

CRITERIA FRAMEWORK FOR THE CONCEPTION OF AN ADAPTIVE HOUSING MODEL FOR SUB-SAHARAN REGION

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INTRODUCTION

The present paper refers to a low cost adaptive housing model for Sub-Saharan African region in order to contribute for the solution for the housing deficit and precarious conditions.

According to the United Nations reports about the housing and living conditions, in the next four decades it is expected that the populations from Sub-Saharan African region will have a rapid growth due its fast economic development, which is directly related to slum expansion and growth¹. This situation, combined with political contexts, namely civil conflicts, leads to massive migrations from rural to urban areas. Sub-Saharan African region shows the most severe and urgent case with 62% of the population living in slums in urban areas², where the accelerated development and consequent densification compromises an efficient solution by public entities. The rural areas also show precarious conditions due its remoteness resulted from lack of infrastructures and a mobility network. Mostly distant from urban centres and sparsely populated, most of the public investments aim urban areas, worsening living conditions, hampering development and increasing migrations to urban areas³. These informal settlements, are characterized by precarious housing, namely in which refers to the absence of infrastructure (potable water, electricity and sewage), lack of structural safety, healthiness and thermal comfort, where most of times, lives more than one family, resulting in overloaded spaces⁴. Overloaded spaces and precarious housing is a mostly prevalent situation in urban areas while the infrastructure network shows much lower coverage within rural areas⁵

The solutions currently applied by public entities are based on imported models, namely Asian and western, which are showing inadequacy to African social and economic reality as well as environmental and territorial inefficiency. This situation has two aspects: on the one hand, the densification models with multi-family housing does not suit population needs in terms of social aspects as the household dimension and dynamic and cultural habits, much related to environmental conditions. On the other hand, the single-family models, usually associated to rural areas, do not consider the local economic activities, which hampers the development and subsistence activities of local population⁶.

In terms of social aspects, the main issues are linked to household dimension and dynamic, where the imported models presents a restriction to these cultural characteristics that leads to overloaded housing space. The social habits related to outdoor living are another issue in multi-family imported models, namely the inexistency of common outdoor areas able to hold the existing social relations of slums. This is an important aspect related to social inclusion and cohesion that housing is able to propitiate.

The economic inefficiency of imported models is mostly related to existing subsistence activities, mainly those associated to infor⁷. Most single-family housing imported models do not accommodate

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the adaptability to these aspects, keeping a layout related to developed countries mostly marked by services economic activities.

Environmental and territorial inadequacy is directly related to social and economic aspects mentioned above. Some of these models do not consider local climate, which in Sub-Saharan African region is marked by housing overheating, and thus unhealthy indoor environment, which leads to the usage of mechanic solutions to cooling and ventilation. This has several impacts in household budget but also in environment due energy consumption, mainly fossil fuel based. The main problems of thermal comfort are related to building materials but also the housing layout.

The absence of criteria for material selection has direct impacts in thermal comfort but also in housing affordability. Imported materials non-adaptable to local conditions are one of the main reasons for housing price increase, namely due transportation costs and building process, restricted to technical and specialized labour. Thus, housing becomes unaffordable to the poorer, keeping the housing deficit to be unsolved and propitiating slums growth and expansion.

METHODOLOGY

The research refers to the formulation of an adaptive housing model for Sub-Saharan African region, namely Angola.

The model aims the creation of an integrated solution that considers social, economic, environmental and territorial criteria that will allow the identification of parameters for an adaptive housing model able to provide an adequate solution to local context.

Social criteria are usually related to household characteristics, namely its dimension but also cultural habits, lifestyles and economic activities. These aspects are directly linked to housing layout, dimension and, specifically in developing countries, the housing is inherent to economic informal activities, which, in many cases, have place in domestic space⁸. In turn, these economic activities are associated to household income and thus to housing characteristics in informal settlements⁹.

The adaptability to territory is associated to geographical and climate conditions and its impact on housing i.e. should consider geographical aspects as risks to adapt¹⁰ or as a potential opportunity¹¹. In turn, environmental adaptability is related to territory, namely the available resources and its potential in low-cost housing solutions. The selection and adequate application of local materials show adequacy to territorial conditions, namely the climate characteristics, which have direct implications in environmental solutions trough the adoption of passive solutions for cooling and heating, providing thermal comfort. Local materials application has also economic consequences due the associated costs to transportation but also by developing local economy, helping local communities to improve their quality of life.

The present paper refers to the definition of criteria framework for an adaptive housing model, constituted by parameters and the resulting/expected outputs, which, in further research will be applied in Angola.

