques have failed to find ways of including such essential attributes as part of innovative building materials that use locally sourced materials.

13.2.2 THERMAL COMFORT

Weather conditions in a typical savannah environment can be extreme depending on the season, with long periods of draughts that accentuate high temperatures up to 37°C and intense rainfalls that are usually accompanied by cold temperatures. Besides that, its dry climate often results in low temperatures at night, reaching 13-14°C in some rare cases. Communities are increasingly experiencing the effects of global warming, which increases the average of extreme climate events. As such, concerns regarding the thermal comfort of the sampled house were common amongst dwellers in both villages. According to homeowners, the issue of inner temperatures has to do with the building form and materiality, though responses were heterogeneous and confusing at times. For some, the issue had to do with the type of roof, while for others the main problem was the lack of openings to create air ventilation to cool down inner temperatures.

If we analyse the lack of ventilation issue, it is highlighted how the traditional Maasai house, due to the low technical performance of wattle and daub walls cannot be built with big openings. As it can be observed in picture 13.9, the vernacular hut includes very few openings in the wall, or in other cases, none. Besides structural reasons, windows have usually been very small to prevent the dust of the savannah from penetrating the inner spaces. The inclusion of big windows and doors is one of the advantages of newly built constructions that employ stronger building materials [Figure 13.10]:

13.9 In traditionally built houses, windows are absent, with only some little openings to enable ventilation flow. Source: Own picture

"If I afford it, I will build a modern house, because it allows more fresh air inside. Also, with window shutters, you can regulate the air, avoiding much dust from entering inside".

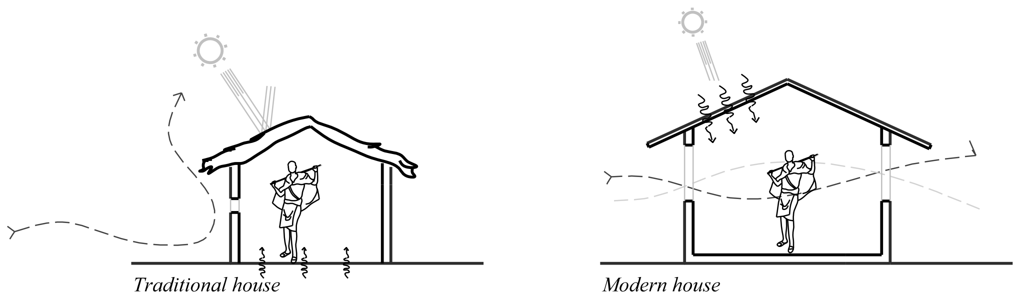
Similarly to Martha from Mikocheni, other dwellers justified the shift to stronger structural materials to allow more windows in the design, claiming the need for ventilation during hot seasons to regulate temperatures. Also, it was pointed out that with the use of stronger wooden beams to place the CIS, a higher roof could be built, reducing the heat transmitted from the metal roof sheets.

13.10 House under construction in Maji Moto, built with fired bricks and plastered with cement. This is the current trend style of house raising in the area. Source: Own picture

By contrast, it seems obvious that the use of thatch as a roofing material cannot be compared to the CIS due to its insulation properties. This has been recognised only by some dwellers, such as Emanuel, who keeps spending most of the time in his old, thatched house whenever temperatures are very high:

"My old house is beautiful because when you enter inside is cool, which is different to this one that we've roofed with CIS, which not having ceiling boards, makes it even hotter".

If we refer to technicalities aimed at increasing thermal comfort, both claims are correct: thatch rooves are way more convenient to avoid heat conduction, as the thickness of the material and the low transmittance of it prevents high temperatures. At the same time, the possibilities that modern constructions offer in terms of openings are more versatile, enabling cross-ventilation [Figure 13.11]. Unfortunately, due to the use of CIS without insulation or separating ceilings, newly built houses reach much higher temperatures despite ventilation. As such, traditional constructions are perceived as hot due to the dimensions, darkness and dusty environment, while newer houses built with bricks and CIS are perceived as well-ventilated, illuminated and clean despite the inner spaces reaching very high temperatures. This denotes the need to consider community's choice and the reasons behind those and proposing appropriate construction details that match both people's needs and desires while providing thermal comfort.



13.11 Thermal performance effectiveness in comparison: traditional thatched house and modern CIS house. Own illustration

13.2.3 DURABILITY AND MAINTENANCE

Around 85% of the total interviewed dwellers have claimed that durability is an essential aspect to consider when deciding the type of material for their constructions. For some, choosing to use fired bricks or concrete blocks for their walling solution and CIS for roofing was not a questioned choice, as the purpose of building a new house lies essentially in improving the strength and durability of the house structure. Those who still live in traditional houses built with earthen techniques are firm with the idea of wanting to build a new house to improve its strength and reduce the need for maintenance. With the rise of a sedentary lifestyle, communities have progressively valued having access to durable materials that require low maintenance. When dwellers express their reasons for refusing to keep using techniques such as adobe bricks or thatched rooves, they always complain about how demanding these are. For example, thatch needs to be replaced every two rainy seasons, implying a lot of labour, an activity that becomes even harder when dwellers cannot do it themselves and need to hire someone to remake their roof every year. Also, a general concern has been on mud walls, both with the wattle & daub technique and adobe bricks [Figure 13.12]. For example, Koixane, a young guy from Mikocheni justified why his family built their new house with cement blocks:

“We wanted to build a house with higher quality than the old one. In the old house, when it rains for 3 or 4 seasons you have to plaster the walls again with cow dung and mud. But with this new house, even if it rains for 10 years you don’t need to plaster because it’s stronger, that’s why he decided to build a house like this”.

Other neighbours from Mikocheni have shown their tiredness concerning the required maintenance of mud walls, which have been traditionally repaired by women mixing cow dung and mud and applying it on top of existing cracks [Figure 13.13]. Anna, a young mum from Maji Moto whose bright green house can be spotted from afar, remembers her childhood and how her house looked like:

“My old house was very nice but required frequent repairs every time. When you repair these houses frequently, they’re just fine, good, and you cannot see the difference, but the problem is the need to repair it every year. Now, we wanted a permanent house.”

13.12 Typical earth house in Mikocheni, constructed with the wattle and daub technique. Little cracks are visible within the house walls. Source: Own picture

13.13 Front view of Balozi's house and floor plan in Maji Moto. Source: Own picture

The testimonies heard before enlightens one of the main reasons why Maasai communities have embraced the use of industrialised materials such as the CIS and concrete blocks. Also, it elucidates why handmade fired bricks have gained popularity in both villages. While some of the dwellers recognise the value of traditional techniques due to their thermal properties compared to newer materials, this seems to be less relevant, with strength and low maintenance qualities being crucial to prompt the use of a specific building material.

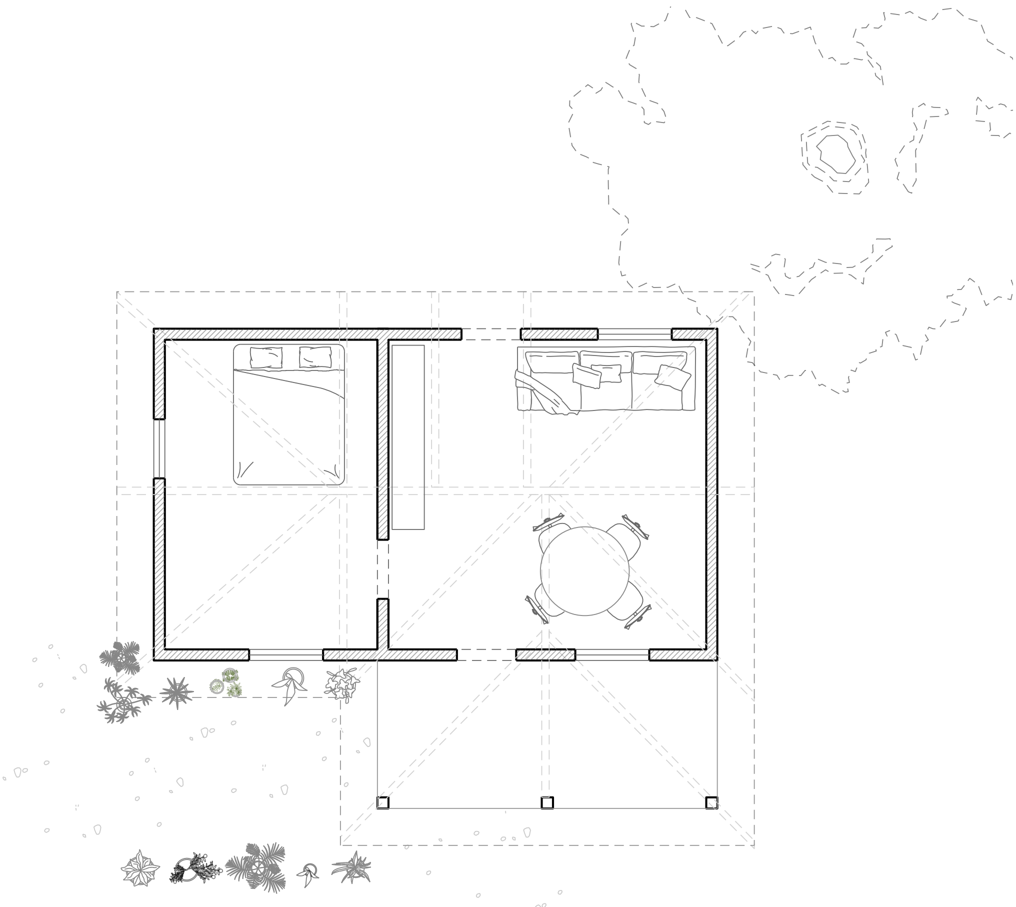
13.2.4 AVAILABILITY

In the context of isolated rural areas, as is the case for Maji Moto and Mikocheni, the existing availability of materials strongly defines the possibilities for using them. The use of very sophisticated materials that need to be specifically provided in larger urban areas is subjected to long-distance journeys with rented trucks, which is unaffordable for most of the households in these areas. At the same time, in the last few years, many little shops selling essential building materials have populated the settlements around Mikocheni, and some of these have been located in Maji Moto. Basic construction tools can be found alongside cement bags, steel bars, different types of CIS, timber beams, steel pipes, nails, painting, gypsum for plaster, and so on. Concrete blocks' production plants are also spread across the geography, easily finding them even in areas that are barely populated. As such, the rise of these shops has somehow endorsed the move from vernacular materials to cheap industrialised ones. There is a need to understand local processes of consumption or object-centred, but that also requires looking at processes of production and distribution or in other words, material-centred (Ingold, 2012).

