Managing Informal Settlements

A Study Using Geo-Information in

Dar es Salaam, Tanzania

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A Study Using Geo-Information in
Dar es Salaam, Tanzania

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Dar es Salaam, Tanzania

(met een samenvatting in het Nederlands)
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List of Acronyms

AI	Artificial Intelligence
ASIST	Advisory Support, Information Services and Training for Employment-Intensive Infrastructure Development (ILO programme)
CBD	Central Business District
CBO	Community Based Organisation
CCM	Chama Cha Mapinduzi: Major political party which has ruled Tanzania since Independence
CGO	Central Government Officer
CIP	Community Infrastructure Project
DAWASA	Dar es Salaam Water Supply and Sewerage Authority
DCC	Dar es Salaam City Council / Commission
DSM	Dar es Salaam
DSS	Decision Support System
EDF	European Development Fund
EMIS	Environmental Management Information System
EPM	Environmental Planning and Management
ERP	Economic Recovery Programme
ESAP	Enhanced Structural Adjustment Programme
GDP	Gross Domestic Product
GNI	Gross National Income
GIS	Geographic Information System
GIT	Geographic Information Technology
GLD	Guided land development
HNCDA	Hanna Nassif Community Development Association
ILO	International Labour Organisation
ILWIS	Integrated Land and Water Information System
IMF	International Monetary Fund
KIMWODA	Kinondoni Moscow Women Development Association - NGO
LGO	Local Government Officer
MCE	Multi-Criteria Evaluation
MLG	Ministry of Local Government
MLHSD	Ministry of Lands and Human Settlements Development
MMA	Minimum Mapping Area
NGO	Non-Government Organisation
NIGP	National Income Generation Programme
PGIS	Participatory GIS
PPGIS	Public Participation GIS
PSS	Planning Support System

SAP	Structural Adjustment Programme
SCI	Settlement Consolidation Index
SDP	Sustainable Dar es Salaam Project
SMD	Surveys and Mapping Division, MLHSD
SSS	Site and Service Scheme
TANESCO	Tanzania Electric Supply Company
TDF	Tabata Development Fund
UCLAS	University College of Lands and Architectural Studies (formerly ARDHI Institute).
UDSM	University of Dar es Salaam
UNCHS	United Nations Centre for Human Settlements
UNDP	United Nations Development Programme
UNV	United Nations Volunteers
UPM	Urban Planning and Management
USEP	Urban Sector Engineering Project
WEO	Ward Executive Officer
WDC	Ward Development Committee
WLC	Weighted Linear Combination

Chapter 1

Introducing the research problem

1.1 The three main research themes

This research is driven by a desire to explore the role that Geographic Information Technology (GIT) [1] can play in improving the effectiveness of urban planning and management in situations of extreme poverty, by designing a methodology that will enable planning authorities to improve the local capacity for managing informal settlements. This emphasis is in keeping with Masser's use of the term 'managing' which incorporates both knowledge (i.e. activities of monitoring, analysis and evaluation of urban development processes) and action (Masser 2001) and is consistent with the view of Abbott and Douglas (2003, p. 4) that the growth of informal settlements in African cities cannot be contained or fully controlled but rather that there is a need to improve the ability to guide such development. As economic growth lags behind in many developing countries where rapid urban growth is occurring, there are considerable problems related to urban poverty and resource constraints will inevitably undermine the ability of the formal institutional system and its instruments for creating well planned and serviced urban development in adequate quantities. The search for approaches and methodologies that can enhance the ability of such societies to better respond to the pressures of urbanisation is therefore of considerable importance and worthy of investigation.

This search process is itself constrained by limited resources and consequently the scope of this study is limited to three aspects that are relevant to the improvement of urban planning and management in developing countries. The three themes that provide the foundation for this research are: *i)* the changing nature and role of urban planning and management in developing countries and specifically in the Sub-Saharan Africa (SSA) region; *ii)* the processes of informal housing development which is a dominant factor of urbanisation in much of the developing world and *iii)* the adoption of information technology as a means to support urban planning and management processes. A brief introduction to each theme is given below, providing a background to the research objectives and questions that form the basis for the case study of the

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[1] GIT refers to the group of technologies designed and used to collect, store, process and visualise spatial information. It therefore includes both systems for data capture such as remote sensing or terrestrial surveying and tools with a broader functionality such as Geographic Information Systems (GIS).

city of Dar es Salaam, Tanzania that is the setting of the empirical component of the research described in this thesis.

1.1.1 The changing nature and role of urban planning and management

The discipline of urban planning is relatively young and has at its roots a general concern with the creation of a clean, safe and beautiful living environment for urban populations, responding in particular to the public health issues arising in the cities and towns as a result of industrialisation in Europe and North America. As a profession it has developed and evolved throughout the twentieth century to be one of the main instruments of public policy to guide and control urban development. However much of the theory and practice of modern urban planning is based on the experience and needs of the developed countries and has been transferred to the developing countries, especially under colonial administrative regimes. Many of the shortcomings of the practice of urban planning in developing countries have been attributed to the legacy of the *"received"* laws, concepts and theories of urban planning transferred under colonial administrations and subsequently through the regular use of western planning consultants in urban planning projects (Kanyeihamba 1980; Okpala 1987; Kironde 1992c). Criticism of urban planning practice, however, is not only limited to the developing countries.

As Healy suggests, human endeavour to shape urban communities is "... built up through a mixture of evangelism, formal institutional practice, scientific knowledge and, increasingly, academic development" . Over time all societies are likely to experience ideological shifts in thinking about issues of public policy such as urban planning, which translate into new institutional practices, and stimulate new lines of learning that seek to strengthen the field itself. The history of urban planning theory and practice in the developed countries shows many signs of such evolutionary development (Breheny and Hall 1984; Allison 1986; Breheny 1987; Hall 1988; Sorensen and Auster 1989). As a result, urban planning has gradually changed from the technical-rational model of the 1960's toward a more open and inclusive planning approaches, with more emphasis on public participation and collaboration .

To some extent these developments are also mirrored in developing countries, though the local capacity to institute such fundamental reform processes in the discipline may also be hampered by the same lack of resources that has prevented the implementation of existing urban plans themselves. However, since the 1990's the reform of urban planning and management systems in developing countries forms part of a global campaign for more effective and responsive urban governance (World Bank 1999). Good Governance here includes the development of appropriate and effective land management and planning systems, which, amongst other goals, strive for socially equitable access to urban land and housing.

1.1.2 Access to urban land and informal housing in Sub-Saharan Africa

Creating systems that ensure that all urban residents have legal access to land for shelter is major bottleneck in many developing countries and as a result so-called informal settlements are a prominent feature of many cities. Their existence is inextricably linked to poor national and local economic performance, the failure of formal systems for the planning and management of urban development, and deteriorating services and infrastructure (Stren and White 1989; UNCHS 1996) and almost in spite of these problems, extraordinarily high rates of urban growth due both to rural-urban migration and high natural population increase (Drakakis-Smith 2000).

Although the term *informal* is often taken to mean *illegal tenure*, it is now realised that land tenure is but one component of development and that the use of a dichotomy such as formal - informal or legal – illegal ignores the diversity of housing situations that are such a characteristic feature of urbanisation in developing countries today. The situation of much informal housing is complex and to better understand the nature of such development it is necessary to examine several characteristics of these informal areas in order to appreciate the way in which they are created and how they develop and consolidate over time.

Typically, the main characteristics of interest to urban planners could be divided into 3 main categories of data: Environmental, Physical and Socio-economic factors (see Table 1.1). At this stage of the discussion it will suffice to emphasize 3 points that relate to the identification and use of such data. First, the factors described below are but examples of the type of data that may be collected in order to describe informal development.

Although many variables may be useful in a variety of situations, it is always necessary to consider the individual requirements and peculiarities of the local context in determining what data to collect. Second, if data are to be collected and analysed in order to understand dynamic processes such as urban development, the ability to manage and process multi-temporal data sets is an evident requirement. Third, as informal development is in one or another aspect unauthorised, data describing such development cannot be obtained via the formal procedures for regulating development. The implication then is that separate purposeful action will be required to collect much of this data if and when it is required.

Table 1.1: Important factors describing (informal) urban development

Main factors	Examples of useful variables	Explanation
Environmental (i.e. site conditions)	Slope of terrain Ground water levels and soil drainage capacity Soil bearing capacity Environmental hazards (risk of flooding, land slides or earthquake damage etc.)	Some factors such as slope may usually be quite stable over time. However, conditions in a settlement can change as a result of exogenous factors. For example, increased construction in the surroundings of a built-up area may increase surface water run-off and increase the risk of flooding or landslides.
Physical – Spatial (i.e development of site and environs)	Building materials and quality of construction Housing types Use of land and buildings Density Structure and condition of road layout Quality and quantity of infrastructure provision (water supply, sanitation, electricity, solid waste, tele-communications) Proximity to social services (employment, education, schools, transport etc.)	Typical factors that are either the direct result of the construction and/or the use of buildings or infrastructure on available land. Many of these factors are potentially very dynamic as they depend on the amount of public and private investment taking place in a given locality. For example, in a period of rapid urbanisation much unauthorised house construction may occur prior to infrastructure being provided. Also, if initial capital investment is not followed by maintenance expenditure the quality and value of investments will decline, contributing to a general neighbourhood decline in living conditions.
Socio-economic (i.e. legal aspects and characteristics of population)	Land tenure Housing tenure Value of land and property Community organisations Demographic characteristics (household size, income, expenditure, age, education, employment, morbidity and mortality etc.) Economic activities	Includes issues that describe the legal status of land holdings and building occupancy and use. While not static, the large scale change of tenure relationships is generally quite complex and not modified or regularised without considerable public expenditure. The nature of the population is however more dynamic. In addition to natural changes due to demographic processes, the characteristics of some areas may vary rapidly due to the rapid absorption of new urban migrant households.

This thesis explores some methods that may be usefully applied to provide some of this data, and in particular methods based on the use of information technology (IT) that is specifically designed to handle geographical data. Such GIT is particularly suited for use with data related to phenomena or processes for which the ability to describe or analyse their spatial properties plays an important role in planning and management procedures.

1.1.3 The adoption of information technology in urban planning and management

Urban planning and management are generally seen as information intensive activities and the adoption of IT by urban planners is therefore quite a natural development. The use of IT as an information processing and support tool for planning processes in developing countries is also not a new phenomena but it is at the same time not one which has been without its critics (Calhoun, Drumond et al. 1987; Cartwright 1987; Cartwright 1991). It has been the advent of micro-computer systems that has significantly increased the opportunities for planners in developing countries to utilise a range of desktop packages, including many standard office systems and, in some cases GIS, in their daily work (Yeh 1987). Despite the diffusion of IT there are still some concerns that the adoption of GIT in developing countries is sometimes by and large a question of prestige and modernity, rather than one of appropriateness for development (Taylor 1991). Particularly in donor funded projects, the adoption of IT may be more due to the normal working practice of the foreign project advisors than a rational decision, based upon an analysis of the host organisation's requirements and its institutional capacity to adopt IT (Calhoun, Drumond et al. 1987).

The situation with GIT is not likely to differ greatly from the general situation of IT adoption. The following example related to GIT in Tanzania illustrates how technological innovation and change in developed countries drives similar processes in developing countries. After visiting national mapping agencies in several countries in Eastern and Southern Africa in the mid 1990's, one GIS academician[2] commented that these agencies would soon be forced to adopt GIT for their map production systems if for no other reason than because of the rising costs of materials required for analoque mapping systems. These costs would rise significantly as the developed countries were increasingly adopting GIT thereby lowering the overall demand for analogue mapping technologies and products. Such changes in the mapping market will have global impacts and affect local investment decisions related to mapping technologies, irrespective of the readiness of potential GIT users to go digital.

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[2] Opinion expressed by Professor Menno-Jan Kraak, Professor of Cartography and Visualisation at ITC, after a visit to mapping agencies in several SSA countries.

As GIS is expected to become an increasingly important support tool for urban planning in developed countries (Masser and Ottens 1999, p. 39) and given the linkages between urban planning practice in both developed and developing countries, and the general trends of IT adoption in developing countries, it is reasonable to expect that GIS will become increasingly adopted by urban planners in the latter countries. Although this potential has been recognised (Taylor 1991; Yeh 1991) it is also realised that there are many barriers to the successful adoption of GIT in developing countries. Some of these barriers relate to the appropriateness of the technology to the problem at hand (Taylor 1991, pp. 80-81) while others concern the organisational setting in which it is being applied (Masser and Campbell 1989; Masser and Sliuzas 1999). As organisational barriers have been found to be critical for the successful adoption of GIS by organisations in the UK (Campbell and Masser 1995), it might also be expected that these factors would be even more critical in organisations in developing countries that generally have more financial, technical and human resource constraints. An examination of GIS adoption by a local government in Lilongwe, the capital city of Malawi, tends to support this view (Sliuzas 2000) but this issue will not be discussed further here. Rather, this research will examine some issues that of a more technical nature related to the supply and use of data that can be used in policy making, planning and decision making related to informal housing.

Given the scale of informal development in many cities world-wide, and the low institutional capacity to manage urban development in a formal sense, it is hardly surprising that the agencies of urban management have insufficient knowledge about the state of informal settlements and the forces that drive their further development. But how important is it to tackle data problems as a means to improve urban planning in developing countries? Different views exist on this subject. Abbott (2001, p. 267), for example sees the lack of relevant spatial data as one of the most serious problems facing cities in developing countries. On the other hand Rakodi (2001, p. 221) places more emphasis on the political realities of planning in developing countries and cautions that investments in data, technology and techniques are relevant and useful only if they contribute to politically relevant tasks and thereby contribute to political legitimacy. These contrasting views point to a tension or conflict that exists within the urban planning field that relates to different perceptions of deficiencies in current planning practice and the related views of appropriate reforms and changes that are required to improve the performance of planning. The research described in this thesis takes place in this setting: seeking to improve the availability of spatial data on informality that is relevant for different actors in the local political environment.

1.2 Research objectives and questions

The main objectives of this research were to:

1. design a methodology for managing the development of informal settlements in cities of developing countries. The methodology should address the requirements of various groups at the local level: the local government and community leaders and seek to respond to the current trends toward more participatory forms of planning;
2. test the application of the methods in a case study that encompasses support for both strategic planning and action planning related to the development of informal settlements;
3. provide recommendations for the implementation of the methodology in the light of constraints to be confronted in resource poor environments.

The research is significant in two distinct ways: *i)* It demonstrates how GIT can be used to improve the knowledge and understanding of informal housing processes which, in the long term, is believed to be an important prerequisite for the development of more effective strategic interventions related to informal settlements; *ii)* It will enhance the ability of the urban planning community in developing countries to apply Geographic Information Technologies within planning processes that are intended to regulate informal housing development.

1.3 Scope of the research

The region of Sub-Saharan Africa (SSA) includes many of the world's poorest countries. Not surprisingly, in this region many policy and planning decisions are taken without access to adequate data, a situation that conceivably increases the risk of inappropriate measures being adopted. Poor data about implementation of policies and plans itself potentially inhibits the learning process of the responsible agencies and thereby enhances the risk of failure of what may be otherwise suitable measures. A main assumption of this work is that for the foreseeable future the planning and management of such cities will be severely constrained by the lack of resources and, as such, the capacity for planned interventions will be limited. Further, it is assumed that the need to regulate the establishment and consolidation of informal settlements will remain an important issue.

In order to illustrate and test the methodologies developed in this research empirical work has been carried out in the city of Dar es Salaam, Tanzania, (see Figure 1.1) a large and fast growing city in one of the world's poorest countries. This city was selected for the case study as it has a substantial component of unplanned development and because of the recent process of urban planning reform that has been instigated, that has also included some components of GIT use. It therefore provides a useful setting for examining how the effectiveness of

GIT as a planning support tool may be further enhanced. As many other cities in the SSA region are experiencing similar types of development and reform processes the lessons learnt from this research should have a wide applicability.

Figure 1.1: Location of Dar es Salaam, Tanzania

(source: http://www.odci.gov/cia/publications/factbook/tz.html)

1.4 Research design and outline of the thesis contents

The research is composed of several, interrelated elements. It is an example of applied planning research that has its foundations in contemporary discourses on procedural and substantive planning theory, and in particular as these affect the field of urban planning in developing countries. Much of the empirical work is descriptive and exploratory in nature, and forms the basis for suggesting improvements to existing planning methodologies in both a procedural and substantive sense.

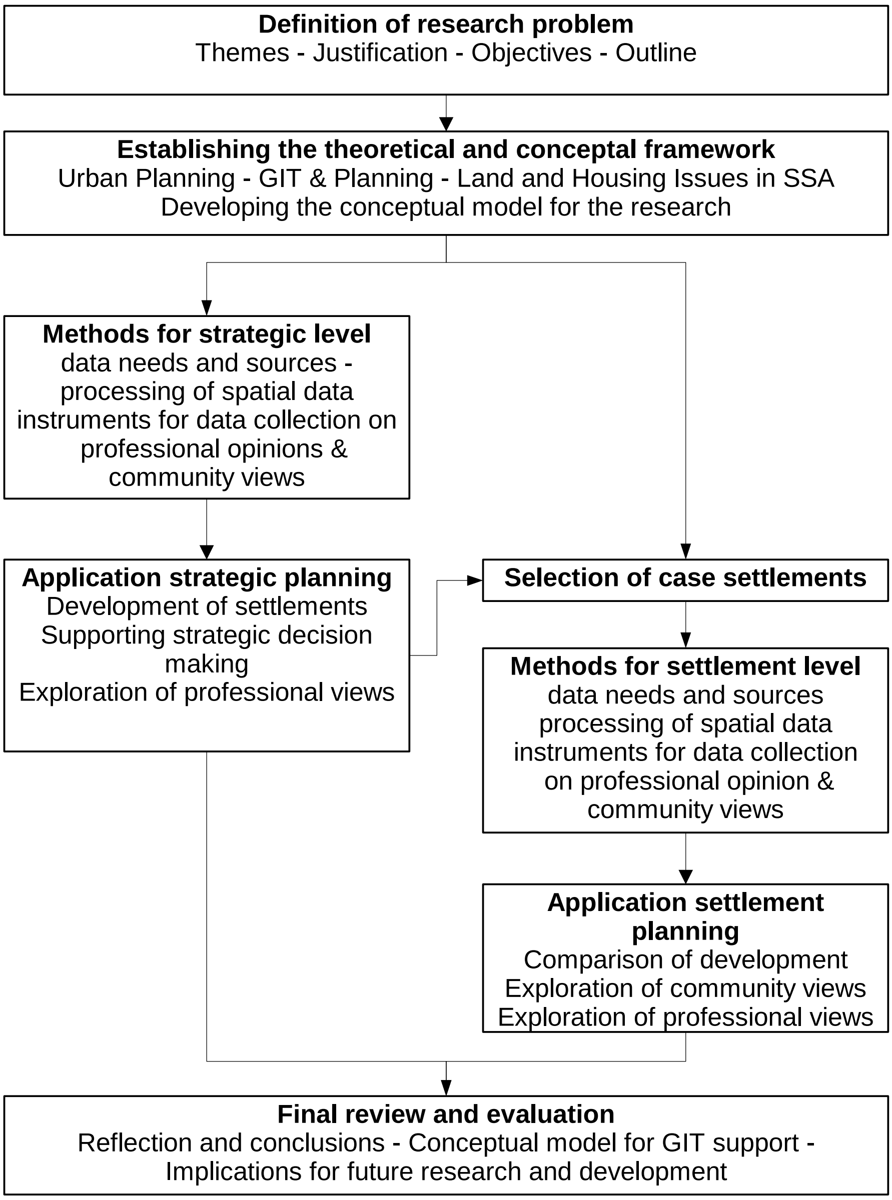
Descriptive elements pertain mainly to the nature of the informal development processes occurring in the city while the exploratory elements are often concerned with gaining insight into the planning context, particularly aspects that relate to the knowledge and opinions of relevant actors in the planning process: professionals, administrative staff and community members. The design of GI based methods for settlement planning is a central concern throughout this work, and like the other elements, is found at both the strategic and settlement levels.

The main stages in the research process are shown in Figure 1.2. The process commences with an overview of recent literature of the 3 central themes that form the core of the study and lead to the development of the conceptual framework. This framework recognises the need for providing support for decision making at two different but related spatial levels: the more strategic citywide level and a local level that is concerned with planning issues within specific informal settlements. Enhancing geographic information (GI) support in urban planning is a main theme at both spatial levels but it is also acknowledged that the use of GI based systems does not occur in isolation. Attention is therefore also given throughout both spatial levels to the context within which the technology is to be used.

For the research design this means that attention is given to technological issues related to GIS support as well as developing a better understanding of the context within which decision making related to informal development takes place. While some of the methods used are routine and well known there are several areas in which innovative approaches have been introduced, enabling the production of new information or products that can enhance the planning process. Innovative approaches are required as the lack of data on the state of informal development in fast growing cities on the one hand and the need for appropriate tools that can support urban planning and decision making related to informality on the other are pervasive but sometimes hidden issues in urban planning practice in many cities today. The search for better or more effective methods is continuous and this research is such a contribution to the field.