Due the connection between several Sub-Saharan African countries with Portugal, the methodology considered a case study approach that studied the evolution of social housing in Portugal through social, economic, environmental and territorial criteria for housing solutions, and its repercussions in Sub-Saharan African Region former colonies.

The methodology considered the analysis of housing criteria of three political and historical periods for social housing in Portugal. Thus, it was possible to identify, through case studies of each period, the criteria for housing formulation in terms of social, economic, environmental and territorial aspects.

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This analysis was then crossed with the main strategic premises for housing in developing countries, mainly defined by World Bank and UN-HABITAT, but also with public housing programs from several Sub-Saharan countries to create a first approach to focus area.

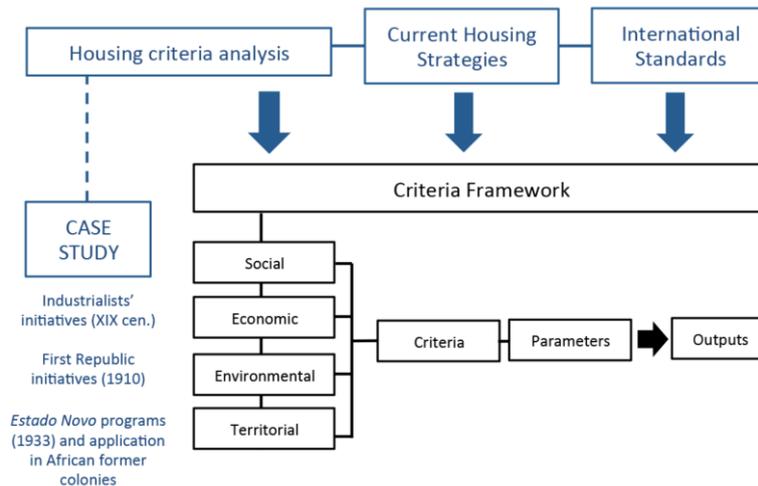


Figure 1. Methodology for Criteria Framework for low-cost housing.

DEVELOPING A FRAMEWORK CRITERIA FOR HOUSING

Case-study: Criteria Analysis of Social Housing in Portugal

Low-cost housing initiatives in Portugal resulted from the Industrial Revolution and consequently rapid growth of main cities¹². The government and municipalities were enabling to respond to massive migrations of the new working class to industrial poles, which have created housing deficit and precarious conditions.

The first housing initiatives came from industrialists in order to perform housing for their working class, whose housing conception considered only the shelter function near job site and affordability. In order to reduce the investment but also maintain the housing supply affordable for workers, these housing types were integrated inside existing plots and perform small dwellers units with 16m² with no access to the main road and, consequently, no infrastructures nor health conditions¹³.

Due public health problems, that started to spread all over the city, public health and housing regulations were introduced together in Portuguese legal framework in the beginning of the XX century¹⁴. These documents defined regulation for all new buildings, namely health aspects, infrastructures and licensing, showing, not only economic principles but also concerns about public health and quality of urban and indoor environment.

The First Republic government in 1910 develops the commonly called social housing. Decree n°4137 of 24th April of 1918 and Decree n°16055 of 22nd October of 1928 defined the principles for what was designated as social housing: (1) houses should had service areas connected to the public infrastructure network (2) number of rooms according to household dimension; (3) single-family housing models with backyard with an intention to adequate the housing layout to a mainly rural population; (4) multi-family housing models, more affordable; (5) specific materials and construction techniques to apply provide thermal comfort, durability and safety against a potential earthquake.

The principles mentioned above had formal application during *Estado Novo*, between 1933 and 1974, although with an update and adaption to African former colonies¹⁵.

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One of the main examples that perform these principles is Alvalade Neighborhood in Lisbon, built under Economic Income Housing Program in 1945¹⁶. This project is an effective example of social, economic, environmental and territorial adequacy, where many options considered had long-term positive impacts.

Housing layout optimization was based in European tendencies with the prefabrication process and optimal minimum areas according to Portuguese household dimension, performing solutions between 1 to 5-bedroom¹⁷.

Prefabrication was one of the major actions in Alvalade housing models through the application principles with economic consequences: (1) use of new materials and techniques according to costs and quality; (2) prefabricated and standard elements that would reduce construction costs and housing value in order to improve its affordability¹⁸.

