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## SUSTAINABLE RURAL HOUSING AND THE CHALLENGE OF CLIMATE CHANGE: EXPERIENCES FROM ETHIOPIA

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### ABSTRACT

*There is now overwhelming evidence that global warming is taking place, but the impacts on the built environment are less effectively documented. Similarly, climate instability is an additional factor in increasing movement of rural populations to urban centres. Inadequate living conditions in rural areas are also recognised as key components in encouraging such migration – hence efforts to create improved rural housing which is sustainable, affordable and desirable is a fundamental challenge. The Ethiopian Institute of Architecture, Building Construction and City Development (EiABC) at Addis Ababa University is committed to developing research and practice into ways of planning and designing housing and settlements to make them more responsive to both to climatic instability and the challenging socio-economic circumstances of Ethiopia. This paper reports on an on-going experimental sustainable rural housing project which is working with local communities to improve traditional vernacular housing through a range of innovative technologies and practices. Following detailed research into local construction technologies and lifestyles, full size prototypes were constructed to explore the positive elements of vernacular architecture within the framework of sustainability, and to test both the technologies and response of residents. This project is one of several live construction projects in the university which is also developing proposals for urban communities. These innovative projects are analysed in the context of climate change responses and sustainable development paradigms.*

**Keywords:** rural housing, climate change, research project, Ethiopia

## ABSTRAK

*Terdapat bukti kuat bahwa saat ini pemanasan global sedang terjadi, tetapi dampak pada lingkungan terbangun kurang efektif didokumentasikan. Demikian pula, ketidakstabilan iklim merupakan faktor tambahan dalam meningkatkan pergerakan penduduk pedesaan ke pusat-pusat perkotaan. Kondisi kehidupan yang tidak memadai di daerah pedesaan juga diakui sebagai komponen kunci dalam mendorong migrasi tersebut – maka upaya untuk menciptakan perbaikan perumahan pedesaan yang berkelanjutan, terjangkau dan diinginkan adalah tantangan mendasar. Ethiopian Institute of Architecture, Building Construction and City Development (EiABC) di Universitas Addis Ababa berkomitmen untuk mengembangkan penelitian dan praktek cara-cara perencanaan dan perancangan perumahan dan permukiman untuk membuat mereka lebih responsif terhadap ketidakstabilan iklim dan keadaan menantang sosio-ekonomi Ethiopia. Makalah ini melaporkan proyek eksperimental perumahan pedesaan berkelanjutan yang sedang berlangsung, yang bekerja sama dengan masyarakat setempat untuk meningkatkan perumahan vernakular tradisional melalui berbagai teknologi dan praktek yang inovatif. Setelah penelitian rinci ke teknologi konstruksi lokal dan gaya hidup, prototipe ukuran penuh dibangun untuk mengeksplorasi unsur-unsur positif dari arsitektur vernakular dalam kerangka keberlanjutan, dan untuk menguji teknologi dan respon dari warga. Proyek ini merupakan salah satu dari beberapa proyek konstruksi tinggal di universitas yang juga mengembangkan proposal untuk masyarakat perkotaan. Proyek-proyek inovatif ini dianalisis dalam konteks respon perubahan iklim dan paradigma pembangunan berkelanjutan .*

**Kata kunci:** perumahan pedesaan, perubahan iklim, proyek penelitian, Ethiopia

## INTRODUCTION

### Climate Change and Development

By the end of the century the world is expected to be on average between 1.8°C and 4°C hotter: large areas will be drier and regions in constant drought will increase from 2 to 10% by 2050 and by the end of the century the proportion of land suffering extreme drought will increase from 1% at present to 30%. Rainfall patterns will become more intense with rain more likely to fall in deluges - washing away top-soil and causing flooding (Brown, 2008).

Climate change and development are closely interrelated (Keller, 2009) and global warming could jeopardize decades of positive development efforts, particularly amongst the poorest people. This is certainly true of Ethiopia which is one of the very poorest in the world - listed 171 out of 182 countries in the Human Development Index ranking (UNDP, 2009). Poor people are especially threatened by climatic risks because of their high economic, social and environmental vulnerabilities.

