Ethiopia is undergoing an immensely rapid growth concerning the development and improvement of urban settlements. At the same time and sometimes forgotten, around 80% of the current population of an estimated 96 million inhabitants (CIA world fact book 2014) still reside in rural areas in living conditions that are to be described as inadequate and in some cases unhealthy.
Fig. 01  Traditional Guraghe Typology, SRDU I and SRDU II (floor plan and section)
Many illnesses still emerge from the combined living of livestock and humans found under one roof in one space. Open fireplaces within huts, combined with no natural ventilation is still the main cause of respiratory diseases, mostly found in the female population. Women in rural areas report with three times more respiratory diseases than women in urban areas. (Orozco 2012) Many of these issues surrounding rural housing are the reason for urban migration and should be investigated both by academics and policy makers in developmental strategies for the country. Noting this demand, a combined research effort between the Ethiopian Institute of Architecture, Building Construction and City Development (EiABC), the ETH Zürich and the Waser Foundation in Lucerne, Switzerland was formulated.

The original project started in 2010 under the leadership of Prof. Dr. Elias Yitbarek and the Chair of Housing at EiABC and was conceived as a full-scale architectural experimental building structure. It was entitled ‘Sustainable Rural Dwelling Unit’ (SRDU). This title referred to a formerly developed “Sustainable Urban Dwelling Unit” in the capital Addis Ababa and understood itself as an extended version of this research into the countryside. The main focus of the research has been on developing, building and disseminating improved rural housing units by introducing enhanced application methods of traditional building materials and alternative construction techniques. This is especially important in a time where traditional local supplies are being substituted with imported industrial materials. These materials are both costly and sometimes degrade the living environment of inhabitants, such as tin roofed structures causing enormous heat conditions in the spaces below. The potential to formulate new design strategies and introduce improved construction methodologies in rural housing through fostering local building materials and techniques was an essential part of the initial project. More often than not though, projects of this nature tend to remain as one-time interventions short of any form of dissemination. Transferring skill is relatively easier than fostering innovation, which is crucial in getting it accepted by the wider population (Yitbarek 2011). For this reason, the implementation of the SRDU project focused not only on constructing individual units, but also in a second phase of the project, which used a ‘hands-on’ approach, in implementing strategies of capacity building and establishing scaling-up and scaling-out scenarios.

To achieve this aim, the team wanted to reach out not only to the higher education sector in Ethiopia, meaning academics in either PHD, Master or Bachelor programs, but very consciously established contacts with vocational training centres within the local regions. The project also hired selected local craftsmen, workers and farmers for the construction of the buildings, in order to educate them in the selected techniques. The hope of Prof. Dr. Elias Yitbarek and his team was that this could help kick start their own business ventures after their training was complete. Describing this aim, the team was aware that achieving such a large dissemination scale needed for this project may take a long time and a careful, culturally sensitive approach.
The research area for the project was chosen in 2010 and located in Gubrie, Guraghe Zone, Ethiopia. It is around 175 km southwest of Addis Ababa and 15km from Wolkite, the capital of the Guraghe Zone. The Guraghe zone is in one of the thirteen zones of the Southern Nations Nationalities and Peoples Regional State (SNNPRS). It is one of the denser areas found in the southern region of rural Ethiopia, with a population of around 5000 inhabitants. As in many others, the town of Gubrie is growing rapidly due to the new construction of a nearby university, a referral hospital and the Guraghe Cultural Centre. Out of this setting and mostly due to the presence of an academic and also a cultural institution which the team could collaborate with, the site was found ideal for the start of the research project. Initially a thorough study was carried out, with the help of the Guraghe Zone Administration in four selected areas. This was done to understand traditional building techniques, spatial layouts, cultural, economic, and social necessities but also problematic conditions such as the combined living of livestock and humans as well as open fireplaces within the huts as mentioned before. This work was done with students from the area and the EiABC. As a result, not only intrinsic information about the site, its people and culture was acquired, but also a participatory dialogue with residents of that region was opened. This included religious leaders, who finally blessed the project because of the many meetings and exchange sessions the team around Prof. Dr. Elias Yitbarek conducted with them. Only then, first ideas were developed on how an improved architectural design could address the specific requirements of the local inhabitants.

