Abstract
Inadequate housing is a crisis that affects all areas of the world. The severity and magnitude of this crisis has been augmented by the exponential growth in the global population. Expounding upon this problem, particularly in the South, is the migration of rural peoples into urban cores, fostering the creation of mega-cities of illegally developed, inadequate housing. These developments lack basic necessities including access to water, proper sanitation, and safe areas to prepare food.

Urban agriculture has presented itself as a key design component in the mission to alleviate the aforementioned crisis. The incorporation of agriculture as a permanent and edible design feature bolsters the design methodology of sustainable urban fabrics by presenting opportunities of cohesion between built and cultural landscapes. Research on one of the largest slum developments, known as Kibera, in Kenya provides a design study in which the addition of edible landscapes contributes to the neighborhood “njia” infrastructure. The term njia refers to the street paths and alleyways that bind the developments. When applied to the model of njia, the potential benefits of the incorporation of urban agriculture into the contextual vocabulary become clear. Designing edible landscapes as a feature of permanence in urban design situations provides the potential to address critical issues concerning development of housing, city planning, and food security.

Keywords: Kibera, Informal Housing, Njia, Urban Agriculture, Sustainability.
INTRODUCTION

The crisis of inadequate housing can be seen worldwide, both in developed and developing countries. Rapid urbanization, natural catastrophes and political turmoil has had a direct effect on the global housing crisis. In response to this crisis, the expansion of illegal squatter settlements is apparent, particularly in the South. These settlements lack basic infrastructure that would provide access to clean water, proper sanitation and adequate housing.

According to UN-Habitat, every year the world’s urban population is increasing by about 70 million. All of these people will require access to shelter and employment and the majority will realize this need through the informal sector. In developing countries more than half of the city’s population currently lives in informal settlements (UN-HABITAT, 2003).

Integrating architecture and agriculture has the potential to directly affect the role of housing in illegal settlements. In addition to providing shelter, the house would generate production of agriculture providing economic opportunities and fostering environmental sustainability. One possible design strategy incorporating the aforementioned multidisciplinary approach for addressing conditions in poverty stricken areas will be explored in the following text. The current global housing crisis will be addressed and the principles of urban agriculture as they relate to architecture will be examined. The undertaking of an architectural research project in Kibera, Kenya will provide a case study to this multidisciplinary approach.

The sudden movement of persons from rural areas into the urban metropolis has had similar results globally. A large number of people have moved closer to city cores seeking employment. Unfortunately, many times this leads to the developments of illegal settlements. The majority of these settlements either lack basic infrastructure or have limited access to safe water and proper sanitation in addition to inadequate housing conditions, overcrowding, and insecure land tenure. These characteristics reflect only the physical similarities that unite illegal settlements globally, thus do not represent the dynamics of the social infrastructure.

Illegal settlements are often referred to as ‘slums,’ which can be defined further as housing areas that have deteriorated over time for various reasons. The decline of housing conditions can be attributed to the result of the original dwellers relocating to better areas of the city; while the housing may often times become subdivided and rented to lower-income individuals. Slum developments are often times not recognized by public authorities and lack access to the city infrastructure. Furthermore, the lack of access to proper sanitation results in unhealthy living conditions. This housing development phenomenon has and continues to occur throughout both developed and developing countries worldwide (UN-HABITAT, 2003).

The Resource Centres on Urban Agriculture and Food Security (RUAF) estimates “by 2020 the developing countries of Africa, Asia and Latin America will be home for 75% of all urban dwellers, and to eight of the anticipated nine megacities with populations in excess to 20 million.” In response to this global housing crisis and the rapid urbanization of the world’s cities, the development and integration of urban agriculture as a means to alleviate the new pressures placed on rapidly growing cities presents itself as an opportunity not to be squandered. In defining urban agriculture Mougeot states:

“Urban agriculture is an industry located within (intra-urban) or on the fringe (peri-urban) of a town, a city or a metropolis, which grows and raises, processes and distributes a diversity of food and non-food products, (re-)using largely human and material resources, products and services found in and around that urban area, and in turn supplying human and material resources, products and services largely to that urban area.” (Mougeot, 2005, p2)

This form of agriculture is incorporated within the urban economic and ecological system. The role of urban agriculture and its specific contribution to the urban poor can be attributed to its ability to provide food security and nutrition, social and economic impacts, as well as contributions to urban ecology (RUAF).