The thesis itself is divided into 8 chapters. Chapter 2 examines the 3 primary themes of that are at the core of this research. The evolution of thinking in the field of urban planning and management and the role of GIT as a planning support tool are discussed together with some problems of the land and housing supply in developing countries. The emphasis in this work on the managing of physical development processes implies the availability and analysis of multi-temporal spatial data. This chapter also considers how the development and availability of IT tools for handling spatial data increases opportunities for the development of support systems that enhance the information available to multiple stakeholders in urban development issues. These ideas are then used in Chapter 3 to examine some important considerations for the design and development of planning support tools for managing informal development which ends with the presentation of the analytical framework for this research.

Figure 1.2: Overview of the research design



In Chapter 4, a description is given of the specific circumstances in Tanzania and in the case city Dar es Salaam, with emphasis on the themes presented in Chapter 2 and the framework developed in Chapter 3. The importance and relevance of the research topic will be elaborated upon, setting the stage for the discussion of the empirical components of the research that is discussed in the remaining chapters.

The data sources and methodology used in the various parts of the research are presented in Chapter 5. The research has been carried out at two levels, the city level and at the level of individual settlements or communities. In the context of informal development and planning these two levels are strongly inter-related though the issues may be treated differently at each level. For the city level there is an emphasis on generalised data related to physical development and support for strategic decision making. While physical data remains a central element at the settlement level the nature of the data is somewhat different, reflecting the level of detail required for local decision making and settlement management.

The development and testing of some GIT based methods for managing informal development is the subject of Chapters 6 and 7. The citywide managing of informal settlement development is examined in Chapter 6. The analysis includes a temporal analysis of land use changes from 1982-1998 and the expansion and consolidation of informal settlements over this period. This data is then used as one input in GIS based multi-criteria evaluation procedure that could be used to select informal settlements for specific policy interventions aimed at altering their further development.

Chapter 7 then focuses on the problems of managing informal development at the local level, using three settlements as cases. Keko Mwanga and Hanna Nassif are both mature settlements with a high development density and many related management problems. However, Hanna Nassif has been the scene of a community based infrastructure upgrading project since 1995 while Keko has been largely unaffected by upgrading or settlement improvement projects. Development in the third settlement, Tabata, is more recent but it too has recently been the target of a community based upgrading project. Chapter 7 examines how spatial information could be utilised at the community level in planning and administration and presents the results of an inquiry among several stakeholders on the usefulness of applying low-cost GIT based aerial photographic mosaics for community planning and management.

In Chapter 8 the findings of the research at the two spatial levels are reviewed and the implications of these findings for the development of a prototype methodology for managing informal settlements in Dar es Salaam are considered. Suggestions are also made concerning further work required in this field.

Chapter 2

Urban planning, planning support and informal urban development

The purpose of this chapter is to establish the theoretical background and framework for this research. Each of the three central themes of this research; urban planning, planning support systems and informal urban development are examined in detail. Central elements in the first two of these themes are the linkages and contrasts between the theoretical development and practice in western countries and those found in Sub-Saharan Africa (SSA). The third theme contrasts the processes associated with formal and informal development and examines some opportunities for their reconciliation.

2.1 The evolution of urban planning in theory and practice

Mandelbaum (1996, p. xvi) defines planning as a process in which individual or collective agents exercise discretion and make choices or decisions about future courses of action. Such choices may imply development (i.e. changes in the object of planning) but they may also imply conservation (i.e. oppose change in order to protect or preserve the object of planning or a specific component of the object). These choices imply that amongst the agents involved in the planning process there is a shared understanding of the issues at hand, of the need for action, of the desired outcomes and that the agents collectively control the means to reach these goals, all matters that are questionable in practice. The interest here, however, is not so much planning theory per se but how urban planning theory and planning practice have evolved and what implications this evolution has for information support for the planning in informal settlements in SSA. In this discussion of urban planning emphasis is placed on the development of the field in the U.K., which has been used as model for the development of urban planning throughout the developing world and specifically in Anglophone SSA (Alexander 1983; Rakodi 1986) and is therefore most relevant for the case studies in Dar es Salaam.

2.1.1 Evolution and diffusion of urban planning approaches

The civic design tradition

Urban planning as a discipline has its roots in European industrialisation, a period which was characterised in part by the rapid expansion of cities and towns (Kwok 1983). Its development in the U.K. date back to the 19th and early

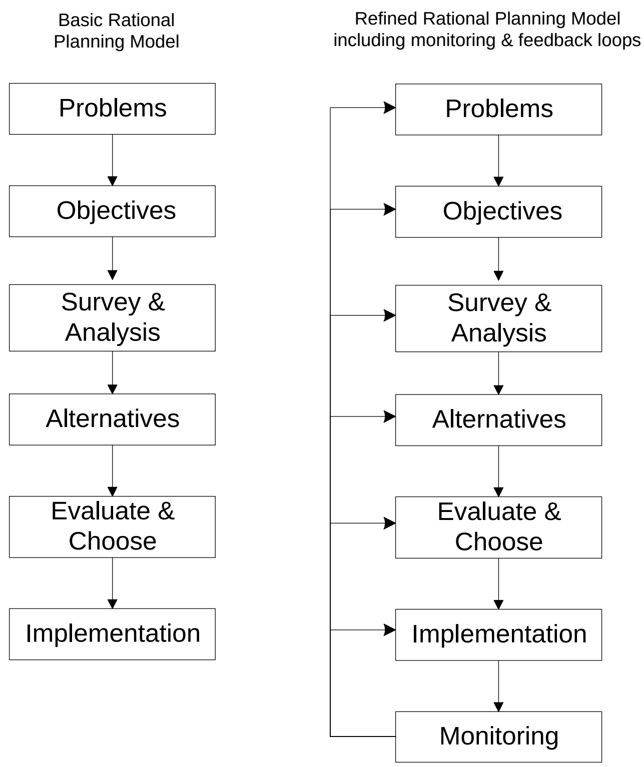
20th centuries and are embedded in the experience of radical utopianism with its idealistic workers' settlements such as Port Sunlight (Ratcliffe 1981, p. 39) and the civic design tradition with its strong links to the fields of architecture, engineering and surveying . However, whereas the impact of the philanthropists was relatively small and localised, large scale solutions to housing problems were needed (Ling 1988, p. 226). In this period, the physical qualities of the built environment were believed to be of paramount importance and the planner was perceived as *".. a master-designer of the built environment, arranging land uses to produce balance and order throughout the city."* (Adams 1994, p. 3) tackling the poor living conditions of the industrial workforce who were trapped in or on the outskirts of the cities . At the end of the 19th century Ebenezer Howard brought various concepts and concerns together in his highly symmetrical model for a so-called *Garden City:* a self-sufficient city in terms of employment and combining the beauty of nature with ample social opportunity that, at a larger scale, would be clustered around and connected to a larger central city (Ratcliffe 1981, pp. 41-43). Howard's Garden City Association was an important movement as it was the forerunner of the Town and Country Planning Association and the concept of garden cities and their concern with balancing physical, social and economic interest in cities and the provision of housing have endured.

The concern with the quality of the built environment in the UK resulted in several rounds of legislation related to housing, health, and planning between 1909 and 1944. Shortly after World War II (WWII), the Town and Country Planning Act of 1947 repealed all other legislation and introduced comprehensive planning incorporating both financial and physical planning. Not surprisingly, given the need to rebuild many war damaged cities (Ling 1988), the 1947 act placed considerable emphasis on physical aspects of urban development and in the established the land use plan and development control as major instruments of urban planning and implementation. Although this approach placed insignificant attention on related issues such as economic development, social development and the environment it was the guiding philosophy more or less until the 1960's. According to Kwok (1983, p. 85), urban planners in the post WWII period until the mid 1960's relied heavily on 3 main concepts: Howard's *Garden City Concept,* Christaller's *Central Place Theory* and Wright's *Radburn Project* as the basis for physical planning and especially for new town development. Many such planning concepts were also exported via international planning consultants to developing countries in SSA, and often with the inclusion of their underlying legislative frameworks, norms and standards, a topic that is taken up in more detail in section 2.2.3. Furthermore, a relatively simple sequential model of planning formulated by Patrick Geddes: *Survey-Analysis-Plan,* drove the planning and development process. Public participation was of limited significance and the plans emphasised concerns of a physical nature related to land and the spatial allocation of uses to land parcels.

The development of rational planning

A new style of rational-comprehensive urban planning came into vogue in the 1960's and 1970's responding to some of the apparent weaknesses of the civic design approach, and drawing on the experiences of systems analysis and operations research in the USA in the 1950's. In this period urban planning became more of an explicit instrument of state policy and moreover, the state was at that time perceived as a powerful but neutral agent serving the public interest (Adams 1994, p. 5). The rational planning process (see Fig. 2.1) that developed placed the planner in the role of scientific policy analyst, collecting and analysing data, modelling and forecasting future trends and developing and evaluating alternative courses of action and preparing evidence that the politicians could use as a basis for decision making.

Figure 2.1: The rational planning model: basic and refined



This model was considerably more complex than Geddes' 3 step model, as it included 2 pre-survey tasks for defining the problems that should be addressed and the setting of objectives. Further tasks are introduced with the recognition that multiple alternative plans (solutions) are feasible. Other refinements to the basic rational model were the inclusion of a monitoring task and feedback loops in recognition of the cyclical nature of the planning process. In a narrow sense the monitoring task was needed to regularly and systematically collect data that would enable planners to measures the progress being made in implementation (Bracken 1981). However, it could also be used to measure the impact of specific aspects of a plan and its associated actions or in a more strategic sense to measure changes in the environment in general, a task of considerable importance in highly dynamic situations characterised by relative poor information, low levels of control and many unforeseen or uncontrolled developments (Wedgwood-Oppenheim, Hart et al. 1975). In all 3 types of monitoring the intention is to collect data that will contribute to the knowledge base available to the planning system and especially to the planners themselves, however the relative importance of strategic monitoring will increase in situations with high levels of unplanned development, such as those found in developing countries.

This rational planning approach is well documented in the work of McLoughlin (1969) and Chadwick (1976) and applied in British structure planning in the 1970's. The approach tends to regard *"… the city not as a place of chaos but of order, functioning as a richly integrated urban system with complex interconnections between its component parts."* (Adams 1994, p. 5). Through the development of urban models and their underlying databases the planning process itself was seen largely as a technical issue. The early attempts at urban modelling were however not successful as they were *".. not able to represent reality adequately, could hardly handle geographic information, had excessive data requirements, could only be operated by specialists and were considered as suspected black boxes by politicians."* (Sliuzas and Ottens 2002, p. 359). In addition, the underlying political processes in which powerful actors engage in shaping the physical and social environment were easily neglected (Forester 1985, p. 130) by the emphasis the approach placed on data and analysis.

The rational comprehensive style of urban planning has several weaknesses. Not only does it create a somewhat artificial separation between the planner as technical analyst and the politician as decision maker, but it is also dependent upon a number of assumptions about the process itself that may well be questioned: that fully rational processes are achievable; that scientific method can be applied to all aspects of the urban study area and that social, economic and environmental issues can all be modelled effectively and included in the planning process; that planers are able to identify the public interest; and that the state is able to direct and control the future . In practice concessions to pure economically rational decision making are the rule, and Simon's concept of *bounded rationality* in the field of Policy Analysis is based upon the recognition that human rationality is limited in a variety of ways (see Table 2.1). These limiting factors are also applicable to urban planning which is essentially a State based intervention in urban development and therefore a field of public policy (Adams 1994).

Table 2.1: Examples of limitations to human rationality based on the work of Herbert Simon

Incomplete and fragmented knowledge
Uncertainty about the consequences of actions and consequent reliance on value judgements
The inability to deal with multiple issues simultaneously
Limited powers of observation and communication and therefore limits to the learning process
Limited memory capacity of the human mind
The persistence of routine and habitual behaviour of humans
The inertia of initiated behaviour
Organisational environments that tend to frame the processes of choice

(Adapted from Parsons 1995, p. 277)

Simon was not alone in his critique of the pure rational approach and the need for adapting the theoretical model to better reflect actual practices. Two other alternatives or adaptations to the rational model are worthy of note here, *disjointed incrementalism* as proposed by Charles Lindblom, and the *mixed scanning* approach of Amitai Etzioni.

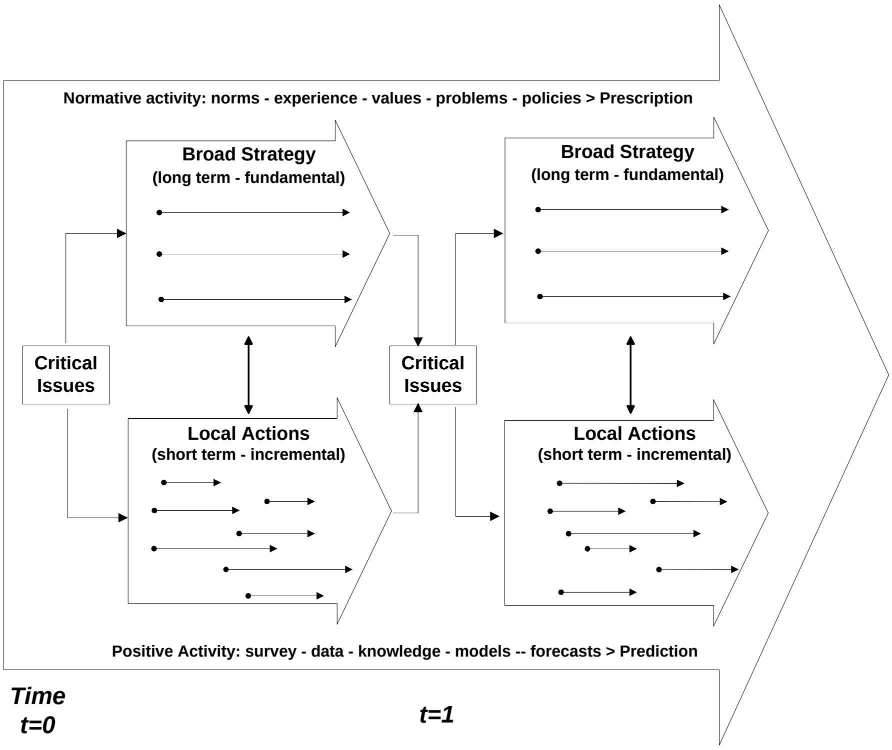
The first, *disjointed incrementalism* sees rational decision making in public policy as a '*futile attempt at superhuman comprehensiveness*'. The alternative model of decision making that is proposed proceeds through a succession of incremental changes involving mutual adjustment and negotiation between interest groups. This approach involves a considerable amount of trial and error and values the quality of a decision in terms of the agreement reached and the process rather than the attainment of goals. The second approach is that of *mixed scanning*, the essence of which is described below:

> *Mixed scanning reduces the unrealistic aspects of rationalism by limiting the details required in fundamental decisions and helps overcome the conservative slant of incrementalism by exploring the long-run alternatives. The mixed-scanning model makes this dualism explicit by combining (a) high-order fundamental policy-making processes which set basic directions and (b) incremental ones which prepare for*

> *fundamental decisions and work them out after they have been reached.* (Etzioni 1967 cited by Parsons, 1995, p. 297).

According to Bracken (1981 pp. 19-20) the mixed scanning approach distinguishes between high-order social policy making processes that comprise normative activity that examine the values of society and set directions for change, and low-order processes that are essentially technical in nature and associated with the positivist (rational) activity in planning. However, he also refers to the interpretation of Donnison (1976, cited by Bracken, 1981) who sees the identification of critical issues giving rise to two types of follow-up activities: one related to broad development strategy focussed on a limited number of key concerns as represented by the 3 arrows (see Figure 2.2) and another that concerns numerous local actions or projects that have variable starting times, duration and focus, as represented by the multiple arrows in the Local Actions activity. The latter view is more in keeping with the concept of urban planning consisting of inter-related hierarchies of plans, e.g. a citywide plan indicating the general structure of proposed development and a set of more detailed local development plans.

Figure 2.2: The mixed scanning approach to planning



(based on Bracken, 1981 and Parsons, 1995).

As Figure 2.2 shows, over time the 3 steps will be repeated, often following a pre-determined cycle of plan review established in planning law. The model counters some of the arguments against rational planning by explicitly recognising that there are costs associated with knowledge generation and that these costs can be controlled by focusing on a limited number of fundamental issues as an alternative to seeking comprehensives . In contrast to the pure rational model, the whole process includes normative activities as well as positive activities (i.e. actions relate to data collection, analysis and modelling that are intended to increase objectivity), which planners and other participants may be involved in as part of a collective learning process, an approach to planning that is receiving greater attention in more recent discussions on collaborative and participative forms of planning (Healey 1998; Innes 1998; Forester 1999; Innes and Booher 2000).

Toward more open and participatory planning systems

The previous discussion has examined some alternative models to the rational planning model that have developed through the 1960's and 1970's. However, there is also another tradition of planning based on social learning that has concentrated more on the process of planning itself and have contributed much to the more recent move toward collaborative planning (Friedman 1996).

The social learning tradition is built upon a pragmatic approach to planning and decision making and is also known as *learning by doing.* Specific characteristics of this approach are the mutual linkages between action and knowledge and the emphasis on the experiences of planning practice as a source of knowledge. In this approach the planning process is built on participatory processes that incorporate the full and open participation of actors including the exchange of formal and informal knowledge. This is not to say that rational planning does not include any elements of public participation. Rather that the rational method in general operationalises participation in terms of informing the public, consultation or placation[3] and higher levels of participation such as partnership, delegated power or citizen control are less common (Voogd 1995). The collaborative planning approach adopts high levels of participation as a starting point and it is very much an extension of liberal-democratic societies, and their concern with the promotion of informed and committed citizens, autonomy, justice and equality (Forester 1985, p. 131). Achievement of these goals is of course not without problems.

The participatory planning process requires all participants "… to adopt a particular attitude that results in a network of mutually interdependent actors

[3] The levels of participation are taken from Arnstein, S.R. (1969). "A ladder of citizen participation". *Journal of the American Institute of Planners,* 35, (July): 216-224.

striving for a common image of reality, for consensus on the problems that need to be dealt with and for a solution to the particular problems that have been prioritised.” (Geertman and Stillwell 2003c, p. 28). However, such processes will not occur spontaneously. Innes (1998, p. 60) for example, proposes 7 principles that can be used to evaluate the communicative rationality of a participatory process:

- Individuals representing all important interests must be present
- All stakeholders must be fully informed and able to represent their interests
- All must be fully empowered
- All contributions should be based upon sound arguments
- Claims and arguments may be freely contested
- All speakers must meet 4 tests:
  They must speak sincerely and honestly
  Their contribution must be legitimate – i.e. be based on experience or knowledge
  They must speak comprehensively – free of jargon
  Their contribution must be factually accurate
- The process should aim to reach a consensus.

Clearly, it is not easy to satisfy all of these principles in practice, especially when much current planning practice is based on the rational doctrine, with its bias toward professional and expert knowledge. Institutional change in planning organisations and practice is likely to meet with internal resistance (Innes 1998, p. 54) as well as from other groups that may wield considerable power in the current planning doctrine. For example if, as Sandercock observes, planning is essentially a state function, then in the case of a capitalist state, planning will tend to serve the interests of capital, and in extreme cases may even by used to regulate pressure and protest from dominated groups in society (ibid, p. 91). The strength of the links between the planning system and the interests of landowners, property developers and major public agencies is well recognised (Davies 1988; Healey 1988; Adams 1994; Healey 1994).

Furthermore there are limitations at the level of individual actors in such processes, including the role played by planning professionals themselves, which raises questions about the value of formal education in planning. Most planning education continues to focus on instrumental rationality despite the evidence that shows that formal analysis and information have little influence on decision making in planning practice (Innes 1998, p. 53). Many planners have therefore not had formal training in communicative planning, creating an additional barrier to its adoption. Perhaps even more limiting is the nature of the assumptive world of the individual actors themselves. While opinions and attitudes to particular issues may be adjusted as a result of a communicative process with other interested parties, the likelihood that deeply held core of beliefs would be changed is much lower . Despite these reservations there are signs that collaborative approaches to urban planning are gaining ground in practice (Forester 1985; Healey 1996; Forester 1999; Bûcek and Smith 2000; Innes and Booher 2000; Healey 2002).

