

Title

Sustainable low-income housing in Uganda, challenges and opportunities

Authors

Arman Hashemi¹, Heather Cruickshank¹, Ali Cheshmehzangi²

¹Centre for Sustainable Development, Department of Engineering, University of Cambridge, Cambridge, CB2 1PZ, UK.

²The University of Nottingham Ningbo China, 199 TaiKang East Road, Ningbo, 315100, China.

Abstract

While the developed world is adapting to the consequences of global warming, climate changes will negatively affect the quality of life and economic growth in developing countries. The low-income people from low and medium HDI (Human Development Index) countries would suffer even more from climate changes because of their vulnerable living conditions and the lack of appropriate and adequate infrastructures. Particular attention should therefore be paid to the low-income housing conditions not only to address the environmental concerns but also to improve the living standards and health and wellbeing of low-income people. The work presented here is a part of an on-going EPSRC funded research programme which intends to identify and develop energy efficient methods for delivering low-income housing in tropical countries namely Uganda, Tanzania, China and Thailand. This paper evaluates the current Ugandan housing conditions in order to identify the opportunities and challenges for improving the energy efficiency as well as the quality of low-income housing in Uganda. The available literature are reviewed and the findings are used to draw a clear picture on the current housing conditions, limitations and the key areas for improvement. The findings reveal some critical areas such as affordability, informal settlement, overcrowding and access to housing facilities which require immediate attention. The research findings also highlight construction methods/materials and embodied energy as the key areas of improvement for reducing CO₂ emissions of low-income housing in Uganda.

Keywords: Low-income Housing, Tropical Housing, Sustainability, Energy Efficiency, Embodied Energy, Uganda.

1 Introduction

Uganda is located in East Africa, neighboured by Sudan, Kenya, Tanzania, Rwanda and Democratic Republic of Congo. Despite a rather stable economy and an inflation rate of 4.9% in 2014¹, Uganda suffers from high poverty rates. In 2013, Uganda was ranked 164 out of 187 countries in HDI (Human Development Index) ranking. Around 38% of Uganda's population live below the international poverty line of \$1.25 a day.²³

Uganda has an area of 241,038 Km² and an average altitude of 1000-1500m above the sea level.⁴⁵⁶ It has a tropical climate with temperatures ranging between 16 °C and 30 °C⁷ with the hottest period between December and February.⁸ There are two rainy and dry seasons between April-May & October-November⁹ and between December-February & June- August, respectively; although the climate change has considerably affected this.¹⁰ The annual rainfall in different parts of the country varies between 750-2100mm.¹¹ Northern and Eastern parts of the country may experience high temperatures above 30 °C while South Western parts may experience temperatures below 16 °C. It

¹ CAHS (2014), Housing Finance in Africa – 2014 Yearbook – 5th edition, A review of some of Africa's housing finance markets, November 2014, Published by the Centre for Affordable Housing Finance in Africa The Centre for Affordable Housing Finance in Africa, South Africa

² HUMAN DEVELOPMENT REPORT 2014

Sustaining Human Progress: Reducing Vulnerabilities and Building Resilience

Published for the United Nations Development Programme (UNDP)

Copyright © 2014

by the United Nations Development Programme

1 UN Plaza, New York, NY 10017, USA

Director and lead author

Khalid Malik

³ EPRC 2013, UGANDA 2013 FinScope III

SURVEY REPORT FINDINGS, Unlocking Barriers to Financial Inclusion, November 2013, ECONOMIC POLICY RESEARCH CENTRE

⁴ COUNTRY PROGRAMME DOCUMENT 2008 – 2009, UGANDA, Excerpts from this publication may be reproduced without authorisation, on condition that the source is

indicated. © United Nations Human Settlements Programme

(UN-HABITAT), 2008. HS Number: HS/1112/09E, ISBN Number(Series): 978-92-1-132030-5' ISBN

Number:(Volume) 978-92-1-132078-7, United Nations Human Settlements Programme, Nairobi, Kenya

⁵ UBOS 2012, Uganda Demographic and Health Survey 2011, Uganda Bureau of Statistics, Kampala, Uganada.

⁶ ACTwatch Group & PACE/Uganda, 2013. Household Survey, Uganda, 2012 Survey Report. Washington, DC: Population Services International.

⁷ 2002 UGANDA POPULATION AND HOUSING CENSUS, ANALYTICAL REPORT, UGANDA BUREAU OF STATISTICS, Plot 9, Colville Street, P. O. Box 7186, Kampala, October 2006

⁸ ACTwatch Group & PACE/Uganda, 2013. Household Survey, Uganda, 2012 Survey Report. Washington, DC: Population Services International.

⁹ COUNTRY PROGRAMME DOCUMENT 2008 – 2009, UGANDA, Excerpts from this publication may be reproduced without authorisation, on condition that the source is

indicated. © United Nations Human Settlements Programme

(UN-HABITAT), 2008. HS Number: HS/1112/09E, ISBN Number(Series): 978-92-1-132030-5' ISBN

Number:(Volume) 978-92-1-132078-7, United Nations Human Settlements Programme, Nairobi, Kenya

¹⁰ AGRA (2010), Baseline Survey, AGRA Interventions in Uganda, Final Report, November 2010, Alliance for a Green Revolution in Africa.

¹¹ 2002 UGANDA POPULATION AND HOUSING CENSUS, ANALYTICAL REPORT, UGANDA BUREAU OF STATISTICS, Plot 9, Colville Street, P. O. Box 7186, Kampala, October 2006

is estimated that the temperatures in East African countries may rise between 3-4 °C during the next 70 years due the global warming.¹²

Developing countries in tropical and subtropical areas will be hit the worst by the climate changes.¹³ The low level of awareness of environmental concerns makes the situation even more critical in these countries. Moreover, although improving gradually, environmental policies are neglected by the governments as the higher priority is usually given to economic growth.¹⁴ The low-income people from low and medium HDI countries, such as Uganda, would suffer more from the global warming because of their vulnerable living conditions and the lack of appropriate and adequate infrastructures.¹⁵

Unlike the rich countries who have the resources to invest and respond to such changes, adaptation in developing countries and particularly in the poorest ones is left to the individuals as a matter of “self-help”. The current strategy in many developing countries is “climate-proofing” of the existing resources and infrastructure in response to the increasing risks.¹⁶ This situation will considerably affect the living standards and health and wellbeing of low-income people the majority of whom live in substandard slums and informal settlements. Particular attention should therefore be paid to the low-income housing conditions not only to address the environmental concerns but also to improve the living standards and health and wellbeing of low-income people to increase their resilience to environmental risks and disasters caused by the global warming. To this end this study intend to evaluate the current Ugandan housing conditions in order to identify the barriers and opportunities for delivering sustainable low-income housing in Uganda.

