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Sustainable Housing Rehabilitation for Inclusive Cities

NATALIE SHAM and CHRISTOPHE LALANDE

Abstract: Inclusive cities and social integration are a key component of sustainable housing; in that there is adequate housing for all, and providing equal opportunities for the urban poor. Sustainable housing policies also need to be future-oriented and directed towards prevention of informal settlements. In many cities around the world, policymakers are facing housing rehabilitation issues in diverse contexts, through the perspective of building inclusive cities and providing sustainable housing. This paper will explore three key global contexts for sustainable housing rehabilitation: cultural heritage, post-crisis, and social housing. These are analyzed according to the four pillars of housing sustainability: social, economic, cultural, and environmental. Housing rehabilitation policies and performance are evaluated across a number of regions, to measure factors of sustainable well-being against development indicators. Policy recommendations are generated from the findings of multivariate statistics through the principle components analysis, demonstrating the need for a sustainable housing rehabilitation strategy at the global level which would contribute to the Global Housing Strategy led by UN-Habitat.

Keywords: sustainability, housing, inclusive, rehabilitation, policy, global

1. State of housing in an urban world

The world's population is expected to grow from 52 per cent to 67 per cent from 2010 to 2050, where 94 per cent of the growth will be in developing regions. Given the projected urban population increase of 1.43 billion people, including the existing slum population, the number of people in need of critical housing is estimated to be 2.25 billion. Assuming the average household size to be five people, there are approximately 450 million housing units that must be built globally to accommodate the increase in population (UN-Habitat 2010). The housing situation is augmented even further from the growth of informal settlements as a result of inadequate urban housing policies (UN-Habitat 2013b).

Slums or informal settlements within cities have inadequate housing, poor living conditions, and lack basic services such as water and waste management. Slums develop from two primary causes: population growth, and governance. The pushing and pulling forces of urban migration, low-incomes from agricultural industries and limited job prospects, has accounted for 90 per cent of the urban growth in the developing world (Cities Alliance 2012). Secondly, slums develop from poor governance, failing to recognize the rights of the poor and

incorporating them into urban planning. It is clear that alternative policies, with a clear legal framework for land rights, are now needed to respond to the demand for inclusive, sustainable housing and to prevent the expansion of urban slum. Hence, a paradigm shift is required to approach these global housing challenges, from different contexts that consider different dimensions of the existing housing stock as an issue.

Preventive action should focus on capacity building and providing affordable land for housing, particularly for low-income residents (GLTN 2012). Rehabilitation of the existing housing stock provides one viable and sustainable alternative to tackling the conditions of the global housing problem with the increased forces of urbanization combined with scare resources and infrastructure in the city. Sustainability is an important aspect of housing rehabilitation, and should consider a holistic approach to housing sustainability, including social, economic, cultural, and environmental components of sustainability (UN-Habitat 2010).

Social integration for inclusive cities, adequate housing for all and equal opportunities for the urban poor, can be accomplished through housing rehabilitation and be used as a way of contending with decaying housing problems, which has the potential to become slums. Physical infrastructure should not prevail as the primary method, but rather policy development from a wider context, many of which are often missing social implications of rehabilitation. Three different contexts are examined in this paper: social housing, cultural heritage, and post-crisis, where all three face similar issues which can be addressed through sustainable housing rehabilitation. Although slum prevention can be clearly identified for the case of existing social housing in decline, and degeneration of inner city areas with the potential for cultural heritage rehabilitation, it often does not have a focus on the post-crisis context. Even within post-conflict and post-disaster contexts, the emergence of informal settlements can occur if it does not adequately respond to the demands of the urban poor, stressing increased costs on water and sanitation, safety, and healthcare (UN-Habitat, 2012a). The General Assembly of the United Nations has recently adopted RES/66/288 to promote sustainable policies to support ‘provision of increased resources for affordable housing and housing-related infrastructure, prioritizing slum prevention and upgrading’ (UN 2013).

The paper accomplishes three things: the first, to establish a global approach for sustainable and inclusive housing rehabilitation, from a comparative analysis of the three entry points as catalysts for addressing future and present housing demand, through urban planning as a preventive measure to the formation of new informal settlements. The second part of the paper creates a sustainable housing rehabilitation index through multivariate statistics to identify the issues presented in the first section (on social housing, cultural heritage, and housing in the post-crisis context), measures progress of countries from five world regions, and quantitatively validates the global approach of sustainable housing rehabilitation. The last section discusses the need for a global housing strategy, and how the approach to sustainable housing rehabilitation integrated with urban planning fits within the context of the Global Housing Strategy (GHS), as one of the prime approaches to slum prevention.

2. Focus, aims, objectives

This paper was developed in association with the UN-Habitat Global Housing Strategy (GHS), initiated by the Housing and Slum Upgrading Branch within UN-Habitat. The

Strategy aims to achieve the goal of adequate housing for all, by improving housing and conditions of slum dwellers, assisting Habitat member States towards the right to adequate housing focusing on both slum upgrading and prevention (UN Habitat 2013a). This paper will focus exclusively on preventative measures through sustainable housing policies and strategies. The guiding principle for the Strategy is that inclusive cities are a fundamental element in sustainable urban development, achieved through mainstreaming human rights, augmenting social integration, and eliminating the urban divide (UN-Habitat 2013a). The Member States at the 24th Governing Council have also backed the GHS in the Resolution 'Inclusive National and Local Housing Strategies to achieve the Global Housing Strategy Paradigm Shift' (El-Sioufi 2013).

There is currently no existing literature defining housing rehabilitation for sustainability from a global perspective. In this paper, three primary contexts and entry points for sustainability are developed as the key subjects of rehabilitation: social housing, cultural heritage, and post-crisis housing. In the proposed policy framework described in this paper, these three conditions are analyzed on a broader perspective of rehabilitation of formal settlements, and incorporate the four pillars of sustainability: social, economic, cultural and environment. The conceptualization of rehabilitation is reframed through these three contexts with the cross-cutting concept of sustainable development and inclusive cities. It is operationalized through a comparative analysis of the three conditions, and an index using the principle components analysis (PCA).

2.1 Rehabilitation/renewal/regeneration

In most developed nations, particularly in the West, rehabilitation describes the process of addressing decline in communities, specifically post-industrial decline (Cumberlidge and Musgrave 2007). Rehabilitation, in this paper, is synonymous with *renewal* and *regeneration*. It will be used as a means to integrate housing with other urban uses, encourage inclusive performance of markets, and enable wider access to adequate housing solutions.

The main principles that guide rehabilitation are that the process of renewal is continuous, opposed to ad hoc interventions that do not maintain long-term sustainability. Secondly, that rehabilitation achieves maximum effect of resources with minimal means. Many cities, especially in developing countries, struggle to cope with the increasing demand for affordable housing, infrastructure and services with increasing urbanization (UN-Habitat 2012). This is a primary reason why urban growth in Latin America, Asia, and Africa contain a proliferation of informal settlements, due to poor and inadequate formal building regulations. Third, that rehabilitation must involve interdisciplinary stakeholders, even considering disciplines that may be outside the normal sphere of practice. For example, in Trekroner, Denmark, artists such as Kerstin Bergendal act as catalysts for housing renewal and in improving the social fabric of communities (Cumberlidge and Musgrave 2007). Fourth, the rehabilitation process focuses on citizen involvement to support long-term sustainable development.

2.2 The four pillars of sustainability

Sustainable housing is central to sustainable development and sustainable cities. It determines quality of life, welfare of people, and has a relationship between society and the environment. Policies for sustainable housing need to consider all the underlying conditions to achieve sustainability in existing or new housing development, and take a multi-faceted approach

(UN-Habitat 2012). The four dimensions of sustainability are social, cultural, environmental, and economic.