The current mix of approaches in urban planning practices

The above discussion seems almost to suggest an evolutionary process, with one paradigm being succeeded by another over time, however this is not the case. Rather, in practice each of the models described above is still in use. The evolution of urban planning should be seen less in terms succession and more in terms of the diffusion and diversification of accepted practice. The concept of diffusion of innovations refers to the process by which an innovation is communicated through certain channels over time among the members of a social system and is particularly concerned with the speed and saturation level of adoption (Rogers 1983, cited by; De Man 2000, p. 143). Although De Man uses the concept in relation to the diffusion of GIS technology it can be applied equally well to the adoption of new approaches to urban planning that should be seen as innovative with respect to currently accepted practices. The adoption of innovations has been found to depend both on the characteristics of the users and on the perceived characteristics of the innovation itself. Individuals who are likely be early adopters of innovations are found to be generally: younger with a higher socio-economic status, have a higher level of intelligence and rationality, be more open to change and more knowledgeable about innovation; while significant characteristics of the innovation itself are: perceived relative advantage; compatibility with personal values, experiences and needs; perceived complexity; the possibility to experiment; and observability (Zaltman, Duncan et al. 1973; Rogers 1983, cited by; Nedovic-Budic 2000, p. 8). The situation is therefore one that offers possibilities for the adoption of new methods but in which it is unlikely that diffusion will be uniform or rapid, and that old and new paradigms will be used in parallel or perhaps even be used in an integrated manner. In the words of Sandercock *"..the various paradigms of planning are alive (and reasonably well), and that adhering to one rather than another involves a political choice rather than scientific verification."* is taken from Sandercock, 1998, Towards Cosmopolis: Planning for multicultural cities, Chichester, John Wiley & Sons, pg. 103. In her view, planners are not only able to choose different paradigms but it may also be possible and indeed even necessary to shift from one model to another in the course of a planning career.

Despite the above statements it would appear that some paradigms are more favoured than others in urban planning practice. The trend in regional planning in the UK at the end of the 1980's was to advocate a form of policy making which provided scope for both collaborative and managerial planning methods and approaches (Breheny 1987, p. 1461). However, an article by Knox and

Masilela which appeared at around the same time refers to research in Europe and the USA showing that *“..urban planners in industrialised countries operate in a professional culture that is dominated by rationalistic, problem-solving, technocratic and managerial orientations..”* (Knox and Masilela 1989, p. 69). Healey (1994; 1998, p. 4) also sees some tension between collaborative planning styles and alternatives based on neo-liberal principles and performance driven criteria. On the one hand, partnerships between groups in civil society (e.g. Public Private Partnerships) are encouraged as a means of increasing the power of civil society in determining development decisions and changing the role of the State from provider to facilitator of urban service provision and development. On the other hand, the adoption of concepts and methods from corporate sector management promoting an urban management system that is concerned with achieving results and consequently increasing emphasis is being placed on monitoring and evaluation systems to measure performance in terms of instrumental efficiency and effectiveness. According to Parsons such managerial approaches are *“... now the dominant ‘operational’ paradigm in the administration (qua management) of public policy.”* (Parsons, 1995, p. 473).

In current urban management practice this is reflected in a move from comprehensive urban planning toward a combination of strategic urban planning and action planning (Davidson 1996), and the use of urban indicators as both measures of the state of the city and performance (Flood 1997). At the same time, numerous methods and techniques that are frequently used in rational decision making such as Strategic Choice, Cost-Benefit Analysis, and Multi-Criteria Evaluation continue to be developed and applied in urban planning processes, although sometimes they now also include adjustments for multi-stakeholder planning and decision making processes, evidence that rational and participatory planning approaches interact and result in methodological innovation. There is however also evidence that the adoption of different planning styles can also lead to conflicts between planning professionals themselves about the purpose of planning and the relative importance of different approaches (Halla 1999).

2.1.2 Types of plans and their evolution

The evolution of urban planning is reflected in changes in its main instruments of implementation as well as in methodological aspects. This section looks briefly at main instruments associated with urban planning at a municipal level and in particular at those which have a strong physical component. The discussion follows the same basic path as the previous section and reviews the different plan types as they have evolved in parallel with changing insights into the planning process and the governing paradigm of each period. Throughout the discussion attention is given to 2 levels of urban plans: one that is intended to provide a long term citywide overview of proposed development and the other that is more detailed and has a shorter and more specific local focus.

The modernist rational approach to urban planning that dominated until the 1960's was based on a *blueprint* model of urban development with a focus on traffic organisation, neighbourhood quality, central places and the spatial separation of industry from residential environments, while implementation comprised public sector investment projects, land use zoning and regulations to control private development (Healey 1998, p. 8). This was also a period in which the development of New Towns throughout the UK was popular, often in combination with slum clearance and urban redevelopment programmes made possible under the 1946 New Towns Act .

This Master Plan approach that was usually formulated with a 20-25 time frame, was considered to be too static and restrictive and rather than encouraging development in some cases even hindered it (Turkstra 1998, p. 214). Other shortcomings of the Master Plan approach include the separation of plan making from questions of resource availability for implementation; the need to have a strong administrative system to oversee implementation; overly long preparation times (in the order of years usually); the lack of coordination between development agents (this includes between various public development authorities as well as between public and private sector bodies; their inflexibility when faced with changes in the social or economic context (UNCHS 1996). As a result of these shortcomings implementation was frequently difficult to realise and, even when it was effective the relatively minor role of participation in plan preparation meant that it could often become bogged down in objections and arbitration (Healey 1998, p. 8). At a lower level central and local authorities had a substantial role in the actual implementation of development being, for example, the dominant provider of housing throughout the 50's and a major supplier in the 1960's (Adams 1994, p. 74). In addition government also acted as regulator of private development, ensuring compliance with the official local development plans and their accompanying norms and standards for development.

The shortcomings of the Master Plan approach led to a major review of planning legislation in 1968 and the adoption of a 2 tier plan system, consisting of structure plans and local plans (Healey 1988). Structure plans were intended to be a framework of strategic plans and policies to guide the social, economic and physical development of urban areas (UNCHS 1996, p. 296). The plans were based on more substantial participation, adopted a more managerial approach with continuous review and adaptation and gave far more emphasis to the written communication of planning concepts and strategies, as opposed to the more previously more prominent role of the plan-map in Master Planning (Bracken 1981, p. 99). Such structure plans were to be produced at county level in the U.K. and are seen as a means to assist in the implementation of national and regional policy by indicating policies and proposals for the scale and general location of all new development, thereby creating a strategic framework for local development plans and the regulation of major development applications .

The structure plan was again to be accompanied by a local development plan, providing detail of land uses and desired development a plot level and forming the basis for development control. The local development plan that is prepared at district level typically sets out detailed policies and proposals for the use of land, thereby providing a framework for development control functions and guidance for public and private investment required to realise the plan over time. These plans have a 5-10 year time horizon and deal with the development of individual sites (plots) in the short to medium term. Although the above description describes two plan types, each at a different spatial level, County and District, an exception is now made to this situation for the Boroughs of London and Metropolitan Councils such as Manchester. Such important urban administrative units are now required to produce a Unitary Development Plan (UDA), that is essentially a combination of the structure plan and local plan and has essentially the same form and content of those prepared separately by the counties and districts elsewhere .

Although the revised two tier plan approach was intended to address the shortcomings of the static Master Plan it has not been without its critics both from inside and outside the planning profession. Keeble for example found little evidence of the promised improvements in the quantity and quality of the new development plans more than 10 years after their introduction and was generally critical of the shift away from spatially explicit plans to indicative drawings and voluminous but rather uninformative written statements of intent (Keeble 1983, p. 91). Central government was also increasingly critical in the 1980’s. The role of the public sector and planning was under particular pressure in the 1980’s in the UK, due to the domination of neo-liberal thinking under the leadership of Margaret Thatcher. The structure planning approach was criticised because it was restrictive and delayed development and therefore undermined opportunities to tackle unemployment or housing problems . This is well illustrated by a 1985 circular of central government *"..that there should be a presumption in favour of granting planning permission unless there was demonstratable harm to matters of acknowledged importance."* (Davies 1988, p. 131). Similarly local plans may take many years to prepare and approve raising concerns about the responsiveness and flexibility of the planning system as a whole. For example, the draft Bristol local plan was produced in 1992 but not finally adopted until 1998, after a public inquiry in 1995 and subsequent modification . While such lengthy planning processes show the inherent weakness of the system, they also demonstrate that the plans are seen as an important mechanism that is worthy of considerable scrutiny and participation from the public, who are all stakeholders in discussions that affect the future of their living environments.

Another key feature of the planning system prior to 1991 was the legal status of the plans themselves, which was an important aspect of the development control process. Both plans were considered to be indicative and not prescriptive . A decision made by a local authority concerning a development application was therefore discretionary and would have regard to the development plan and any other material considerations such as the local amenity, layout of the site, building volume or coordination with other nearby development. As a result of this approach there was some flexibility for the decision making authority but it also implies a that the scope of development control that is very much determined by precedents established on the basis of individual cases where appeals against decisions have been made in the planning courts (Davies 1988, pp. 130-131). In 1991 however the planning legislation was amended to give the considerations and policies in the development plan primacy above other considerations. Though it must be pointed out, the degree of primacy reduces over time, providing an incentive for local authorities to keep their development plans updated .

The above description of British town planning has shown it to be a dynamic field that has helped shape the development of cities and towns throughout the U.K., but it is also a field that has not been without its critics. The profession has, a result of many challenges, been struggling to establish for itself a new role and form that is accepted by the rapidly changing political, economic and social realities of modern life, that no longer calls for the preparation of great plans, *"..but continues to provide the basis for careful scrutiny of environmental change."* is from Cherry, G.E. 1988, Britain, pg. 233 in Ling, A. (ed) Urban and regional planning in the Commonwealth, Howell Publications, through an incrementally negotiated series of decisions related to development options. This is very much in keeping with the shift in the perception of planning from being product driven to a view that is more process driven, and with increasing concerns for the multiplicity and diversity of interests in urban planning (Healey 1998).

2.1.3 Transfer of urban planning ideology and practices to Sub-Saharan Africa

The need for effective town planning is no more apparent than in the cities of the developing countries that are struggling to cope with rapid urbanisation, often under conditions of extremely constrained resources. This section examines how the development of town planning in Britain has influenced town planning in Anglophone Sub-Saharan Africa, thereby providing an insight into the context of the case study that is at the heart of the empirical component of this study. Thereafter attention is also given to some recent international efforts directed at improving urban planning in developing countries including many of those in Sub-Saharan Africa.

The linkages with the British planning system

The period of British colonial rule profoundly influenced the nature of urban development in SSA, especially from the late 19th century until independence. As with other colonial powers of the time, the British established cities and towns for purpose of facilitating trade with Britain, for organising military, political and administrative control systems . As in Britain, concerns of public health and housing were also of major importance in colonial cities, though they were primarily directed at the European population and were therefore also very much linked in practice to issues of racial segregation .

The legacy of the colonial planning practice is long lasting, both in a physical sense through the segregated residential quarters that were established as a result of racial segregation policies (Rakodi 1986, p. 193), and also including the adoption of planning concepts and strategies such as Garden Cities, New Towns and growth poles, that were transported from Britain to the colonies particularly during the 20th century . In a physical sense distinctions were frequently made in plans between the quarters for residents of European, Asian or African origin. The first would typically have the lowest densities and if possible be sited on locations segregated from other groups or on sites that provided the best environmental conditions. Asian areas were planned at medium density while residential areas for the African population had the highest densities, lower standards in terms of infrastructure and in some cases there were no controls exercised over building construction at all.

There are also strong connections in terms of planning legislation, institutional structures and administrative processes (Okpala 1987). The town planning legislation that was adopted in the countries of Zambia, Tanzania, Botswana, Zimbabwe, Kenya, Nigeria, Uganda to mention but a few, had their roots in the British Town Planning laws (see Ling 1988, for descriptions of urban and regional planning systems throughout the Commonwealth), and was often simply transplanted without modification to the new situation, irrespective of the different circumstances in the recipient country (Kanyeihamba 1973, p. 243). The adoption of transported legislation as a basis for town planning in SSA countries, while conveniently familiar for the colonial administrations (ibid, p. 244), was a recipe for failure for a variety of reasons related to the different political, cultural, social and economic conditions. Whereas the planning laws in Britain have been reviewed and revised, the laws that were translated to East Africa tended to be more static and unresponsive to changes in both the host country and in the recipient country (ibid, p. 247). Even more than in Britain, it was difficult to coordinate the economic, social and physical aspects of developing planning, despite the more centralist approach to government that was often adopted. Not only were most rural people unfamiliar with the intentions of the town planning schemes and development control (Ling 1988, p. 300) but the political and economic systems were often substantially different. While the planning system in Britain was based on a liberal capitalist economic system, after independence many SSA countries adopted political systems with a socialist approach implying strong centralised planning functions and little local autonomy in decision making. However the adoption of the British style discretionary planning systems in a highly centralised administrative system will tend to overburden those planning staff that were available as each development application requires careful, professional scrutiny.

The shortage of trained manpower was a problem during the colonial period and has continued well after independence. The planning system was almost totally dependent upon British professionals. For example, in a study of Anglophonic African countries, Kanyeihamba (1980, p. 261) states that in 1964 "*..over 70% of the region's planners, technologists, senior administrators and managers, all carrying considerable responsibilities for policy, planning, finance and development, were expatriates.*", and he even remarks that the requirement of expatriates after independence increased further still (ibid, p. 257). Increasingly some expatriate planners were becoming specialised in the niche of planning in tropical countries, leading to the creation of special units and publications dealing with building in the colonies and many of the urban development plans produced in SSA after independence continued to be prepared with foreign capital and using foreign planning expertise.

However, there have also been programmes to build the local planning capacity. Particularly since independence many academics and town planning professionals from SSA have been trained partially or even fully overseas in British and other European planning schools. These professionals, though relatively few in number, were gradually supplemented through graduates from local planning schools established after independence. However, effective capacity building requires a sustained effort over an extended time period and the supply of trained planning professionals still falls far short of demand. For example, in Ling's review of Urban and Regional Planning in the Commonwealth (Ling 1988) the shortage of trained manpower in the countries of SSA is a consistently mentioned barrier to effective planning and development.

Another issue related to manpower that deserves some attention and that relates to the perceived roles of planners and their attitudes to planning in general. Although some recent research shows that the typical developing country planning practitioner with a local education "*...attaches a good deal of importance to managerial skills,... is rather technocratic and yet at the same time pragmatic and grassroots-oriented*" (Knox and Masilela 1989, p.76), it is not inconceivable that the most senior staff who have been largely trained abroad are protagonists of the technical rational planning approaches that were dominant throughout the 1960's and early 1970's.

Although Ling's work has shown that many SSA countries now possess the capacity to train some if not all of their planning technicians and professionals this does not mean that they are necessarily independent of influence from the developed countries. Planning schools in the developed countries, including Britain, still play a major role in setting the agenda and providing the content for debates on the future of planning and in developing planning methodologies. Still the influence of received planning concepts lingers on in the developing countries (Kironde 1992c; Adebayo 2003), and is reinforced by the continuing substantial influence of International Development agencies, the 'donor community' and the planning doctrines of Britain and other countries.

Recent international linkages – the Urban Management Approach

The Urban Management Programme (UMP), a cooperative effort of UNDP, UNCHS and the World Bank, has been instrumental in the development and transfer of new approaches and methods for urban planning and management to many developing countries, including several in SSA. Building on a 6 year phase of policy and tool development from 1986 to 1992, UMP phase 2 (1992-1996) sought to develop operational capacity at country level in 5 substantive areas: municipal finance and administration; urban infrastructure management; urban land management; urban environmental management; and urban poverty alleviation . Included in this work have been several efforts to develop and introduce new forms of urban planning that are more responsive to community needs, more realistic in terms of their objectives and more effective in terms of meeting their objectives.

Approaches to urban planning based on structure plans, strategic plans and action plans are seen as providing a means to make urban planning more responsive and effective and are now advocated widely throughout the developed and developing world (Clarke 1992; Davidson 1996). Although at times there is some confusion in terminology used, there is general agreement that the more traditional statutory development plans that are a basis of the British style planning system should be supplemented by the more flexible and responsive strategic plan for planning and coordinating investments and interventions related to city-wide development, and action plans for the coordinating short-term interventions focused either on specific topics or on specific localities. Both Clarke and Davidson see a continuing role for a detailed local plan that provides a statutory basis for development control based on regulatory requirements for land use, density, plot sizes etc. given that it provides developers and land owners with a degree of certainty and clarity about their rights and obligations with respect to their land holdings. Both strategic plans and action plans are seen as 'performance oriented' rather than statutory (Davidson 1996) implying that they are typically created through collaborative planning processes with the specific intention of not only formulating plans but also agreeing on the implementation process and the respective contributions of the various stakeholders. The combination of statutory and no-statutory plans can however cause problems.

> *"A sensitive issue is the relationship between statutory and non-statutory plans. Ideally they fit together, and this will be the case with a recently prepared, sensitively developed (ed. statutory) plan. Where there is a difference, then it will be necessary to negotiate modifications."* (Davidson 1996, p. 457)

If, as Davidson observes, the planning system allows for changes to be made to statutory plans in a relatively flexible and fast manner, such problems may be minimal, but such flexibility is usually not incorporated in British based planning systems and specific changes may have to e made in the legislation to support such an approach.

Flexibility is one of the pillars of the new internationalist thinking about urban problems discussed by Webster (1994, p. ix) who reports that *"..Planning and development controls should guide the development of cities, but provide sufficient flexibility to not interfere significantly with the supply of housing and facilities .., or deter low cost solutions to problems."*. Tied to this concern for flexibility is the question of creating effective standards for planning, building and servicing, which are a critical factor in determining the effectiveness of land use regulations (UNCHS 1996, p. 297). Many countries now consider lowering standards for low-income groups, ostensibly while retaining the possibility for future incremental improvement. De-regulation of the development control system has been advocated in the developed countries as part of comprehensive programmes to reform government and, in particular local government, through decentralisation, increasing liberalisation, privatisation and the creation of improved governance structures based on principles of accountability, legitimacy, transparency, effectiveness and equity (Edralin 1996/97; Rakodi 2001, pp. 214-216). These policies are now the accepted doctrine for developing countries too, though Rakodi (2001, p. 221) cautions that *"..existing power relations and ways of operating are deeply entrenched.."* and as a consequence there is no guarantee of improved performance.

Another concern that has always been central to the interest of urban planners is the need for data on urban development. Rational planning models place great importance on the availability of data for modelling and decision making and it is not surprising that the shift of emphasis form rational planning styles to collaborative approaches is not without consequences for the data requirements of planning. Although Rakodi recognises that economic and environmental information should be made widely available for reasons of transparency, she is critical of supporting "*Improvements to data, technology and techniques … unless they can be shown to be contribute to the tasks that matter politically*."(2001, p. 221). Other authors also stress the growing importance of up to date knowledge about the state of urban development and its processes (Webster 1994, p. xi), the adoption of techniques that will allow for effective monitoring and evaluation of plan policies and programmes at local level via key sets of indicators (Clarke 1992, p. 159) and the creation of an effective guidance system based on a shared information base, possibly in a GIS environment, that provides clear and easily accessible information to all stakeholders via direct or indirect communication lines (Davidson 1996, p. 451). While Rakodi's cautionary words should not be ignored, it is also apparent that information technologies for handling spatial data such as GIS and remote sensing are seen as part of the suite of tools that can be adopted by local governments in developing countries as an aid to effective urban planning (UNCHS 1996, p. 300) and there is a rapidly growing amount of experience in developing countries with GIT applications (Cartwright 1991; Taylor 1991; Yeh 1991; Yaakup and Healey 1994; Turkstra 1998; Abbott 2002; Abbott and Douglas 2003). However, for this research a specific concern with applications of such technology that seek to support planning and the development of so-called Planning Support Systems is most important.

2.2 Planning Support Systems

Batty (2003) describes the notion of Planning Support Systems (PSS) as "*.. loosely coupled assemblages of computer-based techniques which form a toolbox into which decision-makers can dip in the quest to manage and tame their decision problems.*". This definition implies that a PSS is considerably less than a fully integrated computer based support system for planning and is a reflection of the practical applications which tend to favour modest incremental applications rather than the construction of monolithic systems (Bishop 1997, p. 47). A view that is in keeping with the evidence from studies of the adoption of GIS in the UK that suggest that systems should be developed incrementally, but within an overall information strategy (Masser and Campbell 1989; Campbell and Masser 1995).

The discussion here starts with an examination of the role of geographic information in urban planning, establishing linkages to the previous examination of the development of urban planning. Following this the recent theoretical discussion on the PSS, which is based primarily on western experience and the pioneering work of Michael Batty is examined. Thereafter some examples from the developed and developing countries are presented, showing how in practice, most PSS tend to have a rather limited focus on a specific problem situation and often from the perspective of a single decision making body from the public sector.

2.2.1 Geographic information in urban planning

Urban planning is generally recognised as information intensive activity and geographic information in particular is considered to be of fundamental importance to urban planning practice (Huxhold 1991; Masser and Ottens 1999). This view is consistent with the origins of urban planning as a design discipline and later models related to rational decision-making. Although the image of the planner as an *"..objective information provider serving instrumentally rational decision makers is no longer accepted as an adequate view of practice.."* (Innes 1998, p. 52) and despite of the failures of the data driven planning in the late 1960's and 1970's (Lee 1973), much public and private funding is spent on creating and maintaining databases of urban areas throughout the world. This is consistent with the development of public administration systems and bureaucracies and it has been further stimulated by the rapid development of information and communication technology (ICT), including more recently the development of ICT specifically designed to handle geographic information, known as GIT.

