Pathways to Drive (Social, Economic and Physical) Transformation of Informal Settlements into Sustainable Urban Neighbourhoods: a Case of Johannesburg

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1 ABSTRACT

Globally, several studies have been commissied on informal settlements, particularly in cities such as Barcelona, Johannesburg, Cairo and Lagos. Much of the literature on urban informality from several disciplines maintain that informality occurs as a result of globalisation and population exclusions that occur due to development and urbanisation. Besides the prevalence of this phenomeon, there still lacks scholarly work that fully tackles the epistemology behind informal "otherness" of the urban form. Apparent gaps are notable in informal economies and communities which are detached from formal communities and thus, function to a greater or lesser extent without the intervention of formal economies. This paper focuses on investigating pathways to transforming informal settlements into sustainable urban neighbourhoods. The research adopted a case study research design wherein Johannesburg was used to investigate the socioeconomic political dimensions of informal settlements. This draws from various narratives that were employed to articulate the rationale behind informal settlement developments along with a contemporary understanding of the concept. This will further be contextualised under the spatial theme with reference to the urban form of the informal regions Therefore, the paper adopted a mixed method approach making reference to both a quantitative and qualitative research approach by means of a case study research design wherein various spatial planning tools are reviewed pertinent to the research objectives and offered a narrative perspective to the research aim and questions. We further conducted multiple interviews with various officials of the Johannesburg Department of Housing as a primary data collection method and a thematic analysis was respectively employed as tool of analysing the data The findings indicate that Johannesburg functions as a partial satellite city with sub-cities connecting to it and informal settlements in these areas have developed in a similar pattern. They form behind commercial spaces for the convenience of accessibility. A common trend across these settlements is their informal design typology and the lack of formal masterplans in conjunction to the city's spatial development initiatives. Proximity to existing economic nodes such as Midrand, Kempton Park, and Sandton, provides a vantage point to both informal, transitioning, and formal urban forms. Across Kaalfontein, the informal urban form comprises natural and formalised street layouts. The erven are densely divided and are often influenced by the spatial landscape and density of the population. These findings indicate that there exists a need to critically and intrinsically query the expectations and rationale that lies behind local government strategies and policies that purport to be directed towards the sustainable upgrading of informal settlements and slums. Set against a background of entrenched socio-cultural protocols, limiting institutional processes, and economic disparity as noted in other strategic documents of the city, there exists a difficulty in integrating informal settlements into sustainable urban forms. In an era of joint ventures and ascendancy of neo-liberal market policy, informal settlements are increasingly at risk of being subject to the "full force" of formal state law to enable the redevelopment process to proceed. Consequently, The paper concludes by generating new perspectivess on sustainable urban forms under the context of informal settlements and provides clarity on how the city can employ the proposed indicator matrix toolkit to gauge informal settlements urban form sustainability performance. Key to the application of this matrix tool is geographic information systems software and spatial processing tools that can effectively deduce the relationship performance of various elements in facilitating the desired growth.

Keywords: Informal Settlements; informal urban form; sustainable urban form; Informal settlement upgrading; spatial transformation.

2 INTRODUCTION

A variety of studies maintain that informality occurs as a result of globalisation and population exclusions that occur due to development and urbanisation (Romero et al., 2016). Drakakis-Smith (1981) however, provides an alternative argument in which the scholar maintains that the "urban growth of the 21st century is taking place in the developing world, but many of the theories of how cities function remain rooted in the

developed world". As such, contemporary urban sociology reveals new points and factors which lead to a contemporary understanding of urban informality, with factors such as social, economic, and political issues being some of the focus areas that urban sociological studies tackle. Jones (2016) elaborates that in contemporary city planning and urban renewal, there has been a development of new theories and approaches focused on the space division of the city, which debunk the myths encircling informality. The new city planning theories bring a new division and approach which states that informal economies and communities are detached from formal communities and thus, function to a greater or lesser extent without the intervention of formal economies. These new theories paved the way to a broader understanding of informal settlements - subsequently defining the existence of informal settlements as a result of socio-economic growth and spatial improvements made in cities.

The formation of informal settlements in a historical context, therefore, needs to be understood in-order to develop city planning methodologies that will satiate all needs of city planning. As such, this research assesses the socioeconomic political dimensions of informal settlements and aims to assess informal settlements within the national mandate of radical spatial transformation to provide for a just spatial economy that is equitable and sustainable from a socio-spatial economic perspective. The research aims to offer an outline on the role of spatial planning mechanisms and housing policies in achieving sustainable urban forms. In order to realise the research aim, the research is premised on the following 4 objectives:

- Conceptualising the notion of "sustainable urban form" from an informal settlement perspective
- Providing a status quo overview analysis of the current spatial planning mechanisms and directives in relation to informal settlements.
- Evaluating various socioeconomic spatial elements taken into cognisance in the incorporation of informal settlements within sustainable urban forms
- Proposing a performance-based monitoring matrix for assessing the sustainability of urban forms in informal settlements.

