

APPLICATION OF G.I.S IN IDENTIFICATION, DOCUMENTATION & MONITORING BROWNFIELD LAND

CHAPTER 1: INTRODUCTION

Globally, challenges of the emerging climate change and energy crisis impose additional constraints on options for urban development, as they clearly indicate that the usual paths of development are becoming impracticable.

While cities and towns in the developing world depict vulnerability to effects of climate change, Nairobi is experiencing urban sprawl onto arable greenfield land thus taking up the country's breadbasket. Local urban development therefore runs environmental risks, consuming huge amounts of resources, puts strain on the environmental system, and depletes natural carbon sinks and other ecological systems which have a climate mitigating role.

Planners must therefore embrace innovative approaches such as redevelopment of Brownfield land, so as to address important goals of planning in developing countries, namely sustainable urban development and renewal, enhancing economic development, urban carbon emission reduction, plus, environmental and public health protection.

However, there is lack of integrated and comprehensive knowledge on the condition, location and management of brownfield sites throughout Kenya and little attention is given to contribution of brownfield sites to biodiversity, nature conservation and amenity. Further, Brownfield redevelopment involves a multitude of stakeholders including community groups. This paper demonstrates that GIS aided identification, documentation and monitoring of brownfield land can address the above mentioned challenges.

1.1 The Problem with Brownfield land

Brownfields are defined as sites or portions thereof, which are underutilized or abandoned due to actual or perceived contamination associated with previous activities that were located on them, and have an active potential for redevelopment/reuse. On the other hand, some of Brownfield lands even with perceived /real contamination, may have minimal physical constraints, already have infrastructure, and are located in desirable areas.

Brownfield redevelopment can be as a strategy to develop sustainable urban communities by promoting sustainable land use and urban revitalization. Byproducts associated with ignoring brownfields include; long term health risks, loss of tax revenues, a hollow urban core, a decrease in density of economic activity in urbanized areas, Urban sprawl into outlying green spaces and redundant infrastructure.

With a finite supply of land within city boundaries, reclaiming brownfields is an important strategy for economic growth. Expansion of the tax base is necessary for the city to have the resources to meet challenges inherent in an urban environment.

Brownfields redevelopment starts considering (1) the future land use of the brownfield site among a wide array of interests: community members, environmental regulators, local governments, private sector, and (2) its future use possibilities weighed against other local land use efforts and zoning. The process continues with remediation, redevelopment per se, and return to a productive status.

Redevelopment of brownfield sites is undertaken largely by the private sector. A significant proportion of projects take place with very little direct involvement from public bodies and government agencies, except in their roles as regulators, issuing and enforcing necessary approvals and legal permissions.

Noteworthy, the primary objective of brownfield redevelopment is not the reuse of the land and the reintegration of the properties into the economic cycle per se. Rather it is redevelopment to deliver a combination of social, environmental and economic objectives. Sustainable development incorporates economic, social and environmental needs, and is concerned with reconciling economic demands and social needs with the capacity of the environment to cope with pollution and to support human and other life. In this respect successful brownfield redevelopment requires integration of environmental management with spatial and urban planning.

Below in summary are problems associated with brownfields

- ✚ Potential developers face challenges *including; finding sites, assessing contamination and remediation, estimating costs and benefits, and engaging community groups.*
- ✚ Some brownfield sites may have insufficient sewage or water, lack road capacity or even access or are located in flood hazard areas.
- ✚ Some brownfields are public health and environmental hazards. Property values of neighborhoods can be depressed because of perception of health and environmental threats.
- ✚ Hazardous or perceived hazardous brownfields are disproportionately in areas where the population is relatively poor. Hence, uncontrolled brown-field sites often represent environmental justice concerns.

1.2 A Description of the study area

Though Nairobi was founded as a railway town, the once thriving central industrial area as an area of economic activity, and which owes its existence to operations of Nairobi Railway station is currently underutilized. Also known as the industrial quarter, the central industrial area can be traced back to the very early years of Nairobi. Situated next to Nairobi City center, it occupies a large area in the south and south east of the city centre and takes its distinctive urban pattern from the presence of the railway. In the last decade, the railway system which used to feed and service large parts of the area including the industries, workshops and production facilities along the trucks has ceased to operate. This factor coupled with lack of expansion space, changes in Kenya's geopolitical make-up, industrial

restructuring and obsolete/overwhelmed industrial infrastructure makes the main reasons of the original existence of this area disappear.

Indeed, most industries have relocated to Athi River town and along the Nairobi-Mombasa highway corridor as these places present better infrastructure for industrial production, plus adequate space for expansion.