The use of GIT in urban planning is very much related to the type of planning activity under consideration. Masser and Ottens (1999) make a distinction between two traditions in urban planning: the plan making tradition and the administrative tradition. The former is generally associated with work in ad hoc teams for the preparation of policy reports and various forms of development plans (e.g. Structure plans and local development plans discussed previously). The latter tradition is associated with more routine activities linked to the planning agencies themselves such as development control. The emphasis in this research is primarily on the use of GIT in the plan making tradition at both strategic and local levels and the concern with the identification and implementation of possible interventions in on-going development processes. Typically the preparation of a plan for a specific area requires geographically referenced data to be complemented by other non-spatial data describing past, current and prospective states of 4 main subject areas: population, economic activity, environment and finances (Masser and Ottens 1999, pp. 33-34). These data will be stored in various databases that are accessed and processed throughout the planning process. The creation and maintenance of such databases is therefore an important component of the practical implementation of PSS concepts.

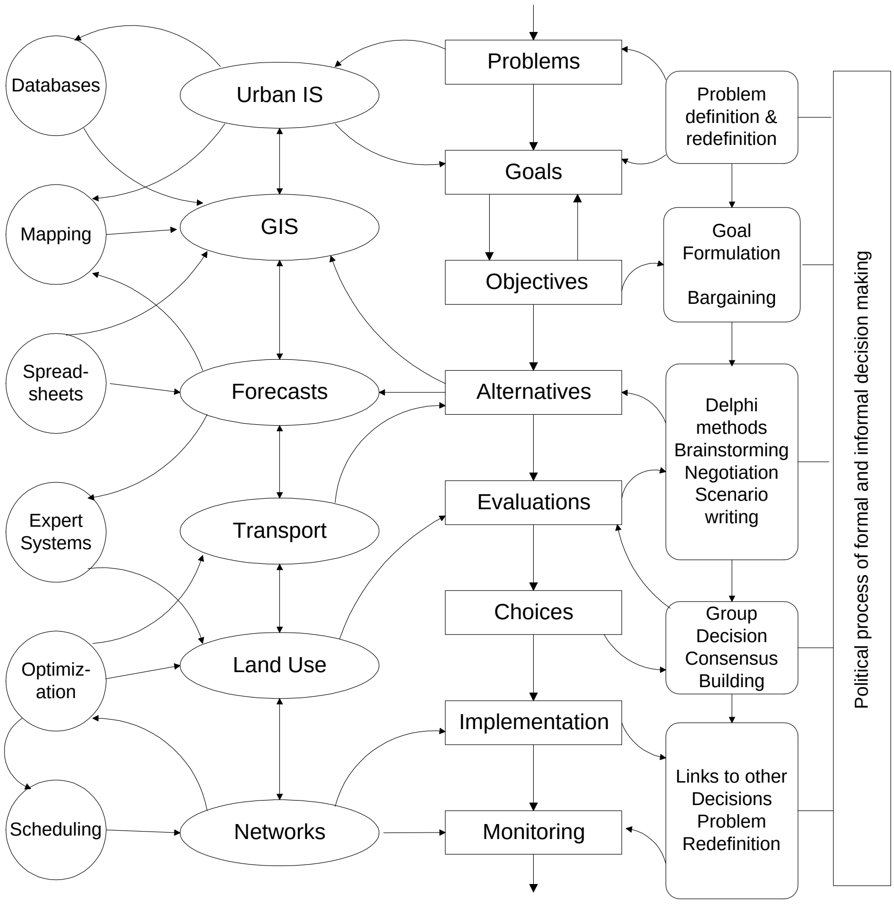
2.2.2 Evolving models of PSS

This view of multiple database types that are linked through a set of models to various stages in a rational planning process is evident in the work of Batty (1993; 1996) who is one of the leading academics in the PSS field. One of his earliest models of PSS showed the planning process being 'driven' by various models and methods that are essentially *"... a variety of decision support* *systems which inform our ability to define and redefine problems and goals and objectives, to understand and predict the future nature of the problems in question, and to ensure the generation of imaginative planning solutions."* (Batty 1993, p. 60). The data required by these models were drawn from one of 3 information systems: a general information system that contains data on broad socio-economic and environmental conditions, a GIS that contains small scale georeferenced data related to the planning area and possibly also a LIS that typically contains large scale data for the planning area that would for example be related to individual land parcels and utility networks.

In 1995 an adapted version of this model appeared (see Figure 2.3) that differed in two main ways from its predecessor. First, it identified some generic types of data processing tools and datasets (respectively indicated as circles and ellipses in the figure) that were linked to each other and to various stages in what was essentially a rational planning process. Second, it explicitly recognised the political dimension of the planning process. In Batty's terminology these "*non-computer based processes"*, are also a vital element of the planning process, creating a planning system that "..*essentially is driven by its response to policies and problems, but not by data requirements or model characteristics."* (Kammeier 1998, p. 107).

Although these refinements were an improvement over the earlier PSS model several points perhaps require further attention. For example, it may be more appropriate to show the Transport, Land Use and Network models in a more integrated way, thereby reflecting the inter-relatedness of these fields and visualising the connections that also exist between Land Use and Network models and the plan preparation stage *Alternatives*, that are currently surprisingly absent. Nor does the figure reveal how the technical inputs to planning are actually connected to the political processes. While the technical processes are primarily the realm of the planning professionals and academics (Kooiman 2003), the outputs of these processes should in principle be one of the inputs into the political processes and decision making in which the planning professionals are joined by politicians, stakeholders from the private sector and the wider public. Invariably the political processes involve two-way communication between experts and non-experts (Batty 1997) and a major challenge in the more collaborative form of urban planning today is therefore to create effective communication between stakeholder groups that may have a great diversity of backgrounds and interests. The PSS should enable all stakeholders to make well-informed contributions to the various stages in plan preparation and implementation.

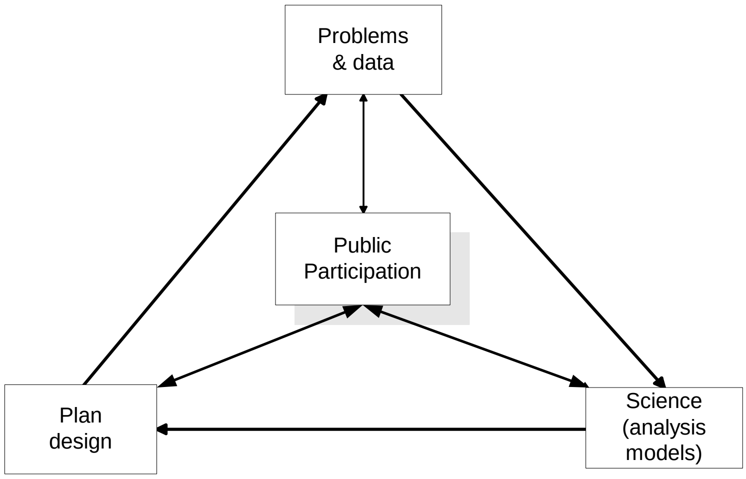
Figure 2.3: The planning process supported by a formal computation desktop PSS



(source: Batty 1995)

An even more recent but more generalised model of the planning/design process prepared by Batty gives a central place to the public participation in the planning process (see Figure 2.4). A minor adaptation made by the author in this figure is the inclusion of two-way linkages between the central activity of public participation and the 3 other elements that together represent a simplified form of the urban planning/design process used in earlier models. This is an important change as it recognises that high levels of participation are possible in which the public participation plays an increasingly important role not only in problem formulation, but also through contributing their local knowledge and in the preparation of solutions. The increasing interest in participation is also evident in many of the recently developed PSS, some of which are discussed below.

Figure 2.4: Public participation in the urban planning/design process



(adapted from Batty 1997, p. 19)

2.2.3 Reviewing PSS practice from developed and developing countries

Theoretical developments and practical applications of PSS with a focus on spatial planning are receiving increasing attention in the literature. Two substantial collections of papers on PSS in urban and regional planning have been complied recently (Brail and Klosterman 2001; Geertman and Stillwell 2003). A striking feature of the two books is the dominance of applications in developed countries. This is particularly evident in Brail and Klosterman's compilation that provides an overview of contemporary PSS developments with a strong focus on the USA. Four trends are prominent in this book: *i)* a revival of interest in integrated land use and transportation modelling that has evolved out of early developments in this field in 1960's and 1970's; *ii)* a strong emphasis on the visualisation of data and landscapes, including the development of tools for 3D modelling, visualisation and the manipulation of actual and possible future landscapes in a virtual environment; *iii)* the development internet based tools that are intended to provide a mechanism for a broad range of stakeholders to not only be informed about local planning issues but also to participate in the finding of solutions and *iv)* the prominent use of Multi-Criteria Evaluation (MCE) techniques as a support tool for evaluating alternatives and in decision making.

Similar trends are also seen in the more recent compilation of Geertman and Stilwell that contains papers dealing with 5 major topics: *i)* enhancing participatory planning; *ii)* the development of specific software tools[4] which can support some parts of a planning process; *iii)* systems that are designed to support strategic plan making in both the public and private sector; *iv)* systems that provide support for dealing with questions of land use and infrastructure planning, a field that is traditionally important in PSS application and, *v)* systems designed for handling environmental issues. Here too, issues of model development, simulation, multi-criteria decision making, visualisation and participation are key elements that correspond well to the research agenda for the application of GIS in urban and regional planning that emphasises intelligence and collective design as the current modus operandi of urban planning (Nedovic-Budic 2000b). Nedovic-Budic also points to the need to operationalise the tools provided by GIS and PSS and *"..to put them hands of the planning professionals*" and further identifies 3 main areas in which research and development is required: *i)* building tools for policy making, decision support and visualization; *ii)* institutionalisation of technology into the planning process; and *iii)* stimulating the adoption of technology by all participants in the planning process (ibid, pp. 88-89).

Despite the apparent growth of interest in research in this area the lessons of practice are mixed, even in the developed countries that appear to have a lead in this area. A recent study of 4 Spatial Decision Support Systems (SDSS) in the Netherlands has shown that technical sophistication is no guarantee that such systems will be intensively used in practice (Uran and Janssen 2003). In their experience the failure to use such systems is related to both the nature of the decision process being addressed as well as the SDSS functionality and operability. Typically the problems that are addressed with SDSS are complex and require considerable amounts of data and knowledge, and this contributes to rather vague functional specifications for the development of SDSS. Therefore, although the 4 systems compared by Uran and Janssen all satisfied their users' specifications reasonably well, they all preformed less well in relation to the actual support provided to the decision process itself (ibid, p. 525).

While it is evident that some caution is justified in adopting a highly sophisticated PSS approach, particularly in the least developed countries, there could also be potential benefits. Technical expertise may be in limited supply and systems that enable knowledge and skills to be more widely and effectively exploited have therefore an obvious appeal. In such environments data on which decision making and planning is based may also be in limited supply and systems that encourage such scarce resources to be more effectively managed, shared, combined and utilised are therefore worthy of examination. By creating systems that allow data to be used more effectively communicated and shared,

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[4] Such tools can be seen as examples of the bubbles and ellipses in Batty's PSS model shown in Figure 2.3 above.

planning professionals may be perceived as more legitimate and authoritative by both citizens and policy makers (Innes 1998b).

This may be true of the more traditional approach to PSS, but some PSS developments are also directed at non-professional users. Communities themselves also stand to benefit from PSS developments and GIT based tools are being used in a variety of institutional configurations involving local governments, CBO's, NGO's and universities to support community planning processes (Leitner, Elwood et al. 2000). Similar partnerships between communities and bodies with more GIS knowledge and skills can also be found in developing countries (Abbott, Huchzermeyer et al. 1997; Abbott 2002b; McCall 2003; Sen, Hobson et al. 2003). McCall (2003) for example provides a good overview of the opportunities and concerns that exist for using GIT in participatory planning processes. He notes that the development and use of participatory GIS can enhance governance in several ways: through the recognition and incorporation of local knowledge in planning processes and by improving the ability of communities to register, analyse and communicate those of their interests that have a distinct spatial dimension. Such benefits may contribute to the empowerment of communities though McCall and others such as Pløger (2001) also recognise that information in itself does not empower, that GIT tools in whatever form are not value neutral . More often than not the use of GIT may be more traditional, in that it is targeted at use only by professionals who are required to analyse and prepare alternatives for consideration by decision makers (Yaakup and Healey 1994; Han and Peng 2003).

Interestingly, many of the examples discussed in the Public Participation GIS (PPGIS) literature in developing countries include applications that deal with the concerns of informal communities, though in widely different contexts. As we have seen earlier, the field of urban planning has arisen out of broad concerns with the quality of residential environments in cities and it is therefore natural that this focus should also be reflected in emerging fields such as PSS and PPGIS. In the following section the third and final theme of this research, access to land and informal housing processes is examined, completing the description of the general context in which this work has been undertaken.

2.3 Formal and informal urban housing processes – issues and responses

The focus of this study on housing is deliberately chosen, as residential activity is generally by far the dominant user of urban land and may comprise as much as 70% of developable land in cities in developing countries (Wakely 1988, p. 121). Where as housing supply was once seen as an independent task of government, it is now realised that housing and land are closely related issues (Angel 1986). Rakodi (1997b, p. 393) for example refers to access to land as *".. the single most important component of housing supply"*. The fact that land and housing are also *“..intricately linked to urban poverty in general”* (Berner 2000, p. 555) make both topics increasingly important subjects for research.

2.3.1 The importance of housing and land supply

Traditionally, both land and housing are topics for public sector concern and regulation, and both therefore receive considerable attention from organisations involved in urban planning and management. Land can be seen as a social commodity as its use is often associated with externalities that imply a need for the consideration of interests that go beyond those of the individual property owner and therefore justify guidance and coordination via planning agencies in government (Adams 1994; Webster and Lai 2003). The State is also traditionally interested in the housing sector and has often taken an active role as a supplier via public housing institutions and programmes (Hardoy and Satterthwaite 1986). This is also true for many governments in Sub Saharan Africa that for many years have been involved in the provision of state owned rental housing, albeit generally unsuccessfully (Rakodi 1997b, p. 391). Although ostensibly for low-income groups, such public housing projects were in fact often unaffordable for the poor and either remained vacant or were taken over by wealthier families , leaving the poor with no alternative than to look for solutions to their shelter requirements that fall outside of the formal systems for housing delivery.

The SSA region has experienced some of the highest rates of urbanisation in the world over the last 30 years. In part this is due to the comparatively low level of urbanisation in the region at the end of the colonial era (Simon 1997, p.. 87). However, seen in the light of the prolonged poor economic performance of many SSA countries in the same period (ibid), sustained urban population growth has come to be associated with the urbanization of poverty (Kreibich and Kombe 1999). Although the quality of population data is often poor, (Simon 1997), it does, in general, confirm that rates of urbanization in most SSA countries have exceeded economic growth rates. While rural-urban migration flows were often established for temporary, predominantly male labour under colonial administrations (Potts 1997), the abolition of such discriminatory restrictions on urban residence in the post-colonial period has been a major factor in rapid urbanization in SSA.

Rapid urbanization has outstripped the capacity of the State to provide and maintain adequately serviced land in cities (Stren 1982; Stren and White 1989; Kreibich and Kombe 1999). This is not to say that no attempts have been made to establish institutions and procedures for the planning and management of urban development. Rather the systems developed are, by and large, based on received concepts that are inappropriate for local socio-economic conditions (Okpala 1987; Kironde 1992c) and are based upon wrong assumptions concerning the availability of the technical, human and financial resources required to operate them. The following section looks briefly at how housing and land delivery in SSA has been subjected to various paradigm shifts. Not surprisingly the development of new policy initiatives related to land and housing and instruments to implement exhibit similar trends as those discussed previously in the field of urban planning, with a clear evolution from strong state control toward more neo-liberal approaches, though here too, the result is more of a mixed approach rather than a total paradigm shift.

2.3.2 The practice of land management and housing delivery in SSA

Colonial governments in SSA frequently established a dual system for land and housing supply based upon racial grounds. Especially within urban areas and towns the government prepared and implemented development plans that were aimed primarily at the needs of the population of the colony's administrative personnel and their families. Formal laws and regulations for land tenure, and development based upon UK laws were applied to all land located within the designated planning areas (Alexander 1983; Rakodi 1986; Wekwete 1988; Myers 2003). However land that was located outside of the designated development areas, and which had not been allocated for formal large-scale agricultural enterprises, was managed according to the customary practices of the specific locality. The freehold or leasehold land titles available for agricultural estates and land parcels in urban areas were primarily intended for families belonging to the colonial administration, other westerners or some specific but wealthy minority groups such as traders with a predominantly Asian origin. In the case of the colonial administration, it was common practice for the government to provide housing and services in keeping with their status and requirements. On the lands that fell under the customary land management practices, chiefs generally maintained their role in allocating land to developers and resolving disputes as and when required, and those allocated land were responsible for constructing their own shelter according to local custom and affordability. Such areas generally provided shelter for the African population either as house owners or as tenants.

Inevitably, as cities grow in population, rural land is required to accommodate the additional land needed for urban development and it is in this aspect that the received practices of land management have contributed to the break down of the formal systems for managing urban development. In the UK, one system of land tenure applies to both rural and urban land and the development process generally proceeds relatively smoothly, via a combination of state and private investment that ensures adequate financial compensation to the original holders of the converted land (Adams 1994). The establishment of parallel systems of formal and customary land management in the SSA colonies, however, failed to consider the implication of the development process for land management and this has had major repercussions for the inability of both colonial and, more importantly, post-colonial governments, to effectively manage the development of urban land. There was no precedent in the UK for dealing with customary land tenure. Consequently the management practices and the mechanisms required to accommodate it customary development into urban areas were given little or no attention in the colonial laws and whenever the boundary of an urban area was expanded to accommodate growth, customary settlements would effectively become illegal settlements on a number of grounds. Customary landholders do not have formal land tenure, the settlements themselves are unplanned and usually have a haphazard layout, infrastructure and services are usually sub-standard and the building materials and construction was also often not in accordance with the formal standards for urban development.

Although the problems arising form this duality were already recognised in the colonial period, they have not as yet been dealt with effectively, and given the currently high urbanisation rates in SSA, they are an increasingly important problem. In the post-colonial period a variety of instruments have been developed and applied in order to address the problems of informal housing in SSA. These instruments can be divided into two broad categories that should be applied in a parallel and coordinated manner for maximum effectiveness: proactive instruments that attempt to pre-empt the creation of new informal settlements and retroactive instruments that seek to address the problems via interventions in existing settlements. The two types of instruments will be discussed with the aid of the model of formal and informal urban development of Baross (1986; 1987). Subsequently the information requirements and the use of spatial data for each type of development will be discussed.

Formal urban development and housing

Proactive interventions that are designed to prevent the creation of informal settlements are equated with the formal model of urban development. From a formal planning perspective the interactions between major actor groups (Public organisations, Development Firms and Individuals and households) and their demands for land and services should be known or estimated and the planning process will then allocate land for various functions, such as housing, facilitate its servicing and regulate access to the land by the various activity agents who can then pursue their various development goals. Baross (1986) shows the urban development processes divided into 2 phases, similar to the 2 levels of urban planning described earlier in this chapter. The two phases in the formal model of urban development are:

City Development Phase: in which public authorities undertake broad zoning of land (land use planning) and provide trunk infrastructure and public and private developers consolidate land in preparation for actual site development

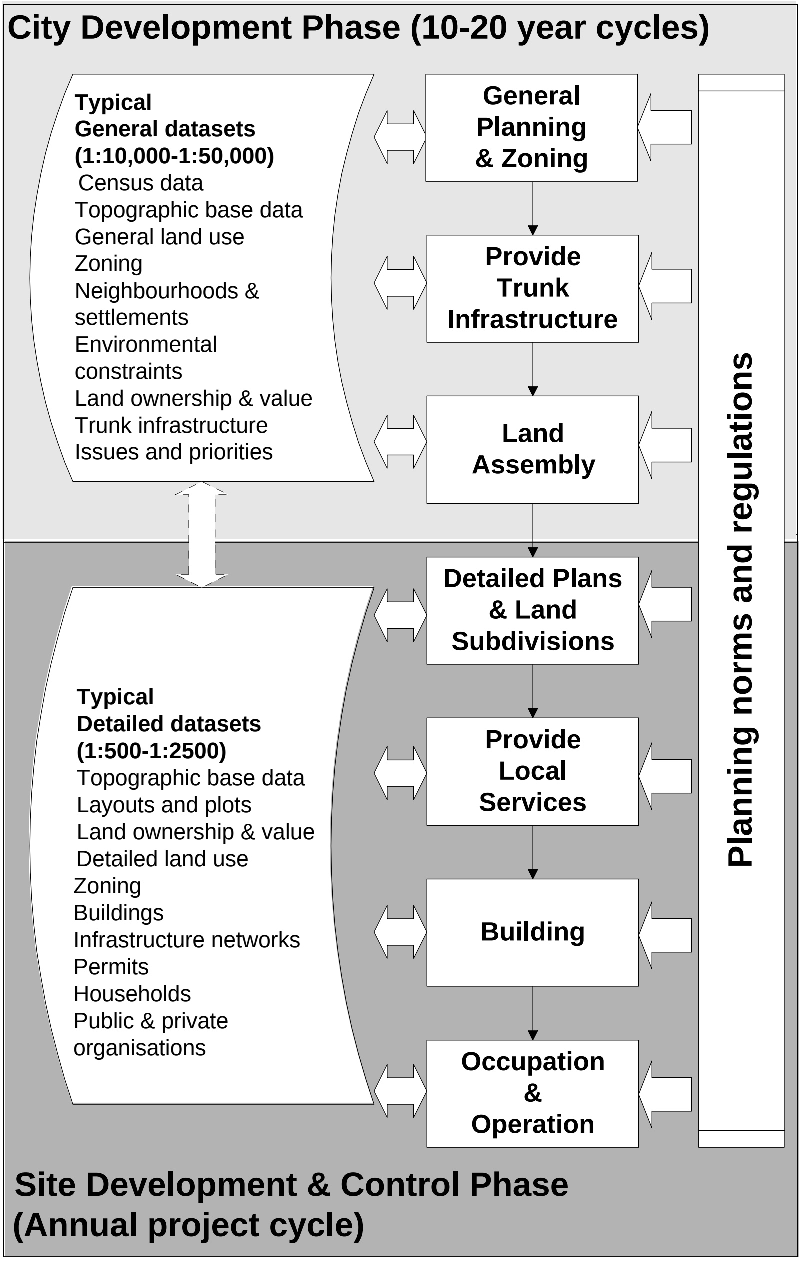
Site Development Phase: the subsequent phase consisting of detailed planning of subdivision layouts and land use allocation at plot level (P), provision of minor infrastructure to service individual plots (S), building of required structures (B) and occupation by the users (O).