Environmental sustainability of housing is concerned with the impacts of housing on environment and climate change. Cultural sustainability deals with the cultural worldviews, values, norms, behaviours, traditions, and lifestyles of individuals and communities to support the dignity of community life. Economic sustainability is based on housing and related infrastructure as the most valuable man-made capital assets, which provides the basis for human welfare, labor productivity and mobility. Social sustainability creates affordable, inclusive, diverse, healthy and secure neighborhoods and communities to be integrated into wider urban and national systems (UN-Habitat 2012).

In many countries, especially developing countries, only one aspect of sustainability is considered, which further strains the accumulation of vulnerability and uncertain housing conditions for certain groups in the population (UN-Habitat 2012). Including sustainable urban planning is also a key component to guide urban growth, achieving both sustainable housing and neighborhoods for existing and new urban residents (UN-Habitat 2013b).

2.3 Inclusive cities

Inclusive cities promote growth with social equity from a human-rights perspective, with participation of all in social, economic, and political opportunities. Inclusive urban development is socially just, beneficial for sustainable growth, reduces inequality in cities, incorporates local knowledge and productivity, utilizes social and physical capital, and increases local ownership of targeted programs for the poor and disadvantaged (UN-Habitat 2013a).

Slum prevention strategies are important in achieving equitable and sustainable housing options, which may be achieved through rehabilitation and renewal. Prevention is a key priority area in the GHS for bridging the urban divide, and for sustainable housing policy development (UN-Habitat 2013a).

3. Current state of affairs and major challenges

There is an overall underutilization of the housing stock within cities, particularly in older housing areas, which are reaching a state of decline and deterioration. All cities contain older, existing housing, and they represent a large percentage of housing units, seen in developing cities such as Shanghai and Bombay. In other colonial cities, such as Jakarta and Cartagena, housing units represent a smaller, elite percentage (Steinberg 1996).

However, a quantitative approach to policies in housing does not always match supply with demand. Hence, a results-based policy is required, to achieve housing households that need housing (UN-Habitat 2013a). In this paper, housing household's data are not used due to their limited availability for selected countries surveyed. Housing units will be used to represent the current state of existing housing stock that does not have basic services, and for any type of informal housing.

Table 1: Percentage of critical formal and informal housing units to be rehabilitated for selected countries

Country	**Critical No. of housing units to be rehabilitated (%)**
Romania	67.32
Poland	49.83
Peru	48.94
Hungary	48.29
Zimbabwe	47.41
Azerbaijan	43.86
Nicaragua	38.76
Bulgaria	34.56
Latvia	34.05
Mexico	30.60
Algeria	29.86
Morocco	28.11
Lesotho	27.89
Portugal	27.66
Colombia	27.03
Slovakia	21.94
India	21.69
Austria	13.13
Chile	12.03
Czech Republic	10.76
Palestinian Territory	10.40
Slovenia	6.73
Croatia	6.30
Belgium	6.27
Armenia	5.54
Greece	2.86
Philippines	1.81
Uruguay	1.05

In the post-crisis context, a different situation is presented where housing is a fundamental to the basic needs of life. In many post-conflict countries, 20 to 25 million people have been displaced due to violence and abuse of human rights, 20 million refugees in need of protection, where 90 per cent of the victims in wars are women and children. In post-disaster countries in the last decade, approximately 200 million people were affected by natural disasters, even higher than those suffering from post-conflict affects (UN-Habitat 2004).

A comparative analysis will be used to emphasize the three entry points as catalysts for addressing future and present housing demand, through urban planning as a preventive measure to slums. It will also create comparative understandings of three contexts that stress the principle of inclusive cities rather than singularly focusing on physical infrastructure as the primary solution for rehabilitation. It will also help derive appropriate indicators to study for the sustainable housing rehabilitation index. Although the method of comparative analysis has its weaknesses, requiring the commensurability of concepts across all cases (Janssen-Jansen *et al.* 2008), it may be used as all terms are based on predefined concepts.

3.1 Social housing

3.1.1 Sustainability gap

Rehabilitation of existing housing is usually viewed from the entry point of environmental sustainability, to increase energy efficiencies in buildings (Pedro 2012). However, it should also have a social component, for social housing and to ensure affordable homes for all, including disadvantaged groups (UN-Habitat 2012). On the national scale, this would include fulfilling the right to adequate housing and promoting choice and security of tenure. On the city-level, it is important to integrate communities and regenerate neglected and inadequate housing and areas into the wider community through sustainable urban planning.

3.1.2 Demolition versus Rehabilitation

There is a shift in policy from eviction and demolition, towards resettlement and rehabilitation. Increasingly, there is a need to rehabilitate the existing housing stock within cities, particularly social, subsidized, public housing. Particularly, public housing built from 1950s to 1970s in developing countries have now transformed into slums. There are some examples of successful rehabilitation of degenerated inner city areas, such as the Al-Dar Al-Ahmar Housing Rehabilitation Program, to improve deteriorated tenement buildings; however, gentrification continues to pose a major challenge to these areas (UN-Habitat 2008a).

In many developing countries, as the housing infrastructure of the city reaches its fifth decade of use, there is a major decline in the quality of housing, many becoming wasteful and ecologically irresponsible. There is a need to upgrade existing structures, reduce the greenhouse gas emissions of these buildings, decrease energy costs, in conjunction with preventing the displacement of populations from existing social housing and improve living conditions (ERA Architects 2008).

3.1.3 Social housing towers

Towers account for a third of the total housing stock in developing countries. Many have become areas of social and economic disparity, contributing to greenhouse gases, and are energy inefficient. The deterioration of the building envelope has negative environmental impacts on the region. As they were built in an era of cheap energy, aging mechanical systems, exposed slab edges, single-glazed windows, and minimal insulation have resulted in high costs of energy building inefficiencies (ERA Architects 2008).

Density, a tool used in planning to develop compact cities, is commonly used to aid sustainability. Nonetheless, the stock of slab apartments demands more energy per meters square than other housing types, and up to 20 per cent more than contemporary single detached houses (ERA Architects 2008). In Europe, apartment towers take a large share of the housing market, and post-Soviet Union countries make up the majority. Addressing tower blocks has been key to the many housing policies in most European countries.

3.2 Cultural heritage

3.2.1 Conservation versus rehabilitation

The existing housing stock constitutes a historical link to the past, acts as a manifestation of cultural and social traditions, and one that could enhance the modern city in many ways. Conservation of the historic fabric of the city and its infrastructure has gained increasing

relevance in the 21st century (Steinberg 1996). As the idea of urban rehabilitation emerged, there was an increased awareness that social communities were being destroyed in the face of demolition as an approach to urban renewal. Moreover, it was apparent that conservation could have multiple values other than socio-cultural advantages. Rehabilitation could range from the creative use and reuse of older areas, to the upgrading of infrastructural services. This particular definition of rehabilitation gained support in developed countries with UNESCO's World Heritage Sites Programme, although in developing countries, the concept gained less traction as older housing areas were seen as blight on the urban landscape (UNESCO 2008). A common trend in rehabilitation, especially neighborhood revitalizations in city centers, is that urban renewal often leads to gentrification. As a result, this has led to a greater gap between the higher and lower income classes, where 'seas of decay' surround islands of renewal (Carmon 1999, p. 149).

3.2.2 Cultural diversity

Cultural diversity is a key dimension of sustainable development. Development has in many instances damaged the social fabric and foundations of communities and a culturally sensitive approach must be taken to deal with development issues, particularly those dealing with housing rehabilitation, which affects the areas of existing residents and communities. Defined by UNESCO, cultural diversity is a dynamic set of interactions between cultures, and sensitivity to cultural contexts. This is a key principle of implementing sustainable, holistic development strategies (UNESCO 2009).