2 Methodology and limitations of the study

The main method of data collection for this paper is literature review ...TBC

¹² EMI (No dates) (Architectural Design Guide, Engineering Ministries International – East Africa, Kampala, Uganda

http://emiea.org/documents/eMiEA_Architectural_Design_Guide.pdf

© 2012 ENGINEERING MINISTRIES INTERNATIONAL, USA. ALL RIGHTS RESERVED. On the site!

¹³ Human Development Report 2007/2008, Fighting climate change: Human solidarity in a divided world, by the United Nations Development Programme (UNDP), 1 UN Plaza, New York, New York, 10017, USA, 2007
Director and lead author

Kevin Watkins

¹⁴ Bertelsmann Stiftung, BTI 2012 — Uganda Country Report. Gütersloh: Bertelsmann Stiftung, 2012.

¹⁵ Bartlett, S. 2008. “Climate Change and Urban Children: Impacts and Implications for Adaptation in Low- and Middle-Income Countries.” *Environment and Urbanization* 20 (2): 501–19. QUOTED in (Human Development Report 2011, Sustainability and Equity: A Better Future for All, Published for the United Nations Development Programme (UNDP), by the United Nations Development Programme
1 UN Plaza, New York, NY 10017, USA, 2011)

¹⁶ Human Development Report 2007/2008, Fighting climate change: Human solidarity in a divided world, by the United Nations Development Programme (UNDP), 1 UN Plaza, New York, New York, 10017, USA, 2007
Director and lead author

Kevin Watkins

3 Population growth, urbanisation and slums

Africa is experiencing the highest rate of urban growth in the world. All African countries, except East African ones, have an urban population of 40% or more. The majority of population in African cities live in slums and informal settlements.¹⁷ It is estimated that by 2050, around 56% of the African population live in the urban areas (Table 1).¹⁸

Table 1: Urban and Rural population and rate of annual changes.

Source:¹⁹

Area/Country	Population (1000s)						Proportion Urban (%)			Average annual rate of change (%)
	Urban			Rural			199	201	205	2010-2015
World	228503 1	388012 8	633861 1	303578 6	336365 6	321233 3	43	54	66	0.9
Africa	196923	455345	133856 6	433064	682885	105460 9	31	40	56	1.1
East Africa	35564	96610	378763	162822	287296	490458	18	25	44	1.7
Uganda	1942	6124	33367	15593	32721	70711	11	16	32	2.1

Uganda can be considered as an agricultural country since, despite high growth rate (5.6% p.a.) in urban population, only around 14-15% of the population live in the urban areas.²⁰ In 2009/10, the number of households in Uganda was 6.2 million showing an increase of one million since 2005/06. During the same period, urban households grew by 1.4% from 17.4% to around 18.8%.²¹ According to the National Census in 2002, Uganda's population was 24.2 million.²² With a growth rate of 3.2%, the country's population is estimated to be around 38 million in 2015^{23 24} and 68.4 million by 2035,

¹⁷ The State of Planning in Africa, An Overview, UN-Habitat (United Nations Human Settlements Programme), Urban Planning and Design Branch, P.O.BOX30030 Nairobi 00100 Kenya, February 2013, HS Number: HS/010/14E

¹⁸ World Urbanization Prospects The 2014 Revision (2014), Published by the United Nations, New York, Department of Economic and Social Affairs, (UNDESA, 2014)

¹⁹ World Urbanization Prospects The 2014 Revision (2014), Published by the United Nations, New York, Department of Economic and Social Affairs, (UNDESA, 2014)

²⁰ COUNTRY PROGRAMME DOCUMENT 2008 – 2009, UGANDA, Excerpts from this publication may be reproduced without authorisation, on condition that the source is indicated. © United Nations Human Settlements Programme

(UN-HABITAT), 2008. HS Number: HS/1112/09E, ISBN Number(Series): 978-92-1-132030-5' ISBN Number:(Volume) 978-92-1-132078-7, United Nations Human Settlements Programme, Nairobi, Kenya

²¹ UBOS 2010, Uganda National Household Survey 2009/10, Uganda Bureau of Statistics, Kampala, Uganda.

²² 2002 UGANDA POPULATION AND HOUSING CENSUS, ANALYTICAL REPORT, UGANDA BUREAU OF STATISTICS, Plot 9, Colville Street, P. O. Box 7186, Kampala, October 2006

²³ COUNTRY PROGRAMME DOCUMENT 2008 – 2009, UGANDA, Excerpts from this publication may be reproduced without authorisation, on condition that the source is indicated. © United Nations Human Settlements Programme

(UN-HABITAT), 2008. HS Number: HS/1112/09E, ISBN Number(Series): 978-92-1-132030-5' ISBN Number:(Volume) 978-92-1-132078-7, United Nations Human Settlements Programme, Nairobi, Kenya

²⁴ UNFPA, 2013, The State of Uganda Population Report 2013

Theme: Population and Social Transformation: Addressing the needs of Special Interest Groups
Population Secretariat, Ministry of Finance, Planning and Economic Development, Statistics House, 9 Colville Street, P. O. Box 2666, Kampala

30% of which would live in urban areas.²⁵ By 2050, Uganda is estimated to be one of the most urbanised African countries.²⁶

The high population and urban growth rates have considerably affected the land and housing demands.²⁷ Such conditions have resulted in increasing slums and informal settlements in Uganda and in many other African countries. In some African countries, slums and informal settlements make more than 50% of the whole city's population.²⁸ For instance, over 60% of Kampala, the capital city of Uganda, live in slums.²⁹