This idealised formal model of planned urban development is referred to as the *PSBO* model (see Figure 2.5). It consists of a sequential series of processes that are designed for the orderly conversion of rural land to urban land. Phase 1 activities are usually performed at a cycle of approximately 10 years and are used to guide a series of annual site development cycles throughout Phase 2. The various steps are dependent upon a set of planning norms and regulations that provide a basis for the preparation and implementation of plans at both levels. An important assumption here is that the norms and regulations are appropriate to the local context. They should not only be technically sound but they should also be grounded in the local culture, reflect the behaviour and aspirations of the population and be affordable. Where this is not the case, such as when planning and building standards are imported and applied without due regard to the local context, the development planning system will almost inevitably fail (Okpala 1987; Kironde 1992c). Evidence of such failure abounds in the examples of housing delivery systems in SSA.

The *PSBO* model is also based on other assumptions about the behaviour of actors in urban development. In Table 2.2 some of these assumptions are listed in relation to the 3 basic actor groups suggested above which are those that may be expected to be found in market economies, such as those found in the developed countries where this model originated. Fundamental pillars of such systems are the recognition of individual property rights in the ownership and use of land, relatively strong public authorities and, increasingly a well developed and active development firms and finance organisations that attempt to extract profit from the construction of buildings, including housing, for sale or rental to individuals and households. In the UK for example, housing supply increasingly depends on the activities of housing corporations, professional property developers and large landowners (Adams 1994). These groups often work in close cooperation with public agencies but the government retains a role of guiding and coordinating the overall process and should be accountable for the overall performance of housing delivery (Healey 1988; Adams 1994; Healey 1994; Allmendinger, Prior et al. 2000).

In the SSA context, many of the above assumptions are not satisfied and consequently public housing and para-statal housing schemes have been largely unsuccessful in delivering an adequate amount of serviced housing units, especially for low-income groups. In response to the failure of large-scale public housing schemes for low-income groups and, in keeping with general international developments in the housing field, there has been a general shift from the delivery of housing toward the delivery of land.

Figure 2.5: The formal urban development process (PSBO Model)



(source: Baross 1986)

Table 2.2: Examples of assumptions related to the roles of different actor groups in urban planning processes

Public planning and utility agencies
Demand for land and services are known or can be relatively easily established
Resources required for service provision are available or can be recovered from users over time via user charges or taxes
A form of serviced development can be provided to cater for all income groups
Rural land owners will agree to sell their land to developers or develop it according to the plan
Accurate land tenure information is available
Conflicting demands for land can be resolved to the satisfaction of all parties
Households
Households will only buy or rent and occupy serviced buildings created via the formal system
Households can afford to buy or rent serviced buildings
Households have a regular source of income
Households have access to affordable mortgage finance
Development firms
Public and or private sector developers have the capacity to satisfy the demand for shelter
Speculative land assembly will not take place in anticipation of zoning (planning)
Land that is zoned for development will not be withheld from development for speculative purposes
Developers have a good understanding of market (user) requirements

This development has taken place in two phases. The first phase, in the 1970's and 1980's, a project based approach to land and housing delivery known as Sites and Services was popularised and widely implemented with the support of the international donor community throughout the region. Planned land subdivisions provided with a minimal level of infrastructure, often comprising gravel roads, communal water points and low-cost sanitation systems, were seen as providing an affordable means to increase serviced land supply (Davidson and Payne 2000).

Such projects follow the *PsOB* model, with the lower case *'s'* referring to the possibility of adopting reduced standards and levels of infrastructure than would be the case for higher income housing areas. Low-income households allocated plots in such schemes were expected to construct their own housing according to accepted building codes and make regular payments to the government to cover the cost of constructing and maintaining the infrastructure. Although some sites and services projects were successful, they have generally not had the anticipated impact. Typical problems in these schemes were: a technocratic approach with inadequate community involvement and commitment; inadequate cost recovery; failure to maintain infrastructure; corruption in the plot allocation system and unauthorised plot reselling leading to infiltration of higher income groups (Peattie 1982; Magembe and Rodell 1983; Materu 1986; Rakodi 1987; Kironde 1991).

The failure of the Sites and Services approach to create a structural and sustainable mechanism for low-income housing has forced a further rethinking of land and housing issues. The essence of current thinking is both pragmatic and strategic in its approach. Although there is now little or no support for public housing approaches (Gilbert 1992; Pugh 1997b), the issue of infrastructure supply is seen as a critical area for public sector concern and emphasis is put on deregulation (Dowall 1992b; Payne 2001b), and the possibility to incrementally increase standards over time. One means of achieving this is the Guided Land Development (GLD) or Rapid Land Release (RLR) approach (Marulanda and Steinberg 1991; Turkstra 2000). GLD creates a spatially ordered urban development that allows private (low-cost) housing to be constructed prior to servicing. In this manner it is hoped that infrastructure can be provided when funds are available and incrementally improved over time without the need for costly demolition that is often associated with unplanned development (see the later discussion on upgrading). This approach could be represented as the *POBs* model of development and is gaining some attention internationally as a pragmatic alternative to haphazard informal development (UNCHS 1996). However, while the GLD approach satisfies the planner's desire for spatial order, the major weakness of the approach remains the ability to turn the promise of infrastructure and services into reality, that is in the end also dependent upon adequate financial resources and cost recovery, two factors that also contributed to the weakness of earlier approaches such as Sites and Services.

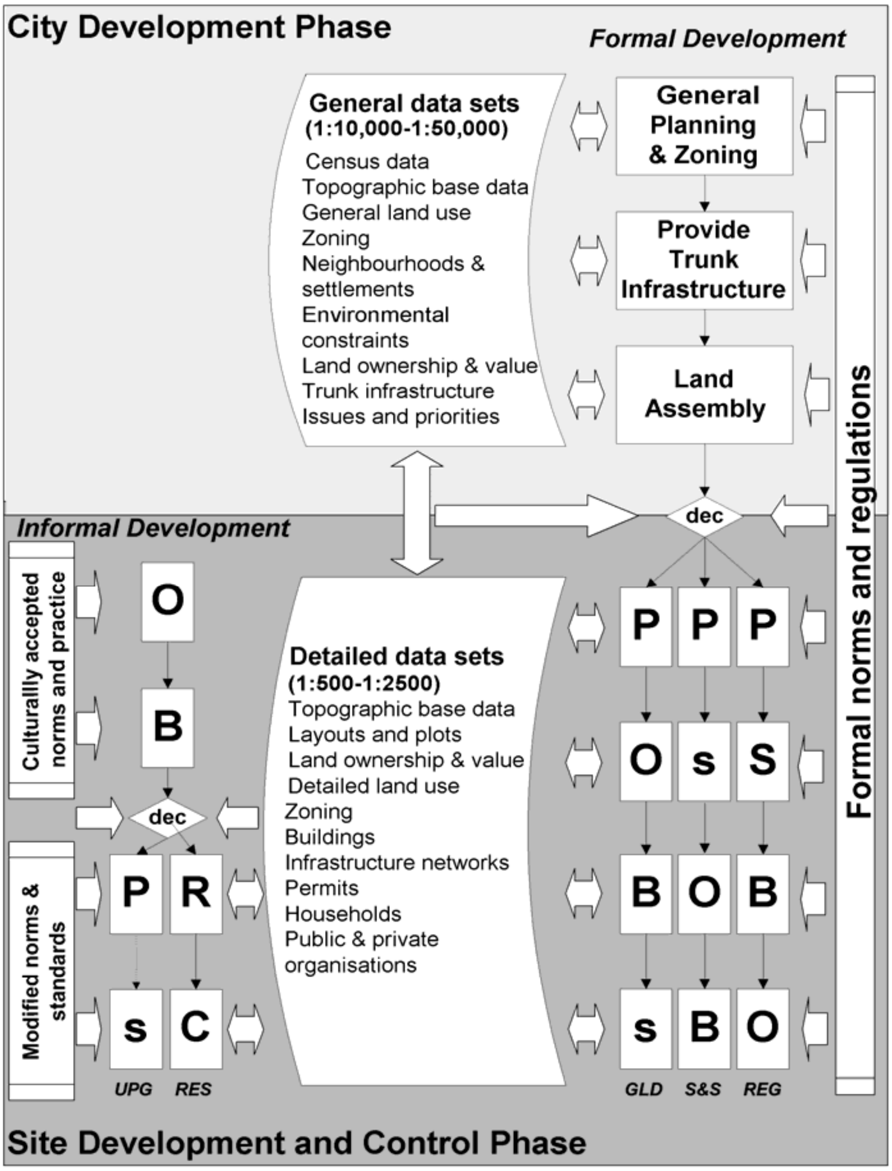
Informal urban development and housing

As a result of the inadequacies of the formal systems for housing supply such as those discussed above, parallel informal housing processes develop. This section examines the basic model of informal development and looks at two retroactive interventions that can be applied to existing settlements.

The informal housing process is more eminently more flexible and responsive than the formal housing system. It enables low-income groups to find affordable shelter and income generating opportunities in urban areas that would otherwise be impossible via formal systems and it differs from the formal *PSBO* model in several ways. First, and perhaps most significantly, the sequence of site development differs in that land occupation and building precede planning and servicing: following what Baross terms the *OBPS* process (Baross 1986) that essentially represents a settlement upgrading process. Second, the *OBPS* process operates in parallel to the formal *PSBO* process and rather than being under formal design and control mechanisms, it is guided by informal institutions and practices that are grounded in the local culture and practices of land management. Third, the first stage of the *OBPS* process, land occupation, is the result of informal land transactions that may take a variety of forms. For example, in Latin America and in South Africa there are many examples of organised over-night land invasions (Hardoy and Satterthwaite 1986; Hardoy and Satterthwaite 1989; Gilbert 1992; Gilbert and Gugler 1996), while many cities in Sub-Saharan Africa tend to develop through a gradual incremental process of individual land transactions between traditional (rural) land owners and households seeking to build a new house in the city or in the urban fringe (Haywood 1986; Nostrand 1986; Kombe 1994; Kombe 1995; Lupala 1999). Particularly in SSA it is evident that customary systems of allocating land continue to operate parallel to the formal land supply (Kironde 1992b; Kironde 1995; Rakodi 1997b), yet despite their significance they have only comparatively recently been officially recognised as an important mechanism with the potential to provide a means for gaining a degree of guidance over the development of informal areas in many cities (Kreibich and Olima 2002). Fourth, the *OBPS* process may be subject to temporal discontinuities. While occupation and building are autonomous processes that occur despite the intentions established in formal plans, the latter stages of planning and servicing effectively require at least the same amount, if not more, intervention and investment by the government as in the case of formal development and they are therefore subject to the same capacity problems that affect formal processes. The planning and servicing stages will therefore only occur if and when the necessary resources are available for settlement upgrading to take place. Therefore in situations where there is a high proportion of informal development, it will be necessary to set priorities for interventions and to phase them over an extended period.

The *OBPS* process relates to informal settlement upgrading. Although some form of upgrading is now the most common response to informal development it is not the only retroactive intervention possible. Resettlement is another option for retroactive intervention in informal settlements that involves the movement of residents to alternate, planned sites, such as a site and service scheme or GLD and the subsequent clearance of informal buildings (Davidson, Zaaijer et al. 1993). In the colonial period and even immediately after independence resettlement was seen as an appropriate instrument to deal with the sub-standard conditions found in many informal settlements. Although it is now a form of intervention that generally has a low priority it may, under certain circumstances be a legitimate form of intervention reserved for those situations where upgrading is not possible due to excessive risk from natural or technological hazards or where there are overriding policy considerations such as those related to the siting of important land uses or infrastructure requirements. Extending Baross's model to include these types of intervention creates a process of Occupation, Building, Resettlement and Clearance (*OBRC*) as an additional form of intervention that is linked to one of the other forms of formal development such as *PsOB* or *POBs* (see Figure 2.6).

Figure 2.6: Models of formal and informal development and interventions



(based on Baross, 1986)

These retroactive interventions have a dual purpose. In the first instance they aim to provide a direct improvement of the living conditions in informal settlements by creating a more orderly spatial development and/or through the provision of services. They also have the effect of bringing the informal settlements either partially or fully into the realm of formal development. The extent to which a specific settlement is formalised will depend on the nature of the particular intervention. For example, not all upgrading projects include a component for land tenure regularisation, although for some this is a critical element of such projects (Fourie and Nino-Fluck 2000). However, other upgrading projects may concentrate on land tenure issues and give less priority to service improvement, often in response to the priorities of the individual communities. Whenever one such component such as tenure regularisation is not included, the improved settlement will not be fully formalised by the intervention.

As these examples show, the informal and formal systems for housing are linked whenever interventions are planned and implemented. However, given the scale of informal development in many SSA cities and the lack of capacity in the public sector (Stren and White 1989; Rakodi 1991; Rakodi 1997) the implementation of a comprehensive programme of upgrading or resettlement for all such settlements will usually require many years to accomplish. Pragmatism is therefore called for in developing programmes related to informal housing. It is important to examine what might be done to utilise the apparent capacity of the informal institutions and actors to deliver land and housing while at the same time enabling them to play a more substantial role in steering the individual private developments in such a way that development goals of households do not override the interests of the community as a whole in obtaining public services and infrastructure. Some current thinking is taking the direction of such reconciliation between formal and informal processes.

2.3.3 Reconciling formal and informal urban development in SSA

In the Sub-Saharan context, systems for land delivery and housing must inevitably consider the traditional land management practices that are often based on some form of communal land ownership and that remain important in both rural and urban areas. Within such systems a tribal leader or chief typically allocates land to families that belong to a community or, in some cases immigrants, according to their needs (Doebele 1987). Traditional systems of land allocation, or adaptations of them, remain a dominant means of land supply in Sub-Saharan cities (Rakodi 1997b). That they have survived the imposition of European legal frameworks related to land and development, in some cases nationalisation under post-independence governments, the inadequacies of formal land supply systems (Kaitilla 1987; Kironde 1992; Kironde 1992b;

Kironde 1995) and even civil wars[5] is, in itself, a tribute to the flexibility and resilience of local, socially accepted practices and procedures.

The ability of informal land management practices to adapt to changing local conditions and fill the void left by the failure of formal land supply systems may provide a basis for future improvement of the formal systems in SSA. Kombe and Kreibich (1999; 2000) for example, have studied the workings of both the formal and informal land management systems in Dar es Salaam. They have identified both linkages and conflicts between the actors involved in each process (see Figure 2.7) and suggest that the relative success of the informal structures and mechanisms should be recognised and utilised by the formal systems of land management and urban planning in a variety of ways, including: neighbourhood level property registration and taxation; to guide building so as to encourage development that avoids hazardous land, that follows a layout that will facilitate the provision of physical and social services and that maintains densities at levels that are appropriate for the level of sanitation and water supply.

While optimistic about the potential of informal institutions, Kombe and Kreibich also have some reservations that relate to democratic participation of citizens in the community level management structures, and the technical capacity of the local actors. Partly such issues may be dealt with via capacity building efforts concentrated at creating a cadre of local land administration technicians who can administer land at low cost and deal with the majority of land related issues (Fourie 1998). While it is important to look at how the performance of government bodies and their staff can be improved, this in itself is not sufficient. Otiso for example, argues that the answer to the housing problems of the poor in Africa may lie in the formation of tri-sector partnerships involving the state, the private sector and the voluntary sector in mutually beneficial partnerships, citing positive experiences in Mathare Valley, Nairobi as evidence of their potential. Otiso, K.M. (2003). “State, voluntary and private sector partnerships for slum upgrading and basic service delivery in Nairobi City, Kenya.” *Cities*, 19, (4): 221-229. This view is very much in keeping with the general support for strengthening the role of civil society in urban development and planning (Carley, Jenkins et al. 2001), and forming partnerships that draw on the relative strengths of each participating group.

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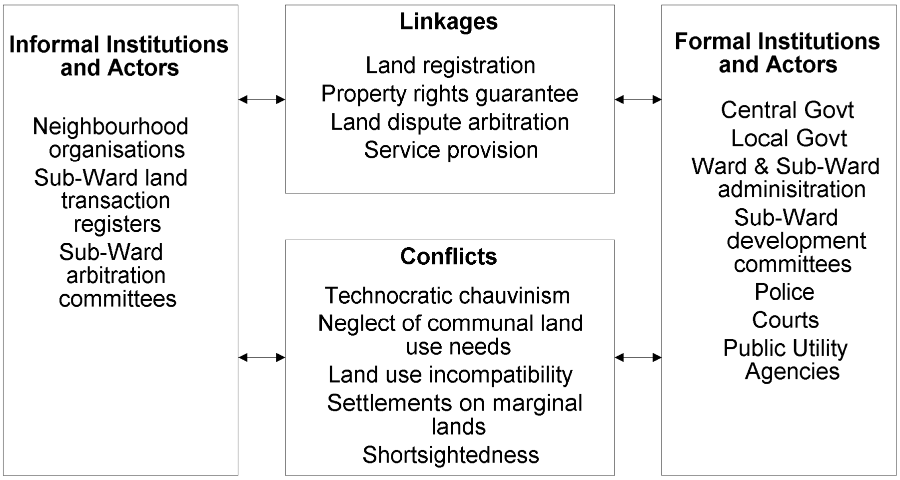
[5] See for a brief description of the situation in Mozambique and Angola: Ahmed, M. A. (1998). Urban and peri-urban land tenute in Southern-Lusophone Africa: lessons from post-socialist countries’ experiences. in proceedings International Conference on land tenure in the developing world with a focus on Southern Africa, University of Capetown, January 27-29.

Figure 2.7: Linkages between informal and formal land management in Tanzania



(source: Kombe and Kreibich 2000, p. 233)

Such partnerships include processes for the knowledge generation and exchange that, in this particular case, should improve the ability of the partners to regulate and guide informal housing processes. Models of PSS should therefore explicitly incorporate such exchange processes. In the following chapter an attempt is made to conceptualise a PSS that does just this. Further, in keeping with the focus on physical aspects of informal development the important objects and processes that constitute informal housing processes are examined, as these are the critical elements for data acquisition.

2.4 Conclusions

The review of the three themes of this research reveals that much of the practice of urban planning in Sub-Saharan Africa was dependent on the development of western urban planning. This influence has included not only the adoption of western methodologies for plan development but also the adoption of western norms and standards as a basis for formal development. These effects have been long lasting and their legacy is still clearly evident. Similarly, the development of concepts and experiences related to planning support systems is more evident and pronounced in western countries. However, even in western countries many PSS are still very much in the research environment with relatively few practical applications existing at present. Although there is evidence of the diffusion of GIT in developing countries in general, there are to date, relatively few examples of attempts to develop urban PSS in Sub-Saharan Africa. Given the relative state of economic and technological development it is to be expected that western countries such as the USA and those in Europe will maintain a leading role in the development and adoption of spatial information technology in this field and that in general PSS developments in SSA will be driven by the transfer of such methodologies and technology as and when required. Here it is pertinent to mention that this technology transfer may be as much driven by the requirements of foreign experts and advisors as by the expressed needs of local professionals and communities.

The linkages between western countries and SSA related to informal development are of a somewhat different nature. Although land and housing are important elements of public policy making in all countries, western planning has neither had to contend with the rate of urbanisation that is typical of SSA nor with the levels of poverty and informal development that are found there. Although some similarities were identified between approaches to housing issues, the situation in developing countries is such that unique approaches to housing issues have evolved that have no parallel in the west. The widespread adoption of Sites and Services projects throughout SSA in the 1970’s and 1980’s and the more recent Guided Land Development are examples of housing policy instruments that have no parallel in developed countries. Finally, it is also evident that the transfer of urban planning, housing policy and land and housing delivery systems from the U.K. to SSA did not explicitly consider the specific cultural and societal conditions in the recipient countries thereby contributing substantially to the likelihood of policy failure.