The value of cultural diversity also varies from country to country. In Norway, cultural diversity is an incentive for development, whereas in Cameroon, diversity is a roadblock towards the development of cities. An increasing trend in improving cultural diversity, is adapting cultural heritage towards tourism means, whereby restoration and rehabilitation improve quality of life and create alternate means of employment, as depicted in Valparaiso, Chile's chief seaport and resort (UN-Habitat 2012b). The implications of this trend is seen in the city of Tongji, China where tourism has eroded the cultural and historic fabric of the city, and further rehabilitation must be undertaken to restore the original cultural context of the city (Steinberg 1996). Alternatively, in Rio de Janeiro, rehabilitation has become leverage for a cultural corridor, to revitalize the city center with cultural and economic activities.

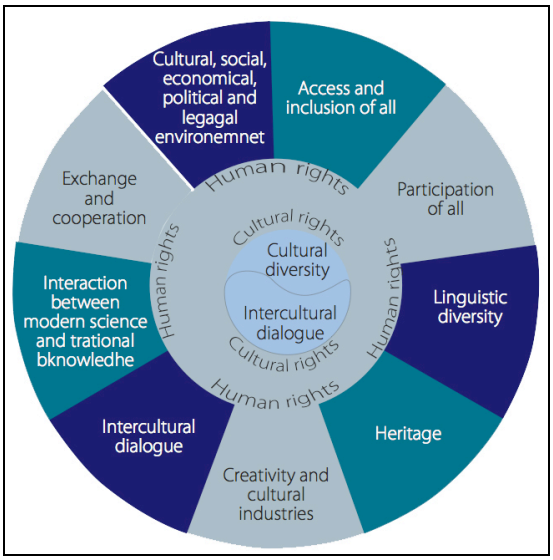

Figure 1: Relationship between cultural rights and human rights (UNESCO 2008)

3.2.3 Social issues

Low-income community groups usually comprise a majority of those living in historic housing areas. Many areas within the historic housing stock are overcrowded, and services are often over utilized and outdated. There are few examples of rehabilitation that have properly addressed a mixed group of residents, such as the cultural revitalization through participatory processes in Tel-Aviv from 2001–2004 (UN-Habitat 2008). Those dwelling within these areas must be incorporated in the participation of the rehabilitation process, and the right to the city retained despite the change of land uses throughout rehabilitation. More importantly, low-income residents must be protected from gentrification, exhibited strongly in Portland (UN-Habitat 2008).

3.3 Post-crisis

3.3.1 Mitigation and response

Unsupported urbanization will constrain sustainable development of cities, and increase the vulnerability to future conflicts and disasters. The approach is towards sustainable relief, where mitigation is a method to reduce the impacts and risks for disasters, and build a culture of prevention through civic empowerment. Response towards post-crisis should not be piecemeal responses, or projects that operate in isolation, but towards a shared realization of recovery processes for sustainable development (UN-Habitat 2004).

3.3.2 Social equity

Sustainable relief strategies also need to promote gender equality, and involve women in long-term relief-based approaches (UN-Habitat, 2004). Inclusion of women's contributions to post-disaster reconstruction and sustainable planning is a major concern that needs to be addressed, where one of the primary methods to overcome these marginal conditions is through empowerment (Thurairajah 2011).

Displacement of populations through disasters or conflicts also erodes social capital. Particularly, conflict not only destroys buildings, but targets organizations and individuals who govern communities, and eliminate positive forms of social capital (Rugumamu and Gbla 2003).

3.3.3 Policy frameworks

An approach to capacity for disaster mitigation and reconstruction is through developing policies, frameworks, and guidelines at a global scale (Amaratunga and Haigh 2011). In line with the GHS, different levels of governments must cooperate to ensure sustainable and inclusive development, by redefining their roles to establish community networks, disseminate knowledge, and mobilize adequate resources (UN-Habitat 2013a).

Common issues, especially in developing countries, are centralized systems, which are difficult to relate to communities on a local level. Also, there is a lack of coherence in policies and capacity gaps towards post-disaster rehabilitation, which has not incorporated the four pillars of sustainability in developing policies (Thurairajah 2011). Codes, practices, and standards will have to be re-evaluated for sustainable mitigation, with community adherence. Bridging the gaps in capacity and policies are important to achieving successful post-disaster rehabilitation for sustainable buildings and neighborhoods.

3.3.4 Post-conflict

Post-conflict reconstruction deals with the rehabilitation of the enabling conditions towards a functional society through peacebuilding efforts. Destruction of property is typical during conflicts, mainly physical structure such as housing, schools, roads, commercial and telecommunication enterprises. In Kosovo, 2003, a third of the existing housing stock was destroyed by conflicts (UN-Habitat 2009). In Sierra Leone, approximately three million homes were destroyed, leaving a million people displaced (Barakath 2003). In Bosnia and Herzegovina, Croatia, Serbia, and Montenegro, at least a million dwellings units were badly damaged, where little attention was paid towards housing maintenance, particularly for publicly owned housing. The combination of war and the demise of public housing have led to impoverishment, where 25 per cent to 30 per cent of the population does not have affordable housing. This is particularly important for systemic reforms to integrate housing with economy, employment, and poverty reduction, a key theme in the GHS.

3.3.5 Post-disaster

Post-disaster reconstruction usually focuses on the rehabilitation of physical infrastructure; however it requires a holistic perspective and should incorporate the principle of developing for inclusive cities (Amaratunga and Haigh 2011). Disasters emerge through a triggering agent, a hazard such as earthquakes, and vulnerabilities, which is the dependent variable of a disaster (Ginige 2011). Disaster risk reduction is significant in that the vulnerabilities are the controllable components; by reducing these components, the risk of disasters may also be minimized. McEntire (2001) outlines different categories of vulnerability from a natural or artificial disaster: physical, social, cultural political, economic, environmental, and technological vulnerability.

Sustainable housing rehabilitation has an important role in disaster risk reduction, aimed at reducing vulnerability, where low-income households are particularly vulnerable to disaster due to poor structural conditions. Inclusive rehabilitation should adopt planning tools to strengthen community recovery, and building more sustainable urban landscapes (UN-Habitat 2010).

4. Priority areas

There is a need to involve all actors in the housing process, and rehabilitation must be part of city-wide strategies, for a twin track approach to rehabilitate existing housing that have the potential to be transformed into future slums. Scaling up is also vital for policies and strategies to be formulated according to the local situation, and not based on imported ideologies (UN-Habitat 2006). Rehabilitation should focus not on the building alone, but on the surrounding areas and neighborhoods that strive toward a holistic approach in the social, environmental, cultural, and economic dimensions of sustainability. However, in the post-crisis context, buildings and surrounding areas are conjointly discussed due to the scale, nature, proliferation of disasters/conflicts, and scarce resources (Seneviratne and Amaratunga 2011).

4.1 Social housing

4.1.1 Rehabilitation of buildings

Multi-faceted building approaches to upgrade existing towers are required, for community

revitalization, a cleaner and greener city, and regeneration of underused green and open space near towers. Affordable units can also be improved, and have large potential for significant energy-savings (City of Toronto 2008).

Community building and the carbon cutting potential of aging towers can result in innovative projects in building and neighborhood renewal. Case studies include Bijlmermeer, Amsterdam, where aging towers have been transformed to produce urban agriculture, cultural facilities, markets, and provision of affordable housing. Other notable cases are Marzahn, Berlin, and Topli Stan in Moscow (ERA Architects 2008). Some strategies are in building renovation and housing upgrading. New housing and infill are also viable approaches in planning, as well as new housing ownership models for inclusive zoning. Over-cladding of high-rise buildings is a key strategy for carbon reduction especially in Europe. Other means to reduce GHG emissions are in green retrofits such as thermal over-cladding, clean energy installations, grey water recycling, smart metering, enclosed balconies, and geothermal heating (UN-Habitat 2010a).