Across this research's ethnographic account, dwellers have pointed out how their choice of building materials has depended on material availability at the local

13.14 Front view of Balozi's house and floor plan in Maji Moto. Source: own picture

level. Only for some dwellers it was possible to transport materials from town as they envisioned very specific details for their houses, as for example Balozi, who lives in one of the flashiest houses in Maji Moto [Fig.13.14]:



13.14 Front view of Balozi's house and floor plan in Maji Moto. Source: Own picture

"I saw they are the materials that are being used in the cities around our areas and I thought they would be suitable for what we wanted, also because these are stronger. We went to Arusha to buy the materials that were not found here".

It seems clear that learning by assimilation is what has brought the use of industrialised materials in the area, after the wealthiest neighbours started to show these 'innovations' with their house constructions. The cost of these materials has also been put down since higher demands have made these available and cost-effective in different areas. The Maasai have for long been mastering in adapting their constructions to the local availability. It has been observed in the previous chapters, how the traditional Maasai hut was entirely built by using locally sourced materials. This close past has not been forgotten by the analysed communities. Many have claimed how supportive still is the indigenous building knowledge to build with what is available in the savannah environment. This is essential mostly for the rural poor who do not have enough income to acquire manufactured materials, for example Moses, an elder from Maji Moto:

"I built it myself without any help. I did not pay any money. I cut the trees with my own hands, collected them and put them here. I did the plan by myself, took measurements and did the holes myself. I tided the house, prepared the soil from the ground, mixed it with water and then I filled the walls with it".

This tendency is less common in Maji Moto, where only Moses and another neighbour still live in mud-thatched houses. But in Mikocheni, there are still many who build their house by themselves with what is available around them. Moreover, it has been interesting to discover how other dwellers who do not own mud houses anymore, value and justify the use of vernacular materials as a supportive system for those who have 'not managed yet' to improve their dwellings:

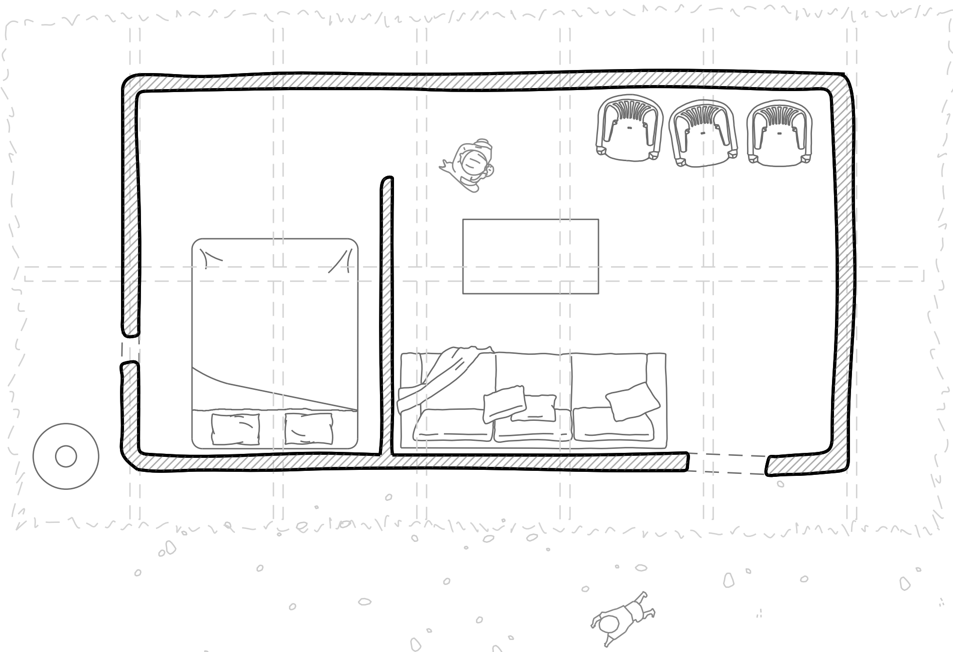
"We still value mud houses. It carried us from the past so we cannot ignore it. But also, here in Maji Moto, there are still people who cannot build like I have. Therefore, they build in the way we used to and use soil that is our resource, together with our trees and thatch. In general, they are still suitable for us and we're still going to use them, we cannot leave them".

Suzanna's statement highlights a crucial aspect of vernacular materials. Its availability is an essential condition for having access to housing. However, the availability of many of these materials is also subject to the management of resources at the local level. Also, the impact of draughts due to climate change is reducing the extent of grasses and trees, with which thatched roofs and wattle & daub structures are built. As such, local communities are confronted with the challenge of dealing with an important reduction of resources, also due to population growth, that will need serious measures to protect the local environment and access to essential resources.

13.15 Picture and floor plan of the cheapest house and surroundings built amongst the sampled housing types in Mikocheni. Source: own picture

13.2.5 AFFORDABILITY

According to Africa Housing Finance (2021) in Tanzania, the minimum wage was around 500,000 TSH (€216). Contrary to the official data, this research has collected the salaries of a sample of rural Maasai neighbours and, out of 23 households, only one exceeds such amount. On average, dwellers from Mikocheni make a living with around 50,000 TSH (€19) a month, while in Maji Moto the average is a bit higher, with numbers between 100,000 TSH (€40) and 300,000 (€114). Also, the cheapest formally built house in the country is 115.400.000 TSH (€50,000), while the most expensive house among the sampled analysed in both villages is 29 million TSH (€11,000), and the cheapest house has been built with 100,000 TSH (€40). Both houses are in Mikocheni [see Figure 13.15].



13.16 Picture and floor plan of the cheapest house and surroundings built amongst the sampled housing types in Mikocheni. Source: own picture

With this data and the numerous claims made by interviewed dwellers, it can be said that the affordability of materials is for most rural dwellers, the first limitation at the time of deciding how to build their houses. The financial problem has been mentioned by more than half of the interviewed dwellers as having a big influence on the choice of building techniques. It has been observed that 100% of dwellers living in mud houses, whether with a thatched roof or with CIS, have opted for this material only because of budget limitations. John, who managed to build a newer house with his wife a decade ago (8 Million TSH / €3100), explains how they strategised to build a durable house with fired bricks:

"When we were living in mud houses, we thought: how can we move away from this? What would help us to move? Is it our economic capacity that makes us stay in this house? That's how we decided to continue farming more intensively, so we would earn more in order to move away from the thatch houses".

For dwellers having budget constrains at the time of starting a self-construction, the pathways are usually three:

1) Household members decide to build a house with less durable materials such as mud and thatch and upgrade these slowly as they get the needed income. This mostly happens by changing the roof trusses and installing CIS in replacement of thatch. For walls, it is harder to upgrade these, therefore the usual improvement lies in adding a more resistant layer of plaster. Unfortunately, this practice leads to overall high costs as resources are doubled, which is also environmentally unsustainable.

2) Household members opt for a less sustainable option in the long term if they are struggling to find the required economic resources at the moment of construction. In this case, they self-build a house with the least resources possible, using locally available materials such as poles, mud and thatch. Whenever they have saved enough, they build a new house from scratch in the same compound, using more durable materials. In this case, the former house is not demolished but keeps being used as a kitchen or store.

3) This case, which is more common in Maji Moto, requires the support of family members to stay in their places during construction. Homeowners who receive a presumably stable income decide to build their houses in parts. Once they have enough savings, they build first the foundations, then the walls (that can happen even after 4/5 years) and finally the roof. In this way, all the resources are focused on one single building, saving from waste of material, time and money. Homeowners that opt for this option, usually hire local workers to build their houses, as they have a better income capacity and are usually busier working elsewhere.

This put into perspective the choice between short-term and long-term expenses, in the effort of constructing newer buildings with higher standards than their previous houses. This is a worrying issue consequence of the lack of financial assistance and housing programmes directed to rural dwellers. If micro-credit programmes or other supporting bodies were active in those areas, a large number of wasted materials, efforts and resources would be saved. In this way, families would be able to plan from the beginning the type of house that they want, and with financial support, they could build an adapted house without having to construct two or three on the way.

13.2.6 TIME INVESTMENT

The role of time in the development of dwelling constructions is very much linked to affordability, which has been presented in the previous section. These two components go hand in hand and influence the capacity of dwellers to build in a specific way. As it has been expressed by many homeowners, the typology and quality of their houses have largely depended on time constraints, as with the case of Gabriel, a family dad from Mikocheni:

"I'm just preparing the materials to build my new house now. After I move to that house, I will start buying bricks. I could not start building it with bricks from scratch because it would have taken too much time so I would stay in people's houses for a long time with the children".

This statement explains why in most cases the pressure of having a family and therefore an owned place influences how houses are built. Due to his current situation [see pictures of his house and the one he is building in Figures 13.16 and 13.17] he cannot wait to have a better financial capacity to build a brick's house. Therefore, many families move on with the awareness that it will take many years to complete their houses in the desired way. Turner (2018) introduced the notion of housing as following the process of life, as it might take decades to finish a self-built house. Hence, while it is highly inefficient to build a house

13.16 Gabriel's boma and house on the right side in Mikocheni. Source: Own picture

13.17 New house that Gabriel is building in a new by compound, built with wattle and daub but differently from the current one, roofed with CIS.
Source: own picture

over 15 years, sometimes it is the only affordable option due to the limitations of access to finance (ibid).

Eventually, Maasai communities have been adapting to time constraints over centuries. Just as they used available local resources as an advantage to build their nomadic huts in little time, currently, the value of a sedentary lifestyle requires permanent housing solutions. As such, aware of the required lifespan of buildings due to new societal needs, homeowners do not hesitate to spend longer times in the construction phase, patiently waiting to benefit from the finalised and permanently built houses.