## Climate Change In Ethiopia

Meteorological data show that since the 1960s, the temperature in Ethiopia has increased at about 0.2° C per decade and minimum temperatures have increased by approximately 0.4° C per decade (Keller, 2009:4; Regassa et al, 2010). Precipitation averages appear to have remained fairly stable, but both seasonal and annual rainfall has exhibited high spatial and temporal variability. Some studies indicate that in some regions mid-year rainfalls have declined considerably since 1997 (Regassa et al, 2010).

Most global climate models project an increase in precipitation in both the dry and wet seasons, and the projected increases in inter-annual variability of precipitation combined with higher temperatures will likely lead to increases in the occurrence of droughts. In addition, heavy rains and floods are projected to increase as well (Keller, 2009). Clearly the impacts of climate change and variability will be widespread in both socio-economic and natural systems. In rural Ethiopia the majority who are already poor and marginalized are struggling with the added burden of climate change – both more variability and more extreme weather events. ‘Whole communities are struggling to understand this new variability, identify new patterns, and establish what resources they need to be able to move beyond reacting and coping to adapting to the new realities and being resilient. Policy makers, likewise, face the daunting challenge of how to refine policies [which] focus on poverty and vulnerability reduction in the context of the new realities of climate change’ (Regassa et al, 2010:4).

The impacts of climate variability and change include agriculture and food security (lower productivity); availability of clean drinking water; health (expansion of areas prone to malaria as well as expected increases in cardio-respiratory and infectious diseases); ecosystems and biodiversity (change and loss of habitats, forest fires etc.); and infrastructure (damage to roads, buildings and communication systems by heavy rainfall and flooding).

All of the above will take place against a background increasing population which will add to pressure on livelihoods and resources, especially the overexploitation of natural resources such as fire wood which is one of the key issues associated with environmental decline. Ethiopia is the second most populous country in Africa and the projected population increases are high. Figures for the current population vary between 85-90 million and Hebel (2008) states that the population will increase by 45 million in the next 15 years.

Where will all these additional people live? At the moment Ethiopia is one of the least urbanised countries in the world – with approximately 17% living in areas defined as urban (Regassa et al, 2010:14). This means that over 80% of the population are rural and dependent on small scale agriculture-based activities for their livelihoods. This is significant at national level as agriculture accounts for 46% of GDP, and climate change could cause an 8-10% reduction of GDP by 2050 (Robinson et al, 2013: 2).

## Will All These People Remain in the Rural Areas?

The Intergovernmental Panel on Climate Change (IPCC) believe that the greatest single impact of climate change could be on human migration, but with so many factors at work, *'establishing a linear, causative relationship between anthropogenic climate change and migration has been difficult'* (Brown, 2008:9). A key issue is the impact of climate change on the 'carrying capacity' of particular areas –which if compromised, would lead to displacement and migration as adaptive res-ponses to climate stress.

According to the International Organisation for Migration, forced migration to urban areas hinders development by 'increasing pressure on urban infrastructure and services, by undermining economic growth, by increasing the risk of conflict and by leading to worse health, educational and social indicators among migrants themselves' (Brown, 2008:10). In rural areas, such forced 'environmentally induced' migration is likely to be increased by those who choose to move both as an expression of dissatisfaction with conditions in rural areas, as well as the aspiration to seek livelihood, educational and lifestyle opportunities in urban areas. In a longitudinal study of the impact of drought on mobility in the Ethiopian highlands, Gray and Mueller (2011) found that men's labour-related migration increased with drought and that land-poor households are the most vulnerable. However marriage related moves by women decreased, suggesting a 'hybrid narrative of environmentally-induced migration that recognizes multiple dimensions of adaptation to environmental change' (Gray and Mueller, 2011:1). The United Nations Population Fund recognises that migration is an 'essential part of development, as well as a principal method of coping with environmental change.' They argue that environmental migration must be integrated into national development frameworks and urban planning policies (UNPF, nd).