These issues are taken up again in chapter 3, which builds on the above discussion and develops a framework for the analytical and design components of this research. The framework incorporates elements of spatial data modelling relevant to analysing informal urban development and decision making for intervening in informal settlements and some elements that are concerned with the context within which planning takes place, and in particular with some of the characteristics of some key actors involved in planning processes at strategic and local levels.

Chapter 3

Considerations for managing informal settlements with GIT

The discussion in Chapter 2 has highlighted a number of key issues that must be considered in any attempt to design information systems that can contribute to better management practices in informal settlements:

- Current approaches for managing informal settlements are built on the basis of collaborative planning practice and intensive community participation and therefore tools and support systems must explicitly consider the needs of professional and non-professional actors for data and mechanisms that promote effective inter-actor communication;
- Managing informal settlements requires an integrated planning approach incorporating strategic planning and decision making with local action planning, implementation and management practices;
- Given the resource constraints confronting actors in developing countries, it is preferable to develop systems that are cheap to build, easy to use, robust and flexible in their application. This implies a preference for well tested tools and methods that can be combined flexibly as required.

This chapter examines these issues in detail leading to a basic framework for the empirical investigation in the various case studies undertaken in Dar es Salaam.

3.1 A model of PSS for collaborative planning

Previous discussion highlighted the evolution of planning from the rational paradigm toward the collaborative paradigm, and a parallel development of PSS models. Central to this evolutionary process have been steps to a) improve the quality of spatial plans, b) to improve the systems for regulating development and c) to devise governance arrangements that will produce better decision-making (Rakodi 2001). While the first 2 points include many issues that are concerned with technical and or legal frameworks for planning, the question of governance touches at the heart of how public policies, such as those of urban planning, are formulated, implemented and modified over time. The UNDP defines governance in the following manner:

> "*The exercise of political, economic and administrative*
> *authority in the management of a country's affairs at all levels.*
> *It comprises the mechanisms, processes and institutions*
> *through which citizens and groups articulate their interests,*

exercise their legal rights, meet their obligations and mediate their differences". (cited by UNCHS 2000, p. 6)

From this definition it is evident that urban planning processes are a component of governance arrangements, and specifically those that deal with the allocation of resources related to urban development. Typically three groups are recognisable to a greater or lesser degree in governance processes: government, the market (private sector) and civil society (Jenkins and Smith 2001). The governance concept increases the scope of participation in urban planning from formal, but often limited, consultation. It gives more deliberate attention to both the formal and informal relational networks within and between these groups in society. Furthermore, governance processes, including those associated with spatial planning, can be used to sustain such relational webs or to transform them , creating a *'shared power world'* in which power and decision making is exercised by numerous stakeholders in a variety of forums, arenas and courts (Bryson and Crosby 1996). The need to broaden the scope of actor groups with a stake in planning is also encapsulated in the following statement by Berner:

> *"Neither the upper classes nor any other group have a monopoly on strategic action. Individuals, families, clans, cliques, patronage systems, associations, non-government organisations, labour unions, etc. - do not merely react spontaneously to events in their environment but also pursue plans and aim to have an effect on future developments."*
> (Berner 2000, p. 41)

If the planning process is seen as a component of governance arrangements then a model of a support system for collaborative planning is likely to differ from the traditional PSS model that was based on planning as a rational process (see Figure 3.1). This model places each of the three main stakeholder groups at an apex of the governance triangle, which in turn encloses the collaborative planning process[6] that appears in the centre. At the core of the planning process is a set of documents, data, methods and models that are shared and developed by the stakeholders throughout the planning stages. Included in this set are relevant documents of a legal, political or administrative nature as well as the type of models and tools proposed by Batty (see Figure 2.3) but it may also include less formal data (e.g. local knowledge of population) and methods that are designed for participatory planning processes (for examples of methods and techniques for community planning see Wates 2000).

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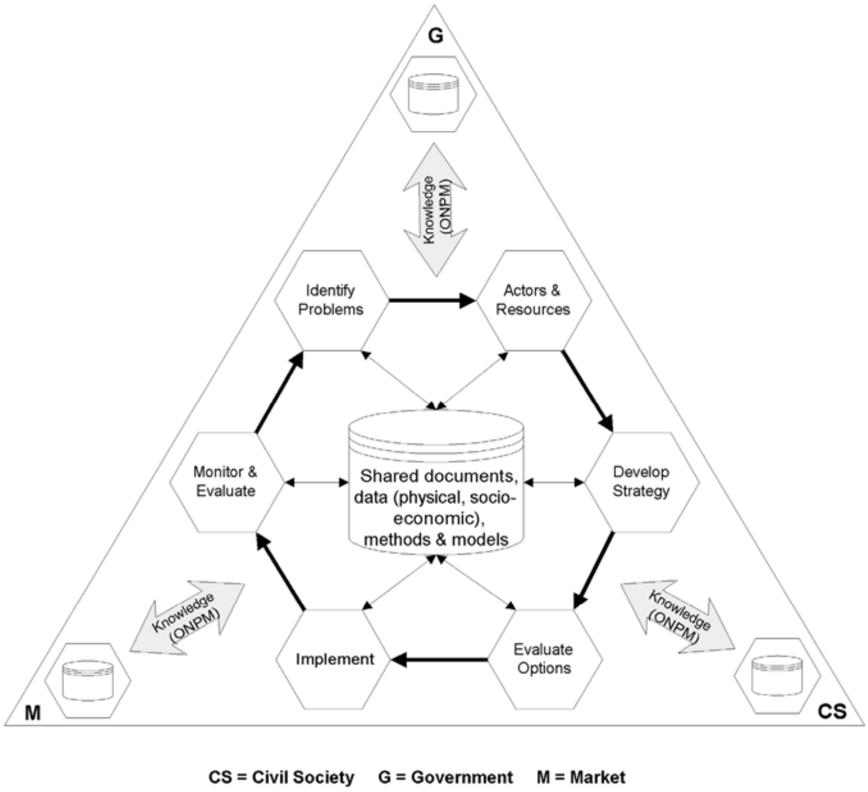
[6] The model of a 6 stage planning process is taken from Devas, N. and Rakodi, C., Eds. (1993). Managing fast growing cities: new approaches to urban planning and management in the developing world, Longman and John Wiley and Sons.

Figure 3.1: Planning support systems in a collaborative planning setting



The model also recognises that stakeholders within each group are also likely to have their own planning processes, data, methods and models that operate independently from the collaborative planning cycle (these are shown as small hexagons with a central cylinder at each apex). Of the 3 groups the government and the market sectors will be most likely to have the resources and infrastructure required to build and operate more formalised systems for data management, analysis and planning. For example, urban planners in government service may use such formalised information systems to perform analyses that will provide inputs into multi-stakeholder planning processes. In contrast, the civil society group may be less likely to have formal systems for data management, analysis and planning (however, for an example of a NGO that is using GIS to support informal communities see Sen, Hobson et al. 2003).

The single-stakeholder planning processes, however also have two-way linkages with the multi-stakeholder, collaborative planning process. In the figure these linkages concern the exchange of 4 different types of knowledge that are required in the planning process, designated by the letters *O, N, P* and *M*. This aspect is drawn from the work of Van Lammeren who identified the following categories of knowledge relevant in planning processes (Eweg 1994, p. 17; Lammeren 1994; Masser and Ottens 1999):

Object knowledge that states the nature, location and the functioning of the object of planning. This type is therefore concerned with the state of the planning area and its functioning, and may be subject to many deficiencies in terms of thematic content, aerial extent, temporal and spatial resolution, accuracy and precision

Normative knowledge concerning the values and guiding principles upon which intentions and goals are developed

Process knowledge that concerns the procedures and stages of the planning process itself

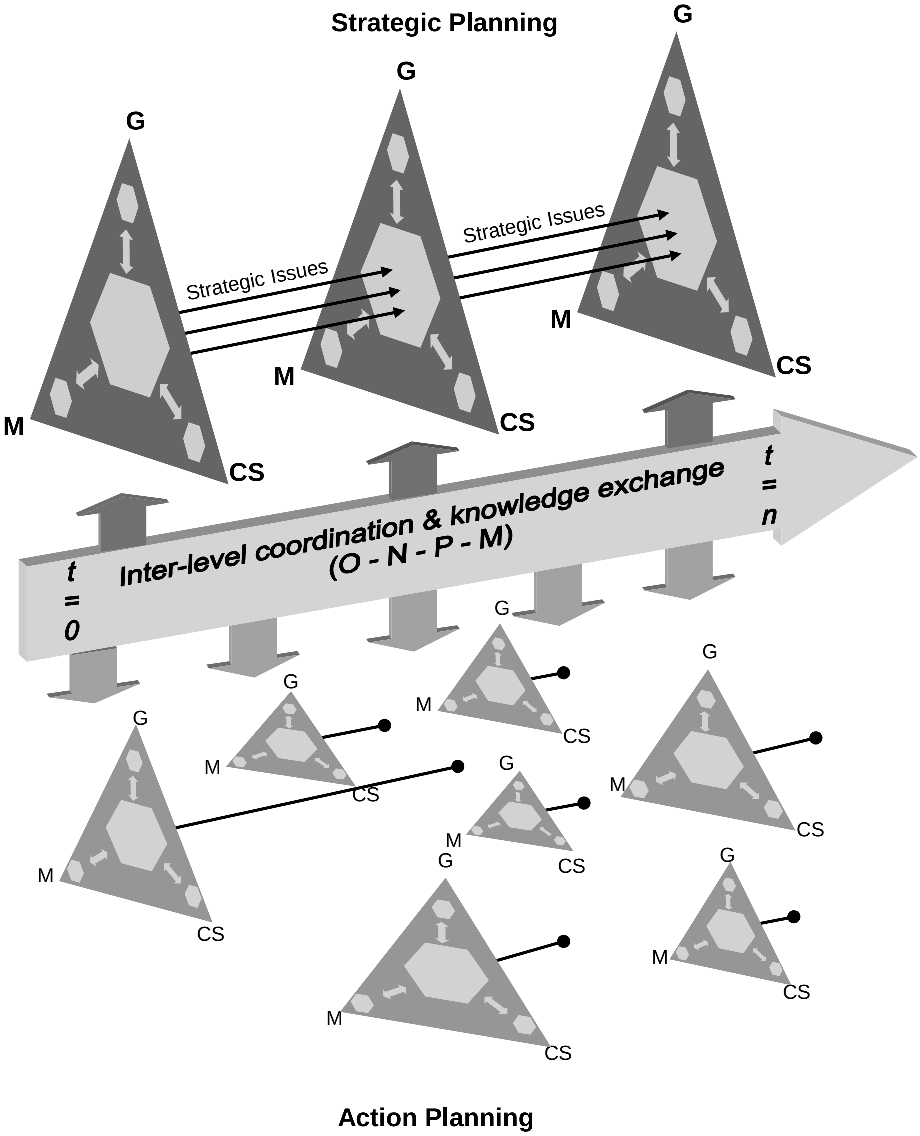
Method knowledge related to methods and techniques relevant for data handling, information processing and plan generation

The figure shows how a stakeholder group inputs its knowledge into the multi-stakeholder planning process but also that this process can generate new knowledge or understanding that is fed back into the *knowledge base* of each group. The important implication here is that the ability for actors to communicate effectively is an important element of successful collaborative planning processes. Communication in urban planning will be performed via a variety of media, including written and spoken language, and graphical and cartographical language with actors required to shift between roles as senders and receivers of information (Lammeren 1994, p. 47). However, in situations characterised by high diversity within and between actor groups, such as may be found in the cities, establishing effective communication between actors could be a considerable problem.

Three important issues are still not explicitly considered in this model: *i)* How to deal with the diversity of actors?; *ii)* How to deal with the temporal dimension?; and *iii)* How to deal with multiple levels of planning?. The first is significant because each of the 3 stakeholder groups may consist of a large number of organisations and individuals with an interest in a specific planning problem. For purposes of clarity they have been grouped into 3 main categories, however it is essential to bear in mind that each of these 3 groups in themselves may contain a number of organisations with diverse interests. An attempt is made to deal with the other issues in Figure 3.2.

This figure places the model of a support system for collaborative planning (Figure 3.1) within a multi-level planning framework based on the mixed scanning approach discussed in Chapter 2. The governance triangle incorporates planning processes at a strategic level in which attention is focused on a limited number of critical (strategic) issues (Hall 1989) that are reviewed systematically at regular intervals.

Figure 3.2: A model of a multi-level collaborative planning support system



Each action project is also developed and implemented within an overriding governance framework incorporating relevant stakeholder groups. Projects have varying degrees of complexity, represented by the size of the triangle, and variable duration, represented by the time line attached to each action project. The model also shows the need for coordination and the exchange of knowledge between the both levels. One of the outcomes of the periodic strategic discourses is an agreement on the critical issues that provide the focus for action projects in the following planning period. This information and any relevant knowledge are communicated to action projects (down arrows) that are created in order to implement strategic policy decisions. The knowledge and experiences obtained via such projects also forms a part of the input into successive rounds of strategic planning (up arrows), helping to revise and redefine the policy agenda, forming an essential element of the learning cycle.

Clearly this is still a very abstract model of a collaborative planning system and it was certainly beyond the scope of this study to address all questions related to its development and implementation. However, as a generic model it aims to establish a basic framework that can be applied in a variety of different settings in response to different urban problems. It is anticipated that in the process of developing a PSS the model would help to distinguish between components and processes that are concerned primarily with single stakeholders and those which are indeed a part of a multi-stakeholder process. Further it is almost certainly likely that in attempting to build and apply any PSS, lessons will be learnt about the various components of the PSS as well as the planning process itself. Such lessons may indicate shortcomings in the model and provide a basis for its modification and enhancement.

3.2 Planning levels, physical objects and informal development processes

In order to demonstrate and test some elements of the model, this work focuses on the development of some methods and techniques that will improve the collection, communication and utilisation of geographic information related to the physical development of informal settlements within both strategic and action planning processes. To do this it is important to define what type of data on physical development could be collected for the two planning levels and explain how the development of urban monitoring systems could improve the capacity of stakeholders to manage informal development.

3.2.1 Planning levels and basic physical objects

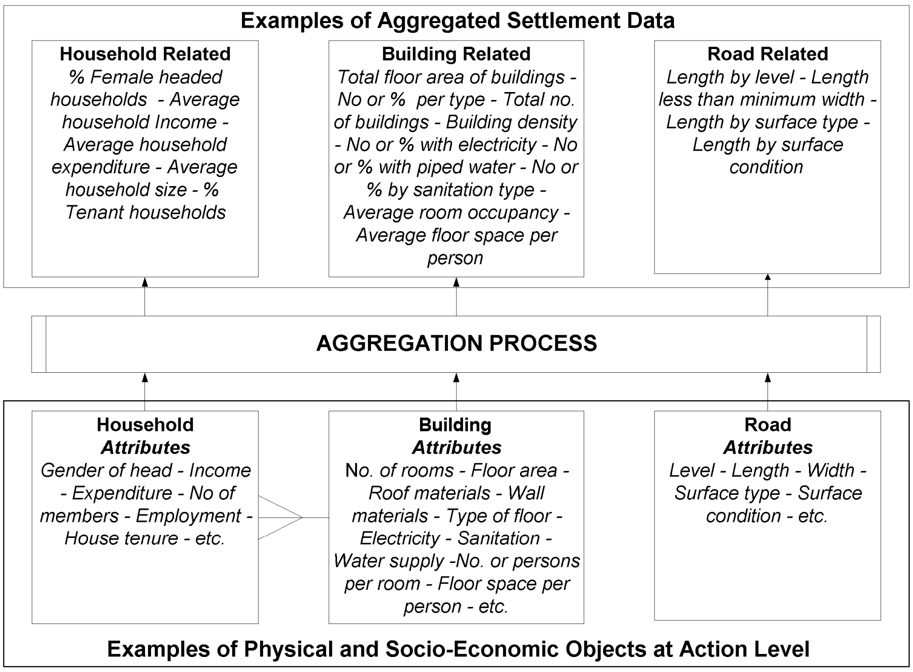
Data on physical development is required for both strategic planning and action planning, and in keeping with the concept of inter-level knowledge exchange, there could be some exchange of data from one level to the other. Such data manipulation processes are commensurate with vertical data integration for higher level decision making related to management - i.e. resource deployment - or strategy development - i.e. policy making and strategic planning (Huxhold 1991; Huxhold 2003). Although the ability to aggregate data from detailed data bases to support strategic decision making is important, this is not the sole data source at this level. If, for example, the large scale database is outdated or only partially covers the urban area then aggregation procedures alone cannot provide the necessary information base for strategic planning. Further, it is also conceivable that some data required for strategic planning is not available at the detailed level. Finally, there could also be considerable technical problems related to the generalisation of highly accurate and detailed spatial data for integration into less accurate and simplified spatial data for strategic work. Although these considerations cannot be ignored, it is also true that planning processes require spatial data but that it is often incomplete or error ridden (Klosterman 2003) and in practice planners may have to rely heavily on what little data is available simply because of overriding time and costs constraints (Dandekar 1988). Such issues certainly arise in this research.

In this study the two most important physical objects were the individual buildings that were constructed by households that have obtained land via informal land transactions, and the informal settlements that were ultimately created as a result of the combined construction activities of several households. Although the importance of access to land has been acknowledged earlier, the informal land parcels themselves were not considered as a basic object requiring specific attention for several reasons. First, in many instances informal plot boundaries are not well defined physically (see for example Schlyter and Schlyter 1979) and they therefore do not always appear on photographs. Consequently plot boundaries can only be mapped reliably via extensive field surveys including household interviews. Second, buildings are readily distinguishable both on aerial photographs and in the field and they provide an implicit linkage to the piece of land on which they are located, whether that land is demarcated or not. The decision to concentrate on buildings rather than land was in line with the view of Abbott (2001) who also prefers to concentrate on the buildings as the main physical object. However, in instances where settlements may be located on formally subdivided land it can be useful to know how these properties are defined in order to determine the extent of informal encroachment (see for example the situation in Cape Town as described by Abbott, 2001).

At the action planning level, interventions in a community are planned and executed in a highly detailed manner. In the process the extent of the settlement or project area and the individual buildings should be identified and their outlines mapped at a large scale along with other important environmental and physical elements (e.g. roads, drains, wells etc) that may have a bearing on the site or its development (Davidson and Payne 2000; Abbott 2001). Although several physical objects are of interest, the buildings have special significance because they provide shelter to the households and they can therefore be used to localise the households of both owners and tenants. This linkage is especially important for detailed planning and community management processes. For example, when proposals for improvement are being prepared that may require the relocation of one or more buildings together with their owners and other occupants. It is also only at this stage, when plans to actually intervene in the development of such settlements are made that it actually becomes necessary to establish the extent of current land holdings in order to facilitate detailed discussions about future land configurations, including the possible redistribution of land between private land holders and the re-allocation of land for infrastructure and public services. Any such discussion will almost inevitably reveal a number of land boundary disputes between residents and it is advisable to postpone discussions over land ownership where possible.

The strategic level of planning and decision making revolves around determining what type of intervention (e.g. upgrading, resettlement, sites and services or GLD) would be most appropriate for each settlement and, given the limited resources, to setting priorities for these interventions. The settlement is therefore the basic physical object at this level. In principle some of the data required for analysis and decision making could be obtained via aggregation procedures similar to the examples shown in Figure 3.3 along the lines proposed by Huxhold (1991; 2003) or at the very least it could provide a means for cross-checking or perhaps for calibrating other data sources at the strategic level.

Figure 3.3: Examples of data aggregation from large scale database for strategic settlement level database



There is an additional aspect that needs to be considered in this discussion about the physical objects related to informal urban development. As physical development is a process, it has both spatial and temporal dimensions. In the

SSA region, which is experiencing some of the highest rates of urbanisation in the world and is known to have relatively poor performance in terms of formal land and housing delivery, the two basic objects described above will be highly dynamic and it is therefore useful to conceptualise the processes at work in informal settlements.

3.2.2 The life cycle of basic physical objects

The fundamental physical processes that may be recognised in the dynamics of the two main object types for a hypothetical situation involving the incremental development of a vacant piece of land over time are shown in Table 3.1 and Figure 3.3. Each time frame (1-7) in the figure is equivalent to a temporal snapshot of the piece of land such as might be obtained via a sequence of aerial photography. Generally each object may be subject to a number of different processes over the course of its life cycle.