**Traditional Guraghe House**

The investigation of the traditional Guraghe house and its functional patterns formed the base on which the design process started. The typical house found in this region comprises of a circular, single roomed space, typically 6-8m in diameter. This space serves all purposes of daily life for all family members such as sleeping, cooking, eating and meeting. Families sleep together with their livestock to protect them from predators or thieves, in some cases with a permeable wooden divider. This often leads to unhygienic living conditions and sickness. Another cause for concern is the lack of ventilation within the traditional house as there are little or no openings. Cooking is usually done on an open flame, within the central internal space. This helps to smoke the thatched roof to prolong its lifespan by keeping insects and other organisms at bay. On the other hand, this traditional practice causes serious eye and respiratory problems, which makes it a highly problematic practice. The houses are typically made from a compactly clad wooden outer wall structure, whereby wooden poles are placed directly into the ground without proper foundations. The interior walls are then plastered over using a wet mud and straw mix in a “wattle and daub” technique. This traditional construction method can rapidly decay the structural elements, which are in direct contact with earth and moisture. Bacteria and other microorganisms present in the ground, along with splashing water in the rainy season eat away at the wooden structure, destroying the lower part of the house. In general, most houses investigated
Fig. 02  Interior of a traditional Guraghe House
showed heavy signs of decay, due to insect infestations, poor construction qualities and improper or missing foundation systems.

Unique to the Guraghe house is the ‘umbrella’ like central wooden column, which holds the roof structure and a thatched grass roof covering. This column is usually inherited from generation to generation and forms thereby the most important cultural base for the structure. It represents the unity of the family and showcases the distinguished responsibility of the head of the household. The research found poles, which must be several hundreds years old.

The inherent umbrella roof structure of the house gives it a unique circular appearance and forms a strong symbolic character of the Guraghe culture. In recent years, the limited availability of materials and applied skills used in traditional constructions form a barrier to continue this unique building culture. Timber used for the walls and roof structure is in very short supply due to a nation-wide deforestation. Even the grass used for the thatching has become rare due to the expansion of farmland and increasing erosion patterns. For those who can afford it, there has been a growing trend of building small rectangular, tinned roof houses. This very unspecific typology is seen by many as “modern”. This except for the fact, that climatic conditions in the structures are not very comfortable due to the overheating of the spaces caused by the metal roof. But it does not hold people back from continuing to build in this fashion, also due to a lack of better alternatives.

These observations taken from the field prompted the SRDU research team to come up with design strategies that respected and maintained the Guraghe traditions, but did so using improved building techniques and materials which were locally and readily available. Another essential objective was to keep the cost of construction down, so as to become a competitive player against current building prices of mass rural housing constructions with in the area. It was the initial belief, that by introducing the concept of premade building components, the research and resulting implementation step could promote ease of construction and enhance entrepreneurial endeavours using local materials only and therefore re-establishing a link to the local culture.
SRDU I

The first full scale structure - called SRDU I - was envisioned as a test scenario for the designers as well as builders. It merged new ideas of improved construction methods coming directly out of the investigation phase with the traditional Guraghe house typology. As such, it was decided to change the layout of the house completely and introduce an enclosed stable as part of the rectangular floor plan, which is only accessible from the outside. With this move, no livestock would need to be housed in the main living area. On top of this stable and reached by an internal staircase, a mezzanine sleeping area was created, which furthermore allowed the specification of certain functions and at the same time freeing the main floor for day time activities. A ring of smaller spaces, again only accessible from the outside, was placed around the main living space, including a toilet, a shower and storage areas, such as chicken coops. In order to avoid the practice of having an open fire pit, a biogas plant was erected just next to the house, which is fed by cow dung. This plant allowed for the introduction of a small kitchen area, which used the gas as the main energy and heat source for cooking.