Given this scenario of increasing population, climate induced pressures on rural populations and concern about increasing rural to urban migration, it is unfortunate that little has been done in assessing the impact of climate change on rural housing – and hence this paper is a contribution to this discussion. Clearly if large numbers of rural residents move to urban areas, the carrying capacity of the cities will in turn be severely compromised. The basic elements of food, water, infrastructure and shelter housing would become overstressed and cities would have to expand as well as densify on a large scale, almost certainly beyond the economic capacity of the country. In addition such large urban conglomerations would become increasingly unsustainable.

So what can be done to make it possible for more people to remain in rural areas? From a housing perspective, the challenge is twofold. Firstly, to contribute to significantly improved housing conditions. This would not only lead to improved health, safety and comfort but also to play a role in encouraging positive perceptions of rural life – and secondly to encourage the spread of environmentally sensitive construction systems and material uses which avoid undermining natural ecosystems already under stress from climate change, and also offer more sustainable approaches to construction. This includes the development of housing construction systems which challenge the increasing tendency to introduce energy-intensive 'modern'

materials such as corrugated iron roofing sheets, provide alternative energy sources and at the same time support the development of new livelihoods in rural areas.

### **Social Processes Not Just Technical Solutions**

From a technical perspective it is also vital that any proposed construction systems minimise emissions of greenhouse gases which are recognised as the key factor in increasing global warming. However the challenge is much more than technical. In order to move towards long term sustainability it is vital that local communities are fully engaged in the process to ensure that any proposed projects reflect the aspirations and cultural traditions of particular groups. Without such active participation it will be impossible to move beyond pilot projects to replicate and scale up to larger population groups.

This is what is being attempted by a phased research project initiated by the Housing Chair of the Ethiopian Institute of Architecture, Building Construction and City Development (EiABC) at Addis Ababa University. The Sustainable Rural Dwelling Unit (SRDU) project focuses on developing, constructing and disseminating radically improved housing units with the use of alternative building materials and construction techniques, all within a broader framework which aims to make a positive contribution to reducing vulnerability to climate change.

The project emphasises strategies for capacity building, scaling-up and scaling-out, to ensure it does not remain as a one-time intervention without wider applicability. The transferring of skills is relatively easy compared to the promotion of innovation and its final acceptance by a wider population. Achieving large-scale implementation can take a long time and a careful, culturally adjusted strategy, but without such scaling-up any efforts to improve rural housing conditions and increase people's capacity to confront climate change will merely remain as token gestures. So far, the findings of the research indicate that providing hands-on training to local people recruited from different parts of the project area, is one of the key methods for scaling-up.

A key element of the research is the construction of full-size prototypes that embody the positive elements of vernacular architecture within the framework of sustainability. The project has two components: firstly the documentation and study of the existing rural housing, local building materials and lifestyles; and secondly the construction of the SRDU housing prototypes which include renewable energy (solar energy and bio-gas). The project is designed in three phases: Phase 1 focused on the documentation and study of the existing vernacular rural housing and the construction of the SRDU-I prototype; Phase 2 was the construction a revised house type – SRDU-II; and Phase 3 focuses on scaling-up the SRDU units and the contextualization of vocational training. The first two phases have been completed and phase 3 is currently underway and will later include detailed analysis and evaluation by PhD students from both EiABC and ETH Zurich as part of an international academic collaboration programme which also includes the Future Cities Laboratory in Singapore.

## THEORY / RESEARCH METHODS

The research area is located close to the town of Gubrie in the Guraghe Zone, approximately 175 km from Addis Ababa. The town has a population of about 5,000 and is expected to grow rapidly as many facilities are either under construction or being planned (e.g. Wolkite University). These developments will attract a large number of migrants, who will eventually require housing in or within an accessible distance. However the SRDU approach can be understood as a ‘densified rural model’ (or a low density ruralised urban model) which aims to blur the classic distinction between urban and rural, and where ‘*questions of health, energy production and sustainable material application are combined with the question of available local resources*’ (Hebel, forthcoming). Such an approach offers much greater opportunities to achieve more sustainable solutions.

