ANALYSIS OF THE BUILT ENVIRONMENT OF INFORMAL SETTLEMENTS USING SYSTEMS OF SETTING S AND ACTIVITIES.

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Abstract
This study seeks to identify and propose relevant elements and components of the built environment of the informal settlements that need to be considered in intervention strategies and design. The paper is based on empirical research that focuses on informal settlements in Nairobi with the objective of establishing parameters that adequately address the physical, social and economic aspects of the dwellers, which are considered useful in the regularization of these settlements. The built environment provides the setting for human activity and Environment-Behaviour Relations which deals with the relationship between people, society and the built environment offers an appropriate framework of analysis for the derivation of useful design parameters for settlement improvement. With this intention, the paper is composed of three main parts. In the first part, the concept of environment is related to systems of settings and the embedded systems of activities. The second part presents systems of settings and activities in an informal settlement both at the neighborhood and dwelling levels. Finally, the third part presents elements and components of the built environment that play dominant roles in informal settlements. According to the study, systems of settings and activities offer a useful framework for the analysis of the built environment and facilitate the identification of settlement characteristics that form important design parameters in the improvement and regularization of informal settlements.

Keywords
Systems of settings; systems of activities; built environment; informal settlements; design parameters.

Introduction
Most studies in housing describe the different ways to house the poor and deal with the complexities of urban settlements. As summarised by Hamdi (1991) some studies focus on institutional changes needed to lever more equitable housing with more efficient cost and resource saving techniques. Some focus on market operations and enabling environment that encourages housing delivery and choices. Some point to technical aspects of building, designing, and utilizing land more efficiently. Yet others measure the impact of policies on housing delivery systems. Some look at housing in the context of development and urbanization seeing housing as a developmental and urbanization problem. As observed by Rapoport, (2001) and Clapham (2002), very little attention is given to environmental/behavioural determinism of the built environment that has
great impact on the way people live. The built environment generally refers to the manmade surroundings that provide the setting for human activity, ranging from the large-scale civic surroundings to the personal places (Bartelmus, Bringezu, & Moll, 2001). It reflects a settlement’s history, culture, beliefs, lifestyles, social, and economic organization (Vischer, 2008). A clear understanding of the factors that generate the built environment is a useful approach towards the understanding of the link between housing and its neighborhood. This is important information for designers dealing with aspects of settlement upgrading, urban renewal and redevelopment. In this regard, Environment-Behaviour Relations which deals with the relationship between people, society and their built environment offers a useful framework of analysis for the derivation of useful design parameters that can assist in the design of informal settlements intervention strategies.

Culture has been established to be the link between the built environment and human behaviour (Rapoport, 1993). Behaviour entails “activities” and these take place within “settings”. This paper is concerned with the relationship between “activities” and “settings” and the “systems” within which they interact. Whereas this approach gives emphasis to physical environment, it entails a holistic evaluation of the settlements’ built environment including forms of shelter, organization of space, systems of settings, cultural landscape and other fixed, semi-fixed and no-fixed features, including all the actors within the established context (Moore, 2004; Rapoport, 2001).

This paper illustrates a systematic approach to development of a comprehensive and exhaustive framework for analysis of informal settlement’s built environment by way of deriving specific variables from fundamental principles and constraints that determine neighborhoods and dwellings characteristics and functions. The paper examines informal settlement parameters that could be useful in the design of sustainable housing environment for the urban poor. The study adopts Moffatt and Kohler’s (2008) definition of variables of built environment based on a sequence of elements and components that sustain a neighborhood system as well as the dwelling system. The built environment of selected informal settlements in Nairobi were explored to identify, account and document the prevalent systems of settings and activities at neighborhood and dwelling levels and their implications on the characteristics of the built environment. The objective was to establish positive built environment attributes that relate to the dwelling and neighborhood qualities associated with the urban poor.