What is left behind is a strong prevalence of run-down buildings and streets, abandoned railway lines as well as large underutilized tracts of land which then give way to dumping grounds, or encroachment by informal settlements and makeshift kiosks.

Nairobi Eastlands located in the marginalised urban fringe to the east of Nairobi Central Business District, is a predominantly low-income densely populated area, having been earmarked as such when Nairobi was being planned. Sandwiched between the CBD and railway station in the west, High density low to medium income residential areas (including Government and institutional housing) in the North and a fast growing belt of informal settlement to the south, the centrally located Brownfield sites in Eastlands, Nairobi are the focus of this paper since, even though they contain levels of contamination, they may have minimal physical constraints, are supplied with trunk infrastructure, and are located in prime/desirable areas thus have the most redevelopment potential and the greatest economic, environmental and social benefits.

CHAPTER 2: Planning of Nairobi and study area

Nairobi's history dates back to 1895 as Uganda Railway headquarter, and serving as British provincial capital from 1899 to 1905, the year which it became the capital of the British East Africa Protectorate. By 1900, Nairobi Municipality consisted only of railway buildings, a European business administrative centre, railway quarters, and separate areas for European and Indian settlements plus military barracks outside the town, which became Kenya's capital in 1907 (Mitullah 2003. Rakodi 1977).

In 1919, with its becoming a municipality, some residential estates were included and an industrial zone developed as a separate entity from the CBD.

The planning of Nairobi was done on an ad-hoc basis until 1926; when the first comprehensive plan was commissioned to recommend zoning arrangements. This plan also advocated for Nairobi's containment as a colonial town. Later, came the 1948 Nairobi Master Plan, prepared for the first time for a colonial capital in Africa. This plan premised on separation of different functions introduced the segregation of residential areas into Europeans, Asians and Africans. In addition, it introduced the principle of garden city and neighborhood units, and is wholly responsible for the present layout of the industrial area in relation to Nairobi Railway station.

As provided in this plan, industries dealing with bulky goods were to locate along the railway line, light industries to be built in the area close to the CBD, and a smaller strip for noxious industries was planned in a separated portion in the East. Though this plan formed a basis for guidelines on residential, industrial and other public purposes for the next 20 years, its intention of zoning industrial area stipulating where industries would locate based on scale of their activity has almost not been followed at all.

Next, came the Nairobi Metropolitan Growth Strategy formulated in 1973 for the development of Nairobi up to the year 2000 made ambitious development proposals, which have only been implemented in a piecemeal fashion over the last 30 years. This plan diverted from containment to acknowledge that Nairobi would grow, the growth direction of the City was envisaged within an arc from Kikuyu in the West, towards Thika in the North-east.

Further, dispersal of commercial and Industrial areas to achieve a multi-nuclei structure, and creating incentives for development and redevelopment of derelict areas in the CBD was proposed in this plan.

Hitherto, the main formal employment zones in Nairobi are the Central Business District (CBD) and the industrial area along Jogoo and Mombasa Road, Westlands, Upperhill, Eastleigh, Ruaraka, Thika Road and Dandora. Although there have been efforts to decentralize employment concentration from the central areas to satellite centres, the Central Business District (CBD) and the Central industrial area (between Jogoo and Mombasa Road) still remain the core employment zones. It is for this reason that the city is often described as being a mono-polar centre.

With the expiry of Nairobi Metropolitan Growth Strategy in the year 2000, Nairobi's urban development is currently guided by specific area plans prepared in a piecemeal fashion.

CHAPTER 3: APPLICATIONS OF GIS IN REDEVELOPING BROWNFIELD LAND IN EASTLANDS, NAIROBI.

3.1 Identification

Brownfield redevelopment process is a complex exercise consisting of many phases, involving many stakeholders, and calling upon many different sources of information to arrive at a solution that is advantageous to the population at large.

Brownfield identification requires a team approach encompassing a range of multidisciplinary knowledge and skills. This would provide sufficient data of adequate quality to allow stakeholders to confidently make decisions about the potential reuse of Brownfields sites.

Geographic Information Systems (GIS) is useful in creating base data, delineating project area plus offering stakeholders the power to collect and compare a wide range of data thus providing multiple redevelopment options. However, It is imperative to obtain site specific data (such as name, transportation access, infrastructure, zoning, size of parcel, and previous use) to differentiate and assign unique identity among brownfields. It is also important to know the user needs in relation to the brownfields since having choices for redevelopment allows neighbors to feel represented and empowered. From the foregoing, success in establishing a GIS for brownfields and Identification of contaminated sites relies on public/private partnerships, and can be achieved if in place is an interactive data collection process that allows several stakeholders operate in a participatory

manner. This would ensure that anticipated redeveloped sites are economically feasible, environmentally responsible and satisfy the needs of the various community members.