Alvalade also showed an important role for environment, even if some options were unintentional. In multi-family models, it was adopted a four-storey building in order to dispense a lift, according to legislation at the time. Thus, it would reduce construction and maintenance costs but also energy consumption, showing long-term impacts. The implementation of passive solutions would have important repercussions in reducing energy consumption and associated costs. These solutions were complemented with urban strategies, namely the implementation of deciduous trees to protect against solar radiation during summer and allow solar heating during winter.

The principles applied in Alvalade were then transposed to African former colonies through an adaption process.

Aware of the different context of African former colonies, Portuguese architects applied several principles of local traditional housing to imported model, resulting in so-called *architectural regionalisms*¹⁹. This adaption process crossed social, economical, environmental and territorial criteria at the same time and with the same importance.

In former colonies, the House acquired a symbolism related to colonists and natives. The combination between Portuguese housing model and local traditional housing thus presented two paths: (1) to colonists it was expected that the introduction of local architectural elements would help in integration process; (2) for native population, the introduction of new building technologies and new housing layouts would represent a *modern way of living*²⁰.

Both multi-family and single-family models were adopted. However, this last was the preferred one due local lifestyle, directly connected to climate characteristics but also cultural aspects of African settlements²¹.

The housing adaption process was achieved through the application of the minimum areas, space optimization and prefabrication elements presented in Alvalade models but introducing new components as: (1) housing built on stakes and constituted by a porch or balconies in order to provide cooling and cross ventilation due the specific climate conditions in these African countries (**Figure 2**); (2) new layout disposition, namely using a courtyard as housing *familiar core*, respecting cultural habits of local population and their relation between indoor/outdoor; (3) Application of local materials with better performance to territorial and environmental conditions, namely local wood or thatch for roofs; (4) incorporation of elements/layout to prevent endemic diseases as nets or cross ventilation.

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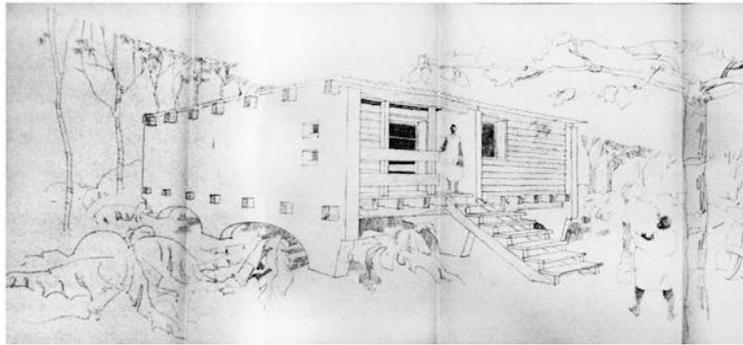


Figure 2. Economic Housing for São Tomé and Príncipe in 1964²².

The use of local materials was able to reduce housing costs, namely due transportation, and also observe better performance to climate conditions, presenting economic and environmental formulation criteria. Socially, the housing appropriation process would be facilitated through combination between housing to local culture and imagery, having consequences in terms of social inclusion and collective identity.

Criteria Framework for Low Cost Adaptive Housing Model

In order to formulate a criteria framework for low-cost housing for Sub-Saharan African region, the criteria identified through Portuguese low-cost housing case studies was crossed with the main premises for housing, defined by social housing strategies of several countries from this region but also from UN-HABITAT and World Bank experiences in developing countries²³.

One of the main premises that have been applied in developing countries, in order to solve the housing deficit and simultaneously develop local communities and improve social inclusion is self-construction process. This method, already institutionalized in several countries²⁴, is no more than the exploitation of informal settlements population capacity to build their own houses under technical guidance in order to ensure quality and optimal solutions.

Another strategy related to assisted self-construction is evolutive and incremental housing, integrated in site-and-service schemes²⁵. The major difference between the initial solutions of incremental housing and the current approach is the new role of technical team in the whole process (Greene and Rojas 2008).

Thus, assisted self-construction and incremental housing were added to the framework considering as parameters the household and/or community skills and capacity in terms of self-construction.

However, observing the development schemes as well as demographic dynamic, evolutive models should not only consider expansion but also retraction. Through household development related to education and employment, the household has shown a tendency to retract that will consequently change needs and ambitions related to housing.

Beside parameters associated to local characteristics as cultural habits related to housing or required minimum standards of each country, it is intended that should be used international standards in order to support the model effectiveness. This situation refers to international criteria for overcrowded housing²⁶ and the use of International Standard Industrial Classification Codes in economic activities survey.

Public participation should be also considered as global criteria to all fields in order to achieve the effectiveness of an adaptive housing model²⁷.

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Table 1. Social criteria, parameters and outputs for housing adaptability.