All of these ideas and improvements had to be discussed and approved by the Guraghe Zone Administration, the Guraghe Cultural Centre, the involved academic partners, the elders of the neighbouring villages, other local decision makers, as well as representatives from religious groups. Several meetings took place, where the design was discussed improved and communicated via models and plans. Only after all parties agreed, did the project commence with the already mentioned blessing ceremony.

Fig. 03    Prof. Dr. Elias Yitbarek discussing with elders of the community
Fig. 04  SRDU I constructed with a rectangular floor plan
Apart from improving the spatial arrangement, the new typology focused mainly on the question of improved building techniques and adequate material choices. Due to the increasing scarcity and lack of durability, some construction materials such as timber, which is traditionally used for the construction of the walls, was simply not available to the team and required a new approach for the construction. As a result, a robust foundation system was introduced using natural stone to a depth of 60 cm below and 30 cm above ground to provide a sturdier elevated base for the walls. As the traditional "wattle and daub" technique used in the wall requires a large amount of timber for the main structural system, the team decided to build the walls entirely out of load bearing air-dried earth blocks. For this, 50 cm x 25 cm x 25 cm blocks were produced using a loam and straw mix. To produce the blocks on mass, special metal moulds were welded at EiABC and transported to the rural site. Other format moulds for non-loadbearing walls (i.e. the stables) and the vaults spanning the mezzanine level were produced. This work started almost immediately after the beginning of the project, as the blocks needed several weeks for drying before being used for construction. With the larger block formats, it was relatively easy to construct the walls, leaving a number of openings to guarantee natural ventilation for the inner spaces. Most walls were plastered with earth plasters, protecting and finishing the surfaces, making it impossible for insects to nest. The team chose to decorate the façade with a very distinct pattern, emphasizing the openings and doors and showing horizontal lines that resulted from a cultural anchoring concept.

Fig. 05  The improved foundation system of the SRDU proto-typology
As timber is in shorter supply, a different system needed to be created regarding the roof structure and roof cladding. A combination of much younger timber and locally sourced bamboo found in plantations less than 40km’s away created the new roof system. Special craftsmen from the southern regions of Ethiopia were invited to show the construction team how to use this inherent local material, from harvesting and storing to questions of application. Four younger eucalyptus trunks that grow much faster replaced the traditional central wooden column, which is both very expensive and hard to find. These four trunks were roped and bound together to give back the old appearance and dimension of an individual column. The umbrella like sub-structure was built using a combination of bamboo and timber poles, while the main roofing element was woven out of bamboo splits. On top of this woven bamboo substructure, bamboo sheaths were laid replacing the traditional grass thatched roof, making the entire structure lighter and waterproof.

Fig. 06  The bamboo-woven substructure of the roof construction
Fig. 07  The central pole as a identity-giving element in SRDU II
The work was mainly carried out by 13 farmers from 10 different villages in the Guraghe Zone, while the EiABC team came for training and inspection sessions. From the very beginning of the project, the capacity building aspect stood in the foreground of all activities. It was not meant to simply bring an improved construction type to rural areas, but to understand the work as a tool for dissemination of knowledge and skills. The knowledge part was taught to the trainees during long sessions, explaining the reasons, why certain decisions were taken, such as improving the health conditions or why a proper foundation system was needed. The skills part was concentrated in workshops, where smaller test-structures were constantly built as well as the learning of the chosen materials, their properties and how to handle them. At the end of the construction of SRDU, every participant received an “accomplished work” certificate, and received a set of metal formworks for block production. Traveling a couple of weeks later through the area, the team found several trainees as fresh entrepreneurs, selling earth blocks and the design of whole structures within their villages.