13.3 SOCIO-CULTURAL ASPECTS

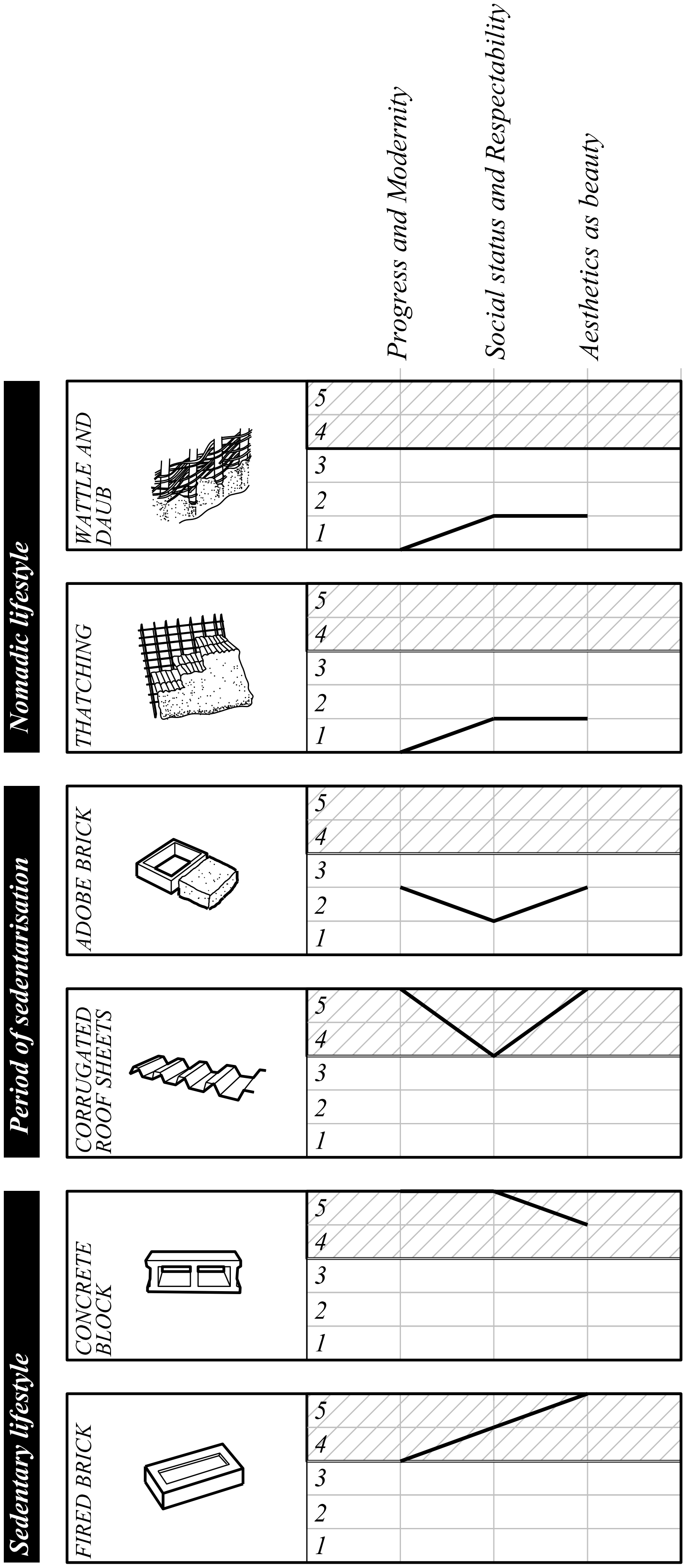
After carefully analysing the practical factors that influence the choice of building materials, this section wants to look at how culture and societal behaviour also impact decision-making dynamics in the built environment. Separating the practical from the socio-cultural does not mean that the construction of meaning attached to these happens independently from one another. The meaning of the built environment is formed alongside the continuous interaction between people and places within specific cultural codes and contexts. However, to facilitate the comprehension of the data findings, I have divided these into two different sections. In the same way that the importance of maintenance or availability cannot be understood without positioning it within a newly settled Maasai society and culture, aspects such as aspirations, progress or status would be meaningless without understanding the environmental and material context of the analysed settlements. The local environment is therefore positioned as both the result of culture's influence and the cause of it, which is not only natural but also man-made and vice-versa, embodying both material and symbolic environments (Hauser and Banse, 2011), breaking the nature-culture dichotomy. If knowledge is developed through experience with a close environment, how local resources are used should encompass cultural habits and behaviours. Such specific knowledge has always been essential to survive and adapt to the natural conditions of a given environment. In this sense, the importance of culture lies in understanding the unbreakable connection between local knowledge and the environment. Thus, to achieve environmental and social justice, the role of culture is crucial (Uzzel et al, 2002). Is for this reason that the aim here is to unpack how socio-cultural features influence the selection of building materials, as their conspicuous nature has the capacity to turn them into powerful symbols which embody connotations of status and identity (Kaitilla,1991).

Several authors have argued that vernacular building technologies are being lost as contemporary societal values are opposed to notions of indigenous traditions (Livingston, 1992; Beckman, 1972; Rapoport, 1983). While this claim might be true in some cases, it has usually lacked a thorough understanding of the embedded material attributes that are connected to these socio-cultural variables. Analysing them and their implications requires a deep connection with the context in which architectures of various kinds are displayed, to find the key to encouraging the use of sustainable building solutions, avoiding thus architectural solutions that are not culturally appropriate and therefore rejected by local communities.

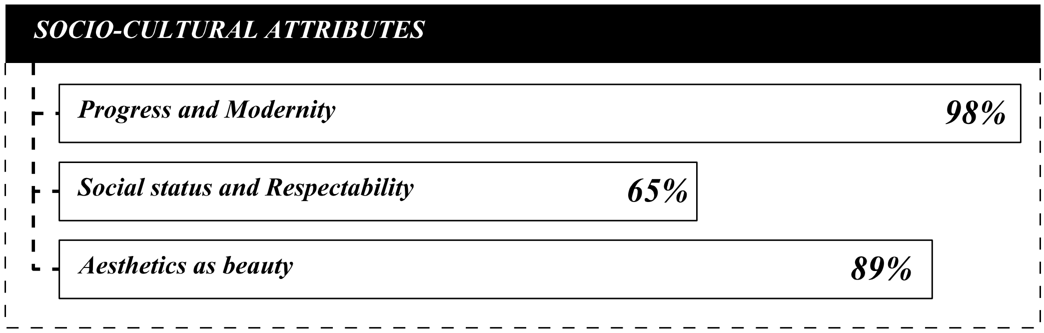
To further enrich socio-cultural dynamics and their link to preferences for building materials, this section seeks to shed light on these nuances as part of the Maasai society. However, it is acknowledged that culture as a subject of research 'can hardly be captured completely because of its complexity' (Bolten, 2001:128). Additionally, understanding its implications in the case of the Maasai society, which is undergoing a substantial transition, becomes even more challenging as it has to deal with rapid change, both socio-cultural and environmental.

By incorporating social and cultural appropriateness into the decision-making process of design projects, sustainability efforts can be more inclusive, respectful, and reflective of the diverse needs and aspirations of communities. This approach facilitates the creation of sustainable built environments that not only mitigate environmental impacts but also promote social cohesion, cultural continuity, and a sense of pride in local building knowledge.

As such, the following sections are devoted to analysing the socio-cultural aspects that have arisen from community member's conversations around their houses and the materiality of these [see figure 13.18 to find the details of responses related to each attribute and table 13.19 to see the correlation between materials and socio-cultural attributes].



13.18 Analysis of socio-cultural attributes that dwellers have attached to the different building materials existing at the local level. Own illustration



13.19 Average of interviewees concerned with the socio-cultural aspects of existing building techniques. Own illustration

13.3.1 PROGRESS AND MODERNITY

Rapid cultural change has defined, and still does, the extent to which the Maasai society has consciously embraced the need for development. One of the most surprising elements found in the interviews with dwellers is their awareness of how Maasai traditions have been progressively replaced by so-called modern practices[3]. As Bruno Latour (1993) points out, modernity by definition refers to the passage of time. He also added that "the adjective 'modern' designates a new regime, an acceleration, a rupture, a revolution in time. When the words 'modern', 'modernisation', or 'modernity' appear, we are defining, by contrast, an archaic and stable past. Furthermore, the word is always being thrown into the middle of a fight, in a quarrel where there are winners and losers, Ancients and Moderns. 'Modern' is thus doubly asymmetrical: it designates a break in the regular passage of time, and it designates a combat in which there are victors and vanquished". (1993:10) By all means, the passage of time influences all non-human and human beings. Maasai ethnicity, therefore, is not differently experiencing such passage of time, dynamically evolving alongside the developed world. The adoption and discard of building techniques is yet another representation of the society's modernisation and distancing of a nomadic past. The new language expressed by the built forms of Maasai settlements expresses an openness to conveying a new social identity. The refusal to conserve traditional buildings and construction knowledge while embracing newer techniques has been elucidated by most dwellers in both villages. For Lucy from Mikocheni, living in a mud and thatch house is a sign of failure:

3 - While this research does not want to categorise building types as whether traditional or modern, as it recognises architectures as always evolving and adapted, these concepts are used to make the reader understand easily the different analysed types of buildings.

"I would like to change my house because this mud hut is not in the standard of living, but I just had to accept this situation. These mud houses can fall at any time, but also I can see how others live in their modern houses, and despite the modernity that exists, I still have not been able to move in life".

The perception that dwellers have about their own 'stage in life' seems almost a materialisation of a concept that should be abstract. As if modernity could be measured objectively, or if it was something tangible that could be touched. Despite it might seem that modernity and progress are abstract concepts, for the communities analysed is a driving force that is constantly shaping their built environment. Also, for dwellers like John who have been able to improve their houses, the justification is somehow similar:

"We like our house because is something that came with progress and we received it, and we're moving forward with it. We're going with time. Of course, a thatched house would better represent our traditions, but our modern house goes alongside technology".

John, who proudly showed us his big, coloured house, would also talk about the good properties of a thatched roof, and how houses are now much hotter than in the past due to the use of CIS. But at the same time, he stressed how this aspect is to an extent, less relevant than matching the current moment of societal development. The substantial change that the Maasai society has undergone requires new building technologies that are adapted to newer cultural practices. Among others, the arrival of electricity, their shift to farming practices, the inclusion of Maasai kids into the instruction system, and so on, motivates the need for adapted building solutions that match these new social and cultural practices. Koixane, one of the younger dwellers that were interviewed, expressed clearly the thirst for modernity and change, both at the level of the built environment and at the level of practices:

"We, Maasai, are developing. After centuries of practising pastoralism, now we want to move from our traditional practices to embrace the use of modern practices".

In the last decades, the Maasai society has seen a considerable improvement in quality of life, having access to health, education and infrastructure. As such, the need to improve their housing conditions moves alongside, accommodating their knowledge of traditional building practices to more adapted solutions considering the current trends and the need for development. This sort of hybridisation of building techniques is an interesting pattern that has been observed among some dwellers in the analysed villages. Due to the need to convey a certain image of modernity, but in the impossibility of accessing more expensive building materials, houses can be built by using traditional materials but covering these with cement plaster and paint, obtaining as a result, a building that looks modern but that uses locally available materials:

"My parents lived in a traditional Maasai house, but looking at how the trend is changing, I wanted to build with fired bricks. Because I could not afford it, I decided to use adobe bricks, so that it could look a bit like a 'normal house'. In the end, if a mud house is properly built, it can be very strong even with modern forms, so I have built a house that when someone looks at it without looking at the details, they might say that it has been built with cement blocks or fired bricks. Therefore, it looks alike those techniques. In this way, I can go with the present time even if I did not use a modern material".