4 Housing Conditions

The share of the construction industry in Uganda has increased from 4.1% in 1988 to 12% of GDP in 2008. Since 1988 the housing sector has been growing with an average rate of 6.3%. This is while in 2005/6 less than 1% of the labour force were employed by the construction industry.³⁰ Private sector is the major housing provider in Uganda and the government therefore only needs to develop and implement appropriate housing regulations and standards to improve the housing conditions.³¹

In 2010, Uganda's housing stock was around 5.28 million dwellings with an estimated shortage of 612,000 residential units.³² The projected housing deficit in 2012 was between 560,000 and 1.6 million with an annual demand of 233,000 units, 28% of which was in urban areas. The housing demand is estimated to increase to eight million by 2020 if the current situation remained the same.³³

²⁵ COUNTRY PROGRAMME DOCUMENT 2008 – 2009, UGANDA, Excerpts from this publication may be reproduced without authorisation, on condition that the source is indicated. © United Nations Human Settlements Programme

(UN-HABITAT), 2008. HS Number: HS/1112/09E, ISBN Number(Series): 978-92-1-132030-5' ISBN Number:(Volume) 978-92-1-132078-7, United Nations Human Settlements Programme, Nairobi, Kenya

²⁶ CAHS (2014), Housing Finance in Africa – 2014 Yearbook – 5th edition, A review of some of Africa's housing finance markets, November 2014, Published by the Centre for Affordable Housing Finance in Africa The Centre for Affordable Housing Finance in Africa, South Africa

²⁷ COUNTRY PROGRAMME DOCUMENT 2008 – 2009, UGANDA, Excerpts from this publication may be reproduced without authorisation, on condition that the source is indicated. © United Nations Human Settlements Programme

(UN-HABITAT), 2008. HS Number: HS/1112/09E, ISBN Number(Series): 978-92-1-132030-5' ISBN Number:(Volume) 978-92-1-132078-7, United Nations Human Settlements Programme, Nairobi, Kenya

²⁸ Quick Guide 2: Low-income Housing: Approches to helping urban poor find adequate housing in African cities. Copyright © United Nations Human Settlements Programme

(UN HABITAT), 2011, United Nations Human Settlements Programme (UN-HABITAT), Nairobi, Kenya, HS Number: HS/181/10E, ISBN Number: (Volume) 978-92-1-132317-7, ISBN Number (Series): 978-92-1-131926-2

²⁹ SITUATION ANALYSIS OF INFORMAL SETTLEMENTS

IN KAMPALA, CITIES WITHOUT SLUMS, Sub-Regional Programme for Eastern and Southern Africa, KIVULU (KAGUGUBE) AND KINAWATAKA (MBUYA 1) PARISHES (names?)

Copyright © United Nations Human Settlements Programme

(UN-HABITAT), Nairobi, 2007

HS/873/06E

ISBN: 92-1-131862-9

³⁰ NATIONAL DEVELOPMENT PLAN 2010/11 - 2014/15, National Planning Authority, P. O. Box 21434, Kampala, 2010

³¹ NATIONAL DEVELOPMENT PLAN 2010/11 - 2014/15, National Planning Authority, P. O. Box 21434, Kampala, 2010

³² NATIONAL DEVELOPMENT PLAN 2010/11 - 2014/15, National Planning Authority, P. O. Box 21434, Kampala, 2010

³³ CAHS (2014), Housing Finance in Africa – 2014 Yearbook – 5th edition, A review of some of Africa's

Although the draft National Housing policy gives particular attention to low-income housing aiming to improve slums and enforce minimum housing standards, considering the current allocated budget, housing is not one of the Ugandan governments' priorities. The intention, however, is to increase the private sector housing from less than 10,000 to 250,000 units by 2025 aiming to reduce the housing deficit by 50%.³⁴

According to Uganda's National Development Plan 2010/11-2014/15 the main issues related to housing sector performance are as follows:³⁵

- Old, weak and unharmonised governmental laws and policies
- Limited access to and expensive financing (e.g. high interest rates on mortgages)
- Skill shortages in areas such as architecture and structural engineering
- Expensive construction materials (e.g. a 50kg bag of cement is \$15 in Uganda compared to \$4 in the Middle East)

4.1 Housing types

With around 58% of the total housing stock, detached houses are the most common housing type in Uganda (Table 2). Huts and Tenements (locally called Muzigo/Mizigo) take the next places with 21.5% and 18.4% respectively. Although the share of Huts has almost remained the same since 2005, the share of Tenements has increased by more than 3%. This is while in urban areas, the share of Tenements has increased sharply from around 49% to 58% (9% since 2005 and 11% since 2002) compared to only 1.1% increase in rural areas. Moreover, according to the national surveys in 2002, around 27% of households lived in "room/rooms" dwelling units. The share of "room/rooms" dwelling type was considerably higher in urban areas (62%) compared to rural areas (21%).³⁶

Table 2: Types of dwelling and tenure in Uganda (2005-2010).

Source of tables:^{37,38}

Indicator	Year 2005/06			Year 2009/10		
	Urban	Rural	Uganda	Urban	Rural	Uganda
Dwelling Types						
Detached house	36.8	65.6	60.5	30.2	64.4	57.9
Huts	8.9	24.8	22	6.2	25.1	21.5
Tenements/ Muzigo	48.9	8.1	15.2	58	9.2	18.4
Others	5.4	1.6	2.2	5.7	1.4	2.2
Tenancy Types						
Owned		78.4			76	
Rental		15.3			17.9	

housing finance markets, November 2014, Published by the Centre for Affordable Housing Finance in Africa
The Centre for Affordable Housing Finance in Africa, South Africa

³⁴ CAHS (2014), Housing Finance in Africa – 2014 Yearbook – 5th edition, A review of some of Africa's housing finance markets, November 2014, Published by the Centre for Affordable Housing Finance in Africa
The Centre for Affordable Housing Finance in Africa, South Africa

³⁵ NATIONAL DEVELOPMENT PLAN 2010/11 - 2014/15, National Planning Authority, P. O. Box 21434, Kampala, 2010

³⁶ 2002 UGANDA POPULATION AND HOUSING CENSUS, ANALYTICAL REPORT, UGANDA BUREAU OF STATISTICS, Plot 9, Colville Street, P. O. Box 7186, Kampala, October 2006

³⁷ UBOS 2010, Uganda National Household Survey 2009/10, Uganda Bureau of Statistics, Kampala, Uganda.