This draws from various narratives that were employed to articulate the rationale behind informal settlement developments along with a contemporary understanding of the concept. This was further contextualised under the spatial theme with reference to the urban form of the informal regions. This study was premised on the scholarly work of the likes of Escobar (1985); Sánchez (1985); Augustijn-Beckers et al. (2011) and Vaughan (1997) to mention a few, who have closely monitored and assessed the urban form of informal settlements in the context of the socioeconomic political themes to oversee the influence they have on the communities who reside in these spaces. The study starts with providing a conceptual synopsis of sustainable urban form relating to the physical, ecomonical, environmental and social challenges of informal settlements, it goes on to discuss applicable policy and regulation and it ends by proposing a conceptual performance-based monitoring matrix for assessing the sustainability of urban forms in informal settlements.

3 CONCEPTUAL SYNOPSIS

The development and growth of informal settlements has been an on-going challenge globally. Although city planning initiatives have been established to mitigate informal land occupation, these land occupation anomalies still continue to grow all over the world, more especially in low-income countries. As per the nature in which land is occupied, informal settlement inhabitants are susceptible to many dangers due to the lack of safety, a clean environment, lack of access to basic services and lack of access to health care. There are many reasons behind the development and mushrooming of informal settlements; with the rationales being interlinked. At the forefront of these reasons is population growth and rural-urban migration, which serve as the most influential push factors towards the development of informal settlements. Additionally, the role urban settlements play in the process of this facilitation is acting as temporary domiciles for migrants who come to occupy these spaces. Global political activity and unrest contribute greatly toward the issue of global migration, as a result, the observed trend in this is that contemporary demographics will be affected by the development of informal settlements (Winayanti, 2004). Thus, informal settlements as part of unsustainable development have to be understood in the context of rural-urban migration and population growth as subsets of socioeconomic political dimensions. With the existence of these issues, policy making and the implementation of it thereof becomes a strenuous and rather crippled process due to the fact that

rural-urban migration grows rapidly and the formation of informal settlements is in direct proportion to rural-urban migration globally (Weksea et al., 2011).

3.1 Sustainable Urban Form

Development motives in Gauteng reflect numerous global patterns. It is South Africa's smallest province, but its demographic growth is the quickest in the country (Condo, 2010). However, the inheritance of apartheid racial discrimination continues to have an impact on spatial imbalance, as a result of deliberate spatial division between racial groups as well as functions (separating commercial and residential areas). This has resulted not just in structural discrimination with disproportionately worse accessibility for the black population of resources and opportunities, as well as in cities with isolated housing and commercial areas.

The post-apartheid government placed substantial importance on building completely funded low-cost houses for underprivileged South Africans, through the 1994 Reconstruction and Development Programme (RDP) (Dovey, 2013). The dual purpose of this programme is to offer enhanced living conditions and the needed support to let these inhabitants rise out of poverty (Huchzemeyer, 2011). In South Africa, the delivery of low-income houses is realised as a opportunity for people to get on the housing ladder, with the main purpose of altering the tenure profile of property (Argo et al., 2013).

Government housing developments in the initial post-apartheid years, tending to be low-compactness and situated on the urban advantage, have been disparaged for aggravating spatial apartheid, inequality, barring and urban sprawl, and establishing incompetent land-use designs with high resource consumption trajectories (Gnatz et al., 2016). Dempsey et al. (2009) suggest that the government's housing policy has created "vast RDP archipelagos that sit in a kind of peri-urban limbo-like loosely-associated satellites".

Considering reviews of RDP, the government announced the 2004 Comprehensive Plan for Housing Delivery: Breaking New Ground (BNG) to address and realign low-income housing policy. The BNG policy redefined the housing delivery method as one that thoroughly tackled wider-ranging effects of apartheid – focusing on "sustainable human settlements". This emphasis moved in the direction of housing as a facilitator for enhancing the quality of life, decreasing inequality, and utilising housing development as an instrument in spatial reorganisation. A significant acknowledgment was the necessity for cohesive housing developments in well-located regions, where needs of more than just housing can be met – exclusively concentrated on urban areas (Dempsey et al., 2010). In compliance with these principles, the Gauteng government proposed public housing programmes as an important tool of constructing integration, by offering essential services and allowing access to economic possibilities.

3.2 Socio-Economic Spatial Elements

Urban planning in South Africa is happening within the framework of extraordinary social and political changes. The social problems have got to do with high levels of joblessness and poverty, the catastrophic HIV/AIDS outbreak, and the rise in crime and worry for both personal and property safety according to data from the Institute for Security Studies (ISS). Politically, the challenge has something to do with the fight to balance out the need for a devolved system of governance from national to municipal and ultimately to the local level of vicinity/ward, with even more unified and graded decision-making procedures. The latter tends to be more conducive to the requirements of government and conferred interests (Hamdi et al., 1997, cited in Handal, 2005:2). The economic challenges have to do with the consequences for the growth in the incorporation of South Africa into the international economic arena, which marked a shift in the macro-economic policy to the neo-liberalism of the Growth, Employment, and Redistribution (GEAR) strategy.

