International Journal of Soft Computing and Engineering (IJSCE)
ISSN: 2231-2307 (Online), Volume-11 Issue-1, September 2021

Assessment of the Social and Economic Impact of Innovative Construction in Housing in Slum Upgrading: A Case of Mathare Valley, Nairobi

Edmund Muthigani, Stephen Diang'a, Wanyona Githae

Abstract: Background: Adequate descent housing is a universal human rights integral component. Resources' costs and intensified rural-urban migration increase demand for sustainable housing. Modern knowledge-based-economy uses innovation. Construction industry uses product and process innovation to provide adequate and descent low-cost housing. Kenya adopted innovation practices of slum upgrading that uses cost effective locally available building materials. This study looked at the outcomes; social and economic impacts of innovative construction in housing in the Mathare Valley Slum upgrading project, Methods: This post occupancy study used exploratory-descriptive research design. Random sampling was used to sample 384 users of low-cost housing projects in Mathare Valley, Nairobi County. Research instruments included semi-structured questionnaires and interview guides. Pilot study, validity and reliability tests ensured quality of study. Ethical considerations included university approval and consent. Statistical package for social sciences (SPSS) software version 21 was applied to compute the descriptive and inferential statistics. Findings: Slum-upgrading had significant-positive outcome on improved houses and community. Social impacts included communal facilities; assurance of security of tenure; and retained frameworks of establishments. Economic impacts included employment; affordable and durable units (p values <0.05). Upgrading process did not influence rent fees, was corrupt and led to displacement of residents. Conclusion: Slum upgrading process affected positively. Similar projects should consider residents in decision-making.

Index Terms; Innovative Construction technologies, Slum Upgrading, Mathare Valley slum, Social Impact, Economic Impact.

I. INTRODUCTION

Provision of sustainable housing has been a global challenge attributed to cost of resources including land, materials and finance; in addition to incremental demand for shelter especially in urban areas due to the rural urban migration. Universal declaration of human rights (1948) underscored adequate housing as on integral component of human rights.

Manuscript received on July 25, 2021.
Revised Manuscript received on August 09, 2021.
Manuscript published on September 30, 2021.
* Correspondence Author
Edmund Muthigani*, School of construction management and property studies, Technical University of Kenya. edmithamo@yahoo.com
Stephen Diang'a, Department of Construction Management, School of Architecture and Building Science, Jomo Kenyatta University of Agriculture and Technology, Kenya. sdianga@yahoo.com
Wanyona Githae, Department of Construction Management, School of Architecture and Building Science, Jomo Kenyatta University of Agriculture and Technology, Kenya.

This has been sustained by subsequent declarations and covenants like the 1992 earth's summit in Rio (Brazil) when the housing blue print on sustainable construction was inaugurated under agenda 21 and the habitat agenda. According to Department of trade and industry in Britain[1], innovation plays a key role in the economic growth a country, enhancing competiveness and raising the standards of living and therefore, innovation is central in modern knowledge-based economy. Innovation enables individuals and institutions successfully to exploit new ideas, products, and processes. There is need in construction industry to reduce the cost of construction, meet the rising demands for buildings by providing dwellings, which are socially acceptable, and economically sustainable and environmentally friendly. Construction industry should be constantly dynamic with innovative practices that focus on products and processes in order to deal with its continued challenges. Effective innovation in construction contributes to development of alternative building materials processes and designs that enable reduction of construction costs and in effect promote provision of low cost housing [2]. State innovations in the construction of low cost housing can take several forms including product innovation (changes in the products/services) which a construction firm employs; process innovation (changes in the ways in which the building designs are created and delivered)[1].Kenya, just like other developing nations, is faced by the need for better housing facilities at minimal costs. David (2014) acknowledges that various organizations have been involved in using effective innovation practices in slum upgrading projects aimed at meeting the increasing demand for houses and to improve the living standards [2]. Since building materials account for about 68% of the cos of residential construction in Kenya and innovative practices have focused on building materials [3]. Innovation especially in developing nations focused on sustaining innovations which have the effect of improving the efficiency, cost and performance of the new methods over the old by the use of the materials available[4]. Innovation in the construction industry in Kenya is advocated for to ensure production of socially acceptable houses as well as ensuring that the houses are economically viable to both the residents and the house owners[3]. The government through the National Housing Corporation (NHC) developed policies to increase allocation on research institutions on building materials and technologies and reviewed taxation on building materials.