The research seeks to draw lessons from the vernacular Guraghe architecture and incorporate it into improved rural housing, with a focus on capacity building through hands-on training through the construction of prototype units (see Figure 1). The typical Guraghe traditional house consists of a single room built of wood and mud walls with a straw roof. Those who can afford to will usually build separate houses for livestock and guests, otherwise, the one-roomed dwelling accommodates both animals and humans, only sometimes separated by a wooden partition. The space has a small window or sometimes no window at all and as a result is dark and lacks ventilation. The smoke from the hearth, although important to control insects, has a negative impact on the health of the habitants, particularly the eyes and lungs. Despite these disadvantages, the Guraghe vernacular house boasts a sturdy construction and unique character.



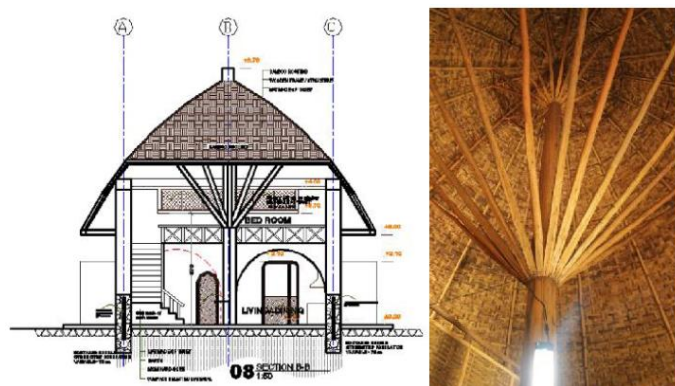
**Figure 1.** A Traditional Guraghe Homestead with Three Buildings  
Source: field survey

Although fond of their traditional house typology, many of those who have the resources construct ‘modern’ tin-roofed rectangular houses, and it is now common to see tin-roofed houses next to traditional homes. The homesteads usually consist of three buildings around an open space, and frequently these modern dwellings

are used only for guests. The traditional house is good in protecting from heat and cold while the opposite is true for the tin-roofed house. Also the traditional house is comfortable and is seen as an expression of Guraghe identity. For example, the umbrella-structured central pole (*echibe*) symbolises the unity of the family and the responsibilities of the head of the household. On the other hand, the modern house has advantages in terms of availability of materials and speeds of construction, and is considered a status symbol. Hence a key objective of the SRDU research project is to design and implement housing that includes both the advantages of the traditional house and the so-called modern house, whilst simultaneously maintaining the Guraghe sense of identity. Part of this was to consider carefully the building process. Except for some details that require specialised craftsmen, house construction in Guraghe culture is a cooperative community endeavour which the project attempted to reinforce.

### The Research Process

Undergraduate architecture students and postgraduate students on the MSc in Housing and Sustainable Development course were involved in collecting data on traditional building systems and lifestyles. This data was analysed by the core team which then developed two housing types. The new designs include separate living and dining areas, kitchen, bedrooms and an integrated byre for animals, as well as toilet, shower and storage areas. Traditional houses use a large amount of timber in a wattle and daub construction (Figure 2). The intensive use of wood for both construction (and as fuel) is creating problems of deforestation, hence a key challenge was to develop alternative walling materials which were available locally. Different kinds of material tests were carried out in order to select the appropriate building materials and construction techniques.



**Figure 2.** The SRDU Prototypes.  
 Left: Section Showing Double Level Living Areas.  
 Right: Central Pole with Umbrella Supports.  
 Source: author's documentation

A range of materials were tested including sun-dried soil blocks which were found to have sufficient compressive strength for the walls, and woven bamboo was proposed for the roof (see Figure 3). The umbrella type central pole was maintained for strong cultural reasons. To enhance the lateral stability and earthquake resistance of the building; bamboo studs were introduced to connect the foundation with the walls.



**Figure 3.** Skilled Craftsmen Fixing The Outer Bamboo Layer Over The Woven Bamboo Roof  
Source: field survey

## RESULTS AND DISCUSSION

### Participation and Partnership

From the outset it was understood that participation and partnership with locals was crucial, not only in developing a sense of belonging and ownership, but also for the future continuity of the project. At the start 13 local men were recruited to participate in the research not only as trainees but also as insiders giving constant feedback to the research team. They were recruited from the different *Woredas* (districts) with the vision that they in turn would later train more people. Moreover, a cross-cultural transfer of knowledge and skill was achieved by involving four roof makers from the Chencha region (500 km from Addis Ababa) to provide hands-on training on the technique of bamboo roof construction. The development of knowledge and expertise about bamboo has been reinforced by the formation of the National Bamboo Construction Centre within the EiABC which is headed by the Chair of Alternative Technology.