Ever Since 1994, the vocational challenge has had mostly to do with the (difficult to fault) great and passionate effort of reforming a broken society (Harrison, 2001:69). Ideas like the compact metropolises approach, comprehensive development planning, sustainable growth, and participatory design approaches have turned into common language in the post-apartheid urban planning dictionary. Nevertheless, the application of these ideas has resulted in utter inconsistencies that escort planning practice. For instance, walling-off and cordoning streets and neighbourhoods from each other and the growing phenomenon of gated communities are the reason behind Integrated Development Plans (IDP), which pursue to attain the exact opposite through big investment in public infrastructure to fight the same disintegration and spatial partitioning of past apartheid (See Landman, 2000).

The aspects of comprehensiveness and well-governance are far too controversial and tend to linger far behind the schedule and aspect of a valuable city. Meanwhile, this aspect of sustainable development disguises these inconsistencies and disputes, at least in the urban development process.

Notably, urban planning practices in South Africa transformed from "planned oppression" that depicted apartheid government urban planning to post-apartheid "planned emancipation" (Mabin, 1995). However, it is contended that existing standard-setting urban planning theories, which compete to replace contemporary sensible urban planning theory and practice, though helpful, are also not strong enough to address the complex and often-conflicting world that planning practice confronts.

3.3 Informal Settlements

Informal settlements can be regarded as areas where groups of housing units have been constructed on land that the occupants have no legal claim to (Satterthwaite et al., 2020). The growth of informal settlements, slums and poor residential neighbourhoods is a global phenomenon accompanying the growth of urban populations. An estimated 25% of the world's urban population live in informal settlements, with 213 million informal settlement residents added to the global population since 1990 (Rush et al., 2020). Various factors have driven the emergence of informal settlements: population growth; rural-urban migration; lack of affordable housing; weak governance economic vulnerability and low-paid work; segregation and displacement caused by conflict, natural disasters, and climate change.

Notwithstanding, these settlements continue to be geographically, economically, socially, and politically disengaged from wider urban systems and excluded from urban opportunities and decision-making (Sinharoy et al., 2018). Informal settlements are often found on the periphery of urban areas, lacking access to markets and resources. Poor quality housing, or eviction and homelessness, can also increase the risk of insecurity and sexual violence.

The regularisation of settlements may not overcome the stigma associated with living in certain areas (Habitat, 2013). National governments must provide enabling environments to develop and implement appropriate policies to bring about change.

Responsible authorities should adopt rights-based policies and integrated governance to create prosperous, sustainable, and inclusive cities. Initiatives work best when they capitalise on agglomeration economies; use innovative financing and taxes; ensure equitable land management; recognise multiple forms of employment; reintegrate informal settlements with infrastructure and services via planning and design; clarify administrative responsibility for peri-urban areas; and undertake sensitive planning to avoid exposure to environmental hazards (Habitat, 2013).Participation must be at the heart of this approach, ensuring an understanding of economic and social community dynamics (Smit et al., 2019). There is a need to provide affordable, adequate housing, including in situ upgrading and avoidance of forced evictions, security of tenure and livelihood and employment generation. All these play a role in urban prosperity. This includes pro-poor housing plans and financing support for all tiers of government. Increasing the potential of urban areas requires institutionalising mechanisms of coordination, planning and accountability among different stakeholders in a way that recognises the complexity of urban challenges. Urban governance is often neither inclusive nor participatory (Smit et al., 2019). Policies to address 'informality' need to involve partnerships among tiers of government, urban actors, and the private sector to expand rather than undermine opportunities and livelihoods. Urban authorities often fail to provide access to services for the poor (Habitat, 2013).

South Africa has a progressive legal and policy framework governing the right to housing. The country has established a comprehensive state-subsidised housing programme, which seeks to redress the legacy of apartheid and grant eligible beneficiaries a variety of state-subsidised housing options. State-subsidised housing, therefore, plays a critical role in addressing the acute shortage of affordable housing available to poor and low-income households in South Africa. However, the implementation of the right to adequate housing has been plagued by poor planning, lack of coordination, insufficient capacity, failure to adequately monitor the implementation of government policies, and lack of political will. These challenges are particularly acute in the context of informal settlements and inner-city 'slum' buildings (Dovey et a., 2020). As this paper indicates, those living in informal settlements experience inadequate housing, lack access to basic services and face the threat of evictions among other challenges.

3.4 Access to basic services in informal settlements

Informal settlements in South Africa are characterised by intrinsic inequalities in access to basic services such as water, sanitation, and electricity. This is particularly apparent in relation to informal settlements located in rural areas (Dovey et al., 2020). For instance, there is a serious divide in access to basic services and adequate standard of living in the country on the basis of race, geography, and economic status, with a disproportionate disadvantage for children living in rural areas and in urban informal settlements (Smit et al., 2019). The gap is further widened for people with disabilities. The government has reported that many persons with disabilities living in informal settlements are further disadvantaged by not having access to other basic amenities.