³⁸ NATIONAL DEVELOPMENT PLAN 2010/11 - 2014/15, National Planning Authority, P. O. Box 21434, Kampala, 2010

Many people in African cities live in rental properties. In 2009/10, around 18% of Ugandan families lived in rental properties. The situation is more critical in urban areas. In 2007, for example, 57% of the urban population were renting their homes.³⁹ This figure was around 70% for households living in Kampala.⁴⁰ The major reason for the very high rate of renting is the high housing costs⁴¹ which makes houses unaffordable for the families living in Kampala. Increasing prices have forced many people out of the housing market resulting in more demand for rental properties.

4.2 Household size and number of rooms

Overcrowding is one of the major challenges in Uganda. Overcrowding increases the risk of contracting infectious and transmissible diseases. The National Housing Survey 2005/06 indicated that more than 50% of Ugandan households lived in single roomed houses.⁴² Also, according to UBOS (2012), in 2011, around 46% of Ugandan households used only one room for sleeping. Overcrowding has been more serious in urban areas as 62.3% of urban families sleep in one room compared with 42% for the rural areas.⁴³ Figure 1 shows the average number of bedrooms and sleeping occupants in each room in different parts of the country in 2005/06 and 2009/10. Table 3 also shows the average household size over a period of eight years in different regions of Uganda.

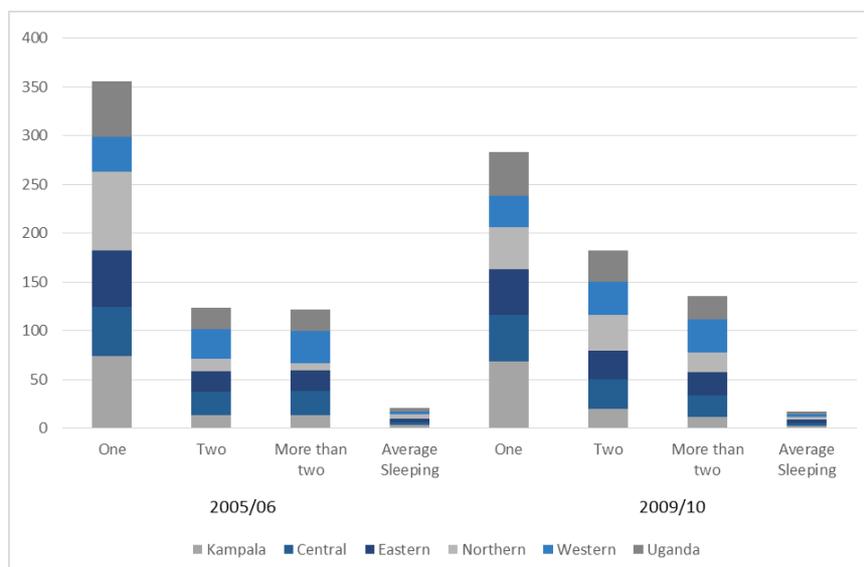


Figure 1: The average number of bedrooms and sleeping occupants in each room (2005-2010).

Source of table ⁴⁴

³⁹ Overview of the Housing Industry and Housing Finance Sector in Uganda

Dr. William S. Kalema and Mr. Duncan Kayiira

<http://www.housingfinanceafrica.org/wp-content/uploads/2012/10/Developments-in-Ugandas-Housing-Finance-Markets2.pdf>

Date October 2012, Centre for Affordable Housing Finance in Africa

⁴⁰ UBOS 2010, Uganda National Household Survey 2009/10, Uganda Bureau of Statistics, Kampala, Uganda.

⁴¹ NATIONAL DEVELOPMENT PLAN 2010/11 - 2014/15, National Planning Authority, P. O. Box 21434, Kampala, 2010

⁴² NATIONAL DEVELOPMENT PLAN 2010/11 - 2014/15, National Planning Authority, P. O. Box 21434, Kampala, 2010

⁴³ UBOS 2012, Uganda Demographic and Health Survey 2011, Uganda Bureau of Statistics, Kampala, Uganda.

⁴⁴ UBOS 2010, Uganda National Household Survey 2009/10, Uganda Bureau of Statistics, Kampala, Uganda.

Table 3: Average household size in different regions of Uganda (2002-2010).

Source of table: ⁴⁵

	2002/03	2005/06	2009/10
Rural	5.3	5.3	5.2
Urban	4.1	4.6	3.9
Central	4.8	4.8	4.1
Eastern	5.5	5.6	5.6
Northern	5.1	5.2	5.2
Western	5.2	5.3	5.1
Uganda	5.1	5.2	5

4.3 Access to Energy Sources

Wood fuel and paraffin are respectively the main fuel sources for cooking and lighting in Uganda. Access to alternative energy sources such as electricity is very limited. In 2011, for instance, only 14.6%⁴⁶ of Ugandan households had access to electricity. This figure was only 5.3% in rural areas compared to 55.4% in urban areas (Figure 2). The situation is even more critical when considering the common cooking fuels since around 95%⁴⁷ of Ugandan households used wood related fuels, such as firewood or charcoal, for cooking purposes. This figure improved by only 2% over year 2002 figures when around 97% of household reported their main cooking fuels as firewood or charcoal.⁴⁸