Urban agriculture and enhanced green spaces are some strategies to rehabilitate neighborhoods around aging towers. In some European cities, such as London's Farm Garden United Kingdom Network, tower blocks have been integrated with council housing, and farms are generated from the surrounding green space of towers for a local school, community kitchens, and seasonal markets. In Eastern Europe, goods and services such as markets, kiosks, and retail podiums emerge from tower districts since the end of the Cold War. In Western Europe, housing types were introduced to publicly sponsored neighborhoods with community facilities and public spaces (UN-Habitat 2012b). In the London borough of Tower Hamlets, the 'Idea Store' emerged, which integrates needed services such as a language center, public library, and shops rented to local entrepreneurs. Apartment neighborhoods could become local green energy hubs, which could reduce the ecological footprint of buildings through renewal-energy installation, combat climate change, and create nodes of growth and investment.

Toronto – City of Towers

The construction of towers in Toronto began in 1950, which was fundamental to the growth of the city. The majority are concrete apartment buildings, built in the 1960s and 1980s. Overtime, the city became polarized, where the historic city and areas along the transport network experienced investment and wealth, and the area beyond becoming impoverished with poor access to services and amenities.

Today, the towers built in the era of growth and developed under the premise of vibrant communities and high-quality housing has become impoverished as these communities approach its 5th decade of use. Aging apartment neighborhoods are two of the greatest challenges facing Toronto: environmental sustainability and social inequity. Some include City Park Apartments, Regent Park South, and the planned communities of Thorncliffe and Flemington.

The City of Toronto, in partnership with ERA Architects, have produced a program for 'Tower Renewal', to improve Toronto's apartment towers combining green technology and community revitalization projects to make greener neighborhoods in the city. They will focus on green retrofits, green infrastructure, urban agriculture, external cladding, and community improvements (City of Toronto, 2012).

4.1.2 Rehabilitation of neighborhoods

Integrated rehabilitation of areas and neighborhoods into sustainable and vibrant neighborhoods are important to integrate housing in the urban fabric with other uses (UN-Habitat 2013b). These include opportunities within the city for new rapid transit, district energy, community facilities, infill housing, retail and amenities. In addition, improved publicly accessible open space, open space furniture, natural areas, community gardening, farmers markets, and vendors markets (Savvides 2010).

Sustainable Policy Delivery is an effective tool that may also be used for political commitment, multilateral collaboration, community participation, capacity building, and financial mobilization (UN-Habitat 2012).

4.2 Cultural heritage

4.2.1 Rehabilitation of buildings

An integrated approach to rehabilitation must be taken, as older housing areas in inner cities typically contain low-income families, with different physical, economic, social, and cultural values (Steinberg 1996).

There is a need to facilitate the expression of human cultural diversity, and for spaces to be rehabilitated that produce inclusion and connectivity for open dialogue among city dwellers. Creating spaces with a common identity, ethics, and guidelines can build inclusive societies with better opportunities for all, as culture is one of the factors of identity. In Columbia, a space is created according to a way of living, which is a form of cultural expression. In Venezuela, traditional markets are spaces for cultural expression, which produce a rich display of products and services, and acts as a meeting place between different backgrounds (Kearns 2004).

Some strategic principles to guide effective approaches for urban renewal and regeneration of buildings include preventing segregation of lower classes, as most severe problems in the city occur in economically segregated areas (Kearns 2004). In addition, relate economic development and social equity of buildings for regeneration through partnerships (private, public, not-for-profit), and sensitive preservation between infrastructure and social and physical systems.

Rehabilitation projects in cities should help positively reshape urban identity, and bring prosperity to the city. This may be done via renovating public spaces, rehabilitation of historic landmarks, architecturally significant buildings, piazzas, and monuments (UN-Habitat 2012b).

4.2.2 Rehabilitation of neighborhoods

There is a need to integrate the neighborhood for revitalization, to modernize local economic activities and infrastructure, and apply an integrated financial policy to pool private and private-sector funds. This should transcend the dominant commercial path of revitalization seen in Singapore, Cartagena, and related cities, where high-income users convert historic mansions to modern residences or offices, without taking into account the building's historical characteristics (Steinberg 1996). Tourism activities could also be charged a heritage tax, and contribute to the sustainability of urban heritage by boosting the financial position of archeology and other heritage related institutions.

Historic city urban patterns should determine the nature of the built environment. Existing urban patterns should be preserved, and detailed design guidelines developed to be used by private investors. In the case of Medina of Tunis, a liberal approach was taken to the quasi-traditional use of housing development of the historic city, to translate into the modernized version of the Tunisian courtyard houses (Carmon 1999).

The key is to include urban rehabilitation of cultural heritage areas within National Policy with clear guidelines of implementation, in partnership with private organizations and donor agencies, and reuse the existing building stock as cultural assets to catalyze social and economic growth and reintegration (Savvides 2012).

4.3 Post-crisis

4.3.1 Post-conflict

The process of successful rehabilitation must be planned and integrated into wider fields involving all stakeholders, where rebuilding is approached as a national project, for public discussion and participation. This would also heal community wounds and revive social capital (Barakath 2002). An integrated approach is needed for development, participatory processes, and governance. For example, in Afghanistan, food assistance and food security are regarded as individual sectors, which make no relation with other pertinent sectors such as employment and mine clearance, which would significantly recover agricultural land and livelihoods (Barakath 2002). Importantly, sustainable development and peace building should be integrated in post-conflict rehabilitation. There are four key elements of this approach: understanding the conflict, linking sustainable development, managing sustainable development processes, and improving building capacity (UNDP 2013).

4.3.2 Cultural sustainability

Cultural sustainability is usually questioned on its relevance for post-conflict countries, where it already does not have adequate economic means for life and well-being. However, culture is not a luxury—it has to power to inspire hope, and remind people of their heritage. Often, destruction of cultural heritage becomes a symbol of the brutality of war, as a way to assert primacy and control. For instance, the destruction of Bosnia's Mostar bridge, and the 1992 attack on the mosque in Ayodha, India, demonstrated how these acts to destroy cultural heritage can ignite tense situations (Eriksonn *et al*. 1998). In attempting to re-establish civil society among ethnic rivalries, protecting cultural heritage is a key task of any housing strategy.

4.4 Post-disaster

Improper construction of buildings and infrastructure poses a threat on the built environment, as disasters frequently occur in poorly constructed development areas. There are four phases in integrating disaster risk management into construction: preliminary, pre-construction, construction and post-completion (McEntire 2001). Post-completion considers the retrofitting of buildings and infrastructures at risk, and its impact on natural hazards to historical buildings as well.

There are two common types of natural hazard mitigations: structural (strengthening buildings exposed to hazards, through building codes, design, practices in construction); and non-structural mitigation (directing new development away from hazard locations, relocating existing developments) (Bosher *et al*. 2007).

Aceh, Indonesia: Community-based Post-Disaster Housing Rehabilitation

The Republic of Indonesia is a disaster prone country, with frequent earthquakes, tsunamis, volcanic eruptions, landslides, droughts, and forest fires. The trends of disaster occurrences have been increasing in the last decade, from 895 occurrences in 2004 to 1,302 in 2008. The highest number of fatalities occurred in 2004, by the Aceh Boxing Day tsunami, which devastated thousand of communities along the Indian Ocean, affecting 12 nations, left 167,000 people dead, displaced 500,000 people, and damaged 110,000 houses. The Disaster Management Law Number 24 in 2007 was approved to bring a paradigm shift to disaster management, under the National Action Plan for Disaster Risk Reduction to the UN Resolution No. 63/1999.

The Rehabilitation and Reconstruction Agency for the Regions and Community Life of Aceh and Nias (BRR) was established in 2005, to restore livelihoods, infrastructure, and strengthen communities through community-driven rehabilitation. A survey was conducted which monitored settlement recovery, using three key indicators to benchmark success, with a construction quality index, satisfaction index, and accountability index. Through these measurement methods to track progress, certain issues were located, such as for the satisfaction index, which was low and reflected lack of community participation (Ophiyandri 2011).