3.5 Informal settlement upgrading policies in South Africa

The current approach to informal settlement upgrading in South Africa is focused on incremental upgrading as a step-by-step process where the municipality provides communal services (Georgiadou et al., 2016). Networked services are provided in the case of a full upgrade which includes subsidised housing and services though often this approach has been proven to be financially unsustainable. Depending on the suitability of the land, informal settlement upgrading can include in-situ upgrading and interim services programmes. The prioritisation of infrastructure services is reflected in the shift in policies with the revision of housing policy in the early 2000s to spark more inclusive and holistic informal settlement upgrading with emphasised inclusion and participation through the Upgrading of Informal Settlements Programme (UISP) as provided in the National Housing Code, 2009. Overall, the government is moving away from housing delivery as the main upgrading response (given the financial and temporal unsustainability of the process) and shifting towards a more rapid, participative, and incremental approach based on the in-situ provision of basic services to informal settlements along with basic, functional tenure (Parikh et al., 2020).

3.6 Planning and regulation

Planning has the potential to play a transformational role in improving the quality of life of urban communities and tackling poverty (Blay-Palmer et al., 2018). It can enhance peoples' well-being and inclusion, facilitate access to services, amenities, and economic opportunities, and empower communities to have a say about their future. Further, globalisation, deregulation and free market policies often shift decision-making powers to the private sector. Where governance and oversight are weak, much urban development takes place outside formal frameworks (Brown, 2015). Several problems arise from unplanned development, including the expense of the retrospective provision of infrastructure and the increased cost of providing water, roads, and sewerage in low-density layouts (Porter et al., 2017).The poor are often excluded from planning and decision-making processes critical to ensuring that cities meet their specific needs. Effective urban governance requires planners to seek legitimacy for plans and for city dwellers to be able to hold them accountable throughout the planning process. While metropolitan plans may channel directions for urban growth, housing development and major infrastructure local plans can identify potential development sites and protected areas. Strategy should focus on key metropolitan functions such as transport infrastructure, solid waste disposal and trunk sewerage and water provision."

To strengthen planning coordination in contexts of weak governance, it is crucial to evaluate existing capacity and processes, noting the legal frameworks for planning, effectiveness of decision-making, development control, as well as appeals and enforcement. Where capacity is limited the focus should be on managing developments that have significant environmental or social impact. Effective urban planning depends on locally appropriate solutions and integrated approaches that combine physical interventions with strengthening governance capacity (Rangel-Buitrago et al., 2018). According to the World Bank (2015), both physical and socio-economic planning processes should be well-coordinated, legally enforceable, inclusive, and cross-sectoral. Action or problem-oriented planning is one approach recommended for increasing the capacity of understaffed and financed planning agencies. Wheras, planning tools such as master planning or zoning, which have proved inflexible in dealing with urban change, are being replaced by innovative strategies such as planning agreements between local stakeholders and tradable development rights. However, establishing transparency and resolving conflicts over new instruments remains a challenge (Afzalan et al., 2017)."

4 MATERIALS AND METHODS

The research adopted a case research design to start with then followed by a qualitative research approach based on a review of literature to allow to develop a theoretical framework based on a review of literature and other methods to attain the aim of the overall research. This assisted in generating a new perspective on sustainable urban forms in the context of informal settlements and provide clarity on how the city can employ the proposed matrix in facilitating the desired growth. Given the variety of designs available, this research employs a phenomenological and evaluative approach as a hybrid approach in addressing the research objectives successfully. The literature review design provided the platform for a theoretical assessment of what constitutes a sustainable urban form in informal settlements while the case study design assisted in assessing the findings premised on the City of Johannesburg, being the chosen locality. Therefore, previous publications and similar research papers and journal papers were reviewed as the study was desktop based. Discussions on, but not limited to the challenges and opportunities, along with existing government interventions are also discussed in this section. A cross-sectional analysis of the comprehensive literature review was applied to facilitate the data collection. The analysis involved a review of the literature pertinent to the research objectives and offered a narrative perspective to the research aim and questions. Thereafter, the theoretical inclinations on what constitutes a sustainable urban form in informal settlements was validated through site and personal experience of such spaces.

5 FINDINGS AND RESULTS

Sustainable urban form is the outcome of ecological division and distribution of the environment and built space. It consists of the relationship between the environment and how city residents experience it socially and economically; the relationship between the environment and the physical use of land; and the relationship between the environment and transportation or accessibility. In this sense, sustainability refers to optimal liveability within the city. Informal settlements are charecterised by informality meaning a lack of sevices, facilities, policy provision and regulation, thereby contending with the notion of sustainable urban form. Hence, the need to conceptualise these contending ideas and formulate a performance based matrix to assess the sustainability of urban form within informal settlements.