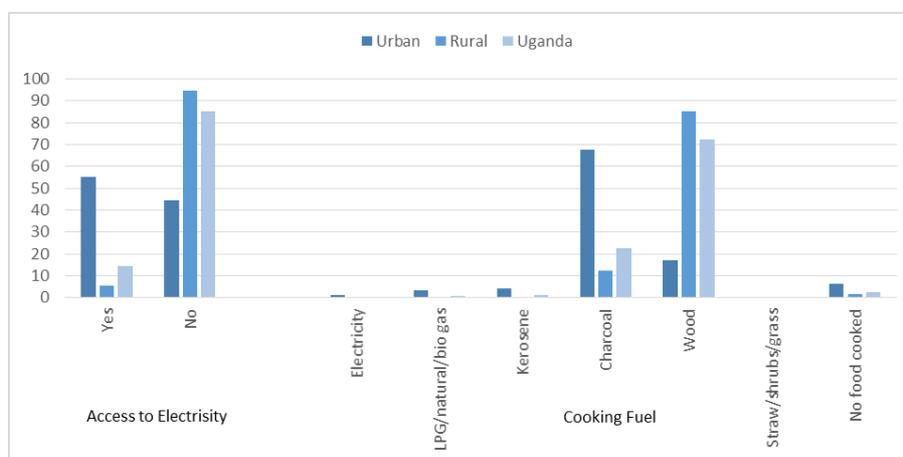


Figure 2: Access to electricity and cooking fuels (%).

Source of table: ⁴⁹

Figure 3 shows the common places of cooking for urban and rural households. Around 22% of urban and 9% of rural households cook indoors while 23% of rural and 48% of urban families cook

⁴⁵ UBOS 2010, Uganda National Household Survey 2009/10, Uganda Bureau of Statistics, Kampala, Uganda.

⁴⁶ UBOS 2012, Uganda Demographic and Health Survey 2011, Uganda Bureau of Statistics, Kampala, Uganda.

⁴⁷ UBOS 2012, Uganda Demographic and Health Survey 2011, Uganda Bureau of Statistics, Kampala, Uganda.

⁴⁸ 2002 UGANDA POPULATION AND HOUSING CENSUS, ANALYTICAL REPORT, UGANDA BUREAU OF STATISTICS, Plot 9, Colville Street, P. O. Box 7186, Kampala, October 2006

⁴⁹ UBOS 2012, Uganda Demographic and Health Survey 2011, Uganda Bureau of Statistics, Kampala, Uganda.

outdoors.⁵⁰⁵¹ This situation could considerably affect the health of the occupants of these houses particularly women and children who are in direct contact with generated fumes and smoke from the wood (Figure 4).

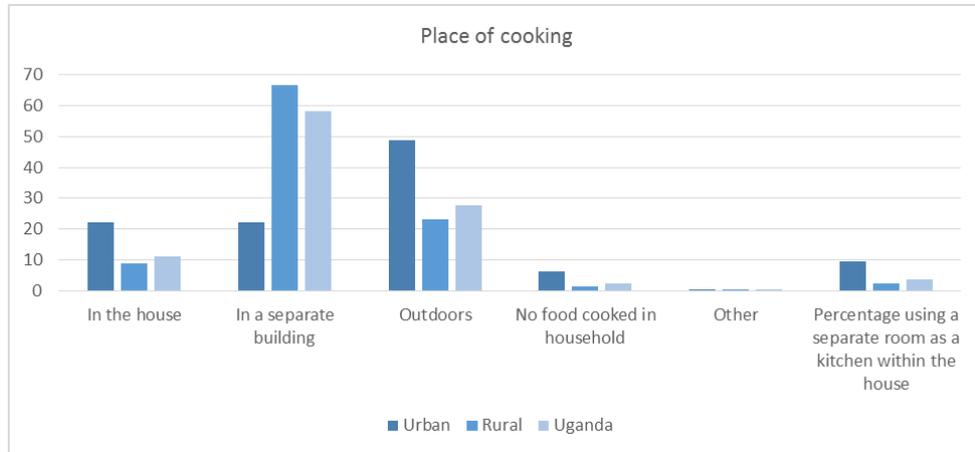


Figure 3: Place of cooking (%).

Source of table:⁵²



Figure 4: Poor indoor air quality due to cooking indoors affects the health and wellbeing of occupants.

Source: The authors

Figure 5 also summarises the sources of lighting in different parts of the country. “Tadooba”, which is a local paraffin candle, is the most common (66%) source of lighting in Uganda. It is followed by Lantern (14%) and Electricity (12%) as the second and third most common lighting source.⁵³ In Kampala, 48% of people use Electricity for lighting.

⁵⁰ UBOS 2012, Uganda Demographic and Health Survey 2011, Uganda Bureau of Statistics, Kampala, Uganda.

⁵¹ 2002 UGANDA POPULATION AND HOUSING CENSUS, ANALYTICAL REPORT, UGANDA BUREAU OF STATISTICS, Plot 9, Colville Street, P. O. Box 7186, Kampala, October 2006

⁵² UBOS 2012, Uganda Demographic and Health Survey 2011, Uganda Bureau of Statistics, Kampala, Uganda.

⁵³ UBOS 2010, Uganda National Household Survey 2009/10, Uganda Bureau of Statistics, Kampala, Uganda.

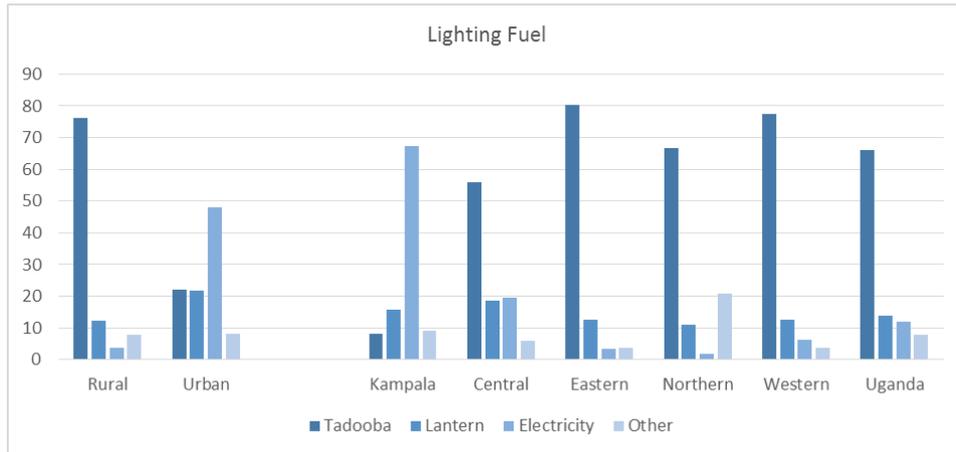


Figure 5: Types of lighting fuels in different regions of Uganda (%).