Building the sample unit with the trainees also questioned the format on how the team was communicating with the decision makers. By building this sample unit, stakeholders were able to visit the design, also during the construction phase and contributed to the decisions made for the house. In addition, a small “how-to” guide was produced in Amharic graphically showing the steps of construction. As a small booklet, this guide could be taken home and used as a source for discussions with others. These two strategies were implemented already before starting to build a second test unit.
SRDU II

The second unit, called SRDU II, was meant as the next evolution step in the project, incorporating the lessons learnt from the first. Most obviously, the second structures design reverted to follow the traditional circular floor plan. The team was actually happy with this community request, as it could demonstrate that the same materials and application techniques could lead to several forms and layouts. As a result, the house ended up becoming slightly bigger than the first, as the stable was not incorporated any more into the floor plan, but was pushed outside the boundary, covered by an extension of the roof. This design change came as a result of the farmer’s request for a visual connection to their cattle, which was realised by an opening on the mezzanine level, looking downwards into the stable. The roof structure was again adapted to incorporate more bamboo into the substructure but the main central column that holds up the roof returned to the original single tree-trunk as this represents a fundamental cultural value of the Guraghe society. Questions of availability were answered by a re-forestation concept, a thought that was also very welcomed by the team.

In terms of the structure, investigations and evaluations of the first unit showed some damages, which occurred due to movements within the soil, on which the foundations were sitting. For this second unit, it was decided to construct a small concrete beam on top of the natural stone foundations, which also contained a minimal amount of reinforcement. This concrete beam also provided a more even base for the walls and an effective protection against splash back as well as arising surface water. Even though this decision was hard to swallow as it meant rising costs, it was taken in the light of durability. Also, new earth plaster mixes were discussed and implemented with the addition of lime as the original recipes showed some limitations with regards to waterproofing.

After completing the second unit, the team organised a gathering inviting stakeholders, governmental representatives such as the Minister of Urban Development and Construction and prominent members of the Guraghe society to see and understand the aims and goals of the project first hand. This ceremony, reinforced by the presence of many important figures, sealed the completion of the first two proto-typologies and the start of a dissemination phase of the gained knowledge by highlighting the importance of the project for the region. Equally important was the certification of the trainees, which had their skills validated in front of their communities.

After being part of the ceremony, and understanding the role of a governmental institution that deals with rural and urban housing, the Ethiopian federal Ministry of Urban Development and Construction changed its name to the Ministry of Urban Development, Housing, and Construction. This move reflects the ministry’s newly acquired intentions in incorporating rural housing in their agenda. Also as a result of the governmental support, the SRDU project was published in various organs of national media. Being known to many members of society, the project gathered supporters and dissemination became an easier prospect.
Fig. 08  SRDU II constructed with a circular floor plan
The work was mainly carried out by 13 farmers from 10 different villages in the Guraghe Zone, while the EiABC team came for training and inspection sessions. From the very beginning of the project, the capacity building aspect stood in the foreground of all activities. It was not meant to simply bring an improved construction type to rural areas, but to understand the work as a tool for dissemination of knowledge and skills. The knowledge part was taught to the trainees during long sessions, explaining the reasons, why certain decisions were taken, such as improving the health conditions or why a proper foundation system was needed. The skills part was concentrated in workshops, where smaller test-structures were constantly built as well as the learning of the chosen materials, their properties and how to handle them. At the end of the construction of SRDU, every participant received an “accomplished work” certificate, and received a set of metal formworks for block production. Traveling a couple of weeks later through the area, the team found several trainees as fresh entrepreneurs, selling earth blocks and the design of whole structures within their villages.

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Dissemination of knowledge: Contextualization of Vocational Training for the Building Sector in Ethiopia

Having celebrated the success of the first two proto-typologies, the project entered its next phase referred to as Contextualization of Vocational Training for the Building Sector in Ethiopia, or in short: Rural Housing, focusing mainly on the dissemination of the acquired knowledge so far. Aiming at up- and out-scaling strategies on a regional as well as national level, this phase concentrated on consolidating and enhancing the process of capacity building. A “capacity building pyramid” was designed explaining the concept of a cascade of knowledge-transfer that makes these dissemination strategies possible, sustainable and replicable.

![Fig. 09](image-url) The education pyramid as developed by Prof. Dr. Elias Yitbarek
As such, topping the pyramid are PhD and other academic programs run by universities such as Wolkite University and the EiABC. This was done to ensure the recognition of the importance of rural housing for the future development of the nation and added to the continuation of development and academic input on the subject. In this light, EiABC under the guidance of Prof. Dr. Elias Yitbarek and the Chair of Housing introduced the first PhD program on housing in the history of Ethiopia, supported by members of the mentioned universities. In addition, it was the task of those universities to develop curricula for higher education programs as well as the vocational training centres focusing on the construction of rural Ethiopia.