Yesse's statement is crucial to understanding how we might move to a future in which more sustainable materials are included in current building methods.

As he properly pointed out, if a house with adobe bricks is built in the right way, it can be as strong as a concrete house. The recognition of the existing possibilities that bio-based and locally sourced building materials have, gives space to diverse building techniques to be introduced into the building culture, showing the potential that new and innovative solutions might have while accommodating dwellers' desires and need for progress.

13.3.2 SOCIAL STATUS AND RESPECTABILITY

In the Maasai tradition, status has been historically linked to age groups, in which elder members are listened to and respected as the higher authority of each clan. These people carry the wisdom of their societal tradition and are usually the most influential members of a group. Another symbol of social status among a Maasai clan is the total number of livestock owned, an element that is visible by looking at the dimension of the livestock enclosure of each boma. Currently, despite age groups are still part of the contemporary Maasai society, these are progressively losing their value, while shifting the attention to the forms of architecture as a symbol of status. The representation of status through the materiality and form of each one's house has gained significant value in the last decade. In the past, all houses of a clan would be built in the same way, using the same building materials and moving from shelter to shelter. In the present, with the arrival of industrialised materials and the rise of standardised architecture, homeowners have found new ways to communicate their wealth and status to the rest of their neighbours. Huge differences in terms of materials, details and dimensions have created invisible categorisations of homeowners. The sophistication of forms that some owners have access to, has put them in the spot of fashion, being a reference for those dwellers that are considering improving or building a new house with modern features. As such, comparison between neighbours has become a common trend, prompting somehow the categorisation of dwellers according to their houses.

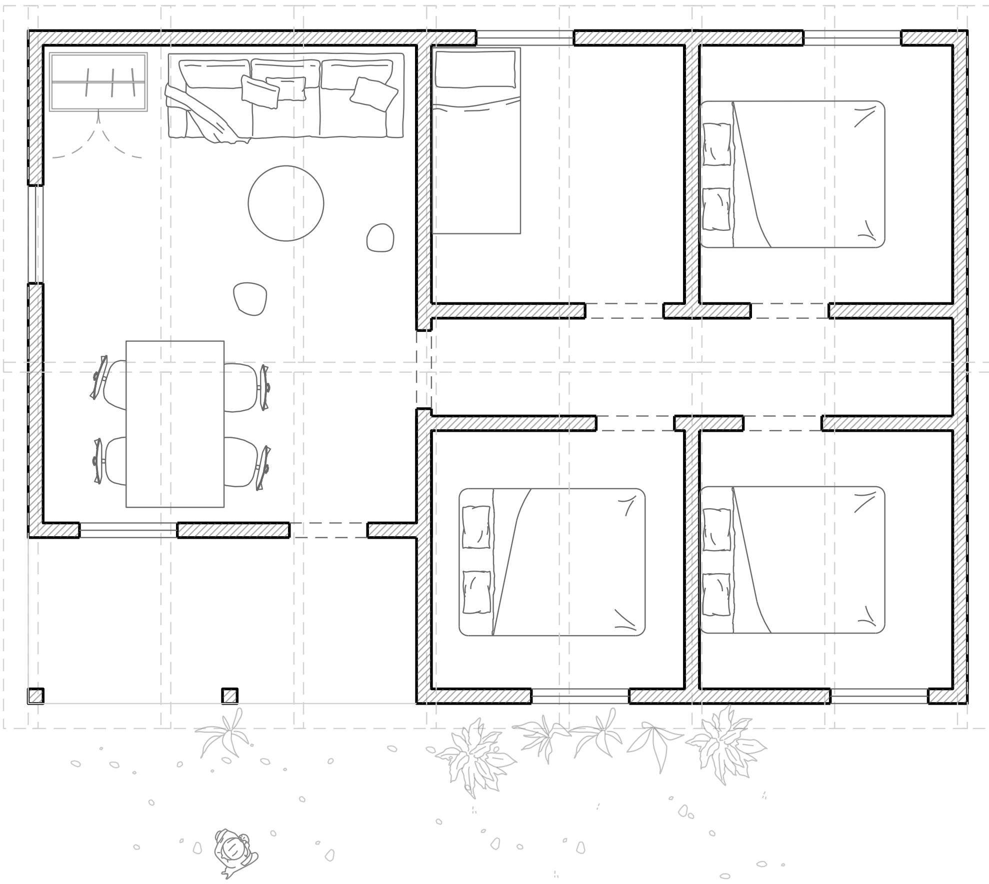
Through conversations with homeowners, it has been discovered how the definition of their houses' condition comes in comparison with wealthier or poorer neighbours, having these as a reference to measure each owner's achievement. For example, Irene, a teacher in the Maji Moto school, commented about her house as such [Figure 13.20]:

"I really like my house because it has been built smartly. My house is strong, beautiful, and different from other houses like those of mud or tree wood".

For some dwellers, their houses encode a huge sense of pride, due to the effort they have made to afford building in a specific way. Oppositely, for others like Moses, looking at their houses and spending time inside is just a reminder of their failures:

13.20 Back side of Irene's house and floor plan in Maji Moto. Source: Own picture

There's nothing I can like about my house. When I look at it, I see how other people are living in good and big houses while I'm still living in a thatched house. I can see my weakness. I would just want to have a house with fired bricks and a CIS roof.



13.20 Back side of Irene's house and floor plan in Maji Moto. Source: Own picture

As these words suggest, the element that is more pressing to dwellers has to do with the materiality of their houses, as many others have also expressed that having a thatch roof, they cannot invite guests at home, as they feel is not proper and rain could leak on them. For this reason, Gabriel, the chairman of Mikocheni Maasaini is working on improving his house. He feels that his leadership position within the community it suffices as a reason to improve his house. Likewise, owners with higher financial capacity in Maji Moto who have flashy houses have expressed how the look of their houses literally 'gives them respect'.

As such, it is possible to claim that the evolution of choice of building materials in both localities is highly influenced by the notion social status, encouraging dwellers to improve their houses by comparison and according to their role within the community. In the end, the choice of building materials is intricately intertwined with social status, reflecting the influence of wealth, prestige, cultural identity, and personal aspirations. Building materials can serve as markers of social standing and contribute to the creation of architectural expressions that reflect the status and identity of individuals or communities.

13.3.3 AESTHETICS AS BEAUTY

The notion of beauty has proven to increasingly gain value amongst Maasai dwellers as a decisive driving aspect of their choice of building materials. While it might seem obvious, it is important to note that beauty as a concept has emerged among settled Maasai communities only in recent years. The indigenous shelter was usually restrained, responding only to specific needs related with their migratory nature and the available resources, while symbols of beauty were related to ornaments such as animal horns, skins and other symbolic decorations of their pastoralist tradition. Later on, after they settled temporary, mud houses have been usually decorated with plants in the entrance area, denotes care and neatness [figure 13.21]. While recently, with the approach of development and raise of industrial materials, building has become a deliberate act of representation and therefore, manifold skills for improving the look of houses have arose. In fact, the aesthetical aspect of houses has been remarked as crucial by many dwellers, mostly in the case of Maji Moto, due to its higher influence from close-by cities. In this way, the beautification of dwellers' homes has become a life-long project for many, who spent their time and money and finances in slowly improving the conditions of their house, focusing on details that have required a higher level of permanence to become relevant. Lindaseku, a neighbour from Maji Moto, confirm it with his words:

"I decided to use fired bricks for my house because these are durable. But also, when you build you feel you are doing something beautiful. I wish I could do more things, like putting grill doors and nice windows, so that I can live in a beautiful house".

It has been common to hear comments such as this, in which dwellers are focused on the improvement of windows, doors, plaster and floors, only after they have reached the desired level of quality of their structure. This pattern has been observed mostly in those houses whose owners have built with concrete blocks or fired bricks and that have a CIS roof. As the permanent house takes the shape of the desired life project, homeowners find joy in the improvement of little details. Anna, a young neighbour from Maji Moto, discussed with us her will to change the colour of her house's walls, undecided between 'bubble-gum pink' or bright yellow [Figure 13.22]. She also proudly showed the tiled floor of her house, which is usually one of the latest improvements made by dwellers once houses are plastered and with steel windows and doors. In fact, in cases such as Anna's, the achievement of the expected house results reduces the possibility of having to build a new house, which in terms of resource use, is more convenient and sustainable. Instead, in cases in which houses have not been built in the manner that owners would have expected, the desire is always that of building a new house, hoping to meet the 'social standard' and trend when the financial capacity will allow. As such, the liminal consequence of not meeting the expected standard results in a less ecological response, by having to build more and over longer periods.

Beauty in the built environment has always been a contested concept in architecture theory. While it has usually been related to the final details and aesthetic of fashion, beauty is essential as part of the experience of human beings in the spaces they inhabit, helping to create connections and improving emotional well-being (De Botton, 2006). The way buildings can transmit a sense of beauty needs to be taken into consideration as it shapes the way we interact with our environments. Alexander (1977) focused much of his work on the concept of

13.21 Family compound in Maji Moto in the morning after cleaning the front space. Source: Own picture

13.22 Anna's house front side with porch and flashy colours, also floor plan (Maji Moto). Source: Own picture

beauty, with an approach that looks beyond superficial aesthetics and focuses on creating environments that are functional, meaningful and visually inspiring. In the case of the Maasai context under investigation, we have observed how functional aspects are essential to define the experience of dwellers in their homes, and how these have become meaningful through improvements that distance them from uncomfortable experiences. All these changes throughout time have also contributed to creating a new sense of beauty, that is not only aesthetical but that tells the story of a house that is strong, spacious, clean, illuminated and ventilated[4]. All these aspects go hand-in-hand, and therefore, the efforts of dwellers in improving their home spaces with little details, are the result of a care that is taken over elements that want to be conserved.

4 - Understanding beauty beyond its aesthetical values, it is demonstrated how other fundamental aspects of spaces are required in creating the overall sense of beauty.

In the end, beauty is a dynamic concept that evolves according to aspects such as culture, individual preferences, societal values, contextual considerations, and so on. Rather than a fixed and universally defined concept, beauty in architecture is a fluid and evolving phenomenon that responds to changing values and influences. However, what has been observed while analysing the importance of beauty for local dwellers, is that the relevance of this is only visible when other house requirements have been met, being the result of a long-term relation in which dwellers eventually find the possibility to focus on details such as the colour of the paint, the type of floor, the material used for doors and the style of the roof.