Source of table:⁵⁴

5 Construction Methods and Materials

Iron sheets (62%) followed by thatched roof (37%) are the most common roofing systems/materials in Uganda (Figure 6). In 2010, around 57% of all dwellings (84% urban and 51% rural) had brick walls and 39% (12% urban and 46% rural) were made with Mud and Poles. Figure 7 summarises the main construction materials between 2002 and 2010. The only noticeable change during this period has been the 6.4% and 3% increase in brick walls and cement flooring, respectively.^{55,56}



Figure 6: Thatched roof (left) and Iron Sheets roof construction (right).

Source: The authors

⁵⁴ UBOS 2010, Uganda National Household Survey 2009/10, Uganda Bureau of Statistics, Kampala, Uganda.

⁵⁵ NATIONAL DEVELOPMENT PLAN 2010/11 - 2014/15, National Planning Authority, P. O. Box 21434, Kampala, 2010

⁵⁶ UBOS 2010, Uganda National Household Survey 2009/10, Uganda Bureau of Statistics, Kampala, Uganda.

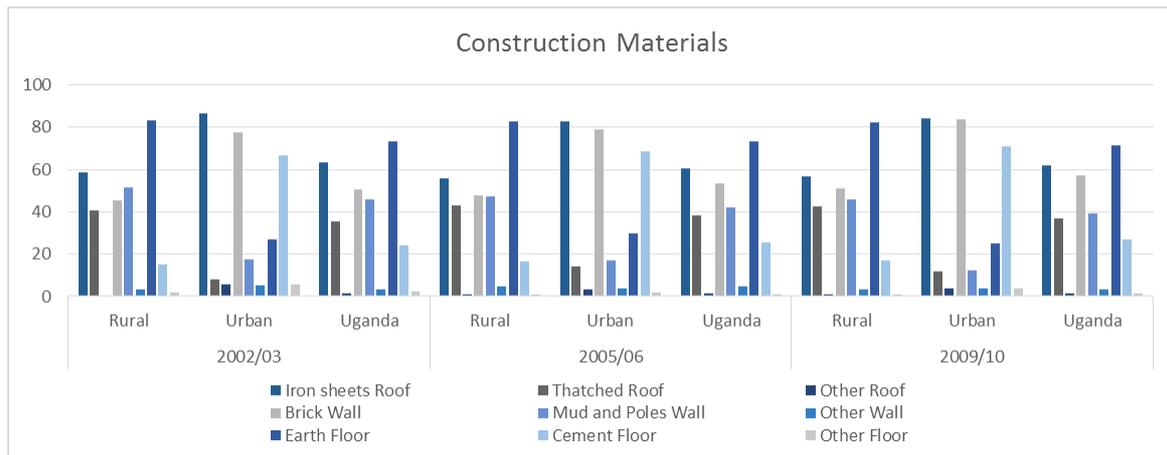


Figure 7: Main types of construction materials during 2002-2010 (%).

Source of tables: ⁵⁷⁵⁸

5.1 Walling methods/materials and environmental considerations

Following are the most common walling techniques used in many developing countries including Uganda: ⁵⁹⁶⁰⁶¹⁶²⁶³

1. Adobe Walls (also known as mud bricks or sun-dried earth block)
2. Rammed earth walls
3. Wattle and daub (also known as Mud and Poles)
4. Burned Bricks
5. Stabilised Earth Blocks
6. Concrete

Adobe (Figure 8) is the most affordable and environmentally friendly material making it very suitable for low-income housing; however, its aesthetics/appearance, low resistance and high maintenance requirements (due to vulnerability to rain/water) are the major issues associate with Adobe. Plastering the external surfaces would, to some extent, resolve the aforementioned issues. The major social challenge for using this material is to change the people’s mentality as Adobe is commonly considered as the “material of the poor”. ⁶⁴ Rammed earth walls are more stable

⁵⁷ NATIONAL DEVELOPMENT PLAN 2010/11 - 2014/15, National Planning Authority, P. O. Box 21434, Kampala, 2010

⁵⁸ UBOS 2010, Uganda National Household Survey 2009/10, Uganda Bureau of Statistics, Kampala, Uganda.

⁵⁹ Construction Reference Manual, A source book For the Use of Local materials In Construction, by Donald Batchelder et. al., Published by: The Experiment in International Living, Kipling Road, Brattleboro, Vermont 05301, USA, Copyright @ 1985, DONALD BATCBELDER, ROBERT E. CAIOLA, STANTON W. DAVENPORT

⁶⁰ Interlocking Stabilised Soil Blocks

Appropriate earth technologies in Uganda, Copyright © United Nations Human Settlements Programme (UN-HABITAT) 2009, United Nations Human Settlements Programme (UN-HABITAT), Nairobi GPO KENYA © UN-HABITAT/Adrian Perez

⁶¹ EARTH ARCHITECTURE IN UGANDA, Pilot project in Bushennyi, 2002-2004 CRATerre Editions, ISBN : 2-906901-36-9

⁶² Gernot Minke, Construction manual for earthquake-resistant houses built of earth, Published by GATE - BASIN (Building Advisory Service and Information Network) at GTZ GmbH (Gesellschaft für Technische Zusammenarbeit), P.O.Box 5180, D-65726 Eschborn, December 2001

⁶³ MUD AS A MORTAR, Practical Action, The Schumacher Centre for Technology & Development, Bourton on Dunsmore, Rugby CV23 9Z, United Kingdom

This technical brief was originally prepared for basin, Building Advisory Service and Information Network.

⁶⁴ EARTH ARCHITECTURE IN UGANDA, Pilot project in Bushennyi, 2002-2004

compared to adobe walls. Rammed earth walls are made from 100-150mm moist earth, tipped into a formwork and compressed by ramming.