The study was conducted in Mathare Valley which is an informal settlement located along the Mathare and Gitathuru river valleys approximately 6 Km to the East of Nairobi’s city center as illustrated in figures 4 and 5. It is the second largest settlement of this nature after Kibera. The 1999 Population and Housing Census put the population of the Valley at 69,003. The settlement is bounded by Pangani to the west (which was originally an African settlement before their houses were razed to the ground and the land allocated to Moslem Asians), Juja Road to the south, Outer Ring Road to the east, and to the north, a section of private housing, the Mathare Mental Hospital, Police housing, several company sports-grounds and a drive-in-cinema. Across the Outer Ring Road is a light
industrial area offering employment to a large section of the population. These boundaries enclose an area of approximately 496 acres. Juja Road connects the entire Valley to the rest of the City and there exists an efficient public service transport to the City Center.

The study was explorative in nature and used qualitative research method. Mathare Valley settlement was selected for the study due to the fact that it is the oldest informal settlement in Nairobi and presents a mosaic of intervention approaches. There are distinct neighborhoods in the settlement providing appropriate setting for the study. There are ten villages (also referred to as neighborhoods) in the settlement including three major housing intervention projects namely Ngei, Huruma, and Mathare North. All these settlements depict varied levels of informalities. On the basis of the objectives of this study, three neighborhoods were selected for in-depth study because of the characteristics they presented. Village III was selected as a case because of its location on government land, high population density, and minimal improvement interventions. Mathare IVA (Village IVA) was selected because of its upgrading program aimed at the provision of rental housing. The third case, Ngei II, was selected because it presents informal settlements of both permanent and temporary buildings.

Four clusters were selected in each case, representing a total of 10 per cent of the household population. The criteria used in identifying the clusters included physical characteristics of the dwellings, network of roads and footpaths, open spaces, activities such as commercial, recreation, and sanitation. This convenience sampling involves purposive or deliberate selection of particular units of the universe for constituting sample that represents the universe. The criterion for selecting these dwelling units was based on their immediate surroundings. Factors considered included their locations in relation to minor footpaths, major footpaths, proximity to open spaces, the two rivers, and public utilities. The selected dwellings were marked on the neighborhood map. The layouts of each of the dwelling units were sketched indicating activity settings. Primary data was collected by way of observation of spatial utility and configuration and interviews of residents.

**Systems of Settings and Activities in Housing**

A system is an assemblage of interrelated parts that work together by way of some driving process (Albeverio, Andrey, Giordano, & Vancheri, 2008). Systems are often visualized or modelled as component blocks that have connections drawn between them. According to Moffatt and Kohler (2008), most systems share the same common characteristics which include: the quality of having a structure that is defined by its parts and processes; a generalizations of reality; systems that tend to function in the same way; functional and structural relationships between each other; a flow and transfer of some type of energy and/or matter; exchange energy and/or matter beyond their defined boundary with the outside environment and other systems through various input and output processes; functional relationships occurring because of the presence of a driving force; parts that make up a system show some degree of integration.
Attempts to define the built environment in relation to systems contrast the built environment to the ‘un-built’ environment or the ecosphere (Moffatt & Kohler, 2008). The argument here is that in a system representation, both the built environment and the ecosphere can be considered as complex, dynamic self-producing systems which exist in loose, nested hierarchies, each component system contained by the next level up and itself comprising a chain of linked subsystems at lower levels. (Rees, 2002, as cited by Moffat and Kohler, 2008).

Rapoport (2001), on the other hand, presents a conceptualization of the built environment that is dismantled into four complementary components namely:

1. the organization of space, time, meaning and communication
2. a system of settings within which systems of activities (including their latent aspects) take place
3. the cultural landscape
4. composed of fixed, semi-fixed and non-fixed elements

These components form part of a system of settings which in turn, is embedded in different ways into larger systems of settings such as blocks, compounds, neighborhoods, and settlements (Rapoport, 2001). Accordingly, a house comprises of a system of settings within which systems of activities take place. Houses may differ in terms of cultural, social and economic backgrounds but they may be compared in terms of activity settings that they shelter such as cooking, sleeping, lounging, etc as depicted by Rapoport (2001) in Figure 1 and by the author in Figure 2 below. These activity settings are present in every dwelling whether a single roomed shack in a slum or a mansion in an up-market neighborhood. What differentiate the settings in the two different dwellings are the
Spatial allocations for the systems of activities.