5.1 Conceptualising the notion of sustainable urban form

During the case study of Tembisa informal settlements, the majority of these spaces were established by the apartheid rule and underwent spatial reconfiguration throughout the years of democracy. Established far away from places of socioeconomic opportunities, these spaces have seen tremendous development, facilitating entrance of newer informal settlements (e.g., Kaalfontein; Rabie Ridge; and Winnie Mandela informal settlement). A common trend of the informal urban form of these settlements is their settlement design typology and the lack of formal masterplans in conjunction to the city's Spatial Development initiatives. Other additional factors are discussed below:
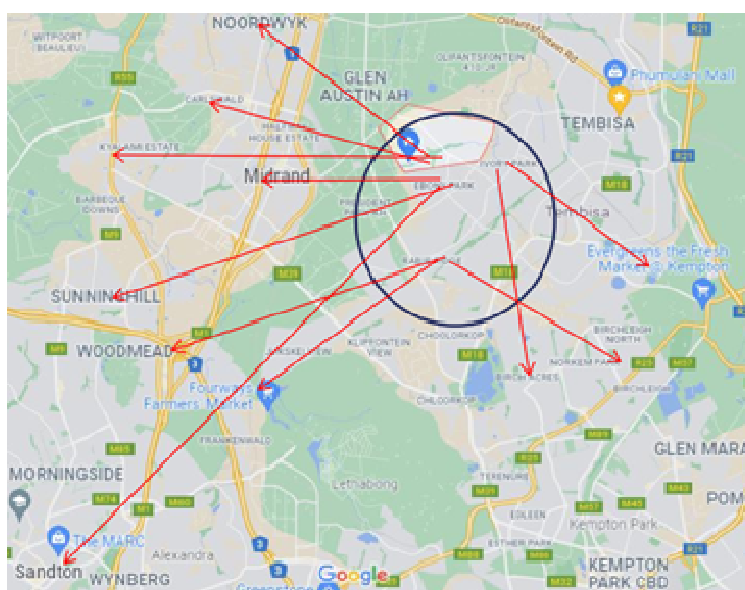

Figure 1: Informal settlements near major economic nodes. Source: Authors compilation.

5.1.1   Size and locality

Studies indicate that urban informality is often on perilous, underutilised, and hazardous land in proxximity of existing formalised settlements. While these areas mushroomed rapidly both internally and externally, their growth has put these spaces into socioeconomically strategic localities. Proximity to existing economic nodes such as Midrand, Kempton Park, and Sandton, provides a vantage point to both informal, transitioning, and formal urban forms as noted in Figure 1 below.

The informal urban form typologies (Pojani, 2021) across the city can generally be observed in the following instances as indicated in Table 1 below:

Urban Form Typologies	Description
Waterfronts	land prone to flooding or exposure along floodlines and wetlands
Easements	Land located along railways, freeways and power lines
Adherences	informal additions or protrusions to formal public façades onto public space
Backstages	urban zones that become more informal the deeper one penetrates behind a relatively formal street frontage

Table 1: Urban Form Typologies. Source: authors compilation.

5.1.2   Layout and density

The informal urban form observed indicates irregularity across elements of sustainability. The street designs are premised on the typology of the landscape and needs of the residents in conjunction to proximity to areas of economic nodes. Across Kaalfontein, the informal urban form comprises natural and formalised street layouts. The erven are densely divided and are often influenced by the spatial landscape and density of the population. As can be seen in Figure 1 and 2, the road systems are frequently curvy and characterised by dead ends and poor hierarchical transitions that depend on space availability.

Figure 2: dense informal form with linear street design, Figure 3: irregular street designs. Source: Authors compilation (2021)

5.1.3   Architecture and symbolism

The architectural dimension of the informal urban fabric in the City of Johannesburg interprets how the building form is often influenced by both market demand and housing models in alignment with the resident's aspirations. In particular, this is why the majority of these spaces undergo inner densification through backyard rooms and unlicensed shops. These backyards are prevalent in emerging (Winnie Mandela) and transitioning (Rabie Ridge) urban forms as compared to formally established (Allandale and Ebony) and/or renewed forms. Adjacent neighbours, particularly in informal forms, have a homogenous approach to development. Often enough, this stimulates internal social competition and status as "landlords" compete over house heights.

5.2 Unsustainable urban form

Figure 3 and 4 below represent the landscape in Swazi Inn, Tembisa, which is associated with unsustainable urban form. Some roads in the area are not upgraded, no storm water management, the use of outside toilets, stand pipes and lack of regulation. Moreover, their natural environment is susceptible to pollution due to the lack of upgrades within the area. Such conditions make the community prone to experiencing floods and blockages in drains, more especially in water drainage and irrigation systems that are full of litter.

Figure 4: poor toilet infrastructure. Figure 5: States of roads in the informal settlement.

The pictures further indicate that some communities lack sanitation services. The lack of these services poses health risks to the residents in the area.

5.3 Policy environment - Introduction and background

Housing in South Africa has long been racially profiled. Communities and households were built according to the provisions of the Group Areas Act of 1950 and the Promotion of Bantu Self-Government (1959). According to the acts, coexistence between different racial groups was prohibited, thus coercing them to inhabit separate designated areas. The spatial ramifications incurred due to apartheid spatial legislation and policy were still discernible in contemporary South Africa. To amend the detrimental effects of past spatial imbalances, the post-apartheid South African government adopted the South African Constitution (1996). The provision of the South African Constitution declares that every individual in the country has the right to access adequate housing. Defining "Adequate housing", however, has been an arduous task for diverse scholars and policymakers.