13.4 CONCLUSIVE REMARKS

This chapter has explored local and global forces that encourage the use of construction materials in self-built dwellings within the Maasai settlements analysed, Maji Moto and Mikocheni. The purpose of analysing both cases comparatively has shown potential for elucidating driving factors that are pushing the introduction of industrialised materials and modern built forms at a different pace and impact while shedding light on the political economy of building materials. The greater isolation of settlers living in Mikocheni Maasaini together with the preservation of their pastoralist nature has prevented the adoption of more globalised building forms and materials. In fact, in comparison with the 20% of dwellers in Maji Moto who own mud houses (most of them built with adobe bricks), almost 90% of Mikocheni houses are built with the wattle & daub technique (poles, mud and cow dung). These percentages are in line with the existing connections between Maji Moto and Arusha, a wide urban settlement where Maji Moto neighbours travel often, but it also reflects the community shift to farming practices which provides better financial stability to the community. In addition, it is worthy to remark that individual housing aspirations widely defers from village to village. In Mikocheni, most of the dwellers have expressed a will to build new houses with fired bricks and plain corrugated sheets, without thinking much of spatial arrangements, dimensions or details. Contrary, homeowners in Maji Moto thoroughly explain their plans for their future or improved houses. In terms of the spatial quality of the house, they have pointed out the need to raise the roof and the inclusion of a ceiling to prevent the heat from the corrugated sheets, as well as bigger houses with more rooms, including toilets and kitchens in the inner spaces of the houses. In terms of materiality, comments on the materials of structures have commonly addressed the use of concrete blocks and fired bricks, but most significantly, they have specifically focused on finishing details such as finishing floor tiles, coloured roof sheets, external and internal plasters, colour paint, stronger doors and windows with glass and steel and so on. Such a difference in building types and aspirations indicates how geographical locations are strategic when considering the level of assimilation of modern building cultures. Nevertheless, these findings suggest that in the case of Mikocheni, such changes will also take place in the longer term. The increasingly common contact of the community with other societies leads to a process of syncretism between different cultures (Coast, 2000), and as a consequence, building materials that were supportive of the nomadic lifestyle have been relegated to a peripheral position. New values have taken precedence over traditional ones, and so the meanings that some materials encode are now obsolete or forgotten. The evolution of building materials' meaning shows how traditional building practices that have been supportive for centuries have now been replaced by others that encode new symbols and functional aspects. This denotes the great versatility that the Maasai community has had to adapt to newer building options, opening thus the opportunity for absorbing innovative solutions that are more in line with environmental change and the climate threat that communities living in the fragile savannah environment are undergoing.

The systemic analysis that this chapter has carried out to deepen building materials meanings within the local contexts, has shown how a combination of ethnography and architectural analysis serves to elucidate local dynamics that can assess the viability of built projects in contexts of vulnerability. This research understands the built environment as a living relationship between people and the place they inhabit. It includes resources, climate, landscape, cultural practices, and historical features. By merging the knowledge of local communities with innovative technologies, we can introduce adaptive and contextual building projects while also pursuing pioneer research on the ecology of building materials.

14 — Conclusions

The last chapter of this book, which is also the last chapter of this research, wants to offer an overall conclusion of four years of researching materiality within the Maasai context. The first section provides a conclusive reflection regarding the entangled world of material dynamics. After that, section 14.2 presents an original discussion focused on the main building materials that have been part of this research, putting into perspective their benefits and challenges experienced at the local level. Section 14.3 provides a further discussion of locally used building materials in comparison to the innovative technique proposed in this thesis, the Compressed Stabilised Earth Bricks. In this section, the pressures of socio-cultural aspects and material properties frame the new paradigm of contextual materials. Finally, 14.4 presents the final remarks of this research.

14.1 MATERIAL DYNAMICS UNFOLD: FURTHER REFLECTIONS

Long before starting my PhD research, I had been physically engaging with the context of Maji Moto. This engagement occurred both as an architecture student volunteering on a construction site and as a user; living and experiencing the spatial and material reality of a dwelling in the middle of the savannah. The experience of living in a Maasai village with a local family for nine months led me to reflect on the impact of social codes and cultural traits in the built environment. The assurance of a neighbour's statement about the need of development and modernity, in a certain way collided with the romantic perspective I had of their traditional buildings. In the desperate search for authenticity, I was primarily concerned by where developments led to threats against their building traditions. It might be worth mentioning that besides this, during my stay I was living with a family of good standing whose house had most of the required elements to feel comfortable: electricity, paved floor, plastered walls and ceiling. There were some small aspects such as having to use a free-standing pit latrine outside the house and the lack of kitchen and taps which were different to what I was used to. However, considering the temporality of my stay there, these minor inconveniences were considered part of an interesting experience. Nevertheless, I have to admit that during my weekend trips to the city, I used to feel relieved to return to my comfort zone, sleeping in a 'normal house' with a 'normal toilet' and a 'normal kitchen'. Whilst some of you might be wondering why I devote time to talk about my personal experience, I do this because my experience is common to many other western architects working in developing contexts. Because of our romantic need of authentic places and the ephemeral nature of our stays in these work sites, we do not fully open ourselves to the reality that local dwellers experience in their everyday life. The natural brown colour of mud walls and the cool thatched house are almost like a museum piece for us, but beyond superficial devotion, we do not really engage with these places. Nigel Barley, an anthropologist who spent two years living with indigenous communities in Congo, expressed this idea very well:

"These corrugated iron sheets contribute greatly to the ugliness of African cities in the eyes of Westerners. This is partly due to pure ethnocentrism: while the thatched huts are "picturesque and rustic", the corrugated iron roofs are a reminiscent of our shanty towns" Barley, (1989: 40)

In the end, we leave, they stay, but it is only in situ where reality unfolds: living without access to safe drinking water, continuous electricity and most of the commodities that the rich side of the world has access to. As such, the time I spent in the village served only to grasp a few of the processes that influence how the local built environment is constantly shaped. These mostly involved dynamics that related to identity, modernity, wealth and so on; often direct consequences of the scepticism/rejection of building techniques such as the CSEB. In this way, by focusing on how to integrate this technique, I kept forgetting the lived experience of bodies in their settings and environments.

After my stay in Maji Moto and the beginning of this PhD, I devoted a lot of time to engaging with research that specifically looked at socio-cultural dynamics. There, I found a wide body of literature to feed my interest in the topic. It was only after planning the approach to my ethnographic research based on grounded theory (see Chapter 10), that I started to think about deconstructing my knowledge to embrace and centre the dweller's experience. Socio-cultural meaning is indeed an essential part of what motivates the choice of building materials, as this research has shown. However, in listening to the experiences of locals and learning through their knowledge, one realises that social meaning is also shaped by the bodily experience of built forms in itself. As Tilley observed (2007) "People are indeed embedded in a material world, immersed within it, and this sensuous world of material things has effects on the way people think and behave, but not in any simple or deterministic sense". As such, identity and other social dynamics are entangled with the mundane reality of the body in any given environment. The everyday life experience of locals encapsulates much more than we think if we look at the subtle dynamics that are essential to understanding the construction of our cities. In the push to understand the material choice of Maasai constructions, it has been crucial to look at the environment which "continually unfolds in relation to the beings that make a living there" (Gibson, 1979:8). In this context, the environment unfolds alongside its material properties that occur parallel to its inhabitants (Ingold, 1992). It is important not to interpret these material properties as fixed. We see the transitional nature of materials through the evolution of which supportive materials were by nomadic communities in comparison to the current sedentary Maasai population. As such, material properties are processual and relational (ibid.). Think for example about mud walls, which were essential for the nomadic Maasai communities as they could be quickly built and then discarded whenever they had to migrate. In contrast, the current need for stable and durable materials means that the flexibility of mud construction is not required anymore. This demonstrates how we cannot truly "functionally" describe the materials we want to use. In this sense, they can only be described through the stories of people who live and experience them. In this way, properties are not fixed and they change depending on the medium, its use and the person who experiences it. For the purpose of this research, it can be concluded that it will not be possible to objectively describe the qualities of a material, but only learn from them concerning people's experiences. The analysis of dwellers' experience within their homes through storytelling and interviews has shown the potential of this study for advancing the adaptation of bio-based materials by taking the sensorial and everyday-life experience of dwellers into account. The relation between material, socio-cultural and historical factors applied into design patterns should be taken into consideration to evaluate the opportunities for adaptation of innovative building solutions, in order to avoid failures that negatively influence the development of communities everyday-life.

14.2 DISCUSSION ON TRADITIONAL BUILDING TECHNIQUES: LESSONS LEARNT

In a discussion article, Karl Knappet argued that "artefacts may have material properties, but it makes little sense to study them in detail as they are secondary to the role of the artefact in social relations" (Knappet, 2007). In considering buildings as artefacts, he is neglecting the value of material properties as part of people's experience with buildings. This research has, across several chapters, demonstrated that material properties do have an influence in directing material choice in self-built contexts. Alongside this, material properties also determine the stress that is imposed on specific resources that are found in our environments. This impacts both humans and non-humans. Moreover, it has been demonstrated how material properties are in many cases, also the drivers of social relations and cultural codes. A good example observed throughout Chapter 12, is the socialisation limitations of homeowners depending on the material their homes are built from. For instance, those homeowners who have a thatched roof, have claimed the impossibility of inviting guests to their houses due to a sense of shame and the fear of having leaks during the rainy season. Not feeling comfortable doing something that has traditionally been commonplace relates both to new social symbols, as well as the material attributes of thatch, which in this case are not completely waterproof if not perfectly installed. As such, humidity, dust, moisture and other elements that affect the users' experience can be caused by material features, impacting aspects of the social and cultural life of local communities. To shed light on the existing relationship between traditional building techniques' attributes and their socio-cultural codes, I have sought to categorise the perception of dwellers from Maji Moto and Mikocheni according to the advantages and disadvantages that they have noted. The aim is to look in greater depth at building techniques currently in use and how these could be improved or hybridised to keep promoting their use, as these are sustainable and locally available building solutions. The considered techniques are thatch as a roofing method and mud walls (wattle & daub and adobe bricks) for walling solutions.