5. Sustainable housing rehabilitation index

From the comparative analysis of social housing, cultural heritage, and post-crisis housing, evaluated according to the principles of sustainability, rehabilitation, and inclusive cities, housing rehabilitation needs to be evaluated through measurement approaches to develop appropriate policies and performance measures for prevention of slums. Indicator frameworks are able to establish the context for an area of work, set management goals for sustainability development, and provide methods to choose indicators that measure progress (Reed *et al*. 2006).

The index quantitatively outlines the state of affairs regarding housing rehabilitation in different countries in the five world regions, based on social, economic, environmental, and cultural sustainability. The ultimate goal of the index is to act as a guide in determining appropriate policy guidelines of housing rehabilitation for different countries based on the GHS principles within its National Housing Strategies. Thus, in the countries lacking certain sustainability components, UN-Habitat can provide support and capacity building while fulfilling the Millennium Development Goals (MDGs), the Habitat Agenda goals, and move towards sustainable development. Consideration of index outcomes should be given to statistical capacity-building, used in the process of policy formation, and in strengthening policy analysis (UN Habitat 2013a).

5.1 Benefits of a composite index in housing strategies

Composite indices have increasingly been used to quantify and assess social concepts, to produce aggregate development indicators. Many international organizations such as the United Nations and the World Bank have such indices such as the Human Development Index (HDI), and the Worldwide Governance Indicators (WGI).

Roberto and Tanner (2011) state some benefits of composite indices in development organizations. Composite indices can summarize multi-dimensional issues in a simple, representational manner particularly for policymakers. In addition, they provide a single estimate for ease of interpretation for a concept. Portney (2003) also discusses that measurements such as indexes demonstrate the evidence of a city's seriousness to achieve greater sustainability, in direct relation to concern for livability, quality of life and ecological issues. From a political perspective, sustainable cities initiatives represent a vehicle for advocates to push their agendas for social and human services reforms.

A broad selection of indicators have been selected, based on the variable that the measure is intended to capture, which would be on sustainable, inclusive housing rehabilitation. In recent years there have been debates in the use of actionable indicators versus perceptions-based indicators (Urra 2007). Practitioners have called for the need of actionable indicators, based on direct measurement of social outcomes, divided into proxy variables, based on measurable outcome, or reported social behavior, from nationally representative surveys. The index in this paper will primarily measure actionable indicators.

However, some practices and norms are difficult to measure directly. Supplementary data must be provided, through perception-based indicators, which are based on assessments of the public opinion and expert assessment (see *Section 5.7*).

Since the index will use a large number of items, indicators have been clustered by thematic area. This is common where there are many subcomponents that need to be aggregated before final indexing, used for instance in the Environmental Sustainability Index, which categorizes indicators from 76 datasets into 21 areas (ESI 2012). To ascertain an appropriate weighting scheme, there has been a range of statistical procedures in literature. The first method commonly used is regression processes, where there is a valid measure of the latent variable for a bounded subset of countries, used in the Quality of Life Index (EIU 2005). Another procedure is the matching percentiles method where scores are assigned to countries based on ordinal rankings. It has been used in the Indices of Social Development (Roberto and Tanner 2011) and the Corruption Perception Index (CPI) (Sampford 2006).

Finally a method, also used frequently by the United Nations Statistics Division, is Principle Components Analysis (PCA), cited by Biswas and Frank (2002), Clark (2012), Howe (*et al.* 2008), Kamanou (2008), Vyas and Kumaranayake (2006), to name a few. Although there are some limitations to this method, such as difficulty explaining the process to non-statisticians, and that the weights change with the continuity of data over time, this method is best suited for the Sustainable Housing Rehabilitation index (SHRI) to be developed. Interpreting the results in a visual format, through the individuals and variables factor maps, offset the weaknesses of the PCA.

5.2 Principle components analysis

The aim of the PCA is to reduce the number of variables of interest into smaller components; extract as much variance with fewest components, and provide a unique solution to complex issues (UN Habitat 2012b).

PCs are linear combinations of the measured variables:

$$PC_1 = b_{11}X_1 + b_{21}X_2 + \ldots + b_{k1}X_k$$
$$PC_2 = b_{12}X_1 + b_{22}X_2 + \ldots + b_{k2}X_k$$
$$PC_f = b_{1f}X_1 + b_{2f}X_2 + \ldots + b_{kf}X_k$$

where b= sum of variables
where X= weight of variable

From a set of correlated variables, PCA extracts uncorrelated principle components (PC). Each PC is a weighted linear combination of the original variables. Meaning, each PC is the sum of each variable, multiplied by its weight. Components are ordered, so the first PC_1, explains the *largest amount of variation* in the data (Howe 2008). PCA is about the performance and pattern of different data rather than individual variables, and build empirical models based on existing data (Chemiometrics 2012).

Averaging of component indexes generally cause concern with weighting procedure. PCA utilizes multivariate methods to select weights appropriately, and incorporate interdependence in its components. Variance is also maximized, categorizing different countries according to set measures.

The steps of PCA are as follows:

1. Compute correlation matrix
2. Extract full components solution
3. Transform data to produce variance of the combination (eigenvalues)
4. Compute component scores
5. Apply components solution

The PCA also functions as a linear dimensionality reduction technique, transforming data into a two dimensional representation while preserving the original structure of data (University of Pennsylvania 2012), used in the SHRI. This is an important element in representing the index in visually clear ways for policy and decision-makers.

5.3 Constructing the SHRI with PCA

The assumption within the SHRI explains that the most important reason why countries have different values between indicators in the PCA is based on how inclusive and sustainable they are in terms of housing rehabilitation.

A comprehensive compilation of statistical data from indexes related to the four pillars of housing sustainability was selected. *Table 2* lists the different indexes used and describes them briefly.

Table 2: Sustainability Indexes Surveyed

Index Name	Year	Function	Category
United Nations Statistics Division Data (UNSD) - Housing	2012	Collection of official, national statistics on housing conditions and stock from population and housing censuses. Published in the Compendium of Human Settlement Statistics.	Housing Indicators
Worldwide Housing Affordability Index	2012	Compares the cost of purchasing a home indexed to the population's income. A low value indicates a typical family can barely afford to live, and a high value indicating affordability to live based on a median income.	Housing Indicators
Inequality-adjusted Human Development Index (IHDI)	2012	Measuring development through life expectancy, educational attainment, and income, adjusted for inequalities in the distribution of the three dimensions of the HDI. Loss for potential in human development due to inequality is accounted for.	Inequality-adjusted Human Development Index (IHDI)
Gender Inequality Index (GII)	2012	Measuring of women's disadvantage in reproductive health, empowerment, and the labor market. Index designed to reveal how human development is eroded by gender inequality.	Social Indicators

Index Name	Year	Function	Category
UNESCO World Heritage List	2012	Listing of properties that form part of the cultural and natural heritage, as designated by the World Heritage Committee to having universal value.	Cultural Indicators
Cultural Fractionalization Index	2003	Measuring cultural diversity through fractionalization scores. Random draw—two people from different countries then computing expected cultural resemblance.	Cultural Indicators
Global Competitiveness Index (Social Sustainability)	2012	Measuring the set of institutions, policies, and factors that make a country productive in the long term, focusing on social sustainability in conjunction with economic measures.	Economic-Social Indicators
Energy Sustainability Index	2012	Ranking of World Energy Country (WEC) member countries, in their ability to provide sustainable energy policies through the energy trilemma of energy security, social equity, and environmental impact mitigation.	Environmental Indicators
Failed States Index	2012	Measuring of state vulnerability based on social, economic, political and military indicators. 'State failure' is defined as the loss of physical control of its territory on the legitimate use of force.	Post-conflict Indicators
World Risk Index	2012	Measuring the exposure towards natural hazards (eg. earthquakes, cyclones, flooding, drought, sea level rise); susceptibility with respect to infrastructure, nutrition, housing, economic conditions; coping capabilities with respect to governance, disaster preparedness, early warning.	Post-disaster Indicators
Various	2010–2012	References to various country profiles to supplement missing data from any of the indexes listed.	Contextual

Twenty-eight countries were chosen from the regions of Africa and the Arab States, Latin America and the Caribbean, Western and Eastern Europe, and, Asia. Selection was based on data availability, particularly for the UNSD housing data, on occupied housing units by type of housing unit to derive the critical number of housing units to be rehabilitated. Although using data for number of housing households would be ideal rather than housing units for a results-based approach, due to limited resources housing units were used. Countries were also selected from the high human development category and lower within the HDI, and on selection of rehabilitation units of 1.0 per cent and higher (see *Table 1*).