Wattle and daub (Mud and Poles) is very common for low cost housing in Uganda. Wattle and daub consists of a wooden grid filled with earth. It stands for around 40% of all constructed houses in Ugandan; however, compared to adobe, wattle and daub is less environmental friendly as it increases deforestation due to the application of local wood in its structure.



Figure 8: Adobe construction?

Source: The authors

Burned bricks (Figure 9) is also a very common readily available material in both urban and rural areas of Uganda. Living in houses built with burned brick represents higher social status compared to adobe and wattle and daub. Burned brick is environmentally harmful due to (often excessive) soil extraction which may directly or indirectly affect agriculture and health of local communities. Due to the need for firewood, it also heavily damages the forests and causes air pollution as well as affects the available fuel sources.



Figure 9: Burned Bricks are very common in both rural and urban areas.

Source: The authors

The other issue is the excessive use of mortar (up to 30mm; Figure 10) during construction due to the uneven sizes of burned bricks. Moreover, the walls need to be plastered as aesthetically they do not look very pleasant. Such issues significantly increase the overall cost of this method of construction making it inappropriate for low-cost housing.

Compressed Stabilised Earth Blocks (CSEB) are also widely used in the construction projects. CSEB is relatively strong and environmental friendly due to the moderate use of cement and energy involved

in production processes. However, consistent production control is required to assure the quality of the final product.



Figure 10: Excessive use of mortar due to uneven sizes/shapes of bricks.

Source: The authors

Concrete is also a common construction material which is more common in urban areas of the country. The use of cement has been increasing during the past decades. Concrete is strong and durable but rather expensive. It is considered as a less environmental friendly material due to high energy consumptions during the production of cement. Yet, in view of unprofessional, energy intensive methods of production for the burned bricks, concrete may be considered as a more sustainable material. Concrete is also considered as a stylish material and living in concrete homes represent a high social status; however, its weak thermal performance may raise concerns over occupants' thermal comfort living in such houses. Moreover, concrete is an expensive material making it unsuitable for low-income housing. Table 4 summarises the advantages and disadvantages of common construction methods and materials in Uganda.

Table 4: Advantages and disadvantages of common construction materials/methods in Uganda.

Source of information:^{65 66 67}

Material/Criteria	Durability	Resistance	Economy	Environment
Adobe	Long life if plastered and maintained well	Weak to medium	Very affordable. Final cost varies depending on the plaster used.	Environmentally friendly considering there is little waste or energy involved making it

⁶⁵ Interlocking Stabilised Soil Blocks

Appropriate earth technologies in Uganda, Copyright © United Nations Human Settlements Programme (UN-HABITAT) 2009, United Nations Human Settlements Programme (UN-HABITAT), Nairobi GPO KENYA
© UN-HABITAT/Adrian Perez

⁶⁶ EARTH ARCHITECTURE IN UGANDA, Pilot project in Bushenyyi, 2002-2004

CRATerre Editions, ISBN : 2-906901-36-9

⁶⁷ EMI (No dates) (Architectural Design Guide, Engineering Ministries International – East Africa, Kampala, Uganda

http://emiea.org/documents/eMiEA_Architectural_Design_Guide.pdf

© 2012 ENGINEERING MINISTRIES INTERNATIONAL, USA. ALL RIGHTS RESERVED. On the site!

Wattle and daub	Require high maintenance	Weak	Low cost, considering raw materials are readily available	Causes deforestation due to the use of wood for the structure
Burned Bricks	Relatively durable	Relatively Strong	Reasonable unit cost; however overall it is expensive due to the amount of cement required for mortar and plaster	Environmentally harmful due to the deforestation/firing and excessive clay excavation
Compressed Earth Stabilised Blocks	Relatively durable (consistent quality control is required)	Relatively Strong	Respectively, 20% cheaper, same costs and 15% more expensive than a fired bricks wall with equivalent, lower or poor quality	Relatively sustainable due to moderate use of cement and energy involved in productions
Concrete	Durable	Strong but weak thermal performance	Expensive	Not environmentally friendly as massive energy is needed to produce cement.

5.2 Embodied energy

Running/in-use energy is not currently a major issues in African low-income housing. Embodied energy, in contrast, is the key factor in evaluating the sustainability of construction projects, methods and materials. Many of the prevailing materials and methods of construction in Uganda are environmentally harmful. This is because of the very inefficient and energy intensive production and manufacturing processes.

Considering the required energy for processing and manufacturing the common construction materials, adobe, rammed earth and unfired clay bricks are the most environmental friendly materials with minimal embodied energy and CO₂ emissions. Unfired pressed clay with no binder has an embodied energy and CO₂ emission of around 525.3 MJ/t and 25 kgCO₂/t, respectively. These figures for the unfired clay brick with binders are between 657.1-667.1 MJ/t energy usage and 40.9-42.9 kgCO₂/t emissions. The embodied energy and emissions of common PC-stabilised bricks with binder of around 12%, are in order 1025.6 MJ/t and 125.1 kgCO₂/t.⁶⁸

Thomas and Cruickshank (2014) have calculated the embodied energy of common construction materials in Uganda. They argue that the material costs and embodied energy are not proportional in Uganda as, for example, fired bricks are relatively cheap.⁶⁹ Table 5 summarises the embodied energy of common materials in Uganda. According to Table 5, “Crudely mortared ‘country’ bricks” is the most environmentally damaging construction material/method followed by “Well-mortared kiln-

⁶⁸ Oti J.E., Kinuthia J.M and Bai J., 2009. Unfired clay bricks: from laboratory to industrial production. *Engineering Sustainability* 162(4), p. 229-237.

⁶⁹ Reducing the energy use and the carbon footprint of tropical housing
By Terry Thomas & Heather Cruickshank
5th International Conference on Sustainable Energy and Environment (SEE 2014):
Science, Technology and Innovation for ASEAN Green Growth
19-21 November 2014, Bangkok, Thailand

fired bricks” and hollow concrete blocks. In contrast, “Unstabilised rammed earth, cob or wattle-and-daub” and “Unmortared, pressed, stabilised-soil blocks” are the most environmentally friendly materials. Yet, as mentioned above, it should be noted that although the embodied energy of wattle and daub is negligible, it is not as sustainable as adobe or rammed earth because of the application of local wood in its construction which contributes to deforestation.