3.2 Documentation

Data useability would depend on thorough documentation of predefined data specifications, that is how the geographical location, address, transportation access, infrastructure supplied, zoning, size of parcel, previous use and land use and planning parameters are to be recorded for each site in Arc GIS 10 attribute tables; and related events that take place during implementation of a project.

Opportunities related to or accruing from redevelopment can be more easily identified when inventories of brownfields are established, while an accurate inventory of brownfield properties can help track the impact of redevelopment projects in the community.

In our case, the documentation may be based on the collection and recording of site specific data identifying the below four categories of vacant and derelict sites and other previously-developed land and buildings that may be available for development

- (a) Previously developed land which is now vacant
- (b) Vacant buildings
- (c) Derelict land and buildings
- (d) Land or buildings currently in use but have potential for redevelopment (but the sites do not have any plan allocation or planning permission)

GIS can provide a useful tool for risk management since, by having an accurate inventory of sites and their liabilities, unknown risks are reduced, causing lenders and insurers to look more favorably on financing brownfields redevelopment.

For the area under consideration, GIS can be used to create a central set of data and information that allows all stakeholders to read from the same page and see the same results. The greatest dividend of such an investment is the opportunity to avoid misunderstandings and different interpretations of redevelopment. Further, all stakeholders can also benefit by accessing and collaborating on all pertinent brownfields information via GIS-based Web sites.

GIS based documentation enables users to benefit from GIS' ability to bring together many different data sources- for instance, community groups and citizens can contribute information such as historic land uses, old photographs, or other data that completes the history of a site-into comprehensive and manageable format making it an excellent tool for data documentation. GIS would also be used to establish a data base to manage projects displaying and utilizing a number of spatial and attribute data, both historic and current.

GIS is a tool that can facilitate multi-stakeholder engagement in brownfields redevelopment on a number of levels. First of all, GIS visually represents a range of technical, environmental, social, and infrastructure data in such a way that participants in the brownfields redevelopment process can understand how components of redevelopment interrelate.

Second, coordination of redevelopment efforts is facilitated through GIS since various stakeholders and development agencies can share information and resources. GIS can also

be used to engage local community members in land use planning by presenting a number of scenarios and encouraging community feedback. In this way, a GIS can be used in public presentations to engage citizens who are unable to attend meetings.

By referencing existing maps and data layers, identifying specific areas of zoning and combining that information with other known features, GIS can be used to effectively compare and qualify brownfield sites for particular types of redevelopment. Information dissemination to potential developers of specific sites for a particular purpose is greatly facilitated with the query and analysis capabilities of GIS. Documented Information about a property's unique features when overlaid with other relevant facts, such as zoning, nearby schools, access ways, rail lines, nearby businesses, and population demographics, greatly simplifies the process of rehabilitating problematic real estate into a valuable asset for the entire community.

3.3 Monitoring Brownfield Land

We can employ GIS to monitor redevelopment progress, capture land cover change and mapping of improvements.

Monitoring may be continuous or may be performed at various intervals, and should be implemented in compliance with a set of rules of law: land use planning, pollution control procedures etc. The main role of monitoring is to highlight whether an objective function delivers the anticipated result.

Monitoring of brownfield land can be aided by the ability of GIS to manage data from project assessment through cleanup, redevelopment and the final stage where the brownfield data is merged with property management information, land use records and other data.

Based on very high resolution remote sensing data the geographical situation of brownfields, their surrounding area and their evolution throughout history can be assessed. Additionally, GIS can facilitate brownfield management by joining, displaying, and using a range of spatial and attribute data, both historic and current.

In the subject project, data collected on the extent, distribution of brownfield land and redevelopment thereof, would provide basis for evaluating and monitoring brownfield policy and targets.

Monitoring of land use change by use of spatial related statistics such as the percentage of dwellings built on previously developed land and the amount of development within Green Belt areas, could help monitor the effectiveness of interventions such as government policies stipulating national target for the percentage of housing that should be built on reused sites can be monitored.

Monitoring program should be structured in such a way that; it provides feedback to relevant agencies, it identifies need for initiation and implementation of action before irreversible environmental damage occurs, and that a chosen intervention endeavours to meet all the provisions of environmental legislation in force.

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