Mean scores were attributed for missing values to reduce variation, to increase the potential for clustering (Vyas 2006). The percentage of missing data was 1.92 per cent, which is

relatively small. In countries that were missing data, country profiles were researched individually to locate the statistical value to ensure data reliability and validity. For the countries that were not included in the Energy Sustainability Index, namely Lesotho, Palestinian Territory, Nicaragua, Chile, Armenia, and Azerbaijan, related missing data were estimated from the Key World Energy Statistics from IEA.

5.3.1 Selection of indicators

The design and selection of indicators takes a principles-based approach, advocated by Atkinson (*et al*. 2002). An indicator should identify the essence of the problem, be statistically validated, is interpretable in an international context, be susceptible to improved methods, and reduce imposition of burden for countries (UN 2010). Housing data was retrieved from the UNDS, on the occupied housing units of type, based on an aggregation of 'Does not have all basic facilities' within Conventional Dwellings, and 'informal housing units' from Other Housing Types.

Cultural values tend to be associated with heritage objects or cultural landscapes, the *genius loci*. However, the cultural landscape must be treated holistically, to include historical significance, aesthetic qualities, and utility (Axelsson 2013). Four categories are described by Mercer (2002) to monitor cultural policies in human development: cultural diversity, cultural access, cultural lifestyle, and cultural conduct, ethics, governance. Hence, the variable of 'cultural fractionalization' was selected, based on the indicator of *cultural diversity*. The variable for *cultural heritage* was represented in the indicator 'UNESCO World Heritage Sites', in relation to the historical remains as recorded per country by UNESCO.

Social inclusion is the process by which societies counter social exclusion and poverty (UN 2010). Social indicators were based on the GHS, under their principles of inclusive cities, which are achieved through *human rights*, *social integration* and *gender responsiveness*, and elimination of the *urban divide* (UN-Habitat 2013b). These were translated into selecting country data from the inequality-adjusted HDI, and the gender inequality index.

The main instrument of economic measurement for production is the Gross Domestic Product (GDP), and the Global Competiveness Index (GCI). In the Inclusive Wealth Report recently issued in 2012, it was advised that measuring the progress of a green economy should stem from stock metrics (wealth) rather than flows (income, GDP) (UNU-IHDP and UNEP 2012). There has also been abundant literature on combining GDP, a country's manufacturing output, with other types of human, natural (Pinter *et al*. 2005), and cultural capital (Gordon and Beiby-Orrin 2007). As the index already encompasses a multi-dimensional sustainability, GDP (PPP in billions) can be considered for an economic indicator in the index. However, the principle of inclusive cities is a dominant theme for housing rehabilitation. Productivity and economic growth has shown to be tied with social living conditions for the development path of economies. The GCI (Social Sustainability) indicators are an aggregate of income inequality, youth unemployment, access to sanitation, drinking water, healthcare services, social safety net against economic employment insecurity, presence of informal economy, social mobility, and vulnerable employment (World Economic Forum 2013).

Finally, the ranking of the World Energy Country (WEC) member countries is based on each country's ability to provide sustainable energy policies through the energy trilemma of energy security, social equity, and environmental impact mitigation, effectively combing the social and environmental dimension. Energy analysis and indices are a good way to evaluate

housing sustainability, as the majority of energy consumed is within the building industry, from manufacturing, construction, to long-term stewardship of building maintenance (Pulselli *et al*. 2007).

5.4 Application of PCA

There are several software's for computing PCA. Notably, STRATA is a common computational tool, used by Vyas (2006) for his study on constructing socio-economic status indexes, where formatted tables for factor scores were created for distribution and regression models.

However, one of the primary limitations of the PCA is its inability to translate multi-dimensional data results for non-statisticians. The results of the index must be able to be graphically represented clearly, with ease of analysis. *FactoMinerR* is an R package for computing multivariate Exploratory Data Analysis, developed by Husson, Josse, and Lê from Agrocampus Rennes, together with Mazet. It allows supplementary information variables, provides a geometric visualization, ease of interpretation, and takes into account structure of data (source).

The data was prepared in a plain text format, and input into the FactoMineR package within the R software. The *FactoMineR* package is also able to compute variables not within the same data unit and scales. This is a useful timesaving advantage, as opposed to the lengthy methods of standardization to stabilize the variance (ie. Logit, Standard Normal, Square Root transformation). Line codes to perform a PCA on all variables are placed into the program, using different options to scale the data, limit number of dimensions kept in the result, as well as plotting the graph. The correlation coefficient between variables and in each dimension is calculated, providing significance values.

Table 3: Data summary from PCA computation

Dimension 1			**Dimension 2**		
	Correlation	**P-Value**		**Correlation**	**P-Value**
Gender inequality index	0.932	5.56E-13	GDP	0.861	4.06E-09
Failed states index	0.883	4.90E-10	No. Of UNESCO World Heritage Sites	0.839	2.49E-08
Critical Housing Units to Rehabilitate	0.495	7.42E-03	Critical Housing Units to Rehabilitate	0.800	3.28E-07
World risk index	0.472	1.12E-02	Cultural fractionalization	0.681	6.72E-05
GDP	0.428	2.31E-02	Housing affordability index	0.402	3.37E-02
Housing affordability index	-0.496	7.21E-03			

Dimension 1		
	Correlation	**P-Value**
HDI (Inequality-adjusted)	-0.777	1.19E-06
Energy sustainability index	-0.867	2.37E-09
GCI (Social Sustainability)	-0.895	1.25E-10

5.5 Interpretation of results

Figure 2 shows the Variables Factor Map to analyze performance, where the first two dimensions obtain half of the total variance of the dataset. The first dimension, with 43.49 per cent of the variance (First Principle Component), correlates social, economic, and environmental indicators for with housing inclusivity. Energy Sustainability is highly correlated with HDI (inequality-adjusted); Critical Housing Units to Rehabilitate correlated with Gender Inequality, Failed States, and World Risk Index. Note that the Failed States Index, representing the post-conflict context for housing rehabilitation, and the World Risk Index, representing the post-disaster context, is negatively correlated with environmental and social sustainability, which demonstrates that it has not been strongly accounted for in many post-conflict and post-disaster countries.

The second axis, accounting for 27.05 per cent of the variance (Second Principle Component), strongly correlates cultural indicators (UNESCO World Heritage Sites, Cultural Fractionalization), with Critical Housing Units to Rehabilitate. This data reveals the lack of social and environmental sustainability presently existing, and provides an entryway with which to further develop the other aspects of sustainability.

The factorial plan may thus be divided into four parts: variables with strong social and environmental sustainability; concentrated relationship between culture and housing rehabilitation; and post-crisis indicators and gender inequality. The comprehensive performance of the index shows that the critical housing units to be rehabilitated have variance between all factors related to the four pillars of sustainability, namely the situations that require public housing, sites with cultural heritage, and in post-crisis contexts—which is the underlying factor for the SHRI.