The government also established National Research Coordination Secretariat (NRCS). The key mandate of NRCS is to provide coordination and dissemination of research results and promote the production of cost effective innovative building designs compatible with locally available and affordable materials [4]. In 2007, government of Kenya identified a set of incentives to encourage developers to employ innovative measures. These measures were aimed at reducing the construction costs by lowering taxes for building materials. However developers say this has had little impact [5]. Provision of decent housing is still a challenge in Kenya due to the continuous population growth and demand for low cost housing that cannot be effectively addressed by the construction industry[6]. Forms such as the tenure security, regularization, provision of infrastructure and community facilities do actualize it [7].

Provision of low cost housing in Nairobi County focused on employing innovative products (such as: Interlocking stabilized soil blocks (ISSB) for walling made by hydra form machine, a technology from South Africa. With the use of Kenyan battery-roofing tile vibrator technology, they made micro-concrete roofing tiles ; the cement sisal fiber using the light gauge steel technology from Kenya and processes such as site and services schemes as in Umoja 1, Dandora, slum upgrading projects like Mathare and Kibera estates have been completed [5].

In Kenya, innovations in building materials to produce the currently used stabilized soil blocks and “waffle” slabs [10]. Stabilized soil technique uses earthly materials, water and cement to make relatively strong-durable construction elements. These elements include blocks, tiles and foundations [10]. This technology presents economically favorable options to the conventional building materials that have been employed in slum upgrading in Mathare valley. Soil which is the main material is not only cheap but readily available while the portion of cement used is minimal. material production can take place on site and this reduces the cost of transportation while presenting work opportunities for the locals [10]. Use of concrete precast elements, which are small in size and laid on top of floor beams manually, and layer concrete topping as floor are becoming more established[10]. Slum upgrading in Kenya embraced use of pre-fabricated concrete units (waffles) that are assembled on and between floor beams. Temporary props support the waffles; respective reinforcements are fixed in between the precast units and a concrete topping is cast. In this case, the waffles are the permanent formwork, while the bottom side of the assembly serves as the ceiling to floors below. Interlocking stabilized soil blocks in walling require less mortar as compared to the quarry stones and are laid relatively faster. Such Innovative materials have ensured sustainable housing projects in Kenya and facilitated in saving about 50% of the cost of the building materials cost and labour[11].

Slum upgrading in Mathare involved the provision of shelters with walls in stabilized soil blocks, cements sisal roofing sheets and general infrastructural improvement. Use of innovative materials in slum upgrading projects has exhibited post occupancy challenges indicated by progressive deterioration of the upgraded elements including weathering of the earth block walls, rammed earth floors and leaking cement sisal roofs. Deterioration leads to increased maintenance cost and loss of the functional performance capacity and potential [11]. A significant negative consequence of slum upgrading among the residents is the fear of being displaced. This is because they anticipate the cost of the upgraded housing would be unaffordable, and that unit allocation would be marred by corruption [12]. The increased innovative construction practice has inspired extensive research on customer and user satisfaction, sustainability, quality and safety of the built environment. Slum upgrading projects should take the participatory approach where the residents are involved in decision making, implementation, monitoring, evaluation, and maintenance levels [12]. This study therefore sought to evaluate the outcome, social and economic impacts that are outcome of adopted innovative construction in housing in Mathare Valley.

II. METHODS

This study used exploratory-descriptive research design. Study sample was 324 established using Fishers formula. Stratified sampling technique was used to sample users of low-cost housing projects in Mathare Valley 4A. Strata included seven divisions in Mathare Valley. Building constructors in Nairobi County were purposively sampled. Research instruments included semi-structured questionnaires and interview guides administered by principal researcher. Quality assurance measures included pilot study, validity and reliability test that had an acceptable Cronbach alpha coefficient of 0.867. Ethical considerations included approval by university ethics committee and consent by respondents. Statistical package for social sciences (SPSS) software Version 21 (SPSS vs. 21) was used to compute descriptive and inferential statistics.

III. RESULTS

The study sample comprised of 67.6% male respondents aged between 30 and 49 years since the study targeted the households’ heads similar to study by UN-Habitat in 2005. Respondents aged from 30 years were presumed to be young when the slum-upgrading project started back in early 1990’s.

A Perception on improvement of houses after upgrade process

Significant majority of 81.1% study respondents felt that the slum upgrading process had improved the houses (p value= 0.012).