In addition to the farmer trainees, key stakeholder meetings were held at critical stages of the research and its implementation. The stakeholder meetings included discussions with the Bete Guraghe Cultural Centre (BGCC), the Guraghe Development Association, Federal and local politicians, representatives from the Ministry of Urban Development and Construction, the Ministry of Education and most importantly, elders and prominent people from the Guraghe region.



In September 2011, a small event was organised whereby each of the trainees received three different-sized metal moulds for block making and an illustrated manual in the local Amharic language which describes the construction process step-by-step. This was to encourage the trainees to begin implementing what they had learnt. It was suggested they try to construct a modest structure in their localities using the SRDU building materials and construction techniques. At this early stage emphasis was not put in replicating the SRDU in its totality, but rather consolidating what had already been learnt. The response of the trainees was encouraging: within a period of six months, four trainees managed to produce hundreds of soil blocks while one of them constructed an outdoor toilet using the SRDU technique. This was the first milestone in the process of scaling-up and it indicated that the trainees had taken the idea of the research seriously and were committed to taking it forward.



**Figure 4.** Local People and Dignitaries  
Attend The Inauguration of SRDU II

Source: field survey

The following January all the trainees returned to the Gubrie research site and worked on the construction of SRDU-II (see Figure 4). This is a circular housing proto-type as opposed to SRDU-I, which was rectangular – to echo the aspirations expressed in the modern tin-roof houses. The wisdom of changing the form of the original SRDU is to show the local people and the trainees that it is possible to have various options using the same materials and construction technique. The change also responded to the feedback of many local people – who although impressed with quality of the first prototype believed that a circular plan in line with their traditions would be even better. This illustrates some of the contradictions which are present in societies undergoing change and modernisation. Both prototypes were inaugurated and local people from a wide area were invited to visit experience and learn about the projects. Encouragingly, three well-known affluent people from the region have commissioned houses using the SRDU techniques – and will no doubt be influential helping to build a positive image for such ‘modern vernacular’ construction approaches.

Whilst undertaking SRDU-II, the third phase of the SRDU research series was launched under the title “*Contextualization of vocational training for the building*

*sector in Ethiopia*". This focuses on consolidating and enhancing the key issues of the capacity building, scaling-out and scaling-up process initiated in SRDU-I and II. The envisioned strategies and further milestones are discussed below.

### **Capacity Building and Knowledge Transfer**

To consolidate and enhance the process of capacity building, with the ultimate goal of scaling-up and scaling-out the SRDUs, a range of actors are involved at different levels. In addition to the horizontal transfer of knowledge and skills between local trainees and researchers discussed earlier, there is a pyramidal cascading knowledge transfer between senior academics, PhD students, trainees from Wolkite University and the local Technical and Vocational college (TVET), and local semi-skilled or non-skilled trainees. The key strategy of the capacity building pyramid is the development of curricula and the transfer of skills through practical experiments involving students and trainees. The objective is that at the end of phase 3, the local university and TVET trainees would continue to provide training to local farmers, using the newly developed curricula, and thus becoming part of the mainstream academic training system. At this stage it is anticipated that control and organisation of future projects would be under the direction of the local university, and the team from EiABC would be able to concentrate on research and projects in other regions of the country.

One of the main objectives of the research is to disseminate the SRDU findings on alternative materials and construction techniques and thereby multiply the housing typologies and/or their components at a larger scale within rural settlements and emerging towns. The main strategy to achieve this will be through entrepreneurship. Trainees who have completed the SRDU curricula will be encouraged to organize themselves into co-operatives and business entities to create small-scale industries to produce the components of the housing units. Therefore the SRDU curricula will incorporate entrepreneurship modules given in collaboration with entrepreneurship experts and experienced business people. These new enterprises would produce rationalised building elements which could be used by for the construction of housing throughout wide areas and thus benefit increasing numbers of rural people. The linking of house construction to livelihoods is a fundamental component of future sustainability especially as rural livelihoods are coming under increasing pressure. Such an approach is line with the approach of the United Nations Population Fund (UNPF) which recognises that small urban centres will be the destination of many environmental migrants and hence recommend policies which support the sustainable growth and development of such centres.