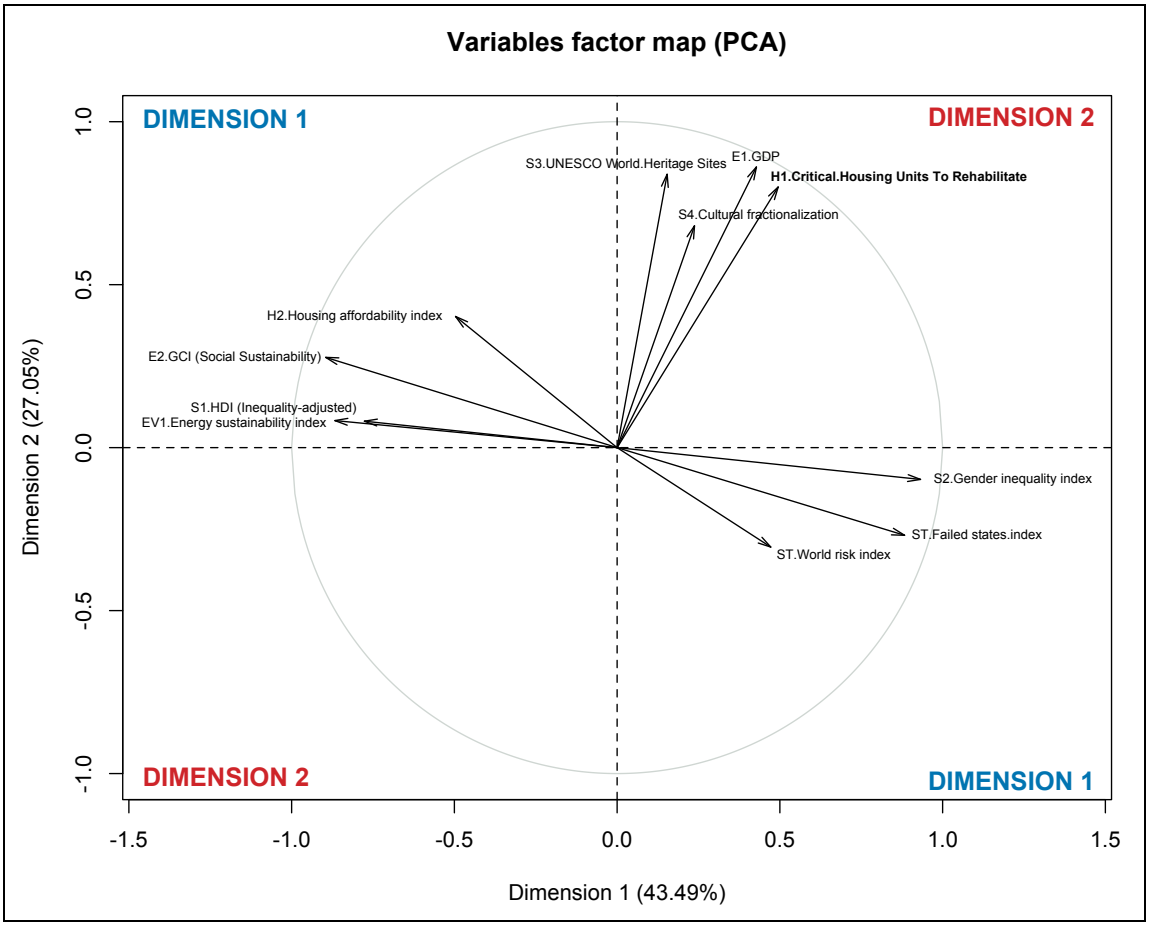

Figure 2: Variables Factor map with dimension boundaries

Figure 3 displays the Individuals Factor Map, color-coded by region. The first quadrant (Q1) depicts the countries with high social and environmental sustainability, and high affordability in housing, mostly for the sample data in Western and Eastern Europe. In the second quadrant (Q2) the countries, mainly based in Asia, show rates of cultural and economic sustainability. The third quadrant (Q3) lists countries that have negative rates of cultural and economic sustainability. The fourth quadrant (Q4) depicts countries in post-conflict or post-disaster situations, mostly in the regions of Latin American and the Caribbean, Africa and the Arab States correlated with gender inequality, a social indicator, and negatively correlated with environmental sustainability.

This figure clearly shows the demand of which aspects among the four pillars of sustainability for housing rehabilitation are lacking within the four global regions. The case study in Budapest, Hungary, within the region of 'Western and Eastern Europe', provides a best-practice insight on programs to integrate social cohesion and diversity, which was previously lacking and in need of urban renewal.

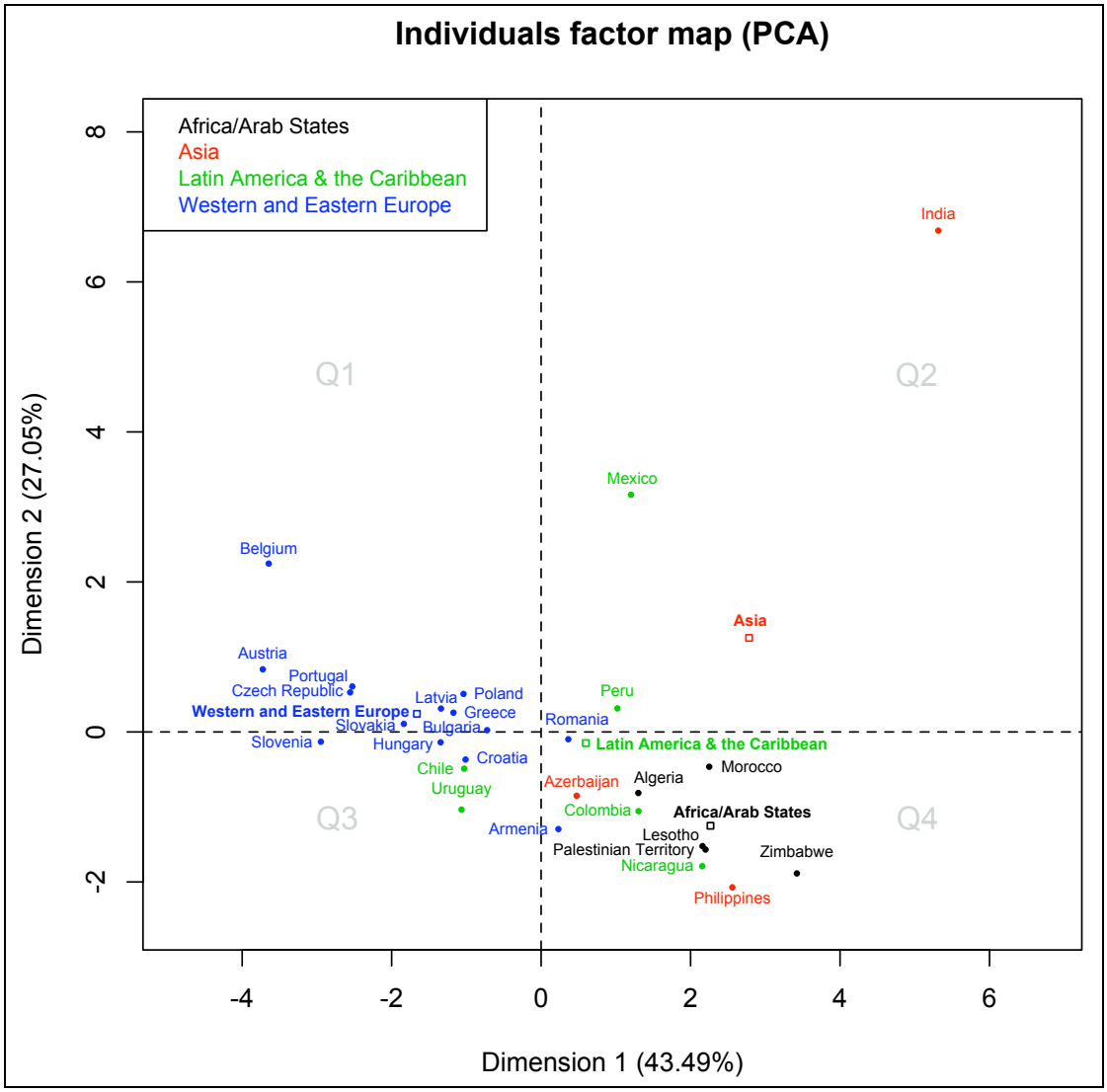

Figure 3: Individuals Factor Map with quadrant labels (Q1–4)

Alternatively, the sample of countries based in Asia portrays negative rates of environmental sustainability with a high number of housing to be rehabilitated, although indicating strong cultural sustainability. A case study of Bangalore, India, demonstrates this occurrence well. It has an ambitious cultural rehabilitation plan for the city, endeavoring to include social inclusion measures within its model; however, it makes no mention of the environmental component.