B Outcome and impact of the innovative construction

Outcomes, social and economic impacts of innovative construction employed in the upgraded slums were assessed on Likert scale.

Outcomes

Innovative construction positively influenced the community (p value <0.05). The positive outcome was evidenced by community improvement (69.2%); addressed problems in the previous buildings (59.4%);

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication

fulfilling experiences associated with the upgrade (60.8%); and lack of plans to leave the houses because of upgrade (50.8%). However, there were still pending problems that needed to be addressed despite the upgrade (93%) (pvalue=0.008).

There was increased perception that the community was better than before, improved self-esteem, care for community members, feeling at home, and acceptance as a community member, and community prosperity in the last five years (p value< 0.05). On the contrary, innovative construction did not positively influence the consistent presence of someone to help, and community honesty and trust for one another (p value >0.05). Innovative construction positively affected the individuals (p value <0.01). The positive outcome was evidenced by individuals' increased willingness to work collectively; willingness to invest further in the houses; willingness to help one another; and the positive perception on slums and the possibility of better living in slums. Innovative construction did not however influence individuals' trust for one another (p value=0.123).

Social impact

The positive social impacts of innovative construction included construction of communal facilities (62.7%); assurance of security of tenure to slum residents (63.2%); retained frameworks of establishments (58.9%); and developed units were not significantly smaller and built with higher densities (56.7%) (p value < 0.05). On the contrary, innovative construction was not concomitant to provision or improvements of infrastructure (44.3%); this led to displacement of residents hence little to no poverty reduction was achieved (67.0%).

Economic impacts

The positive economic impacts (p value <0.05) of innovative construction included increased employment opportunities in the maintenance of the upgraded buildings (58.9%). Middle-income individuals' lack of opportunity to occupy the upgraded houses meant for the slum dwellers (64.8%) more affordable upgraded dwelling units due to subsidies that makes them affordable than other houses of the same standard (85.3%); and durable houses of good structural quality (66.4%). On the other hand, innovative construction did not bring about minimum and maximum rent fees for different cadre of people living in the upgraded slums (62.4%); and allocation process of the units was unfarily affected by corruption (81%).

IV. DISCUSSION

Most of the study respondents felt that the slum upgrading process had improved the houses. The positive perception was attributable to the fact that before the upgrading process, the residents were largely tenants and therefore had to part with relatively high amount of rent to occupy the house. The project reclaimed the land from the former property owners, since it was government land, and compensated the absentee owners for the homes on the land. With this property, the Catholic Archdiocese then upgraded the infrastructure and created a non-profit housing system where the residents paid a fair amount of rent over a period of time (7 Years) to own the houses. These findings support UN-HABITAT (2008) that during the slum upgrading process there was insufficient attention paid to those residents who wanted to continue renting rather than owning the upgraded houses. [13]. The assumption is that considerable numbers of city dwellers wanted nothing more than to become homeowners. Innovative construction had positive outcomes implicated on the community. The positive outcome was evidenced by community improvement with the upgrading process; addressed problems in the previous buildings; fulfilling experience associated with the upgrade; and lack of plans to leave the houses because of upgrade. However, there were still pending problems that needed to be addressed despite the upgrade. The positive outcome was marred with pending problems that could be largely attributed to lack of consultation and involvement of the residents in the upgrading process to ascertain their needs as reported by Amnesty International (2009)[14]. In addition to the positive outcome on the community, there was increased perception that the community was better than others, increased pride for the community, care for community members, feeling at home, and acceptance as a community member, and community prosperity in the last five years. On the contrary, innovative construction did not positively implicate on the consistent presence of someone to help, and community honesty and trust for one another. Innovative construction positively implicated on the individuals. The positive outcome was evidenced by individuals' increased willingness to work collectively; willingness to invest further in the houses; willingness to help one another; and the positive perception on slums and the possibility of better living in slums. There was community improvement with the upgrading process that addressed problems in the previous buildings; fulfilling experience associated with the upgrade; and lack of plans to leave the houses as a result of upgrade. Innovative construction did not however influence individuals' trust for one another.

The positive social impacts of innovative construction included construction of communal facilities including toilet facilities, roads and proper drainage system.