According to RUAF, the inclusion of urban agriculture principles provides a complementary strategy to reduce urban poverty and food insecurity and enhance urban environmental management. The production of food in poor urban areas is usually a direct response to the lack of money to purchase adequate food from the largely inadequate food resources available within developing countries. Economic circumstances in most developing countries do not provide sufficient income opportunities for the expanding population, thus resulting in the
inability to purchase food. (RUAF)

A series of studies by Mougeot in which poor households practicing UA have been compared with poor non-practicing households conducted in Zimbabwe, Kenya, Uganda and Haiti have found the former to have lower food insecurity, eat more meals, maintain a more balanced diet year-round, and use their savings to buy other food items that would otherwise be unaffordable in addition to their children having better health and nutritional status (Mougeot, 2005).

Millions of people around the world have responded to inadequate economic and living conditions with urban agriculture, providing themselves with food security, nutrition, and income opportunities. In 1996, the United Nations Development Programme estimated that 800 million people were participating in urban agriculture worldwide. It is apparent that this form of agriculture has become a global phenomenon that is continuing to develop, adapt, and innovate in a magnitude of ways. The farming constraints of the city have led to important adaptations such as the use of compost and manures that are readily available as urban resources. The effective use of such resources has contributed to the environmental sustainability of the urbanizing world by utilizing nutrients that may have become pollutants in nearby waterways (Girardet, 2005).

Today, the practice of utilizing every attainable drop of water is more apparent due to the increased value of fresh water. There are agricultural practices being demonstrated by farmers globally which substitute the use of water from nearby waterways with the use of collected rainwater. According to the International Water Management Institute, another innovative urban agriculture technique includes the use of human waste as a viable resource and can account for more than 50% of the urban vegetable supply in several Asian and African countries (Halweil, 2007).

The practice of urban agriculture also includes the concept of composting urban organic wastes. The transformation of these organic wastes into productive fertilizer via composting can be utilized more efficiently in areas where the waste can be manipulated easily. For instance, agriculture grown within urban cores, especially informal settlements, enables the agricultural production site to exist within close proximity to the composted organic wastes. It is estimated that in Kano, Nigeria, 25 per cent of the fertilizer needs of nearby farmers are met with urban organic wastes (Halweil, 2007).

CASE STUDY: KIBERA, KENYA

Urban agriculture is a sustainable, strategic, and multifunctional component for developing neighborhood and housing designs. The environmental, social, and economic gains from the implementation of UA principles into community planning designs have been seen throughout various projects. The incorporation of agriculture as a permanent and edible design feature bolsters the design methodology of sustainable urban fabrics by presenting opportunities of cohesion between built and cultural landscapes. Research on one of the largest slum developments, known as Kibera, in Kenya provides a design study in which the addition of edible landscapes contributes to the neighborhood “njia” infrastructure.

Kibera is one of the largest illegal settlements in Kenya. It is located 7 kilometers southwest of the main downtown city of Nairobi. The settlement is one degree south of the equator; however it is located one mile above sea level therefore the temperature rarely rises above 80 degrees Fahrenheit. Kibera was originally traditional Masaai grazing land. Between 1912 and 1928, it became a Kenya African Rifles (KAR) military reserve and was allocated as an area of temporary residency for Nubian (Sudanese) soldiers who had served the KAR for a period of over 12 years. Kibera began as a temporary solution to house retiring soldiers; however the settlement became a source of political and social unrest. The growth and control of the land use was not monitored by city authorities nor were land titles given to any Kibera residents. Over time, Nairobi’s city core began to grow toward the settlement, increasing the value of the land. Administrators developed relocation schemes that proved to be too expensive thus the settlement inevitably became a long-term solution for the lack of affordable housing eventually giving way to the egregious conditions it maintains today (Kramer, 2006).