The South African housing challenges began during the apartheid dispensation where shacks were erected in formal residential areas. In response to the challenges, policy changes were made. The first post-apartheid policy to be developed was the Reconstruction and Development Programne (RDP). The RDP policy provided subsidised housing to those who were denigrated by the apartheid policy. This policy's main aim was to combat poverty, inequality, and unemployment. The RDP policy, however, was not the only policy that was developed to tackle housing issues. Other-core housing policies included the White Paper on Housing (1994) and Breaking New Ground (BNG): a Comprehensive Plan for the Development of Sustainable Human Settlements (2004). The RDP delivered housing without settlement land uses, which mobilised the development of policy that was holistic and inclusive, thus the introduction of BNG. The BNG made it possible for human settlements to grow into sustainable nodes for development.

Additionally ro the above policy is the Enhanced People's Housing Process (ePHP), (2008) which is a revised policy of the 1998 People's Housing Process (PHP). The Enhanced People's Housing Process was established to integrate beneficiaries into housing upgrading. According to Clark (2013), the ePHP model served as a step-by-step process of on-site, incremental upgrading in communities. The process mobilises community members, retains social capital, promotes local economic development, fosters empowerment, involves women and youth, and creates sustainable and inclusive human settlements according to the needs of their specific communities.

5.4 Informal settlement upgrading policies in South Africa.

The prioritisation of infrastructure in the housing policy was created to push the agenda of inclusive and holistic informal settlement upgrading programmes. Huchzermeyer (2006) explained how the emphasis was on insertion and contribution through the UISP. In this regard, the process of advancement entailed on-site upgrades. During the process, structures were kept in their original positions and the focus was on a broad range of infrastructure services. The structures were enhanced through provisional or permanent engineering solutions, the aim was to fiercely confront environmental vulnerability and further entrench social inclusion.

One of the policies that encourage participation in the process of upgrading is The National Housing Code (2009).

According to The South African Housing Development Agency, the main categories of developmental response in addressing basic infrastructure and housing needs include: (1) full upgrading which includes the top structures and formal tenure through upgrading; (2) yhe provision of interim basic services; (3) the basic emergency services for informal settlement; and (4) relocations.

As cities undergo incessant development, growth, and informal settlement growth, this develops various challenges such as an increase in environmental urgencies i.e. air pollution, water pollution, and waste management. "The lack of resilient and adequate infrastructure in informal settlements coupled with poor housing stock in high-density settings greatly increases the risk of illness and injury". Tackling urban informality requires a thorough comprehension of how various deprivations compound each other.

5.5 The Informal Settlement Upgrading Programme

The introduction of the Breaking New Ground Framework encouraged the introduction of the Informal Settlement Upgrading Programme. The programne acts as the platform to develop upgrading projects and has been used as an approach focused on eradicating urban informality through evictions and market-driven infrastructure development upgrading programmes. However, the approaches do not consider the growth of the settlements and their economic security. They do not address the existing economic inequities that accompany informal settlements (SERI, 2014). as well as the deficiency in the provision of infrastructure.

As a resultt, the revised housing programme (the Informal Settlement Upgrading Programme) was named Breaking New Grounds. Considering the factors that led to the upgrades of informal settlements, Huysteen, (2009) deliberated that for the successful integration of informal settlements into sustainable urban form, social and economic requirements must be fulfilled. The Inner-City Housing Implementation Plan (ICHIP 2014 -2021) recogniaes the importance of allowing the private sector to be involved in the ownership and management of the housing stock.

5.6 Physical elements of Sustainable Urban Form

The physical characteristic of a city is described through a term known as "urban form". Anderston et al. (1996) further elaborate that the term urban form is the determinant that configures spatial elements of urban areas at a regional and broad city scale. Scale plays a cardinal role in deducing the urban elements that formulate urban form, and scale has a direct bearing on the urban settlement type, such as towns, central business districts or suburbs. Williams et al. (2020) formalise the interrelation of urban scale as 'morphological attributes' of an urban area at all scales. The localisation of urban form scale is the spatial arrangement and configuration of elements housing type, street patterns, layout, land use, infrastructure, and accessibility. Bickford (2014) notes that urban form is not just physical nature but comprises non-physical elements such as density which can be arithmetically computed to the number of people in a given area or square kilometer. Urban form sustainability needs to be discussed in regard to urban economic and social sustainability, to effectively discuss the interrelation of the above referred to urban elements, together with the examination of these morphological attributes. Inter alia, each of these provides the bedrock in establishing an indicator framework that is capable of gauging the sustainability performance of informal settlements urban form.

5.7 Social Sustainability and The Spatial Dimension

Dekker's (2012) sentiments on tenants and principles of social sustainability loosely uncover the conversion of social sustainability into spatial representation by asserting that social sustainability is underpinned by accessibility to certain elements of the public environment that is central to fostering good livelihoods. From a different perspective, Sebastien and Bauler (2013) pragmatically obsetve the spatial manifestation of social sustainability from a theoretical perspective. The point of departure of Sebastien and Bauler begins by them describing the physical environment and development pattern required for social sustainability. The scholars affirm that land use diversity coupled with pedestrian friendly streets are cardinal for social interaction and citizenship-based cities where a sense of belonging is imperative.