Neighborhoods too comprise of systems of settings embedding systems of activities. These may include elements such as clustering of buildings in lots or blocks, zoning of space for facilities such as commercial, educational, social, recreational, religious, infrastructural, etc. Also considered as an important built environment determinant according to Rapoport (2001) are lifestyles and rules about what behaviour is appropriate in which setting (Baumgartner, 1988 as cited by Rapoport 2001), which influences acceptability and definitions of crowding, privacy, etc. and thus environmental quality. Figure 3 is a graphical representation of the relationship between housing defined as a system of settings, and the larger systems of neighborhood and settlement.

Thus in the context of this paper, the built environment is conceptualized as the set of all facilities constructed by humans to meet their needs and aspirations. Each facility, in conjunction with its users and location, can be considered as a system. Facility systems can then be defined as the set of physical elements comprising a built facility, the site on which it stands, plus the stakeholders who impact or are impacted on by the existence of the facility (Moffatt & Kohler, 2008).

**Mathare Valley Settlement as a System Settings and Activities**

The term ‘settlement’ has varied meanings. In this study the term is used to refer to human settlements. The 1976 United Nations Conference on Human Settlements Vancouver Declaration defined human settlements as:

“... the totality of the human community - whether city, town or village - with all the social, material, organizational, spiritual and cultural
elements that sustain it. The fabric of human settlements consists of physical elements and services to which these elements provide the material support. The physical components comprise of shelter, infrastructure, and services.” (UNCHS 1976)

A settlement can be viewed from Macro, Meso and Micro scales. The Macro-scale views a settlement at city or town scale. The Meso-scale views the settlement at neighborhood scale and the Micro-scale views the settlement at dwelling scale. A city is a settlement but when viewed from a macro-scale level, it comprises of numerous distinct settlements supported by numerous facilities. In the case of Nairobi, these relate to the zoning approach to planning that was applied at various stages of its development. This modern planning approach differentiates residential areas from other facilities such as industrial and commercial. The residential zones are also further differentiated according to social groupings based on income levels. Further division arise from adherence to or none adherence to planning regulations which has led to the development of planned and unplanned settlements or informal settlements.

At macro-scale level, the city of Nairobi as a system was noted as incorporating 135 informal settlements of varying sizes ranging from large one such as Kibera with a population of over 500,000 to smaller one as Runda. Large informal settlements such as Kibera and Mathare are too large to be considered as single neighborhoods. The study concluded that these large informal settlements comprise of numerous neighborhoods with interlinking facilities such as roads, footpaths.

Figure 4: Map of Nairobi showing the spread of informal settlements (Source: City Council of Nairobi, 2006).
Other interlinking facilities include schools, churches, mosques, and health centers which serve more than one neighborhood. Figure 4 is the map of Nairobi showing the locations of these informal settlements. Given the similarities, the paper focuses on Mathare Valley as a case study area.

The concept of the built environment as embodying systems of settings for systems of activities was applied in the analysis of Mathare Valley informal settlements. It was observed that aspects of the settlement’s context were important to this analysis. For example, the inception of Mathare Valley settlements as small villages characterised the existing neighborhoods. In the formative years, the neighborhood settings were predominantly rural in nature with scattered dwellings and cultivated fields. Some of these initial settlements stretched over several plots privately owned by individuals while others were on government land. Over the years the neighborhoods grew into densely populated settlements with elaborate systems of facilities including footpaths, roads, schools, shops, churches, community halls, health facilities etc.

The activities of the 22 land buying companies formed with the objective of securing land tenure for all the squatters aided the definition of the settlement’s built environment. Each company pursued its own objective of meeting the housing needs of its members. As a result, varied housing typologies were developed which are only evident from close scrutiny. Figure 5 shows the Mathare Valley settlement and its neighborhoods. Huruma, Ngei and Mathare North are planned settlements whilst the rest are unplanned settlements. However, in this study the planned settlements are categorised as informal settlements due to the fact that they have flouted Nairobi City Council building development regulations.