14.2.1 THATCH ROOF: BENEFITS AND CHALLENGES

The thatched roof is by large the most neglected traditional technique in both villages. Almost the totality of Maji Moto dwellers have ceased living in their thatched buildings, even if these are still standing and used for animals or as kitchens. While the case of Maji Moto seems more obvious due to higher levels of sedentarisation, also in Mikocheni the thatched roof is progressively being replaced by metal sheets, while maintaining mud walls in some cases. Moreover, the reason why homeowners still live in thatched houses is not related to having access or affordance to corrugated iron sheets (CIS). The reason lies in the requirements needed in the roof structure to install the CIS. Due to the rectangular shape, round buildings cannot be covered with these, and also, these require a specific structure of beams, which becomes an expensive solution in most cases. This denotes an impossibility in some cases for replacing thatched rooves, despite the will of dwellers to do it. Out of the six homeowners interviewed who own thatched houses, only half of them have expressed some of the advantages of the use of this material, while the rest of the positive responses regarding thatch have come from dwellers whose houses are covered with CIS. The main advantages and disadvantages of this traditional technique are the following:

Advantages: Thermal performance, Access and Affordance

Thatch roofs, with their centuries-old tradition and widespread use in various regions around the world, offer remarkable thermal performance and contribute to comfortable indoor temperatures for the hot climate of the savannah environment. This is partly because of the natural insulation properties of the material. It consists of layers of straw, grass or river reeds, tightly bundled and woven together [Figure 14.1]. This arrangement creates a thick, densely packed layer that acts as an effective insulator. The unique structure of the thatch layer helps to trap air pockets within the material, forming an additional barrier to heat transfer. The insulation provided by thatch roofs plays a crucial role in regulating the indoor temperature. During hot weather, the thick layer of thatch acts as a shield, preventing the sun's heat from penetrating directly into the living spaces. The trapped air pockets within the thatch layer provide insulation, reducing the amount of heat conducted into the building. This natural cooling effect keeps the interior cooler, offering a more comfortable environment even in scorching temperatures. Thatch also helps to regulate humidity and due to its porosity, it promotes natural ventilation. As it has been explained by some neighbours, people move to their old, thatched houses when temperatures are at their highest as houses with CIS become extremely hot if not well-ventilated. Thus, thermal performance has been valued amongst Maasai neighbours for providing an energy-efficient solution that enhances thermal comfort, while it preserves the meaning of traditional practices.

The type of material that is used in both villages for thatching differs one from another. The proximity of the river in Mikocheni enables the possibility of collecting river reeds, which are thicker and stronger to roof [Figure 14.2], while in Maji Moto, the remaining grasses and straw used to be collected [Figure 14.3].

Thatch is considered an ecological roofing option as it can be harvested from renewable sources, reducing the carbon footprint associated with production and transportation. The access to the source of this building technique has been for long a supportive material for Maasai communities, who migrating in the search for pastures have also found grasses to cover their rooves. Despite the vernacular Maasai house was covered with poles and mud, its fragility prompted the community to use thatch by assimilation with other ethnic groups. In this way, the technique gained relevance amongst settled communities, who

14.1 In Mikocheni, river reeds are collected and tied together to be sold or installed in a roof. Source: Own picture

14.2 A thatched roof in a mud house in Mikocheni, denoting the thickness of the local reeds. Source: Own picture

14.3 House built with adobe bricks and thatch in Maji Moto, which in this case is leftover straw. Note the difference of thatch in comparison to figure 14.2. Source: Own picture

could provide a decent roof for their houses by collecting thatch from the nearby environment. This aspect has been and is it yet valued by the communities under investigation. Mostly in the case of Mikocheni, dwellers have pointed out how, despite it requiring a lot of maintenance, it is an accessible roofing option for those who cannot afford the improvement of their building structures to replace thatch by CIS. However, it is important to note that access to this material is progressively being reduced due to the threatening effects of climate change, as local rivers that contain river reeds are drying up. Local authorities are campaigning to avoid the cutting of river reeds, as these are essential to protect the river against erosion. Therefore, despite the availability and affordability of this material, its use is being reduced due to the aforesaid reasons. Instead, in the case of Maji Moto, thatch is not easy to find. Locally, communities had used straw and grasses to roof, but currently, these grasses are specifically devoted to feeding the livestock of neighbours, therefore the practice of thatch roofing has almost disappeared.

Disadvantages: High Maintenance, Permeability, safety and representation

The previous section has shown how local communities value thatch as a The previous section has shown how local communities value thatch as a roofing technique mostly due to its thermal performance, which compared to the other available option (CIS), results in better inner temperatures within houses. But while thatched rooves have several advantages, they also come with certain disadvantages that have diminished their use in both cases, having almost disappeared in Maji Moto. In any case, dwellers of both settlements have agreed on the practicalities and social aspects that hinder its application:

Thatched roofs require regular maintenance to ensure their longevity and performance. Over time, the thatch material may become weathered, damaged, or compacted, which can lead to water leakage and a decrease in insulation effectiveness. Re-thatching is necessary periodically, typically after every rainy season, or two in case of not heavy rains. Of course, the quality and type of thatch also influence the number of repairs that each roof needs. Usually, instead of replacing the old thatch, the common practice is to add a top new layer of thatch, as can be observed in Figure 14.4. Overall, the lifespan of thatch in the context of Maasai settlements requires intensive work to maintain its quality, a factor that has overly contributed to a quick abandonment of the technique.

14.4 New layer of thatch is being added to a roof in Mikocheni, tiding them up with ropes and further securing the roof with wooden sticks.
Source: Own picture

The rise of permanent housing solutions has gained strength, decreasing the use of techniques whose quality depends upon investing time and resources in their proper maintenance.

One of the consequences of the lack of maintenance is permeability. Thatch can be challenging when it comes to water resistance. The natural materials used for thatching, such as straw or reeds, are not inherently waterproof like some modern roofing materials. Its permeability can lead to water leakage and potential damage to the building if not properly managed. Also, even in cases of thatched rooves that are well-built, it is important to note that the permeability of the thatch itself means that some level of moisture may still pass through the roof. Regular inspections, prompt repairs of any damage or wear, and proactive measures to address water-related issues are essential for maintaining the integrity of a thatched roof. Therefore, the required maintenance and periodic re-thatching that ensures the roof's waterproof quality makes it difficult for current dwellers to keep up with the quality to avoid water leaks. Given this, dwellers have expressed their fear of leaks during the rainy season, which put at risk their entire houses. This raises another aspect that has been argued by dwellers as worrying, the safety of their thatch houses. On the one side, there is the risk of having water leaks in the house, which mostly worries at night during the rainy season. On the other side, the fragile structures in which the thatched roof is joined risk flying away or getting broken during events of strong winds. For these reasons, dwellers feel threatened by their thatched houses when these are not well constructed. This fear is a common pattern among neighbours, both for those who currently live under thatched rooves and for those who already built new houses with CIS.

Last but not least, an aspect that has been raised among interviewees, is the representation of poverty attached to owners of thatched houses. The functional constraints presented before have promoted the use of CIS rooves in those households with the financial capacity. As such, the small number of dwellers who have opted to keep their thatched houses are viewed as poor due to the bad perception of the technique. The challenges associated with the use of thatch at the local level have rapidly reduced the use of thatch. As such, dwellers who can see the benefits of using thatch would still prefer to have the capacity of building a new house with CIS, as a way of disassociating their identity with the use of traditional and poor building techniques.

14.2.2 EARTHEN WALLS: BENEFITS AND CHALLENGES

Earthen techniques have experienced progressive neglect at the expense of structurally stronger and more visually appealing building materials in the last decades. Despite this transformation has happened at a slower pace than for thatch rooves due to the greater inversion required, the use of the wattle and daub technique and adobe bricks is now discouraged in both areas. In some cases, there are small buildings that are being constructed with these techniques, but these have a secondary role usually for keeping animals or as stores.

Out of the 23 sampled houses in both villages, 13 were built with one of the earthen walling techniques. Most of them are located in Mikocheni, with 9 houses of which 8 were built with the wattle and daub technique and 1 with adobe bricks. Instead, in Maji Moto, only 4 houses have earthen walls, being 3 out of 4 built with adobe bricks, and one with the wattle and daub technique. Unfortunately, the advantages that homeowners have expressed are barely relevant, as most of them have expressed a clear rejection of anything related to these techniques. Despite this, in some cases, there have been some benefits that will be stated below. By contrast, as can be already expected, most of the comments have been related to the challenges and issues of the use of soil or mud for construction.

Advantages: tradition, availability and affordability

Earth buildings usually offer numerous benefits as an available and cost-effective construction material, making them a practical choice in the context of Maasai settlements. These constructions have been traditionally built by this community, using small poles, mud and cow dung. As expressed by local dwellers, earthen buildings embody connotations of decay and poverty, but as well, they also carry the indigenous knowledge of the Maasai society. Some neighbours in Maji Moto, where the use of this building material has almost disappeared, do feel that the use of soil in construction will always be part of the traditional representation of the Maasai and that despite not being used in formal construction, it will become part of the storytelling and image of the once nomadic community. Not surprisingly, visiting Maasai villages has become a touristic activity for many foreigners, for which Maasai build their traditional houses almost as a form of museum tour.

It has been acknowledged by some that these building techniques have not yet disappeared completely because of the support it represents for some dwellers as a free-of-cost technique, giving them a strong sense of autonomy. For this reason, affordability is one of the other benefits that local dwellers have found in the use of earthen building techniques, such as the adobe bricks and the wattle and daub. In general terms, one of the primary advantages of earth as a building material is its abundance and accessibility. Earth is widely available throughout regions, making it a readily accessible resource for construction. Its local availability reduces the need for long-distance transportation, which minimises associated costs and environmental impacts. Moreover, earth-based materials can often be sourced directly from the construction site or nearby locations, eliminating the need for extensive extraction or processing. In this way, access to it is easy and almost everyone can take advantage of its availability to construct. In this case, affordability and availability go hand-in-hand, as none of the required materials to build have a cost. Earth construction materials, such as soil, clay, sand, and organic fibres, are generally inexpensive or even freely available. Its affordability makes earth buildings a suitable option, particularly in this case where financial resources are limited. Additionally, earthen buildings often employ simple and traditional construction techniques that require minimal specialised equipment or skilled labour. This simplicity further contributes to cost savings and promotes community involvement and skill development. The exception comes with adobe brick walls, which as well as rammed earth walls, should be laying on top of a foundation that is usually built with concrete. This is not the case for the wattle and daub technique commonly used by Maasai communities, which is joint to the ground without foundation but just by digging some centimetres into the soil. In conclusion, despite the neglected construction of earthen buildings, dwellers still see some benefits that align with the reasons why the ethnic group has widely used them.

Disadvantages: durability, thermal comfort, ventilation, cleanness, spatiality and perception

Compared to the number of benefits that have been pointed out by homeowners who live or have lived in earthen houses, the disadvantages are unfortunately striking. Almost the totality of interviewed users has complained about the technical performance of mud buildings, beyond their social perception. With the pressure of modernisation and permanence, the durability of traditional Maasai buildings is a critical challenge to overcome. The required high maintenance after rainy seasons and the many claims about buildings falling apart have influenced the local perception of earthen techniques. Both in the case of wattle and daub in Mikocheni and of adobe bricks in Maji Moto [Figure 14.5], the opinions are very similar. This is because buildings lack of a proper structural foundation, and therefore can be thrown away by floods or strong winds. Additionally, how these are built impacts also the thermal comfort of buildings.