The sense of belonging and citizenship based cites, as well as a diversity of land uses indicate an important aspect of what social sustainability is like in the spatial dimension. The elements of urban space should all be

stitched together to each other by a road network that structures walkability movement. Thus land use diversity, walkability accessibility to these land uses, and urban social amenities are key performance areas for an indicator framework to measure urban form sustainability in informal settlements. Several studies have indicated that urban form and pattern is the major key performance area for urban sustainability. Urban form is characterised by intensity, mixture, size, shape, and the spatial distribution of various land uses. (Lynch and Robinson, 2001). Therefore, social sustainability is directly linked to the behaviour of residents with respect to the characteristics of their neighbourhoods.

5.8 Economic Sustainability

The acceleration and installation of the new urban agenda in conjunction with attainment of the sustainable development goals has somewhat relegated the importance of economic sustainability (Tarzia, 2015). In cognisance of the urban agenda, states are rolling out urban infrastructure for urban service delivery at a financial loss. This inefficient course of action has been permitted due to states adopting an anti-ring-fence philosophy in the collection of municipal revenue. This principle on the distribution of funds is particularly prevalent in urban states that are battling with inequality.

Economic sustainability essentially refers to economic growth where the distribution of income amongst individuals is not characterised by stark inequalities. In recognition of theoretical aspects pertaining to economic sustainability Roderick (2009: 32) defines the critical goals behind economic sustainability:

- "Autonomous subsistence based on income from own work. All members of a society must be given the right to be able to secure their own livelihood by means of a freely chosen occupation."

- "Reducing high-income and wealth inequities."

- "Sustainable development of man-made, human, and knowledge capitals". such that economic performance can be maintained or improved.

When it comes to transcending the traditional statistical measures of economic sustainability. such as unemployment rates, income distribution gross value added and gross domestic product to be spatially interpreted, economic geography or the spatial economy have been the common measures of practices. It is noted that they do not consider the spatial variances between economic contribution from industries and business, they are often combined to govern an overall performance of the area. Secondly, they analyse how the distribution of urban services such as infrastructure, social and public amenities correlate to individual's and household's distribution income. The average income distribution statistic is one of the statistical measures aimed at nullifying the deficiencies of economic sustainability indicators. However they in themselve are susceptible to extreme outliers on income earned that mask the true performance of a state's economic sustainability.

5.9 A performance-based monitoring matrix for assessing the sustainability of urban forms in informal settlements

The above discussion on the urban morphological elements and their spatial interaction which constitutes sustainable urban form have been developed in a proposed indicator matrix toolkit to gauge ithe sustainability performanceof nformal settlements urban form. Key to the application of this matrix tool is geographic information systems software and spatial processing tools that can effectively deduce the relationship performance of various elements.

The above urban form matrix discusses how the physical characteristic of a city is described through a term known as "urban form". The examination of these morphological attributes, inter alia, shows that together each of them contribute to providing the bedrock in establishing a monitoring tool to assess the sustainability of informal settlements through the use of primary and secondary performance areas associated with the economy, the integration of infrastructure, service delivery and housing. However, the application of such tools and the success of such upgrading to longer term urban resilience ultimately depends on political will and more inclusive governance.

Primary KPAs	Secondary KPAs	Primary KPI (Singular)	GIS Spatial Mapping	Diagnostic Assessment – Secondary Spatial Indicator (Composite)	
Economy	Gross Value Added	GVA Per Capita	Spatial Mapping GVA Contribution		
	Average Household Income	Average Household Income Per Capita)	Mapping of Household Income distribution	Accessibility	To Commercial Land Uses
					To Industrial Land Uses
	Employment	Gini Coefficient	Mapping of Unemployment and Employment		To Public Transport
					To basic Services
					To Education Qualification
Integrated Urban infrastructure	Education	Higher Education	Mapping of Higher Education (Population)	In relation to	Household Income distribution
					Accessibility to public Transport
		Matric Education Level	Mapping of Matric Education (Population)	In relation to	Household Income distribution
					Accessibility to public Transport
		No Education	Mapping of No Education (population)	In relation to	Household Income distribution
					Accessibility to public Transport
	Health	Number of Clinics Per Capita	Mapping of health clinics	In relation to	Spatial life expectancy data
					Accessibility to public transport
	Public Transport	Rea Vaya BRT stops Per Capita	Mapping of Public Transportation stations and stops	In relation to	Percentage of population/households within 1km ,2km ,3km ,4 Km public transport stations
		Metrobus Stops Per Capita		In relation to	Average Household Income
		Metrorail Stations Per Capita			
		Gaut.rain Stations Per capita			Access to Job opportunities (Commercial and Industrial Land Uses)
		Taxi Ranks per Capita			
Service Delivery (Infrastructure	Water	Household percentage accessibility to	Mapping of Infrastructure coverage in relation to	Public transport	
	Energy			Life expectancy	
	Sewage			Household distribution income	
	Waste Removal			Education	
	Housing			Health Infrastructure	
Housing	Affordability	Affordability Ratio	Mapping of Household Income in relation to	Property Values	
	Location	Access to Job opportunities		Accessibility to Commercial Land uses	
				Accessibility to industrial Land Uses	

Table 2: Urban Form Matrix. Source: Authors compilation 2021.