The Technical Vocational and Education Training (TVET) Colleges in the region form the middle and maybe most powerful part of the pyramid. Working together with the PhD team and informed by their research, TVET trainees, as part of their new curriculum on rural housing, have been engaged in hands-on workshops. Here the theoretical know how is tested and transferred directly into the manufacturing process. To support the curricula efforts and the dissemination of knowledge, EiABC and ETH Zürich produced a digital training manual of 10 lectures, showing and explaining the most vital and important information and application processes based on the findings of the construction of the first two proto-typologies. This multiplication of knowledge was understood as an out-scaling strategy.

The biggest group however, as to say the foundation of the pyramid, are local workers coming out of the adjacent communities. Here, TVET colleges and universities have worked hand-in-hand to transfer knowledge to these craftsmen and farmers, increasing their understanding of the materials used and enhanced ways of application methods. Theoretical knowledge formed also a central part of the training. As such the question of “why” certain decisions are taken that help to improve construction and therefore life quality have been highlighted. In this way, the trainees would understand the rational of the decisions made and take informed decisions when providing future services. The local trainees have been expected to multiply rural housing typologies and their components by applying the acquired alternative techniques and materials. They hold, therefore, the knowledge and potential to up-scale the project.
Fig. 12 Local workers building a vault out of loam bricks

Fig. 13 Workshop with local workers and other trainees
Next to this academic capacity building pyramid, the project developed the idea of a trendsetter program. Trendsetters are prominent people or institutions of the Guraghe rural or semi-urban setting that invest in the idea of building a SRDU house and become a change-agent for the rest of the society. Combining their encouragement and prominent status with the trainees’ gathered skills, the developed enhanced housing typologies will be replicated in various regions and variations of the traditional typologies, spreading the ideas of increased construction quality and addressing urgent health questions. It has been the hope, that this strategy ensures that the changes in materiality, design, and construction will be easily accepted by many. Neighbouring community members would take the SRDU approach, replicate and adapt it on their own property and style. The first trendsetter house was built employing trainees from the local TVET college as well as craftsmen trained by the program. Their input became visible on the enhanced construction details of the construction. The house also showed the ability of adaptations from the original two buildings, following the client’s needs. Situated in the Agena region, the house demonstrated that an out-scaling strategy is indeed possible by providing predominantly knowledge of construction instead of a pre-set and unchangeable set of plans. Many others followed this example and numerous constructions started immediately after the first one was completed.

Recently in partnership with the Wita Kebele Farmers Association, EiABC and ETH Zürich engaged in the idea of building a whole set of smaller buildings to form a neighbourhood which could benefit from shared knowledge and resources. As such, it is the idea to also incorporate the final owners in the construction process of the houses. By learning the building techniques of their own house, this project envisages the farmers to develop a sense of ownership and identity, which will hopefully help to maintain the buildings over a longer period of time. Having been infused into the community, the ideas are likely to be reinterpreted and grown by the farmers and their neighbours. Again, assuring the continuum of knowledge transfer, graduates of the previous training sessions will be employed to help build these units, but at the same time documenting the process and feed this information back to the level of universities and TVET colleges.

It has become evident though that it is almost impossible to track and document all spring-offs of the original constructions, their variations and adaptations. A sign that there is a deep need for programs such as this one that EiABC, ETH Zürich and the Waser Foundation started several years ago. The dissemination of gained knowledge seems to be the key for such efforts, which include long-term commitments in teaching and training in the education sector. The newly established curricula and lecture series could be a guarantee that this will happen in the future and that next to the question of the urban realm, rural development becomes one of the major focal points in academic programs, not only in Ethiopia. One is deeply connected to the other.
Fig. 14  SRDU I and SRDU II in their local setting
References


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Fig. 15  SRDU II under construction
Colophon

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