Kibera is now home to a population estimated to be between 750,000 and 1,000,000 occupants living in an area which measures 3.5 kilometers west to east, and 1.5 kilometers north to south, with a total area of approximately 250 hectares. The settlement is comprised of 10 villages: Gatuikira, Kianda, Kisumu Ndogo, Laini Saba, Lindi, Makina, Mashimoni, Siranga, and Soweto.
The villages vary in culture, ethnicity, religious affiliation, population, and size. The most common construction type remains mud-brick with an iron roof, which is unique compared to Nairobi’s newer illegal settlements, which have begun to use thin concrete walls and foundations. The majority of the houses have earth floors and un-plastered walls. The response to sewage and drainage infrastructure appears in the form of open trenches usually located a few yards away from the house. This improvised system accumulates garbage and stagnant water facilitating the breeding of mosquitoes, which lead to disease (Kramer, 2006).

A quarter of Nairobi’s population lives in the deplorable conditions of Kibera. These conditions include the lack of basic urban services such as water supply, sanitation, solid waste management, proper electrical power, and roads. Poverty not only affects the people but also negatively impacts the environment. These conditions lead to the pollution of Nairobi Dam and Ngong River, two large water bodies bordering the development. The inclusion of sustainable methods to upgrade and further develop Kibera, as well as other squatter settlements, would be beneficial to its inhabitants and the environment.

Kibera, as in many illegal settlements, contains a series of streets and pedestrian pathways developed in a structurally organic manner usually lacking a planned design scheme. Instead there are a series of compounded pathways that provide voids through the built environment. The term ‘njia’ refers to these street paths and alleyways that bind the communities and function as the heart of the communal spirit. When applied to the model of ‘njia’, the potential benefits of the incorporation of urban agriculture into the contextual vocabulary become clear. Designing edible landscapes as a feature of permanence in urban design situations provides the potential to address critical issues concerning development of housing, city planning, and food security.

The housing conditions in Kibera were studied as an architectural research project in which sustainable means of relocation or housing
improvement were explored. Throughout the research phase of this project, data was collected through numerous interviews and direct correspondences with native Kenyans as well as planning professionals specializing in urban upgrading. This data included an extensive amount of photographic documentation of current living conditions and areas of potential opportunities for upgrading the existing informal housing of Kibera. It was observed that the project must address issues of social practice and cultural behaviors. These issues directly affected material choice, methods of construction and means of relocation in the proposed project. The research included numerous method and material studies which highlighted various local materials to be reused and utilized in the housing construction as well as possible generators for agricultural development. The research also yielded key information into the necessary means of designing relocation areas within close proximity to original housing in order to minimize social reintegration factors. This housing upgrading scheme utilizes technical design methods in response to various social, cultural and environmental conditions of Kibera. It should be noted that the cooperation of residents and the local community would play an integral role in the ultimate realization of such a proposal.

The project examined methods to promote the cohesion of sustainable development in the built environment with the inclusion of urban agriculture principles. The project proposed a design scheme for the implementation of urban agricultural principles in the construction of new homes adjacent to the existing settlement. The development of productive built environments, such as homes, schools, or public areas, may yield a beneficial return in areas where space is extremely limited due to overcrowding. The design for housing can provide more than protection; it can function as a generator for urban agriculture as well. The capability of vertical production of agriculture, maximizing total potential growth, was integrated into the housing design. In a series of housing studies, each wall was designed to respond to a specific function. The design explored walls as surfaces for agricultural growing and selling in order to maximize productivity. In Figure 1, the wall adjacent to the ‘njia’ was conceptualized to function as an area for the sale of agricultural products and promote a potential economic opportunity. This design also illustrates the exploration of agriculture as an integral upgrading factor within the njia.