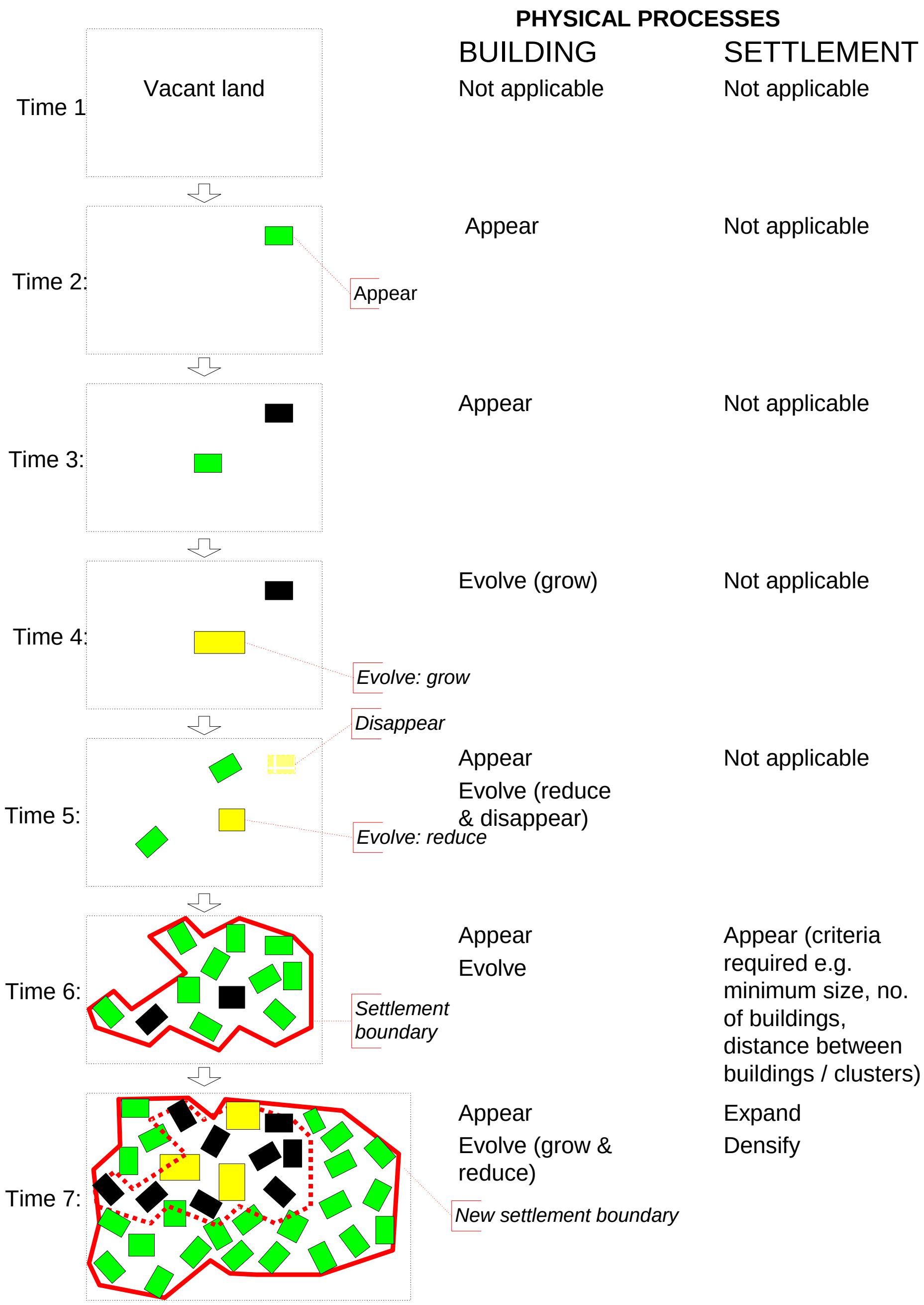
Incremental construction is a common feature of informal housing in SSA particularly when savings are the main source of funding (Kyessi 1990). Settlements, on the other hand, will be formed out of the combined effort of several households and, as more contiguous land is occupied over time, the occupied area will eventually be recognised as a settlement. In some cases the extent of a settlement is more or less predetermined by natural features (e.g. Mathare Valley, Nairobi) or the existence of a previous land holding such as a plantation (e.g. Hanna Nassif in Dar es Salaam or George in Lusaka, Zambia). Where urban development occurs in areas that were previously vacant different conventions may apply but it is likely that over time some form of socially recognised and accepted spatial definitions of settlements will arise.

A further remark needs to be made concerning the physical pattern of development within different informal settlements. The illustration shown in Figure 3.4 shows a settlement that develops in a haphazard manner, with no apparent consideration for the reservation of land for public use such as roads, schools, open space etc. While this is a common situation, some informal settlements do exhibit varying degrees of spatial order and show evidence of a degree of social regulation of space use at settlement level. For example patterns of roads and footpaths that pre-existed intensive urban development seem to have a lasting effect on later patterns .

Table 3.1: Description of physical processes related to the development of buildings and informal settlement formation

Building Process	Description	Possible causes and implications
appear	New building is constructed	Expansion of floor space for residential or other uses e.g. business, religious facility etc
evolve (grow)	Building enlarged - extra floor space	To accommodate a growing family, for rental, for a small business etc. Variations: addition of rooms or buildings at ground level or the addition of extra storeys.
evolve (reduce)	Part of building collapses or is destroyed	Poor quality materials or lack of maintenance or natural disaster, temporary state pending redevelopment by a new (wealthier) owner
disappear	Building totally destroyed	Special case of *evolve* (*reduce)* resulting in the total loss of the building.
Settlement Process	**Description**	**Possible causes and implications**
appear	New settlement formed	The number of buildings has increased to an extent that they are recognised by the local population as a settlement. Social recognition of a settlement may precede administrative recognition
expand	Spatial extent of settlement increases	Additional incremental construction of new buildings on the edge of an existing settlement leading to spatial growth
shrink	Spatial extent of settlement decreases	Loss of some buildings due to natural disasters or human intervention resulting in a reduction of settlement size
disappear	Settlement totally destroyed	Special case of *shrink* leading to total loss of all or part of the settlement. Could be due to a natural disaster such as a flood, earth quake or a administrative intervention to relocate a settlement from one location to another
densify	Increase in floor space within the settlement area	Results from additional construction (either new buildings, or additional rooms or storeys to existing buildings leading to an increase in floor space within the settlement

Figure 3.4: Physical processes in informal building, settlement formation



In other cases it has been found that specific individuals or groups who have a high social status within community can have a lasting influence on the pattern of development, establishing a relatively orderly lines of housing separated by sufficient space for easy vehicle circulation and pedestrian movement (for an example in Zambia see Schlyter and Schlyter 1979; for examples in Tanzania see Kyessi 1990; Nnkya 1996; Lupala 1999). These examples serve to demonstrate that there should be scope for institutionalising community based regulation of informal development along the lines of Guided Land Development (Marulanda and Steinberg 1991) or Rapid Land Release (Abbott and Douglas 2003), which, as a type of minimalist approach to local planning, establishes control over settlement layout and reserves ace for the incremental provision of infrastructure and services over time and subject to available finances.

The above discussion has examined the fundamental processes related to buildings and informal settlements. The former being the result of construction efforts by a multitude of different households are difficult for local government authorities to manage directly simply because of the scale of the process and because of the relative inaccessibility of the newly developing settlements that are mostly found in urban-rural fringe locations. However, it does appear that socially regulated development is possible in certain circumstances and community based planning is increasingly seen as a useful option for both preventative as well as curative planning responses (Watson 1998). There may therefore be opportunities for influencing the building construction processes of individual households via institutionalised community based management structures building upon the informal institutions and actors along the lines suggested by Kombe and Kreibich (2000) that were described previously in section 2.3.3.

From a GIT perspective such an approach raises questions about the type of spatial information support that communities may require in order to enable them to improve their capacity to manage and guide construction and development. Moreover, there are also questions to be answered related to more strategic issues concerning informal development. At the strategic level questions relating to the speed and location of informal development, the identification of appropriate interventions required for each settlement and the establishment of priorities for action are more pertinent. It is therefore also necessary to think in terms of collecting data on the physical objects and their attributes on a regular basis over time, or in other words to monitor the changes in order to better understand the scale, speed and potential impact of such informal development process.

3.3 Monitoring in urban planning and PSS

The term *monitoring* refers to the regular, deliberate and systematic collection and analysis of information (McLoughlin cited by Bracken 1981) and includes information pertaining to the measurement of policy effectiveness as well as information concerning the contextual changes in the planning area itself (Putte 1991). The recent emphasis on urban management and performance oriented planning has meant that increasing attention has been placed on the former type of monitoring that should conceivably lead to more effective or more efficient planning . However, it is also recognised that the use of policy driven performance indicators may suffer from having a very narrow outlook that may ignore indirect policy effects that can nevertheless be very important for policy development (Masser 1986, pp. 22-23). This view of monitoring as a means to measure policy effectiveness is in keeping with the need for a control mechanism that provides negative feedback and facilitates learning from implementation, policy adaptation and the control of action. In contrast the other type of monitoring is less concerned with specific policies and more concerned with the context of the planning issues and the assumptions on which policies are based (ibid). It recognises the uncertainties that are inherent in our understanding of development processes and attempts to reduce this through systematic data collection and analysis (Wedgwood-Oppenheim, Hart et al. 1975; Putte 1991).

The monitoring of the planning context is particularly of concern at the strategic level, where uncertainties are likely to be highest and planning agencies are most likely to be confronted with unforeseen or unplanned events (Wedgwood-Oppenheim, Hart et al. 1975). At this level monitoring is required both to verify the relevance of existing policies as for the early detection of trends that may require new policies or the formulation of new action projects and is very important when the planning authority has little direct control over the environment and development processes (Putte 1991). Such a situation exists in many developing countries and it is therefore of paramount importance that efforts are made to develop local capacity for strategic monitoring.

One such initiative to build capacity for monitoring urban development is the Urban Indicators Programme (UIP). This programme has established a core set of indicators, including some 46 so-called *key* indicators, on urban development issues that were primarily intended for international comparison purposes as part of the Habitat II preparatory activities (Flood 1997). For example the UIP Background Data Module key indicators comprises strategic level data on land use, basic demographic data (city population, growth rates, women –headed households, average household size, household formation rates, income distribution), per capita economic production at city level, and data on land tenure. Key housing indicators also include indicators on the number of permanent structures and floor space per person as an indicator of density. Although there is some criticism of the rather ‘top-down’ approach adopted by UIP, Flood does state that the key indicators were widely acknowledged within developing countries as being a very useful tool that were readily understood and empowered policy makers (ibid, p. 1644). Notwithstanding this criticism, it is worthwhile to note that the list of indicators includes several that are directly related to land use, environmental conditions and physical development including structures such as buildings and roads. These data could be seen a components of a basic system for monitoring the spatial development context of a given city.

The usefulness of such spatial data as an input into both strategic and local level urban planning (MacLean 1972; Ratcliffe 1981; Chapin and Kaiser 1985; Dandekar 1988; Bruijn 1989; Worral 1989) is a driving force behind the development of GIT and some of its many applications in physical, socio-economic and environmental planning . Much of the physical data required for such planning is typically obtainable through earth observation technologies such as aerial photography and satellite remote sensing (Faulkner and Morgan 2002).

3.3.1 Earth observation as a data source for urban planning

The type of spatial data required for urban planning depends on the nature of the problems being addressed and the level of planning being considered. In general action planning and local level projects will require more detailed, spatial data, at a finer temporal resolution than that required for strategic planning. The implication is therefore that, ideally, different systems for the collection of spatial data for planning purposes may be useful. Cowen and Jensen (1998, p. 166) provide a useful overview of the minimum temporal, spatial and spectral requirements for selected urban attributes. Although their work is based on the USA situation, it suggests that for the most detailed urban planning and management functions images with a minimum resolution of 0.3-0.5m are required every 1-2 years. For more strategic work, minimum requirements could be reduced to 5-30m at intervals of up to 5-10 years, with higher resolutions being required for situations characterised by higher densities and smaller object size (i.e. buildings and roads) (Forster 1983).

Although commercial satellite imagery is now available with spatial resolutions of less than 1 metre, such images still do not satisfy the minimum requirements for the most detailed planning work. As a result, aerial photographs that are a well-established source of data for urban planning (Branch 1948), remain important. Their use may be indirect, whereby data is first extracted via photogrammetric procedures and stored in the form of analogue or digital maps which are then accessed and used by planners as either base maps or for more analytical purposes. Alternatively, aerial photographs may also be used directly by planners, as may happen when the official maps are not available (e.g. due to production delays, or lack of access) or when the official map content does not comply with the planner’s requirements . An example of the latter might be when land use information is required which is not shown on available topographic maps or when physical data (e.g. a house count) is used as a surrogate for socio-economic data (e.g. population) (Adeniyi 1983; Pollé 1996). The data sources used will also be influenced by cost considerations.

3.3.2 Cost aspects of aerial surveys and mapping

The cost of producing aerial photography and, even more so topographic mapping, can be considerable and to a large extent are dependent on image-scale (see Table 3.2). Careful consideration should be given to selecting the appropriate image scale for the requirements of each planning level. While strategic planning needs can be satisfied with small-scale images (e.g. 1:25,000-1:50,000) depending on the size and nature of the city, action planning projects and routine urban management functions such as development control will be better served by large scale images (1:5,000- 1:15,000), and spatial data collection costs may therefore be a significant element of operational costs.

Table 3.2: A comparison of costs for aerial photography and topographic mapping for an urban area of 250 km^2

Characteristic	Case 1	Case 2	Case 3
Image scale	1:6,500	1:13,000	1:40,000
Positional restitution accuracy	6.5 cm	13 cm	40 cm
Ground pixel resolution	10 cm	20 cm	50 cm
No of photographs	400	100	11
DEM standard deviation	10 cm	20 cm	60 cm
Cost of digital orthophotos Cost per km^2	$92,000 $368	$26,000 $104	$6,420 $26
Scale of topographic mapping	1:1,000	1:2,000	1:10,000
Total cost of photos and mapping Total cost per km^2	$892,000 $3568	$226,000 $904	$28,420 $88

(adapted from Konecny 2002)

For many developing countries the costs of making aerial surveys and map production may be increased further because of the lack of local technical capacity. Given that cities in such countries tend to be very fast growing, there is a need for quick and affordable imaging/mapping capability. Small Format Aerial Photography (SFAP) can provide this capability in some situations.

The term SFAP refers to aerial photography that is typically produced from a small aircraft using a standard 35 mm, 70 mm or digital camera (Bishop and Mason 1997; Mason, Baltsavias et al. 1997) that is either mounted or hand-held. It is a technique that is particularly useful for map updating, small area mapping or pinpoint photography (Hofstee 1984; Warner, Graham et al. 1996). SFAP has been applied as a technical tool in a variety of situations in developing countries for urban data acquisition related to housig studies and informal development (Hofstee 1984; Chanond and Leekbhai 1986; Bruijn 1987; Galema and Dolstra

1987; Dangol 1998). In this research the use of SFAP as both a technical tool and as a communication medium for community level planning is described in more detail in Chapters 5 and 7 respectively.

For general urban monitoring functions associated with strategic planning a growing number of satellites sensors are producing potentially useful imagery at spatial resolutions below 10 metres. The Quickbird and Ikonos satellites provide the highest spatial resolutions of 1 meter or less for panchromatic imagery. It must be remembered however that the costs of these products are also quite high, with prices ranging from $24/km^2 for low precision products to in excess of $100/km^2 for high precision products (for details of prices of Quickbird see: www.digtalglobe.com or for Ikonos imagery see: www. spaceimaging.com), and the availability and quality of such images is also dependent upon atmospheric conditions such as cloud cover, which can be a significant limiting factor in many regions, including SSA.

Although very high-resolution images are required for detailed urban studies, use is also made of systems with resolutions in the range of 5-30 metres, primarily because of their larger spatial coverage and lower costs. Images with a spatial resolution of 10 metres are, however, comparable to aerial photographs of scale 1:200,000 (Pollé 1996, p. 65) and the use of such images for collecting the type of data required on buildings and settlements is therefore problematic. Many difficulties arise because of the complex surface structure of urban areas and the nature of the sensor systems.

Urban areas are characterised by a great variety of different surface materials and a high degree of surface mixing. Surface materials may consist of both artificial surfaces (e.g. asphalt, concrete, metal etc) and natural surfaces (e.g. water, grass, vegetation, bare soil etc) that can be found distributed throughout the urban area. Typically any land use type contains a mixture of these surface types. Also, if the size of objects in the urban landscape such as buildings, roads, trees, lawns etc is much smaller than the pixel size of the satellite image or when a pixel represents a location on the boundary of 2 surface cover types, each pixel will represent a mixture of surface types (Gorte 1998). These characteristics reduce the performance of image classification techniques for urban studies and many remote sensing users therefore prefer to use visual interpretation when extracting land use data from imagery (Paulson 1992; Mahavir 1996).

In this study visual interpretation was extensively used to extract data on land use from aerial photographs and satellite images. Further, visual interpretation has been used to extract the basic physical objects from aerial photographs and in extracting some attributes of these objects as well. Details of these procedures and a description of additional automated classification techniques that were used to generate estimations of housing density are provided in Chapter 5.

The collection and processing of spatial data in this research were seen first and foremost as methods and techniques that should improve the available information base and enhance the ability of planners and other actors to manage informal development. However, tools and techniques should not be blindly developed or adopted. Rather, a careful examination of possible requirements should be made and choices made based upon an assessment of possible options, which are also an important component in the framework for this research.

3.4 Defining the framework for this research

Much of chapter 2 and some of the preceding parts of this chapter have not been devoted to technical issues, but to discussing the context within which GIT is to be applied. As this research concerns the development of methods and tools that can support the planning and management of informal settlements it is important to understand the context within which this application is developed. Geertman (1999) has identified four contextual variables that influence the functional content and use of GIT (see Table 3.3). The first 3 of these variables form the contextual core of this research, as they are believed to have the most direct influence on GIT use. However, in recognition of the highly constrained resource situation in the SSA region specific attention is also given to financial and technical resources in the research framework shown in Figure 3.5.

The two spatial levels, strategic and local, are included in the research framework. The figure shows that the examination and analysis of the context variables produces 3 main outputs: a description of the specific policy issues related to informal development that will include relevant stakeholder groups and the related information requirements; an understanding of the available resources that provide boundary conditions for the development of PSS components; and a description of the requirements for planning procedures that should be satisfied. The latter might for example, reflect the specific needs for consultation and participation, as well as the spatial coverage and temporal resolution of the physical datasets. The 3 components are essential inputs into the PSS development process where context requirements may be matched with available methods and techniques such as those available from GIT.

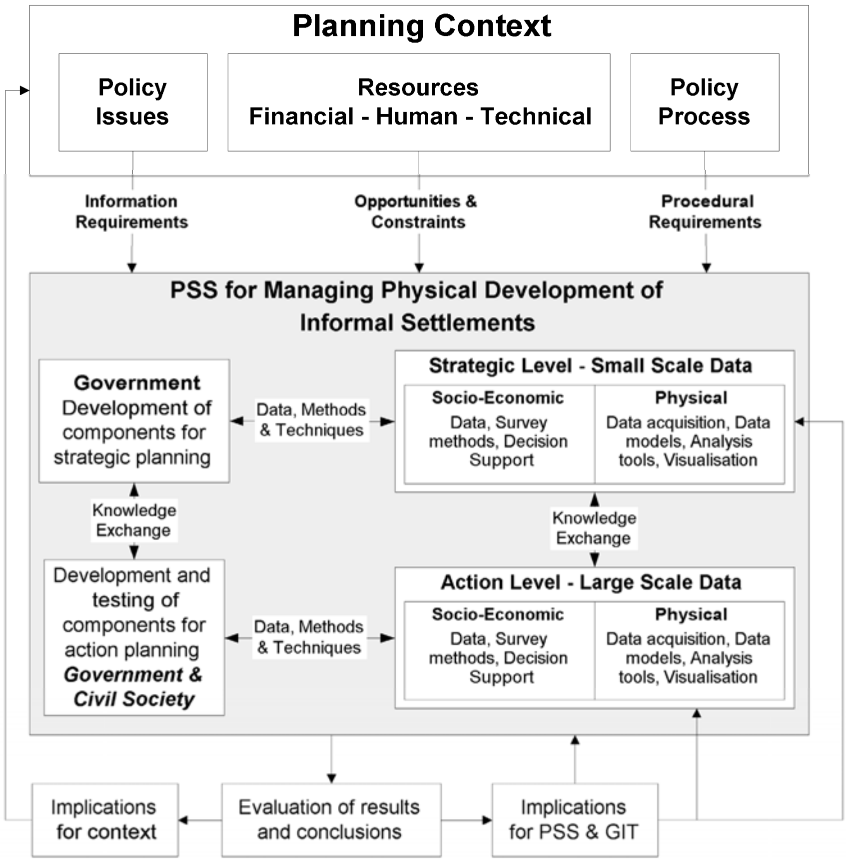
Table 3.3: Contextual variables of GIT

Variable	Description of issues relevant for this research
Content of the policy issue	What issues are being addressed and what methods and instruments are required or appropriate for such issues. This research is focused on the issue of informal housing and in particular those issues related to managing their physical development in terms of location, density, layout.
Characteristics of the users	Includes factors such as education, profession, working habits, knowledge and skills but may also be extended to include factors such as beliefs and opinions concerning the policy issues but also concerning methods and the use of technology. In this study particular emphasis is placed on the existing and possible future roles of formal and informal actors and the linkages between them.
Characteristics of the policy process	May include factors such as time span, degree of participation, and requirements to share information. In this research there is considerable variability in these aspects. As discussed previously there is a growing emphasis on participatory planning and partnerships. At the same time the study works at multiple spatial and temporal scales by including both strategic and local level concerns related to informal development.
Characteristics of the policy context	Relates to the more political and cultural nature of the society in which the GIT is being utilised and refers to the level of democracy and transparency in decision making. Although this aspect is not a direct consideration in this study, linkages related to broader governance concerns and the use of information in them are relevant.