"The most important thing is that we do not live as we used to. We have toilet facilities contrary to when we used to go for long call everywhere or in paper bags. There are roads and proper drainage system preventing flooding and other communicable diseases such as cholera. Water is easily accessible. Mathare has now become a better residential place just like other areas. The slum mentality is slowly fading away." (KII-1)

There was assurance of security of tenure to slum residents. Slum upgrading was actualized in various forms. These forms included the regularizing the security of tenure, provision and/or improving the infrastructure and in constructing communal facilities[9]. Similarly, in a Pumwani-Majengo upgrade project, beneficiaries argued that the project have led improved living standards with better sanitation, water supply and infrastructure [8].There were retained frameworks of establishments. Developed units were not significantly smaller though built with higher densities. Similarly, beneficiaries of an upgrade project expressed satisfaction with the houses functional , size and the aspect of having a storage space. [9].On the contrary, innovative construction was not concomitant to provision of or improvements to infrastructure; and led to the displacement of some residents hence little or no poverty reduction was achieved.

These findings were similar to Buckley and Kalarickal (2005) who found out that since slum dwellers were normally displaced during upgrading, little or no poverty reduction is normally achieved[16].

The positive economic impacts of innovative construction included increased employment opportunities in the maintenance of the upgraded buildings. Similarly, Kvarnstrom (2014) established that slum upgrading normally employed locally produced building materials, such as stabilized soil blocks, which were abundant in supply, and required easily acquirable skills, hence creating more job opportunities. SSBs used for the upgrading project were locally made and during the construction employment, opportunities were created.

"I was part of the group that was involved in the construction of these houses. We were contracted by the program implementers to prepare the construction materials. We used the raw materials, which was readily available where the buildings were being put up, to make SSBs that were used for the walls. Many employment opportunities were available for the women here. Some of us used the money we earned there to start our lives better in the upgraded houses and even to pay back and buy the houses." (KII-1)

Due to subsidies that made, the upgraded dwelling units were more affordable compared to other of the same standard. According to Muraguri (2011), there was high uptake of innovative construction in upgrading the slums due to reduced cost attributed to the availability of the raw materials and the simplicity of the construction[17]. On the contrary, Buckley and Kalarickal (2005) argued that the upgrading program was expensive during in the implementation process due to provision of subsidies making rent became unaffordable to majority of slum dwellers[16]. A Study on Pumwani-Majengo upgrade project reported that there was lack redevelopment strategy to address sufficiently the community economic empowerment aspects to enabled the project beneficiaries to access means of improving their livelihoods. In addition, there was no direct involvement by the government to subsidize the beneficiaries in paying the monthly rents/mortgages [8].The upgraded dwelling units were durable and of good structural quality. On the other hand, innovative construction did not bring about minimum and maximum rent fees for different cadre of people living in the upgraded slums. There was lack of opportunity to occupy the upgraded houses by many middle-income individuals. However, allocation process of the units was subject to be affected by corruption. These findings echo those of Huchzermeyer (2008) who found out that corruption was a significant negative consequence of slum upgrading that would affect unit allocation. Middle-income individuals always had opportunity to occupy the upgraded houses meant for the slum dwellers in Kenya. This was iterated by one of the key informants [12].

"There are several outsiders who were able to get houses during the slum upgrade; additionally those who were able to pay more were able to influence the process so that they can get bigger and better houses than the rest of the slum dwellers" (KII-1)

V. CONCLUSION

The employment of innovative construction technologies enhanced both economic and social development in Mathare Valley. Certainly, the innovative construction in slum upgrading in Mathare Valley had succeeded in building some schools, roads, clinics and other facilities. However, the beneficiaries did not attest to improvement in their standard of living as a result of the upgrades. The innovative construction adoption method should not focus on the demolition of the already existing structure but rather improvement of the existing structures. A more pro-poor approach would stop viewing slums as areas to be demolished but as areas to be rehabilitated. Slum upgrading process should involve the residents in assessing and determining their needs to ensure construction of houses that best suit the residents. This is achievable using a bottom up approach which allows for involvement of the residents in the implementation process and aids decision making. The residents can appoint a representative committee to oversee the transition processes. The committee should be motivated and monitored to ensure optimum service delivery. The committee also allows slum residents to be heard by the project sponsors by representing them. This further promotes participation of the residents and institutionalization of the innovative construction methods as residents identify with the methods. The process of slum upgrading is often marred with irregularities including corruption, lack of political good-will, and influence from middle income earners in the allocation of houses among others. There is need for effective monitoring of every step in the upgrading process to ensure all stakeholders' satisfaction, avoid displacement and minimize chances of political interference.