The built environment can also be designed to collect, filter, and store natural resources such as rainwater that can be used in the growing process as well as everyday water-based needs. A series of studies illustrate the potential cohesion between the built and natural environment through the use of materials that are readily accessible. The first two designs of Figure 2 explore the role of the built the environment in the production of agriculture, with the wall providing a surface for the growing of crops. In Figure 2A, the section illustrates the use of rammed-earth blocks to promote agricultural production on the exterior, while providing the structural element for the sleeping infrastructure. The use of readily available glass bottles was explored in Figure 2B as a viable design method for light infiltration into the dwelling. The next design,
Figure 2C, illustrates the use of the natural element as a provider for shade and ventilation for the occupants in the dwelling. In addition to increased ventilation and filtered light into the dwelling, the design utilizes a ‘transformable’ wall to provide a viable workspace for the inhabitant. In Figure 2D, the design addresses the condition of the collection and storage of water within the built environment for the promotion of sustaining the production of agriculture.

Figure 3 illustrates several methods of addressing the expense incurred in the process of collecting rainwater, ranging from the use of a simple large pot to the construction of a wall. In areas where water is limited, it is of the utmost importance to efficiently use and reuse any available water resource. Furthermore, the concentrated production of vegetables in cities may use less than a fifth as much irrigation water and one sixth as much land as mechanized rural cultivation (Halweil, 2007).

The incorporation of urban agriculture into housing design has the potential to provide nutritional value as well as create economic opportunities for the occupant. Nutritionists and other health professionals have attributed deficiencies in the diet of the poor to the inability to access a sufficient range of fresh produce. The design and incorporation of a permanent agricultural production landscape will help to alleviate this deficiency by providing access to fresh fruits and vegetables while simultaneously providing previously unfeasible economic possibilities. For instance, the skills developed through the agricultural process can be a beneficial asset when seeking other employment opportunities. Furthermore, community gardens promote social interactions, which lead to education and further social development. This interaction can be seen between neighbors practicing urban agriculture within their dwelling site. The proposed housing scheme for Kibera seeks to explore this potential through the design of multiple agriculturally productive dwelling plots within close proximity to each other (Howe et al, 2005).

The study of Kibera also revealed the need of city planning for open public green space. This land can provide a functional area for both cultural interactions as well as agriculturally-based transactions including water collection; composting; and tree planting to create shade, reduce heat and cut down on greenhouse gases. Figure 4A & 4B both illustrate the design of an open green space to be used for community interaction. The design of an open green space was conceptualized for the programmatic function for cultural interactions such as a designated area for recreation that can be transformed into temporary street markets. The design utilizes green space for communal activities such as the collection of water for the use associated with agricultural production as well as everyday needs. The use of vacant land as productive green spaces discourage garbage dumping and squatting (del Rosario et al, 2000).
The collection and use of water for irrigation purposes is difficult for many people living in slums unless they live near a river or another water source. Many times, this condition leads to the use of sewage water for irrigation of crops (Foeken and Mwangi, 2000). According to the Green Towns Project, a local community-based project of Nairobi, the ability to transport sewage water and store it in a series of smaller ponds in which the water becomes cleaner can provide a viable source for irrigation (Foeken and Mwangi, 2000). Decontaminating once polluted waters and soils combined with the safe use of organic and liquid wastes can be realized through some productive growing methods. Human and animal waste can also be transformed to a viable UA production agent. Human waste can be turned into compost (Esrey and Andersson, 2001), and aquiculture can stabilize animal manure (Mougeot, 2005).

The abundance of open trenches in Kibera and other slum settlements is quite common. The idea of turning these landscapes, which are used to transport sewage and waste water, into productive networks of agriculture can be realized through thoughtful design. Similar to the process of hydroponics, where plant roots are exposed to collect water and nutrients, covering these trenches with a permeable membrane and planting them with agricultural crops can transform these dangerous waste removal systems into productive continuous agricultural pathways (Refer to Figure 5). The growth of agriculture into this spatial condition can also provide a visually aesthetic response, in addition to the removal of certain toxins that are present in heavily populated areas, decrease the mosquito population, as well as become a viable agricultural source.

The design of housing and public spaces to incorporate agricultural practices can be recognized as a design methodology for the improvement of slum conditions. As mentioned above, areas of poverty tend to lead to the deterioration of
the natural environment. The inclusion of an agricultural infrastructure in slum upgrading master plans and housing designs can play an important role in the future reduction of environmental impact.