Table 5: Embodied energy of common walling methods.

Source:⁷⁰

Walling Methods/Materials	Embodied Energy (MJ) for 1m ³ of walling
Unstabilised rammed earth, cob or wattle-and-daub	Negligible
Crudely mortared ‘country’ bricks, 25mm plastered & 25mm external render	3800
Well-mortared kiln-fired bricks, 20mm plastered with no external render	2500
Hollow cement blocks (sand:cement = 4:1), 10mm mortared & 25mm plastered	1300
Unmortared, pressed, stabilised-soil blocks (soil:cement =1:4) & 25mm plastered	700

Improving the manufacturing processes could considerably reduce the embodied energy of the abovementioned materials. Following are the potential areas which can be considered to improve the quality and embodied energy of mud/burned bricks:⁷¹

1. Improving moulding systems
2. Improving mixing system
3. Developing small-scale kiln for brick firing

Although mechanisation in many cases improves the production processes, it should be noted that mechanisation in Uganda may not be economical due to the low production scales. The availability of spare parts and maintenance services is another serious issue to be considered.⁷² For this and many other reasons traditional, locally available materials and methods of construction are more appropriate in Uganda. The efforts should therefore be towards improving the processes and quality of prevailing methods and materials.

6 Renewable energy

Effective and efficient use of renewable energies is one of the key opportunities which can address many of the current issues in Uganda. In 2007, the Ministry for Energy, Minerals and Development (MEMD) announced its ambitious objective to increase the share of renewable energy from 4% to

⁷⁰ Reducing the energy use and the carbon footprint of tropical housing

By Terry Thomas & Heather Cruickshank

5th International Conference on Sustainable Energy and Environment (SEE 2014):

Science, Technology and Innovation for ASEAN Green Growth

19-21 November 2014, Bangkok, Thailand

⁷¹ Construction Reference Manual, A source book For the Use of Local materials In Construction, by Donald Batchelder et. al., Published by: The Experiment in International Living, Kipling Road, Brattleboro, Vermont 05301, USA, Copyright @ 1985, DONALD BATCBELDER, ROBERT E. CAIOLA, STANTON W. DAVENPORT

⁷² Construction Reference Manual, A source book For the Use of Local materials In Construction, by Donald Batchelder et. al., Published by: The Experiment in International Living, Kipling Road, Brattleboro, Vermont 05301, USA, Copyright @ 1985, DONALD BATCBELDER, ROBERT E. CAIOLA, STANTON W. DAVENPORT

61% by 2017. It is not clear as to how much this objective has been achieved. Following are the potential sources of renewable energy in Uganda.⁷³

- Solar energy: With an average solar insolation of 5-6 kWh/m²/day and 8 hours of sunshine per day, solar energy is a clean and reliable source of energy particularly for off-grid rural areas. 200 MW of solar electricity capacity is potentially available in Uganda.
- Wind: Although not as viable as solar energy, wind is also a potential source of clean energy for rural areas. Wind speed of more than 6m/s is experienced in areas such as lake shores and hills which is enough to operate wind turbines.
- Biomass and geothermal energy are other potential sources of green energy. Geothermal can potentially provide 450 MW of energy.
- Hydropower: Currently only less than 10% of the potential hydropower energy is exploited. Hydropower can potentially provide 3000 MW of energy in Uganda.

Despite such massive potentials, in 2011, less than 15% of Ugandan households had access to electricity. This figure was only 5.3% for rural areas.⁷⁴ Increased access to renewable energies would not only have environmental benefits, such as reduced deforestation and excessive CO₂ emissions caused by wood related fuels, but also improves the indoor air quality and health and wellbeing of Ugandan families by reducing their exposure to harmful fumes and smoke from firewood.

7 Conclusions

This paper aimed to study the current Ugandan housing conditions in order to highlight the limitations, barriers and opportunities for providing sustainable low-income housing in Uganda. Housing affordability; slums and informal settlements; unacceptable living conditions and standards in terms of overcrowding and access to basic amenities; and low quality, environmentally harmful construction methods and materials were identified as the major issues which should be addressed in Uganda. The following short, mid and long-term actions are recommended in order to improve the current housing conditions in Uganda:

- A) Immediate and short-term actions:
 - a. Improve the conditions of existing slums and informal settlements by providing basic facilities and infrastructure to improve the health and wellbeing of the settlers.
 - b. Address overcrowding issue to improve the living standards and reduce the risk of contracting infectious and transmissible diseases.
 - c. Improve production and manufacturing methods of construction materials to reduce the embodied energy.
- B) Mid-term actions:
 - a. Manage and provide urban lands to control slum growth.
 - b. Provide long-term and affordable mortgages to make houses more affordable providing.
 - c. Develop building regulations and standards to control and improve the quality of housing.
 - d. Encourage the use of environmental friendly, locally available materials.
 - e. Improve the prevailing methods of construction.
 - f. Educate/train local builders and artisans.
- C) Long-term actions:

⁷³ Connect, UGANDA report, Co-creation of network modes for market entry in developing countries – Finnish renewable energy SME's, <http://www.laurea.fi/en/connect/results/Documents/Uganda%20Country%20Report.pdf> 12/01/2015

⁷⁴ UBOS 2012, Uganda Demographic and Health Survey 2011, Uganda Bureau of Statistics, Kampala, Uganda.

- a. Develop new construction methods and consider construction technology transfer adapted to Ugandan conditions.
- b. Increase access to alternative sources of energy such as electricity particularly in rural areas.
- c. Take more advantage of renewable energy sources such as solar and wind energy in rural areas.

It should be noted that reducing embodied energy is currently the key factor in reducing the CO₂ emissions and environmental impacts of Ugandan housing industry. Yet, improving living standards may transform the running/in-use energy from negligible to a major issue in the near future. This should be considered by all stakeholders including designers and policymakers to achieve a truly sustainable low-income housing in Uganda.

Acknowledgements

The work is funded through an EPSRC research programme, [Energy and Low Income Tropical Housing](#), Grant number: EP/L002604/1.

References