14.5 A woman enters a kitchen in Maji Moto built with adobe bricks. The surface of the walls is visibly deteriorated. Source: Own picture

Earthen techniques are widely known for their good thermal performance, however, Maasai have traditionally built these with very thin walls that do not allow for thermal mass to work wproperly. Also, the lack of floor in most cases further increases the inner temperatures of buildings. Yet another challenge is ventilation. Due to the high temperatures of these buildings (mostly if covered with CIS), proper cross-ventilation is crucial, but the fragile mud structures do not allow the inclusion of big windows. This creates a sense of oppression due to lack of ventilation, humidity and high temperatures. All these problems trigger another constraint that has been alleged by homeowners who live in mud houses: cleanness. The lack of a paved floor and plaster in the internal walls leads to the perception of a dusty and dirty environment. Despite efforts to clean the spaces, it never looks neat and clean.

Of all the challenges, the rigidity of the spatial form may be one of the most constricting. The wattle and daub technique only allows for square or circular low walls with almost no openings [Figure 14.6]. The sedentary lifestyle of Maasai communities has shown the need for bigger spaces with higher numbers of rooms. As such, basic building techniques do not have the technical requirements to enable the design of diverse building forms. Indeed, by learning from nearby ethnic groups that have absorbed industrialised building materials which allow for endless building possibilities, Maasai settled communities also envision their houses with many more spatial features, allowing for the inclusion of windows which results in more ventilated and illuminated houses.

14.6 Floor plan and axonometric view of the indigenous Maasai hut, which usually lacks windows and doors.
Own illustration

Lastly, in the same way that thatch roofs are badly perceived, the use of earth as a main building technique has lately embodied connotations of poverty within local communities. The will of progress and the inclusion of modern features in the built environment have diminished the use of these techniques, conveying an identarian label that homeowners do not want to keep portraying.

14.2.3 MOVING FORWARD

The previous section has provided an in-depth analysis on the significance and challenges of the main traditional building techniques that are still common in the Maasai built environment. With the rise of unsustainable and expensive industrialised materials, this analysis has set the foundations to allow for a reformulation of the way in which traditionally employed building techniques can accommodate user's needs. The autonomy that earthen buildings have given to the Maasai community for centuries has been progressively transformed into a series of challenges that self-built projects face if they are to adapt to the requirements of 'modern times'. The pressures of a sedentary lifestyle have raised concerns linked to the use of materials such as thatch and mud that will be difficult to overcome without a systemic change in the way these are employed.

The attributes that inhabitants define as beneficial are, by no means, correlated to ensuring the sustainability of building materials. Affordability and availability are essential conditions to promoting the use of materials amongst vulnerable communities. Furthermore, with evidence of increasing temperatures, materials' thermal performance will be equally important in ensuring the safety and comfort of dwellers, mostly in contexts where active cooling systems are expensive, as well as ecologically unsustainable. As such, assessing the advantages offered by material properties is required in material research, if we are to tackle the aforementioned challenges.

What is important to point out here is that the functional disadvantages discussed by inhabitants are more closely linked to the way these are built than to the materials' performance itself. In fact, it is well known that earthen buildings are highly resistant if well-constructed, and there are plenty of examples of earthen buildings that still stand centuries after their construction. Also, in considering the thatching technique, it is possible to mitigate potential issues through appropriate design, the inclusion of a waterproof membrane and ongoing maintenance. With proper care and attention, thatched roofs can provide unique architectural features while also offering adequate protection against water and heat. Thus, what is argued here is the need to provide technical assistance to allow the use of technologies that increase the qualities of the material itself. This shift in perception regarding materials would not be happening without the involvement of the government, as lately it has been encouraging rural dwellers to adapt their houses to standardised materials (Kasilima, 2008) and they see that by their metrics, housing is broadly speaking improving. In this way, the authority's disapproval of using locally sourced materials is increasing the notion that these constructions are backwards and poor.

For this reason, the main takeaway of this research has been the development of prototype buildings in which innovative and sustainable building solutions have become an example for the community, initiating a transformation of the built environment in which inhabitants can experience the material and spatial qualities of a building technique, whilst being able to reproduce it. The following sub-chapter will elucidate how Compressed Stabilised Earth Bricks (CSEB) could be a potential building material that tackles the poor perception of earthen techniques, promoting its use and the autonomy of low-income communities.

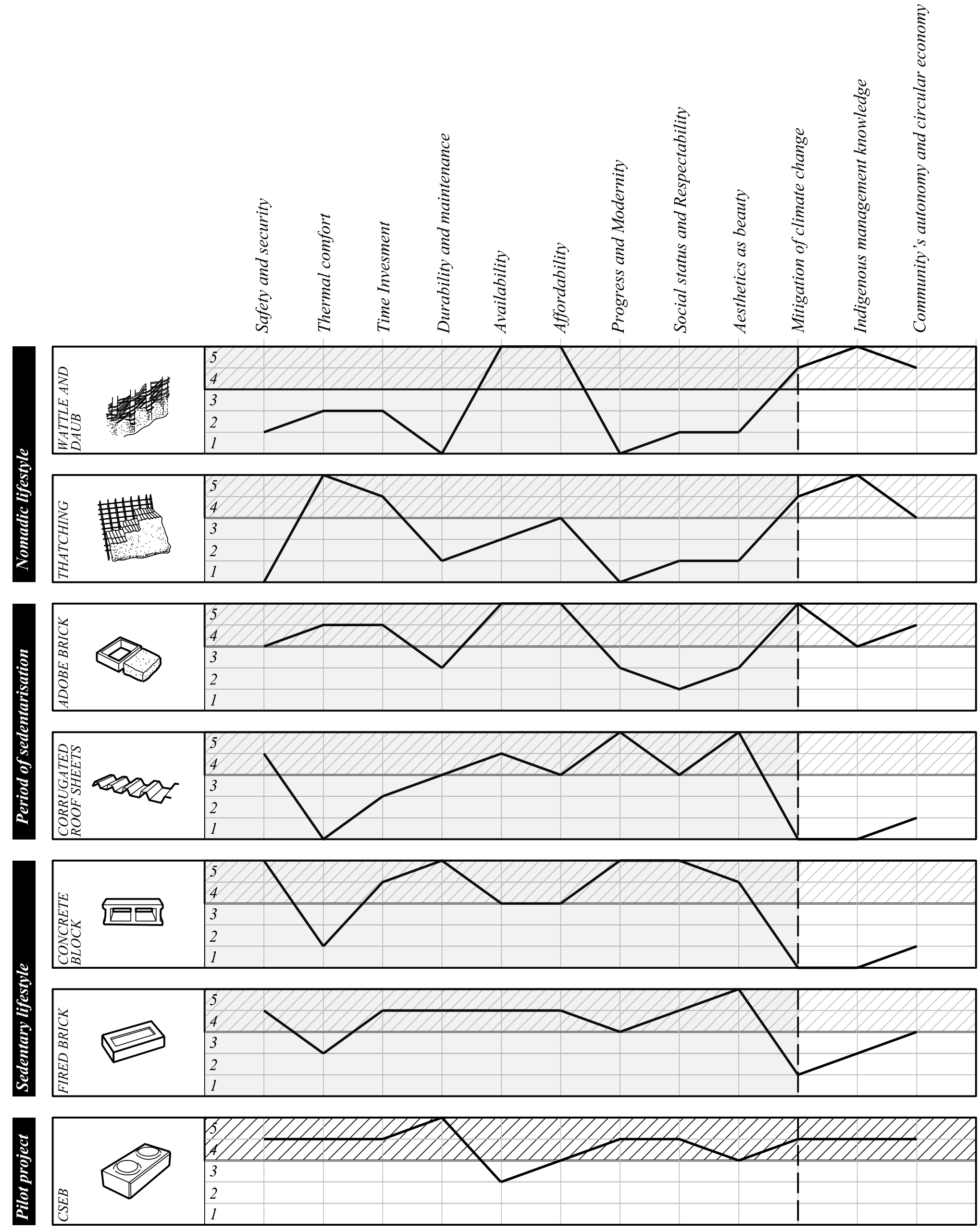
14.3 FRAMING THE NEW PARADIGM: PERCEPTION OF CSEB

Many settlements within the Tanzanian savannah are facing environmental threats due to the impact of climate change, with longer periods of draughts and sudden rainfall. This is being further exacerbated by uncontrolled deforestation at the local level. Such widespread damage is driven partly by the high demand for firewood needed for the production of fired clay bricks. As the population of villages grows, many more houses are required, and fired clay bricks have been the most viable solution for most homeowners. To respond to this environmental issue, this study has focused on the potential of built projects to explore alternatives to the use of fired bricks. Throughout Book 2, Engagement, the CSEB was presented as the main strategic building technique used for the construction of the pilot projects in Maji Moto and Mikocheni. With the design of the two prototype buildings, the objective was to demystify the use of earthen techniques, giving evidence of its properties and qualities. For this reason, this book, Assessment, has provided a review of the perception of local communities on building materials, and what the forces are that motivate their choice for building houses. Once the reasons and attributes that drive building material choice have been unpacked, the aim is to gain an understanding of how alternative building techniques such as the CSEB could be implemented at the local level by considering the material properties and social aspects that are important for inhabitants in both contexts. In this way, this research wants to shed light into the potential opportunities and limitations of introducing CSEB.

By considering the material attributes and the socio-cultural aspects that locals have considered relevant in choosing their home's building materials (which were analysed in Chapter 13), this section wants to discuss these findings in comparison with the properties and perception of the CSEB [Figure 14.7].

Material & Environmental Attributes

Safety and security: One of the concerns raised by homeowners was the lack of safety associated with traditional buildings, originally constructed by using mud and poles and a thatch roof. While CSEB is mainly composed of soil, the performance of the material requires a solid foundation while also including a timber structure where corrugated roof sheets (CIS) and a ceiling can be installed. Thus, the brick shape gives versatility and enables users to build safe structures avoiding the constraints experienced by traditional earthen buildings. In terms of safety and security, the performance of CSEB can be considered similar to that of concrete blocks, which are highly valued by community members as strong and resistant.



14.7 Comparative analysis of currently used materials including the pilot project building technique' CSEB. The chart considers material, socio-cultural and environmental attributes valued at the local level from 1 to 5. Own Illustration

Thermal comfort: The thermal performance of CSEB's resembles that of other earthen materials and is only achieved by the provision of thick walls, providing thermal mass to avoid heat during the day and release it at night. CSEB walls can be built with a double layer of bricks (25 cm) or a single layer of bricks (12,5 cm), with the first option being the best for activating thermal inertia. The problem with traditional building techniques such as wattle & daub is that walls are very thin and therefore, the thermal comfort of the building cannot be achieved in its totality. In this analysis it was also observed that thatched houses provide the best thermal comfort, which suggests that a construction made of CSEB and a thatch roof would achieve excellent thermal performance.