REFERENCES

1. DTI, Innovation in Service. London: Department of Trade and Industry, 2007.
2. K. David, "Construction of low cost houses in informal settlements: A case study of the Nairobi region.," Department of Civil and Electronic Engineering, Chlmers University of Technology, 2014.
3. M., P. Syagga, "Promoting the Use of Appropriate Building Materials in Shelter Provision in Kenya.," Habitat International, vol. Vol. 17, no. No.3, pp. 125-136, 1993.
4. C. T. Koebel, "Innovation in Homebuilding and the Future of Housing," Journal of the American Planning Association, 74(1), pp. 45-58, 2008.
5. Republic of Kenya, "Sessional Paper No. 1," Nairobi, 1990.
6. Ministry of Housing, "Responsibilities and Mandate of National Research Coordination Secretariat," Nairobi, 2004.
7. R Kalra and R Bonner, "Addressing Climate Change with Low-Cost Green Housing," Geneva, 2012.
8. G Cheserek and G Opata, "Environmental and Housing Problems of Low-Income Households in Eldoret Municipality," Department of Social Studies, University of Nairobi, 2011.
9. M Majale, "Employment creation through participatory urban planning and slum upgrading: The case of Kitale, Kenya," Habitat International, vol. Vol. 32, no. No. 2, pp. 270-287, 2008.
10. D. Kvarnstrom, "Construction of low cost houses in informal settlements," Göteborg, Sweden, 2014.
11. Dan Andabati, Interlocking Stabilised Soil Block – ISSB – Construction handbook. Uganda: Good Earth Trust, 2010.
12. Mwangi, "A Study on the Maintenance of Drainage Systems on Public Roads and Pavements, a Case Study of Nairobi's Industrial Area," 2013, 2013.
13. M Huchzermeyer, "Slum Upgrading in Nairobi within the Housing and Basic Services Market: A Housing Rights Concern," Journal of Asian and African Studies, vol. Vol. 43, no. No. 1, pp. 19-39, 2008.

14. UN-Habitat, Housing and Urban Upgrading in Yantai, China. Nairobi: United Nations, 2008.
15. Amnesty International, "Kenya: The Unseen Majority: Nairobi's two million slum-dwellers," 2009.
16. V. O. Mgele, "Evaluation of Slum Upgrading and ReDevelopment in promoting Sustainable Urban Human Settlements: A case of Pumwani-Majengo Housing Project, Nairobi County," Nairobi, 2014.
17. K. Zappettini, "Rural Self-Help Housing: A Post Occupancy Evaluation of Homeowners' Satisfaction with Residential Space Plan Design and Housing Quality," Virginia, 2001.

AUTHORS PROFILES

Edmund Muthigani, is a Lecturer at the Technical University Kenya, School of Construction Management and Property studies. He possesses the following qualifications. B.Phil. Construction project Management (UoN); HND Building construction (TUK); Dip. Building & Civil Engineering) (TUK); Dip. Tech education. (KTTC); M.A.A.K. (CPM). His specialized areas include Construction Project Management consultancy; Construction Contract Documentation; Measurements of building and Civil works; He is a former chairman of the department of real estate at the technical university of Kenya. He is the Managing director. Memconsult, Design and Build projects.

Prof. Stephen Diang'a, is an Architect and Associate Professor of Architecture and Human Settlements in the School of Architecture and Building Sciences, Jomo Kenyatta University of Agriculture and Technology (JKUAT), Nairobi, Kenya. He holds a B.Arch degree from University of Nairobi, M.Arch Eng. degree from Catholic University of Leuven, Belgium and a PhD degree in Architecture from University of KwaZulu-Natal, Durban, South Africa. He is past Chairman, Department of Architecture and past Dean, School of Architecture and Building Sciences at JKUAT. He has participated in a number of urban and housing polices forums focusing on low cost housing and informal sentiments. He is also a practicing architect and a researcher and has published widely in various professional journals.

Dr. Wanyona Githae, is a Senior Lecturer at Jomo Kenyatta University of Agriculture and Technology (JKUAT). He attained his B.A in Building. Economics from the University of Nairobi-Kenya, M. Engineering (Kyoto University, Japan) and his PhD (UCT, South Africa). His specialized areas include Construction Project Management, Construction Contract Documentation, Project Risk Management, Project Procurement Systems and General Quantity Surveying. . He has participated in a various of professional seminars and workshops on housing. He is also a practicing Quantity surveyor and a researcher and is widely published in various peer reviewed journals.