Budapest – Post-Socialist Inner Cities Regeneration

After the collapse of state-socialism of 1990, there was widespread social and economic transformation in Central and Eastern Europe. Therein emerged a polarization of urban spaces, with a growing deregulation of housing markets and differentials in income growth particularly in the historical quarters of cities. In inner urban residential neighborhoods, further decline was observed where extreme forms of social exclusion and segregation accompanied physical deterioration. Alternatively, in neighborhoods that have been affected by rehabilitation programs, a rapid population change is exchanged for gentrification, displacing the older and less affluent population.

The Magdolna Quarter Program is an example of a socially sustainable urban regeneration program launched in Budapest Jozsefvaros in 2005. Urban renewal is brought to a disadvantaged, urban district, through participatory methods and integrating social, cultural, and technical measures. The aim of the project is to improve the standard of living, while ensuring the appropriate involvement of residents, strengthening local community cohesion, and retaining social diversity, such as the indigenous Roma residents of the neighborhood (UN-Habitat 2008).

5.7 Participatory research strategies for perception-based indicators

The proposed policies and design alternatives from the SHRI are by no means conclusive; rather, they provide the entry point and contextual guidelines to structure the direction of the development of sustainable housing rehabilitation.

This paper also advocates for the future development of the SHRI using participatory research methods to generate perception-based indicators, as per the trajectory of the GHS within its media strategy. Although its strategy is commonly used for outreach, advocacy, and generating political and development partnerships, it can also be used for crowdsourcing key, community data.

There is a growing resurgence of participatory research strategies. Traditionally, research is seen as about people rather than with people. However, the participatory design process, a methodology of knowledge generation of researching the social world, is able to provide a communicative space between the systems and its users (Bergold 2012).

With the increasing number of online social network (OSN) services, many scholars and practitioners are seeking to adopt these tools into their professional work (Abdesslem *et al*. 2011). Social media tools are defined as web-based services associated with web 2.0 technologies, with aspects of user-generated content (Gruzd *et al*. 2012). It can facilitate information dissemination, collaboration and communication among peers, and provide a space for information linkages through widespread digital properties such as LinkedIn, Google+, Facebook, and other social microsites.

Many issues that arise from measuring and assessing sustainability assessments and indexes, focus on its lack of local participation and adaptation (Retzlaff 2008, Roseland 2012). Further action steps suggested for the SHRI is to undertake a consultative process with country states

in conjunction with citizens through participatory research strategies, and select perception-based indicators based on priority of its immediate users.

6. Discussion

6.1 SHRI and contexts of housing rehabilitation

The index quantitatively demonstrates the occurrence of the three contexts globally, identifies sustainability issues, and measures progress for rehabilitation. Countries, such as India and Mexico, which require critical housing rehabilitation within some of its cities, have a strong correlation with high cultural fractionalization, although containing the presence of heritage sites. Hence, it may be shown that it is necessary to direct attention towards areas within the heritage context, which have a high potential for its existing housing to be transformed into sustainable and inclusive housing.

Dimension 1 (see *Figure 2*) indicates that countries experiencing post-crisis, either post-conflict or post-disaster, also demonstrate the need for critical housing rehabilitation. These countries, for example Zimbabwe and Philippines, are negatively correlated with human development well-being, and strongly correlated with gender inequality, revealing the lack of the social dimension of sustainability.

The Variables Factor Map in *Figure 1*, in addition to the correlation and p-value data from *Table 3*, show that housing in the countries sample that are not affordable, are evidently those that require critical rehabilitation. However, they often do not have social, economic, and environmental sustainability, for instance in the majority of Africa and Arab States countries. This validates the qualitative conclusions made in *Section 3*, which shows that environmental sustainability should not be the only objective in rehabilitating social housing. Social sustainability is also a prominent component to housing affordability in addition to the environmental dimension.

6.2 Need for a global housing strategy

The SHRI is an effective tool for providing decision-makers with identifying issues in their country on the present sustainability of their housing sustainability problems, and measuring progress according to the four pillars of sustainability towards sustainable development. Importantly, it provides UN-Habitat, policymakers, and other development agencies with an entry point to develop sustainable housing rehabilitation, which has a holistic approach to guide urban growth. Improving sustainable housing is a complex issue and ordinarily it is difficult to determine where to begin. Generated through multivariate statistics, specifically the PCA, the SHRI demonstrates the need for a global housing strategy towards holistic sustainable and inclusive housing rehabilitation that has not been previously explored.
In the GHS, slum prevention is mainstreamed as part of the housing strategy that constitutes a pillar of the national urban policy (UN-Habitat 2013a).

The Global Strategy for Shelter to the Year 2000 has encouraged an enabling approach to shift the role of government to a more enabling role, empowering actors to participation in providing for housing (UN-Habitat 2006). However, a broader perspective needs to be taken for the provision of housing, on issues such as national urban policies and urban planning.

Faced with the present issues of urban exclusion, economic inequalities, and environmental impacts, a new paradigm shift is necessary and the GHS provides a response to these challenges (UN-Habitat 2013a).

The new paradigm must address the root cause of housing shortages, and deprivations that result in slum conditions. There are two main approaches to contending with informal settlements. The first, deals with the eradication efforts aimed at outcome rather than cause, through means such as eviction and forced relocation, discouraged by the UN and contested by many grassroots movements (Huchzermeyer 2008). This may be seen in the many national housing policies in developing countries such as the 2006 KwaZulu-Natal Elimination and Prevention of Re-Emergence of Slums Bill in South Africa, which introduced negative measures for slum eradication, by criminalizing the arrangement of unlawful occupation and occupation itself. It is also evident in India's Slum Free city policy guidelines, methods are towards preventing encroachments and illegal structures, and then supplying affordable housing (Ministry of Housing and Urban Povety Allevation 2011).

The second uses an indirect approach, focusing on the elimination and prevention of informal settlements, aimed at the structural causes of slum formation, improvement of land, services, and housing, to reduce the need for informal housing solutions (Huchzermeyer 2008). Central to this approach is upgrading of existing slums, endorsed by UN-Habitat through its Housing and Slum Upgrading Branch activities, and prevention of informal settlements through policies for urban planning, land management, and low-income housing development for the supply of affordable land (UN-Habitat 2003). The idea is that the gradual development of low-income housing would thus prevent the emergence of more slums, advocated in this paper.

Sustainable housing policies need to be future-oriented and directed towards prevention of informal settlements, in concurrence with achieving the goal of adequate housing for all, and improving access to housing. This paper establishes sustainable and inclusive housing rehabilitation as intrinsically integrated in urban planning within its housing strategies, as one of the dominant approaches to slum prevention. This paper provides evidence-based research to address present and future challenges in housing and slum prevention, contributing to critical discourses on the post-2015 Millennium and Sustainable Development Goals.

Conclusion

Adequate housing and services, and sustainable development are key principles to reformulate what is presently observed in housing rehabilitation, operationalized through the SHRI. Social impacts and cultural heritage is an important aspect of rehabilitation rather than focusing on physical infrastructure alone, with the imbalance of sustainability objectives shown in the findings of the index. The three contexts examined in the paper, social housing, cultural heritage, and post-crisis housing face similar issues which can be addressed through sustainable housing rehabilitation. The comparative analysis addresses future and present housing demand, through urban planning as a preventive measure to slums. The approach generated is directed towards the context of the GHS developed by UN-Habitat, as one of the prime approaches to slum prevention, and development of sustainable housing rehabilitation strategies from a global perspective.

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