Time investment: Since the transition of Maasai communities to a sedentary lifestyle, the use of locally available materials to build shelters quickly has become redundant. With it, materials that required more time to build with were adopted, such as fired bricks and the construction of concrete or timber structures to install the metal sheets. Building with CSEB requires on average the same amount of time as building with fired bricks or concrete blocks. In some cases, even less, as if the compressed bricks are interlocking, there is no need to use plaster after each line, thus reducing the time invested. One thing that needs to be planned in advance is the production of the blocks, which in this case takes some time, as they also need to be cured for around 10 days before being usable. In conclusion, the time investment required to build with CSEB would not be a specific constraint for local communities.

Durability and maintenance: Considered one of the key attributes of materials, durability and maintenance have been a worrying issue for locals living in traditionally built houses. The problem lies in the high level of maintenance required to protect the mud walls of houses built with poles and mud or with adobe bricks. While the CSEB technique repurposes the use of local soil as the main element of its composition, it also adds a small amount of stabiliser agent (usually cement or lime) to strengthen the block. This durability is increased further by the compression process. As such, the prototype buildings have helped to demonstrate the long-term durability of CSEB bricks if plastered. However, it is important to note here that CSEB as a walling solution does not require plastering. If the wall is properly protected by raising the foundations around 80 cm and given appropriate rain protection by the building's roof, a CSEB wall can simply be covered with a transpirable sealant, highlighting the beauty of its natural colour while showing the qualities of the material.

Availability: The materials required to produce CSEB are widely available: Soil can be found everywhere, however it is worth noting that not all types of soil are suitable, and tests need to be undertaken before using any type of soil as a construction material. The type of stabiliser can vary, but commonly used stabilisers such as straw, cement or lime are easy to find. The problem with the use of CSEB stems from the equipment needed for the bricks' production: the compression machine. This is a specialised machine that needs to be rented or purchased and it isn't always easy to acquire. This could be considered one of the main challenges of the use of CSEB in isolated areas, as it requires an organised action plan where a machine can be borrowed. In some cases, local cooperatives formed by small entrepreneurs can solve this issue, or, (in case that there are independent businesses devoted to the production of CSEB) directly purchased.

Affordability: The comparison of material costs has been discussed in Chapter six (Book 2, Engagement), but in looking at the current built environment of the Maasai communities analysed, it can be claimed that the cost of building with CSEB would be an affordable choice for those who are currently envisioning building new houses with fired bricks or concrete blocks. For the low-income families that still live in traditional houses, it might be challenging, as despite the low cost of the technique, there is a minimum cost that not all families have access to. The main costs of building with CSEB are associated with the production of the blocks, which needs to be done by a group of skilled workers. The material cost is only associated with the cost of the stabiliser. In comparison to self-produced fired bricks, it requires the purchase of large amounts of wood to use them as biomass fuel, a cost that could be easily employed in paying skilled workers to produce the CSEB on the construction site. Besides that, the cost of labour for walling would be the same as for using fired bricks or concrete blocks. A possibility that should be explored by the Tanzanian government is the provision of financial and technical support to locals wanting to build with a sustainable technique such as CSEB, ensuring the proper quality of building materials while promoting the autonomy and self-reliance of local communities.

Socio-Cultural aspects

Progress and modernity: The perception of Maasai neighbours regarding earthen techniques has worsened over the last few decades. The proximity to towns and access to social media has opened up the imagined possibilities of architectural forms. In this way, homeowners are finding ways to upgrade their houses, to resemble modern houses. Aspirations of progress after centuries of self-sufficiency have diminished the popularity of techniques such as wattle and daub, adobe bricks and thatched roofs. In this way, industrialised materials have replaced traditional ones: concrete blocks, steel structures, corrugated roof sheets, and so on. In this case, I believe that the CSEB might be initially perceived as poor due to its composition from soil, but it might progressively change as advanced technologies are used in its production, in addition to the versatile built forms that can be designed with CSEB, that can be adapted to modern architectural styles if desired.

Social status and representation: In modern societies, social status can be achieved through the quality of one's house. Currently, in the case of rural Maasailand, fired-brick walls and more recently concrete blocks have become indicators of the wealth and status of inhabitants. While CSEB is mainly composed of raw earth, the final look of a building that includes CSEB could resemble that of other buildings designed with modern features in mind. In fact, there is increased use of these blocks by wealthy families in nearby towns, influenced by its sustainable qualities and durable properties. Whilst this is good news to an extent, as it means that many users are finding CSEB an attractive material to build with because it is sustainable, easy to build with and strong, it might raise the cost of the material itself if it gains popularity amongst the wealthy.

Aesthetic as beauty: Amongst the socio-cultural challenges presented by the newly introduced building technique of compressed bricks, the aesthetic sense is probably the one that will be easiest to overcome. The construction of the prototype has shown how community members have been enthusiastic about the final building, something that was unexpected to many from a building technique that utilises raw soil. The design possibilities of CSEB are endless, and therefore, easily adaptable to homeowners taste and aesthetic sense. In fact, in a conversation with one of the skilled workers who is an expert in CSEB production and construction, claimed that communities need to see more pilot projects like the ones developed in Maji Moto and in Mikocheni, as a way of getting inspired by the possibilities of earthen materials, their natural properties, strength, beauty and contribution to the protection of the environment. The statement of this local bricklayer has put into perspective the crucial role that such workers have in the formation of the built environment. Local fundis or expert construction workers often design the houses they construct, and therefore, their ideas and suggestions can in many cases be found in the final design and materiality of building projects. As such, the training of construction workers in the use of sustainable building techniques might positively contribute to re-shaping construction methods currently employed, allowing them to innovate with solutions such as CSEB.

An impactful transition towards the recognition of locally sourced building materials should start from awareness about its environmental, cultural and social benefits. Education and training about the properties and benefits of such materials is an essential component in the fight against climate change. The use of CSEB can considerably contribute to the mitigation of climate change threats at the local level by avoiding deforestation. Alongside this, its use contributes considerably to protecting indigenous knowledge about the ecological management of local resources, which is essential in the protection of natural habitats. To strengthen its impact, local governments should also be responsible for implementing policies against the uncontrolled felling of trees and nature's degradation. However, most importantly, the use of locally sourced materials such as CSEB contributes to the autonomy of local communities, boosting local economies and strengthening the social fabric, promoting social and environmental justice (HIC-LA, 2019).

Recognising the current crisis and the need to find alternatives to current building technologies, should not be imposed on local communities. Instead, as this research has demonstrated, the absorption of ecological and culturally adapted material innovations should be tackled by analysing local needs and aspirations. Furthermore, local and national authorities must put in place specific policies that foster opportunities to access such alternative building solutions, especially for those who cannot afford high-quality building materials.

14.4 FINAL CONCLUSION

"Only if we are capable of dwelling, only then can we build"
(Heidegger 1971: 148)

For more than four years, this study has sought to look beyond the limits of the Maasai built environment, deepening the material surface of places and the subtle perception of people. Since my first visit to Maji Moto, a strange force has been pushing me towards a spatial world of textures, feelings and colours driven by the tensions of the contemporary world: a back-and-forth between powerful traditions and the pressing urgency of modernity. These entangled pressures have been analysed under the messy umbrella of material ecologies, moving between action-reaction, perception-space, material-atmosphere and thought-imprint. As I have attempted to find responses to questions about the tastes, desires, needs and eventual choice of building materials of locals, the everyday life of Maasai dwellers has shed light on the very value of examining with special care the quotidian. In other words, focusing on both the tangible and intangible ways in which people engage spatially with their social and cultural environments. Responses are out there, but one needs to choose whether to pay attention to them. This is how I have attempted to navigate the profound significance that shapes the individual and collective perception of the built environment's materiality.

Exploring material dynamics has required a close analysis of the construction of homes, both on the ground and in locals' imaginaries. In the context of self-built homes, the resulting forms are nothing but the translation of people's involvement within a specific relational context into a spatial shape (Ingold, 2000). Hence, the act of building is understood as a conscious and contextual response to the manifold specificities of inhabited places. Looking at these relational processes has proved to be an essential tool in analysing any given built environment and the pressures that shape its material surface. Thus, this research has relied on locals' storytelling as a crucial source of information that elucidates the mechanism through which they have built a home out of a house. Indeed, place attachment, or the absence of it, is also the result of a spatial and material choice. Social pressures, cultural change, environmental threats and the absence of essential natural resources threaten the rootedness of local communities to their contexts. In order to build better and to increase homeowners' sense of belonging, buildings need to support socio-cultural traits while giving a contextual response to material and environmental conditions. This activates strategies of care towards the spaces one inhabits, boosting stability and individual and collective identity.

In conclusion, looking at the everyday life of locals and the intricate connections existing between them and the places they inhabit, this research has been able to unravel the meaning of home for Maasai dwellers, who understand their home spaces as a family shelter and a device for self-expression.

Building from the meaning through which local communities have given shape to their built forms, this research has also deepened into locals' choices of building materials. The objective has been to explore contextually and culturally appropriate ways of introducing ecological material innovations into the local building culture. In doing so, the findings have uncovered the corporal relation that exists between people's perception and materiality, opening up a new world of material and spatial possibilities. The incorrect assumption that rural dwellers in Tanzania reject earthen techniques solely due to a desire for modernity has also raised questions about authenticity and to what extent the contemporary built environment can be considered vernacular or not. From my experience, in looking at the surface of building aesthetics, one might think that the effects of globalisation have erased every sign of the indigenous past. Yet in analysing the evolution of the Maasai hut and the relation between people and their environment, one discovers the reality of a community that has struggled for centuries to access decent housing. With this, one also finds a series of environmental, functional and socio-cultural constraints that have further contributed to transforming the very foundations of their lifestyle. But if the vernacular and the authentic are responses given to the specificities of the context, then contemporary built forms are a new vernacular. The pressures of modernity and globalisation are by no means solely responsible for such a transformation, but in a connected world, the influence of global forces is undeniable.

Therefore, what this research wants to put into perspective is that while resisting the standardisation that comes along with globalisation might be challenging, what we can do is propose adaptive building solutions that follow communities' desires in a conscious and sustainable manner. This research has demonstrated that it is possible to carry out a thorough analysis of communities' built forms and the intricate social dynamics that shape them. Using such context as a powerful tool, I believe that technological advances and ecological building materials can be jointly explored, proposing reparative strategies that reconnect people with the very essence of our being: the ground where we stand.

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List of Tables and Figures

Book 1

Book 2

Book 3

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