Criteria	Parameter	Output
Diversity of housing typologies	Household dimension and dynamic; International criteria for overcrowded housing	Affordability to various social levels; Adequacy to household needs
Housing flexibility (evolution, retraction and transformation of internal housing space)	Household dimension and dynamic; International criteria for overcrowded housing	Adequacy to household needs
Optimization of housing layout	Household cultural aspects and habits; Household economic activities	Adequacy to household lifestyle and cultural characteristics; Improving individual and collective development
Assisted self-construction process	Household/community skills and capacity	Facilitates the appropriation process; social inclusion; collective identity; Skills improvement; Individual and collective development
Application of local materials	Inventory of local materials considering its cost and quality	Facilitates the appropriation process; social inclusion; collective identity
Architectural elements to prevent endemic diseases	Identification of local endemic diseases	Quality of life; Public health; Reduced mortality rate

Table 2. Economic criteria, parameters and outputs for housing adaptability.

Criteria	Parameter	Output
Optimization of multi-family housing	Maximum height/floors, according to legal mandatory issues, in order to dispense a lift	Less maintenance costs; Less costs associated to energy consumption
Adoption of required minimum areas	Required minimum areas for dwellings, according to legal mandatory issues	Optimization of housing layout; Less construction costs; Affordability
Optimization of housing layout	Passive solutions for cooling, ventilation and natural light	Less energy consumption costs
Housing flexibility (evolution, retraction and transformation of internal housing space)	Household dimension and dynamic	Affordability (incremental process according to population needs and financial capacity)
Optimization of housing areas (rooms vs. circulation areas)	Required minimum areas for dwellings, according to legal mandatory issues; Household cultural aspects; Household economic activities	Optimization of housing layout; Less construction costs; Affordability
Centralization of service areas and infrastructures (kitchen and sanitary installation)	Infrastructure housing core	Optimization of infrastructure network; Less construction and maintenance costs

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Standardization	Prefabricated materials and elements	Construction process optimization; Quality control (durability); Less construction and maintenance costs; Affordability
Application of local materials	Inventory of local materials considering cost, quality and performance	Less construction costs (transportation and labor)
Architectural elements to prevent endemic diseases	Identification of local endemic diseases	Reduced health costs
Assisted self-construction	Household/community skills and capacity	No costs related to specialized labor

Table 3. Environmental criteria, parameters and outputs for housing adaptability.

Criteria	Parameter	Output
Optimization of multi-family housing	Maximum height/floors, according to legal mandatory issues, in order to dispense a lift	Less energy consumption
Optimization of housing layout	Passive solutions for cooling, ventilation and natural light	Less energy consumption; Thermal comfort
Standardization	Prefabricated materials and elements	Resource management; Less waste; Optimization of energy consumption
Application of local materials	Inventory of local materials considering cost, quality and performance	Less energy consumption; Thermal comfort
Centralization of service areas and infrastructures (kitchen and sanitary installation)	Infrastructure housing core	Resource management (less material to infrastructure network)
Adoption of indigenous vegetation species in single-family housing backyards	Inventory of indigenous trees	Reduced thermal range – thermal comfort and less energy consumption (as a complement of passive solutions)

Table 4. Territorial criteria, parameters and outputs for housing adaptability.

Criteria	Parameter	Output
Optimization of housing layout	Adequate layout to territorial conditions (floods, sea level rising, among others)	Better performance to biophysical conditions – durability, less maintenance and household safety
Application of local materials	Inventory of local materials considering cost, quality and performance	Better performance to climate conditions
Adoption of indigenous vegetation species in single-family housing backyards	Inventory of indigenous vegetation species	Benefits to local ecosystem

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CONCLUSIONS

Low cost housing is usually related and assessed only in terms of economic viability. Household income and housing expenditure relation, which corresponds to a quantitative measurement easier to implement, support housing affordability, ignoring social and environmental aspects directly related.

In terms of adaptability criteria, the Portuguese cases-study showed that economic factor was determinant but not exclusive in order to solve the housing deficit and to responds to housing demand, indeed, the environmental and territorial aspects were equally important in adaption process on former African colonies.

The historical and cultural relation between Portugal and some countries of Sub-Saharan African region, namely Angola where the model is intended to be applied in further research, was able to provide a first approach to housing adequacy to those territories. In order to conciliate these criteria to current strategies and initiatives for low-cost housing were considered international standards but also the main premises for housing in order to formalize an effective solution.

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ENDNOTES

¹ United Nations, “Millenium Development Goals 2014” (New York: United Nations, 2014).