Figure 5: Mathare Valley Villages and environs. (Source: Derived from 2006 Survey of Kenya aerial photograph by the authors).
Mathare Valley as an urban settlement comprises of several neighborhoods whose origins as villages have already been described above. These neighborhoods are interrelated and complimentary. They are interlinked by systems of roads and footpaths and flow into one another. They are also served with common facilities such as schools, churches, and government administrative set ups among others, making the settlement a community. Among the neighborhoods, Mathare 4A is the most discussed because of the on-going upgrading program which aims at developing rental housing units in response to the dominant tenure system in the settlement. The concealed location of the settlement in the valley encouraged its growth. The study concluded that at macro-scale level, systems of settings and systems of activities were limited to facilities such as commercial, social, and infrastructural nature.

**Systems of Settings and Activities at Neighborhood Level**

Neighborhoods are localities where dwellers live closely. They are typically generated by social interaction among people living near one another (Mumford, 1954). In this study, neighborhoods were considered as occurring at the meso-scale level and comprise of groups of dwellings and supporting facilities. Three neighborhoods were selected for in-depth study but in this paper, only one neighborhood is reported namely, Village 4B. Contextually this village was developed on land that was not so easily accessible at the confluence of Mathare and Gitathuru rivers.

Unlike most of the informal settlements in the Valley, Village 4B developed on government land, a fact that has contributed to its relatively high density. There was a response to the topography with dwellings being constructed along the contours on the gently sloping land. Figure 6 is an aerial photograph of the settlement clearly showing the configuration of the neighborhood. Dwellings and an inventory of the existing facilities were mapped as shown in Figure 7 following a general survey of the neighborhood by the author. Four clusters indicated in Figure 7 were identified for detailed and formed the basis for the analysis of the neighborhood’s systems of settings and the embedded systems of activities.

![Figure 6: An aerial photograph of Village 4B neighborhood showing the densely built environment. (Source: Authors).](image-url)
from the aerial photograph. The system of settings in the neighborhood is dominated by a system of footpaths serving the dwellings and related facilities. Two categories of paths were established. Narrow paths of an average width of 1.2 Meter serve the dwelling blocks. Broader footpaths of between 2 and 3 Meters form the major pedestrian circulation spine. In addition to being the major spine from which the smaller paths radiate, the spine hosts facility systems including shops, social halls, religious premises, a school and a health center. This sequence of activities is illustrated in Figure 7. The network of footpaths and the facilities it supports were informally planned and is an indication that dwellers of informal settlements can establish and provide some of the basic needs of their neighborhoods. Figure 7 below indicates the systems of settings and facilities in the neighborhood. The pink paths are the narrow paths while the yellow paths are the broader one described above.

The 3 by 3 meters configuration of dwelling units has formed a module that is applied in all the facilities in the neighborhood. Facilities such as schools and churches respond to this module. This is attributed to the fact that such facilities are a later introduction and have been hived off from existing dwellings. Open spaces, unlike the footpaths appear to be incidental as opposed to being consciously considered.

Sanitation is provided communally with the city council and charitable organizations having built sanitation blocks. These are complemented with pit latrines especially along the riverbanks. Unfortunately, the location of the pit latrines along the riverbanks and the damping of solid waste here has contributed to the heavy pollution of the river. It can be concluded that Village VB neighborhood is based on maximum utilization of the available land albeit to the detriment of the dweller’s well-being. Majority of the dwellers interviewed are dissatisfied with the state of their neighborhood environment but display considerable apathy towards its improvement having resigned their tribulations to fate that befalls the poor. Despite these setbacks, the neighborhood presents an effective system of settings and related activities.

**Systems of Settings and Activities at Dwelling Level**

According to the study, there is one common housing typology defining the dwellings’ systems of settings and activities. This single roomed dwelling configuration is set in closely built rows of blocks, set back to back as indicated in Figure 8. Even though the setting of the dwelling
unit limits the systems of activities that it hosts, it was observed that the systems of activities in each dwelling had the following basic systems of activities: sleeping, cooking, eating, and resting. These are basic systems of activities that would be expected in any dwelling of minimum standards.