6 CONCLUSION

It can be justified to consider informal settlements as areas that rampantly develop without a sustainable urban form, outlining a need for adequate housing, For instance, in the National Housing Needs Registry for the City of Johannesburg, there is an approximate figure of 457 thousand people within the database that are awaiting housing. This backlog is further exacerbated by government intervensions, political will, increased infrastructural and associated bulk service demands for these fast-developing informal areas. It is as such pivotal to understand the conception of sustainable urban form, particularly looking at it as the division and distribution of the environment and space.

To tackle the issue of growth and spatial development that caters to all its residents, the city of Johannesburg aims to make the city more compact as a means to achieve easy access to health care systems, easy accessibility to jobs, social integration, high economic development, functional diversity in neighborhoods, access to transport systems and full basic service to communities. In understanding the policy implications for sustainable forms of informal settlements, this chapter discussed how housing in South Africa has long been racially profiled. To amend the detrimental effects of past spatial imbalances, the post-apartheid South African government adopted the South African Constitution (1996). The provision of the South African Constitution declares that every individual in the country has the right to access adequate housing. The. preconceptual conclusions observe urban informality as a pre-existing form of development before formalization, particularly in the earlier centuries of planning. A common trend across these settlements' informal urban form is their settlement design typology and the lack of formal masterplans in conjunction to the city's Spatial Development initiatives.

6.1 Socioeconomic spatial elements taken into cognizance in the incorporation of informal settlements within sustainable urban forms

The most problematic service issues for black residents in the study area are electricity, water, toilets, health services, and street lighting. Additionally, the scholar maintained that service delivery issues are related to electricity cuts, the sharing of taps, queuing for water, the lack of water supply in houses, insufficient public water supply points, and supply interruptions without warning. The infrastructure investment to deal with backlogs in deprivation areas initiative focuses on servicing backlogs and deficiencies in engineering, and social infrastructure in various points in the city that have experienced marginalization and service provision that is below the minimum standards. Under the Gauteng City-Region (GCR), the CoJ has set its priorities of addressing informal settlement developments within the jurisdiction. Faced with the SDG-11 obligation, the city's 2040 Growth and Development Strategy, the Integrated Development Plan (IDP), and the Spatial Development Framework 2040 (SDF) will be key in fostering the established aspirations. The SDF plays a key role as it facilitates the environment for successful Spatially Targeted Investment Areas (STIAs).

6.2 A performance-based monitoring matrix for assessing the sustainability of urban forms in informal settlements.

Scale plays cardinal factor in deducing the urban elements that formulate urban form, scale has a direct bearing on the urban settlement type, such as towns, central business districts or suburbs. The localisation of urban form scale is the spatial arrangement and configuration of elements housing type, street patterns, layout, land use, infrastructure, and accessibility. Urban form sustainability needs to be discussed in the themes of urban economic and social sustainability, which means effectively discussing the interrelation of these urban elements which provides that platform for the importance of the utilisation of spatial indicators to capture these relations.in gauging sustainability performance of informal settlements urban form.

Land use diversity coupled with pedestrian friendly streets are cardinal for social interaction and citizenship-based cities where a sense of belonging is imperative. The sense of belonging and citizenship based cities, as well as a diversity of land uses together with good governance indicates an important aspect of what social sustainability is like in the spatial dimension. Economic sustainability is the improving of the productivity of the public states finances through improving the productivity an individual's finances. Key to the application of this matrix tool is geographic information systems software and spatial processing tools that can effectively deduce the relationship performance of various elements.

7 RECOMMENDATIONS AND POLICY IMPLICATIONS

Smith and Berlanda confirm several philosophies for refining informal settlements from the preceding study. John Lupala has seven recommendations for district plans in informal African cities: (1) manage city spread; (2) create tenancy systems through land merging and replotting; (3) impact participatory and gradual regularising of "informal urban types" and properties; (4) device localised planning and upgraded information management systems; (5) recognise suitable housing forms for the city's future; (6) decrease plot sizes; and (7) legalise and advance external public spaces.

Moreover, Janice Perlman sets out eight recommendations for the development of informal settlements: (1) offer a diversity of housing selections in regards to tenancy and imbursement, for instance, short-term rental, long-term tenancy, cohousing, and financed acquisition; (2) capitalise in education, healthcare, and social services for people, not just in infrastructure and constructions; (3) include the community in the development and continuing decisions; (4) offer a sturdier government attendance in informal settlements; (5) continue refining and integrating preceding government-subsidised schemes and peripheral neighbourhoods; (6) avert scoundrel designers and landowners from conducting deceitful property transactions and housing rental practices; (7) secure land and housing in expectation of future relocation and population development; (8) political support inclusive of clearly directed governement development intervension at all sphere of government and (9) foster development and augmented density according to the long-term needs of the metropolitan region and the best welfares of the inhabitants.

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