The climatic and cultural diversity of the country, with over 80 distinct cultural groups and dramatically contrasting climatic zones, will pose a great challenge in scaling-up and applying the findings of the SRDU research to other parts of the country. The housing units developed for the Guraghe region cannot simply be replicated elsewhere as different cultural and climatic zones will require specific substantive approaches. The availability of building materials, cultural outlook and local climate conditions will require corresponding construction techniques, materials and house forms. Conscious of this, the SRDU research will focus on developing appli-

cation methodologies and generic strategies that could be applicable, and easily adaptable if and when necessary, for each particular region. Regional universities will be able to play a key role in this process and the Ministry in Addis Ababa has expressed official support.

## **CONCLUSIONS**

### **Sensitivity to Context**

This project demonstrates the value of detailed, thorough field research and analysis which goes beyond superficial visual surveys. It is vital to understand how people live, the reasons for current choices; the significance of material choice and spatial layouts, and to understand individual, household and community aspirations. Housing is a social process which by definition is rooted in specific climatic and cultural contexts which must be well understood before proposing any changes. Studies of rural life in Ethiopia indicate its rich complexity and how human behaviour is deeply rooted in historic belief systems in which everything in the natural world is divinely inspired and closely interrelated (Carlson and Carlson, 2008: 57). For example this can mean some people believe that inappropriate actions and behaviour can impact on harvests, health and fertility. Hence all proposed changes and interventions must be sensitive to such issues. For example, in the Guraghe region cattle are considered a part of the family and must be housed in the same building. In this project the designers proposed a way of integrating the cattle but at the same achieving sufficient separation for health and practical reason. It is vital not be restrained by ideas of static cultural models: all societies are in a process of change, even when it may not be visible or apparently tangible (Kellett, 2010). The challenge is to direct change in positive, inclusive and sustainable directions and to ensure people are able to appreciate the reasons behind decisions and are willing to adopt them.

### **The Importance of Testing**

The project recognised the importance of thoroughly testing new materials and construction techniques, firstly as individual components then full-size prior to implementation. This was facilitated by the EiABC laboratories). The credibility of professionals rests on avoiding fundamental mistakes. The testing process also allows for testing for more severe conditions and offers the opportunity to build in tolerances for future climate changes such as higher rainfall or drier conditions.

### **Full Size Prototypes**

There is great value in building full size prototypes, not only assess the effectiveness of the design and construction system but equally important to allows people to really experience the new forms, spaces and materials, and hence to assess their cultural and economic acceptability. We can also consider full size prototypes as a type of pilot – which is important in research as well practice.

## **Locally Sourced Materials**

Current traditional solutions develop from materials obtained locally and it is important to continue this approach. However this does not necessarily mean using the same materials. The exploration of alternative materials (and associated construction systems) needs to bear in mind the future natural resource availability and in particular their renewability. The project also examined building approaches from other regions to gather and test examples of good practice which had the potential for wider applicability; for example the introduction of bamboo not currently used for construction in the study area, but which grows locally. As with other aspects of the project, a key aim is to reduce reliance on manufactured goods and those imported from other regions to minimise the additional energy and carbon costs implicit in manufacture and transport. Equally important are locally sourced skills.

## **Resource Efficiency and Resilience**

Future population pressures and climate instability will undoubtedly increase the pressures and competition for limited resources hence it is vital that all human and natural resources and assets are used efficiently. This is a key tenet of sustainability (Chambers and Conway, 1991) and was a constant theme underlying the project. To achieve this requires innovation and creativity and new ways of thinking – which architects should be to offer on all projects – but is especially important for low income communities who have limited resources. Knowledge and information are key resources – and the development and reinforcement of local knowledge and skill is a vital component of reinforcing resilience of potentially vulnerable communities

## **Independent Energy Generation**

Like most rural areas the Guraghe use wood as the main energy source. This is leading to deforestation and other negative environmental impacts. The introduction of Biogas and solar power reduces dependency on grid and plays a vital role in increasing local autonomy and independence as well offering significant environmental gains.