The study of ‘njias’ in Kibera illustrates the possible upgrading of slum housing and other spatial conditions into a productive built environment that generates the production and selling of agriculture. Figure 6 illustrates the relationship between an individual dwelling, the growing production plot, and the community ‘njia’ condition. The agriculture growing plot is embedded with the dwelling to provide security in response to the ‘major problem’ of theft (Foeken and Mwangi, 2000). The idea of designing new construction or upgrading existing built environments to accommodate a high level of agricultural production promotes a sustainable future. The potential benefits of this concept can be seen in many examples in various locations of the world; both in developed and developing countries.

GLOBAL REPLICATION OF DESIGNING EDIBLE LANDSCAPES

Although this study focuses on one of the largest slums in Kenya, these conditions can be observed globally. The conditions of overcrowding, inadequate housing and lack of access to safe water can be seen as a result of rapid urbanization. The principles proposed through the concept of designing edible landscapes in Kibera can be replicated in other areas of the world.

Urban agriculture has and can continue to provide a valuable resource for the urban poor. For example, agriculture has been the source of treatment for Beung Cheung Ek Lake in Cambodia. This sewage-contaminated lake has been cultivated by the locals to produce water spinach that thrives in nutrient rich water (Halweil, 2007). Also, in Kampala, Uganda the process of making mud bricks has left the land with multiple voids. Figure 7 illustrates how the process of digging, which has been viewed as a negative process, can be transformed into a positive resulting condition using common materials from the area to utilize these voids as pockets for agriculture. The design utilizes locally found plastic crates to house plants which can thrive off the existing nutrients.

The inclusion of urban agriculture in the design of built environments can provide multiple benefits to poverty stricken areas. There is a network of key components that must work together for the true potential of poverty alleviation to be realized. It is noted that there are many issues concerning the inadequate housing crisis, however the addition of urban agriculture principles to community design can play a significant role in diminishing inadequate housing. One of the main reasons noted for the housing crisis is the insecurity to land tenure; with this being granted individuals could invest in their land and community. The practice of incorporating agricultural principles could provide economic opportunities to invest in housing. The addition of urban agricultural practices to certain spatial and physical conditions common in illegal settlements can also provide the individual a sense of pride for the area in which they live. Furthermore, upgrading the socially driven ‘njia’ condition with agriculture can foster a community spirit through providing educational and economic opportunities while simultaneously alleviating the health issues that spring from the deplorable trench conditions.

CONCLUSION

The Millennium Development Goals call for the significant improvement of at least 100 million slum dwellers. The global housing crisis is a result of poverty which is comprised of a series of complex factors. Addressing these conditions is necessary in
providing housing for many of the world's inhabitants living in poverty. Viewing the role of the house as a generator for potential socio-economic opportunities can lead to the improvement of current slum conditions. The process of housing the urban poor, whether through upgrading or new construction, would benefit with the inclusion of productive growing as a permanent feature in the overall design.

The inclusion of agriculture can promote economic, social and nutritional opportunities that can provide improvements to the current slum living conditions as well as reduce environmental health hazards. The planting of agriculture can also benefit the city/slum development through beautification, cooling of the climate, decrease risk of erosion and absorb air pollution and odors (Mougeot, 2005). In addition to the environmental benefits, the social dynamic of the urban community can have the opportunity to grow.

The housing crisis and development of informal settlements is a global condition growing at an exponential rate. The 'njia' condition in Kibera, Kenya was chosen as the research site with the intention to illustrate the potential improvement of current slum conditions through the permanent design of edible landscapes within the context of an informal settlement. The term 'njia' is unique to Kenya, however similar physical conditions can be seen in developing as well as developed countries across the world. The transformation of deplorable living conditions and inadequate economic opportunities into viable productive landscapes and economic advancement, respectively, can be attained through the implementation of urban agricultural principles. This multidisciplinary approach for addressing the global housing crisis utilizing permanent agricultural landscapes as a key factor can promote the house as a generator for sustainable development and economic improvement for the urban poor.

REFERENCES


Author's Address:
Michael Sean Honing
M. Arch (University of Florida, 2006)
Designer
USA
mike0013@ufl.edu