The narrow footpath between the residential blocks are multifunctional spaces and forms the immediate open spaces supporting numerous systems of activities in addition to pedestrian circulation. These include washing of clothes and dishes, drying of clothes, lighting of charcoal stoves, outdoor relaxation, and children’s play area. These footpaths also serve to light and ventilate the dwellings in addition to embodying the storm and foul drainage. Observations indicated that these paths are overloaded with activities and in most instances, present the filth of the built environments. Mothers and toddlers spend most of their time in these paths/open spaces. Older children and men tend to spend their time along broader open spaces and the broader footpath.

Systems of activity settings were sketched in each of the dwellings surveyed samples of which are indicated in Figure 10. Sleeping as a system of activity dominates the dwelling system. 60 percent of the dwellings have two bed spaces while the rest have only one bed space. The use of double-decker beds is much lower than would have been expected.

Lounging is as an activity is given prominence in the dwelling even though it takes much lesser hours as compared to sleeping.
Furniture provision defines the spatial utility for this activity. Furniture provision ranges from use of simple stools to more elaborate sofa sets. Cooking, although a much more complex system, is generally confined to a much smaller space. There is much flexibility of spatial utility for this activity with some households shifting the cooking stove towards spacious area of the room when the nature of cooking demands more space. The use of paraffin stoves eases this flexibility. The dwellings have no flues over the cooking area but the roof structure in most cases allows fumes to pass through. Eating as an activity utilizes the same space as lounging and multiple use of space for a number of activities is a common occurrence. For example the bed is used as a seat when the need arises.

**Conclusion**

Design has been defined as a process that focuses on the components or elements of a structure or system and unifies them into a coherent and functional whole. System based analysis of the built environment enables a critical review of the built environment leading to useful data that can assist in the formulation of intervention strategies and design. At macro-scale level of a settlement, systems of settings and activities are not as evident as they are at meso-scale level. This can be attributed to the repetitive nature of systems of settings at the neighborhood level, as it is these neighborhoods that make up the macro-scale settlement level. Thus the neighborhood is the most significant element within the settlement systems of settings.

Systems of settlement settings center more on socio-economic settings of the community, which determine the elements and components of a settlement. Associated with this is access to land with the economically disadvantaged groups squatting on public and private land with

![Figure 9: Two blocks of back-to-back 3 x 3 meters single roomed dwelling units set closely with a narrow footpath in-between (Source: Authors).](image)

![Figure 10: Sample sketches of activity settings as observed in the dwellings (Source: Authors).](image)
minimal amenities. Even where settlements are planned, categorization of the housing as low-income housing bears a reference to the low-income social group. Thus the housing typology and the resultant built environment characterize the socio-economic group’s capabilities.

Elements and components of neighborhood systems bond the neighborhood community. The clustering of houses, the network of roads, footpaths, open spaces, and services such as water, sewerage, define the resultant built environment and are important design parameters for neighborhoods. Social, cultural, and economic elements are important design parameters at the neighborhood level and play a major role in the definition of the neighborhood’s built environment.

At the dwelling level, the ability of households to adopt minimal spatial standards is evident. Even within these minimal spaces, there are indications of variations in the provision of facilities for varying systems of settings within the dwelling. Poorer households exhibit very limited provision of furniture with some only providing mattresses laid on the floor and simple stools as furniture. This is indicative of limitations arising from livelihood capabilities of the households.

The 9 square meters floor area provided for each household in the informal settlement is a dismal provision in comparison to the 36 square metres stipulated in the housing policy as minimum standard for adequate housing. However, the study could not establish whether the size of the dwelling units in this settlement limits the spatial allocations for the activity systems or whether the activity systems as set by the households are all that they can afford and need no more spatial allocation than is provided. This can only be established by linking the analysis of the built environment to analysis of livelihood capabilities and constraints.

References


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