² Ibid.

³ Karen Lucas, “Making the Connections between Transport Disadvantage and the Social Exclusion of Low Income Populations in the Tshwane Region of South Africa,” *Journal of Transport Geography*, Special section on Alternative Travel futures, 19, no. 6 (November 2011): 1320–34, doi:10.1016/j.jtrangeo.2011.02.007.

⁴ Adesoji David Jiboye, “Urbanization Challenges and Housing Delivery in Nigeria: The Need for an Effective Policy Framework for Sustainable Development,” *International Review of Social Sciendes and Humanities* 2, no. 1 (2011): 176–85.

⁵ United Nations, “Millenium Development Goals 2014.”

⁶ Duane Kissick et al., “Housing for All: Essential to Economic, Social, and Civic Development” (Vancouver: PADCO, 2006), <http://www.hrc.co.nz/>.

⁷ Edmundo Werna, “Shelter, Employment and the Informal City in the Context of the Present Economic Scene: Implications for Participatory Government,” *Habitat International* 25, no. 2 (2001): 209–27, doi:10.1016/S0197-3975(00)00018-7.

⁸ Ibid.

⁹ UN-HABITAT, *The State of African Cities 2013: Re-Imagining Sustainable Urban Transitions* (Nairobi: United Nations Human Settlements Programme (UN-HABITAT), 2014).

¹⁰ Marie Aquilino, ed., *Beyond Shelter: Architecture for Crisis* (London: Thames & Hudson, 2011).

¹¹ José António Bandeirinha, *O Processo SAAL E a Arquitectura No 25 de Abril de 1974* (Coimbra: Imprensa da Universidade, 2007).

¹² Christine Whitehead and Kathleen Scanlon, *Social Housing in Europe* (London: LSE London - London School of Economics and Political Science, 2007).

¹³ Manuel C Teixeira, “As Estratégias de Habitação Em Portugal, 1880-1940,” *Análise Social* XXVII, no. 115 (1992): 65–89.

¹⁴ Uno Teutónio Pereira, “Pátios E Vilas de Lisboa, 1870-1930: A Promoção Privada Do Alojamento Operário,” *Análise Social* XXIX, no. 127 (1994): 509–24.

¹⁵ Maria Manuela Fonte, *Urbanismo E Arquitectura Em Angola* (Lisboa: Caleidoscópio, 2012); Maria Tavares, “Leituras Da Produção [moderna] Da Casa: As HE Nos Anos 50 E 60 Em Portugal,” *Resdomus - Plataforma Editorial de Cruzamento E de Divulgação de Cultura Arquitectónica*, 2010, 1–17.

¹⁶ João Pedro Costa, *Bairro de Alvalade: Um Paradigma No Urbanismo Português*, 3rd ed. (Lisboa: Livros Horizonte Lda., 2006).

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- ¹⁷ Marco Giorgio Bevilacqua, “Alexander Klein and the Existenzminimum: A ‘Scientific’ Approach to Design Techniques,” *Nexus Network Journal* 13, no. 2 (2011): 297–313.
- ¹⁸ Costa, *Bairro de Alvalade: Um Paradigma No Urbanismo Português*.
- ¹⁹ Ana Vaz Milheiro, *Nos Trópicos Sem Le Corbusier* (Lisboa: Relógio D’Água, 2012).
- ²⁰ Ana Vaz Milheiro, “Africanidade E Arquitectura Colonial: A Casa Projectada Pelo Gabinete de Urbanização Colonial (1944-1974),” *Cadernos de Estudos Africanos* 25 (2013): 121–39.
- ²¹ *Ibid.*
- ²² *Ibid.*
- ²³ “Preventive Resettlement of Populations at Risk of Disaster” (Washington: The World Bank, 2011); UN-HABITAT, “53 UN-HABITAT Model Projects - 2013/14” (Nairobi: United Nations Urban Settlements Programme - UN-HABITAT, 2013).
- ²⁴ Lejone John Ntema, “Self-Help Housing Policy in South Africa: Paradigms, Policy and Practice” (PhD Thesis, University of Free State, 2011).
- ²⁵ Neil Punnett and Alison Rae, *The New Wider World*, 2nd ed. (Cheltenham: Nelson Thornes Ltd, 2003).
- ²⁶ UN-HABITAT, “Urban Inequities Survey Manual (Adapted from Demographic and Health Survey and Multiple Indicators Cluster Survey)” (Nairobi: United Nations, 2006), <http://mirror.unhabitat.org/>.
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