## **Involvement of Local People**

Local people were involved from the inception. Irrespective of the potential value of the technical and design solutions proposed, unless local people are directly involved at a range of levels it will not be possible to move beyond prototypes. In particular this includes those in influential positions and opinion formers. In this project a particular important moment was when the elders came to bless the project and the workers in an ecumenical ceremony which united both Christians and Moslems (see Figure 5). Their public endorsement of the project cannot be underestimated.

In order that new ideas are accepted and rolled out on a larger scale, the backing and support of ordinary people is vital – hence the logic of including local people as trainees. The literature on Participatory Action Research from a range of con-

texts indicates the value of working with rather than for communities, and echoes John Turner's early ideas of housing BY rather than FOR people (Turner, 1972, 1976).



**Figure 5.** Community Elders Blessing The Project and The Workers  
Source: field survey

## **Training**

The project illustrated the importance of focusing on training of local workers who in the future will be able to take the project forward without the continuing support of the project team at Addis Ababa University. Equally significant is the involvement of staff and students from the local university and Technical and Vocational College who are integrating this project into key skill training and educational curricula. This is vital to ensure future projects have skilled and informed people to lead and implementation them.

## **Hands-on Education**

The project involves processes embedded at a range of levels in different academic institutions. This means that the students learn about the vital importance of sustainability and the challenge of climate change in rural areas not from texts books and lectures but from direct engagement in the process. For example master students and undergraduates from EiABC spent time in the field interacting with local people to gather data on building processes and material use. This is invaluable educational experience. Later they were active in a hands-on capacity to help build some of the prototypes. This suggests that other institutions might consider adopting such 'learning by doing' activities in the curriculum.

## **Research and International Collaboration**

PhD students will be active in future evaluation and will be joined by students and academics from European institutions who are similarly gaining significantly from engagement in the process. Such international experience sharing echoes the global importance of climate change and the urgent need to develop sustainable responses in the field of architecture and planning. Such actions begin to blur the distinction between education and research, and to illuminate the potential for more practically orientated and socially-committed curricula. Certainly it underlines the potential for research to be action focused with the aim of making a significant contribution to the development objectives of the country – particularly the issue of substandard housing and the challenge of climate change. The SRDU project is one of a coordinated series of ambitious research/educational projects currently underway in the EiABC which deal with urban as well as rural construction, design and planning issues (Cheremet and Sewnet, 2011).

## **An Evolutionary Approach**

In contrast to contemporary commercial projects which put a high value on fast completion, this research-oriented project moved cautiously but steadily to ensure people were moving along with the project team, and to be able to adopt new ideas and respond to unpredicted opportunities. In this sense the breaks necessary for the seasonal heavy rains were helpful as they allowed time for reflection away from the field in order to test and consolidate before moving to the next stage. The team held weekly project meetings and several retreats to reflect and evaluate progress and to plan future activities. Sustainability cannot be achieved overnight, as it is a long term social as well as a technical process. Such a gentle, slower approach echoes some aspects of traditional vernacular approaches in which a series of minor changes, adaptations and improvements are introduced through time (Rapoport, 1969).

## **Flexibility and Adaptability**

The project demonstrated the value of a flexible design which encouraged future change and adaptability. The SDRU projects are not intended to be rigid and fixed. Therefore it is vital that knowledge, understanding and skills reside in the local communities so that as local conditions fluctuate and change (as well ideas, aspirations and lifestyles), buildings can adjust accordingly in a sustainable way. For local people the experience of witnessing and engaging in this project will hopefully demonstrate that positive change is possible and indicates that future change is also possible, feasible and is to be welcomed. Most important in these challenging and unpredictable times, they can be active agents in helping to define their own futures rather than being powerless and vulnerable in the face of climate change.

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