(based on Geertman, 1999)

The research process includes the development and testing of PSS components that should fulfil the substantive and procedural requirements within the resource constraints at both spatial levels. At the strategic level the main focus is on providing support for government organizations that are expected to have a leading role in the formulation of strategic policies for managing informal settlements. This choice does not imply that other non-governmental stakeholders may not or should not contribute to strategic policy development. It is merely intended as means to limit the scope of the research to manageable proportions. At the local level, where support for action planning is the main issue, consideration is given to two stakeholder groups: government and civil society. This choice is in keeping with the increased attention to community based planning in informal settlements in which the interaction between civil society and government is seen as a critical issue for success.

Figure 3.5: The research framework



The outputs of the research are PSS components and information products that should be evaluated against the initial specifications arising from the analysis of the planning context. The evaluation process is an essential element of the learning cycle and provides 3 kinds of feedback: related to the planning context, related to GIT and related to the further development of the PSS components or systems.

The following chapters focus on the application of the research framework. First the general planning context in Dar es Salaam is examined, providing an explanation of the boundary conditions within which the PSS components are to be development and applied. Thereafter attention is given to the empirical content of the research and the development and evaluation of those PSS components that have been included in this study.

Chapter 4

Exploring the planning context in Dar es Salaam

In this chapter some of the relevant features of the planning context in the case study city, Dar es Salaam are highlighted. The discussion begins with a general description of the city's history and population growth. Thereafter a more detailed examination of the planning context identified at the end of Chapter 3 is provided. To conclude the chapter attention is given to the adoption of GIT by several organisations that are related to urban planning and management processes setting the stage for the investigations that are at the heart of this study.

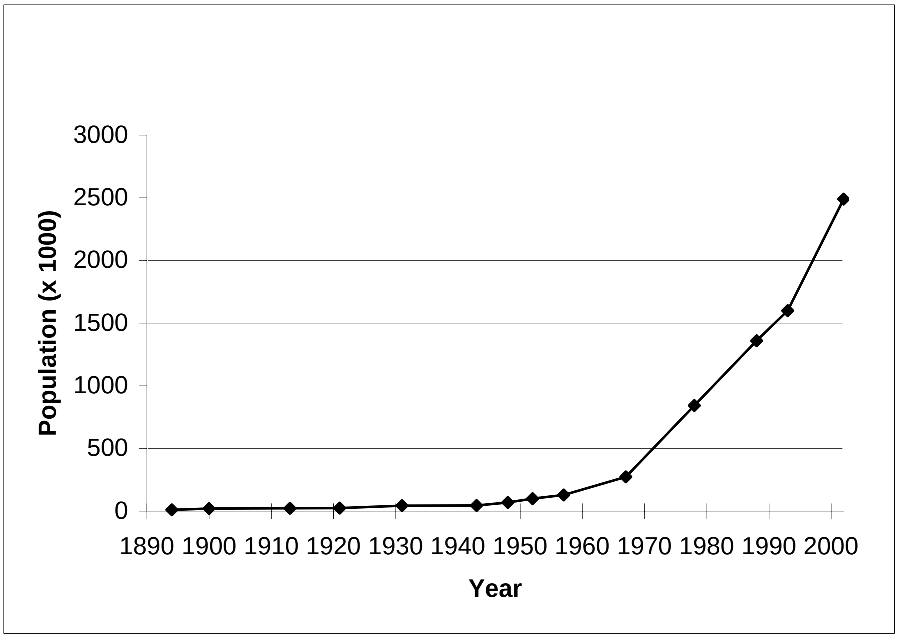
4.1 The establishment and growth of Dar es Salaam

The history of the city of Dar es Salaam can be divided into 3 main periods: one covering its initial establishment in 1862 by the Sultan Seyid Majid of Zanzibar who was based in Zanzibar; a second period of 74 years of European occupation starting in 1887; firstly by Germans until 1916 and thereafter by the British until 1961, and the post-colonial period in which Tanzania has functioned as a politically independent nation state.

Prior to 1862 the area was, however, partially settled. The original residents in the area were believed to have consisted of relatively small family groups belonging to the Zaramo tribe who were engaged in fishing and subsistence agriculture (Leslie 1963). Sultan Majid chose the site primarily for its natural harbour, which offered considerable potential for expanding trade with the interior. Actual construction of the Sultan's city commenced in the period 1865-1866 but his death in 1870 seems to have resulted in a period of relative stagnation. Some accounts of the city dating immediately after Sultan Majid's death refer to it as desolate and run-down (Leslie 1963), while Sutton describes a period in which *"..a more natural and viable economic system developed"* (Sutton 1970) that was to provide the foundation for further growth in the ensuing period of European administrative rule.

Figure 4.1 shows that the population was very small (around 10,000) at the time that the German period commenced and that it rose quite steadily until World War II. This war was followed a sustained period of rapid growth, with the most rapid population increases occurring immediately after independence was obtained from the British in 1961, following the abolition of laws regulating rural urban migration.

Figure 4.1: Population growth in Dar es Salaam 1894-2002



(adapted from Kombe, 1995, 2003)

4.1.1 European colonial rule: 1887-1961

Between 1887 and 1916 the city and much of the hinterland was accountable to German administrative rule, initially under the German East Africa Company and by 1891 under the German Government (Lonsdale 1992) with Dar es Salaam being the capital of German East Africa (Mascarenhas 1970), or as it was later known Tanganyika. In order to transfer their administrative headquarters from the town of Bagamoyo, approximately 60 km to the north, many new buildings were constructed in Dar es Salaam to the north of the harbour, and around the railway station which was opened in 1905, providing further impulses for the city's growth and expansion. Most workers' housing was provided by spontaneous settlements located on the fringe of the planned areas but some redevelopment of such areas was already taking place (Sutton 1970). Although the Germans recognised the need to improve living conditions in the city and prepared the plan for the redevelopment of the Kariakoo area adjacent to the city centre, little was done in terms of anticipatory planning designed on a larger scale (ibid). By 1913 the city's population had risen to around 23,000 and the pattern of housing and services divided along racial lines that typified colonial period in SSA (see Section 2.2.3) was already well established.

The British Government established administrative control over Tanganyika after defeating the local German armed forces in 1916 and maintained this control until Tanganyika obtained independence in 1961. Throughout the British period the city's population grew substantially. By 1957 it had reached more than 130,000 persons, exposing the inadequacies of the formal planning systems and instruments for development that were introduced in this period. Although several new neighbourhoods were constructed, shelter for the African population, which was by far the majority, was largely via spontaneous or unplanned settlements. By 1939 living conditions for the city's working class population were very poor. Unemployment of the African workers was estimated at 25%, less than half of the school aged children attended school and many lived in overcrowded often temporary houses[7] (Iliffe 1970). The city's population grew more rapidly after World War II and by 1947 the growth of slums and shanties was believed to be out of control (Leslie 1963). The colonial administration did respond to this growth by an attempt to improve the planning of the city through a Master Plan (see 4.2.2 below for details) but this attempt fell far short of an effective response to the needs of all of the city's residents.

4.1.2 Growth after independence in 1961

The population growth rate of the city increased even further in the post-independence period (see Figure 4.1), further exacerbating the challenge of providing adequate housing and services. Although both the central and local government recognised the importance of managing the city's growth and responding to the populations shelter and service requirements their attempts to do so have been far from successful. Official 1992 figures showed that 35% of the built-up area of Dar es Salaam was informal settlement providing shelter to 60% of the city' population (Mghweno 1999) though there are others who claim that the percentage of population in informal settlements is as high as 70% or even 80% (Molon, Leoni et al. 2001; Kyessi 2002). While the actual population figures will likely remain an topic for discussion it is evident that the scale of informal development has been and will remain an important urban management issue in Dar es Salaam for some time to come. The long term nature of the issue is reflected by recent population estimates of between 2.5 and 3 million persons and a population growth rate of 7-10 % p.a. (SDP 1999)[8].

As the following discussion shows, the city's rapid growth in the post-colonial period occurred under difficult economic conditions that severely limited the opportunities for many households and contributed to growing urban poverty.

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[7] Iliffe estimates that around 1939 between 20-25,000 Africans lived in some 3,200 houses i.e. between 7-8 persons per house.

[8] The recently released 2002 census figures put the city's population at 2.5 million and the annual growth rate at 4.2%.

The need to develop urban plans that are in keeping with the prevailing economic conditions has until recently never been fully appreciated. After briefly examining the national and local economic performance the discussion turns to the various attempts made by urban planners to plan for the city's growing population.

4.2 The planning context in Dar es Salaam

This section describes the broader societal and economic context in which the development of Dar es Salaam must be seen. The focus is first at the national level and an overview is given of the functioning of the Tanzanian economic and political system since independence[9]. Then in order to focus the discussion on the conditions of local capacity, the level of financial dependency of the local government on central government is examined. The examination of the planning context is concluded with a review of urban planning processes in Dar es Salaam, beginning with the city's first Master Plan in 1949 and ending with the most recent planning reforms and the production of a strategic urban development plan in 1999.

4.2.1 Tanzania's socio-economic performance at a glance

At independence in 1961, Tanzania was one of the poorest countries in the world, mainly depending on subsistence agriculture. Some forty years later, Tanzania is the fifth poorest country globally in terms of income per capita (280 US dollars in 2002), about 30 percent higher than at independence. Moreover, its rank on the Human Development Index, which combines life expectancy, literacy rate and income, fell from 126th in 1990 to 160th out of 175 countries in 2001. It therefore comes as no surprise that poverty remains widespread and deep, with half of the Tanzanians living below the poverty line. Poverty is concentrated in the rural areas although urban poverty has also grown along with rapid urbanization and stagnating urban economies (World Bank 2001).

By 2002 Tanzania had a population of about 35 million people with an estimated annual growth rate of 2.4 percent (for an overview of indicators see Table 4.1). The share of the urban population has risen rapidly, from 6 percent in 1967, to 34 percent in 2002, an urbanization rate that is among the highest in the world. This places considerable pressure on the capacity of urban services and on employment opportunities in urban centres. However, the socio-economic indicators show, that the responses to this pressure have been generally unsuccessful.

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[9] Sections 4.2.1 and 4.2.2 are slightly adapted versions of text prepared mainly by Sherif Amer as a part of his PhD thesis.

Table 4.1: Tanzania at a glance

Indicator	Tanzania							SSA
	1960	**1970**	**1980**	**1990**	**1995**	**2000**	**2001-2002***	**2001-2002**
Population *(millions)*	10.2	13.6	18.5	25.4	29.6	33.7	35.2	688
Population growth *(annual %)*	2.8	3.0	3.2	3.1	2.8	2.2	2.1	2.3
Urban population *(% of total)*	5	7	15	22	27	32	34	32
GNI (Atlas method, US$ bill.)	-	-	-	4.8	4.9	8.9	9.6	311
GNI per capita (Atlas method, US$)	-	-	-	190.0	160.0	270.0	280	450
GDP (ann. % growth)	-	-	-	7.0	3.6	5.2	6.3	-
GDP per capita (ann. % growth)	-	3	-0.2	3.1	0.6	2.6	4.1	-
Inflation (%)	-	3.5	30.2	35.8	28.4	5.9	4.6	-
Aid per capita (current US$)	1	4	37	46	30	30	36	21
Aid (% of GNI)	-	-	-	29	17	11	13	5
External debt *(% of GNI)*	-	-	-	159	145	-	72	-
Life expectancy at birth *(years)*	41	46	50	50	49	44	43	46
Infant mortality (per 1,000 live births)	142	129	106	102	103	104	107	105
Illiteracy (% of pop. age 15+)	-	64	51	37	31	25	24	38
Primary school enrollment, *(%)*	-	33	93	70	67	63	-	86
Secondary school enrollment, *(%)*	-	-	-	5	5	6	-	27

* Most recent estimate used 2001-02

(source: World Bank, World Development Indicators, 2003 CD-ROM)

Like most SSA countries, Tanzania has not yet embarked on a demographic transition to lower population growth. It has a high, though marginally declining fertility rate of 5.0 children per woman and the resulting high dependency ratio, in combination with rapid population increase, is a major hindrance to economic growth and poverty reduction. Furthermore, infant mortality rate is high, 107 per 1,000 live births, and rising, while national education performance is also rather poor, and has been showing signs of weakening further under economic reform packages adopted in the 1990's. For example, primary school enrollment has been declining steadily since its peak of 93 percent in 1980 and secondary school enrollment (6%), is far lower than the 27 percent average for Sub-Saharan Africa. The HIV/AIDS pandemic poses a major threat for eroding the limited gains made in economic and human development (UNDP 2000) as it mainly strikes adults in their prime productive years and has eroded life expectancy from 52 years in 1988 to 43 years in 2002, and further decline is anticipated.

In terms of the structure of the economy, as elsewhere in SSA, there has not been significant change since independence. Agriculture still accounts for about 50 percent of GDP, provides 85 percent of exports, and it is the source of employment for the majority of Tanzanians. Consequently, the non-diversified economy remains vulnerable to weather conditions and fluctuations in world market product prices. Industry is dominated by the manufacturing sector, which currently accounts for about 8 percent of GDP and concentrates on agricultural processing and the manufacture of light consumer goods. However, minerals (*i.e*. gold) and tourism are envisaged to offer a big push toward economic growth in the coming years. The aim is to raise the contribution of tourism to GDP from 8 percent in 1998 to more than 25 percent while the target for the mining sector is to raise its contribution to GDP from 1.8 percent in 1998 to 10 percent (IDA and IMF 2000). To date, however, Tanzania has not been able to exploit its potential. The lack of persistent high rate economic growth, even though it has been one of the largest recipients of aid in SSA in absolute terms, is one of the main factors behind the lack of progress made since independence.

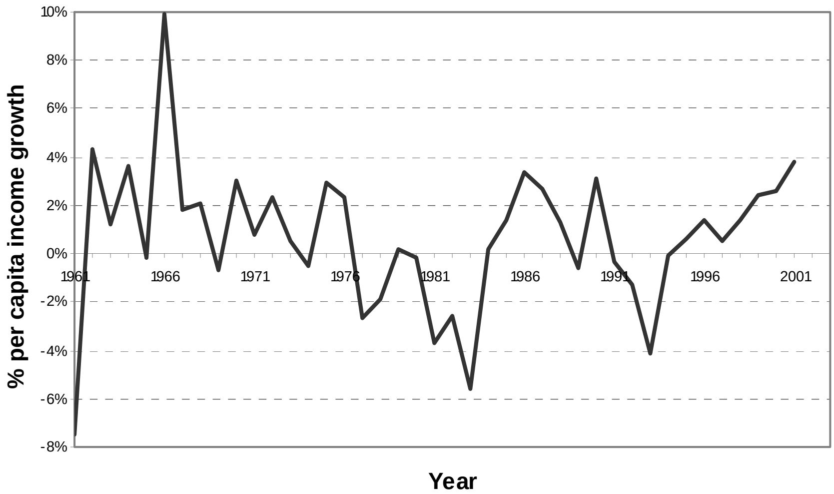
4.2.2 The political economy of post-independence Tanzania

In this section, some of the reasons for Tanzania's poor economic performance are explored. This is done by describing socio-economic development since independence over several time periods that are related to important political developments and shifts in national socio-economic policy.

The pre-Arusha period 1961 - 1967

At independence Tanzania inherited an economy with all the features of a colonial economy: foreign-dominated, absence of an industrial base, weak transport infrastructure, poor delivery of basic social services, mass poverty and a slow growing economy. The new government, headed by President Nyerere, initially followed a cautious development strategy aiming to eradicate poverty, disease and ignorance (illiteracy) in two decades. The strategy to achieve this was to modernize agriculture, to increase exports of primary agricultural products, to attract foreign funds for industrial and infrastructure investment, to accelerate the training of Africans to take over posts in the state and private industry, to improve and expand provision of basic infrastructure and social services, and to weld a colonial territory into a nation (Van Arkadie 1992). During the 1961-67 period per capita income grew at an average of nearly 2% p.a., the highest rate of any period in independent Tanzania (see Figure 4.2).

Figure 4.2: Per capita income growth between 1961 and 2001.



(Source: Bigsten and Danielsson 1999)

Nonetheless, by 1965 it became apparent that the development strategy was not as effective as was intended. The transformation of traditional smallholder subsistence agriculture into a more modern agricultural sector producing both food and export crops did not generate the desired results. Efforts to attract foreign investors proved difficult and import substituting industrial growth was also below expectation. The collapse of the market for the major export crop, sisal, illustrated the vulnerability of the economy and further restricted government investment in agriculture and industry. Finally, the government was concerned that the benefits of independence accumulated in the hands of a small elite of Asians and politically powerful Africans. Confronted with these problems, the government developed a new strategy, which became known as the Arusha Declaration, to speed up development (Heijnen 1976; Bigsten and Danielsson 1999).

The Arusha period 1968 - 1978

The Arusha Declaration of 1967 marked a turning point in Tanzania's political and economic history. The government abandoned the cautious policies pursued up to that point and launched a radical development strategy aimed at self-reliance and African socialism. The declaration emphasized human development and economic growth with equity. It voiced a clear political commitment to raising the living standards of all, and the targeting of government programs to meet basic needs. Rural development was to be the backbone of economic progress, complemented with expansion of import substituting industrialization. The strategy was based on pervasive state control over the economy and on the prospect of a viable public sector as the principal engine of social development and economic growth. As a result banking and the industrial sector were nationalized, while international trade and private retail trade were confined to state enterprises.

To increase agricultural exports and modernize peasant production, the government pursued a program of rural development called *ujamaa*. This involved the creation of cooperative farm villages where, it was argued, agricultural production as well as the provision of basic infrastructure and social services could be undertaken more efficiently. Initially, the government called for the voluntary concentration of the dispersed rural population into villages. After 1973, however, the villigization policy was imposed and by the mid 1970s most of the rural population, nearly 10 million persons, had been forced to give up their original land holdings and resettle into cooperative farm villages.

State spending on agriculture reached historic levels during this period with hundreds of millions of dollars invested in large-scale agricultural modernization projects and in setting up agricultural parastatals. The required investment funds were secured with relative ease for two reasons. First, western bilateral donors and the World Bank were quite willing to provide extensive aid to Tanzania because of the 'human face' of its development strategy. Second, foreign loans and credits were cheap as a result of the 1973 oil price increase ('petrodollar recycling').

Despite massive investments, the approach of cooperative agriculture was not successful. Towards the end of the decade, forced villagization, poor investment choices, political interference, a heavy bureaucratic system and increasing corruption, reduced the effectiveness of investments to very low levels. Ultimately, the *ujamaa* experiment led to a decline in agricultural exports, major food shortages and a tremendous increase in domestic debt. Many of the industrial investments made during this period shared a similar fate.

In 1974 the government began to implement its Basic Industries Strategy of import substituting industrialization, aiming to serve the East African market. This industrial investment program was also state-led and largely dependent upon external funding. Again, the rapid increase in industrial investment outstretched the capacity of the relatively weak African technological and managerial cadres to properly plan, run and maintain the investments and, despite further increasing domestic debts, they generated little corresponding increase in industrial output and earnings. In spite of such problems, overall per capita income growth during the 1968-78 period was still positive at about 0.7 percent per year (see Figure 4.2), but with rapidly mounting foreign debts, little productive growth and the break-up of the East African Community in 1977 it was by then clear that the Tanzanian economy suffered from internal structural weaknesses and was heading for an economic crisis (Bigsten, Mutalemwa et al. 2001).

The crisis period 1979 - 1985

By 1979 the Tanzanian economy faced very severe problems and it was severely affected by the collapse of the commodity boom of 1975-78, the Uganda war in 1978-79, the second oil crisis in 1979 and the resulting global recession. Sharply rising interest rates multiplied Tanzania’s debt obligations, while declining terms of trade reduced foreign exchange earnings. In response, Tanzania turned to the IMF for assistance, but an agreement was not immediately reached and for about two years a deadlock prevailed. The position of the IMF was that aid was conditional to policy changes i.e. currency devaluation, reduction of subsidies, reduction of budget deficit, import liberalization. The government position, on the other hand, was that Tanzania was a structurally weak economy and that the remedies proposed by the IMF would not help to revive the economy.

Following the breakdown of negotiations with the IMF, donors became increasingly critical of the country’s development strategy. There was growing evidence that in spite of the Arusha Declaration neither socialism nor self-reliance had been achieved and that effectiveness of aid had been low. With the cut off of aid from the IMF and the World Bank, and the scaling down of bilateral donor support, aid flows declined sharply and Tanzania was faced with a foreign exchange and economic crisis of unprecedented proportions.

By 1982 the country was in a desperate situation with widespread shortages and sharply deteriorating living conditions. Industrial output collapsed due to lack of imports of fuel, raw materials, intermediate goods and spares, and agricultural production declined. Due to the shortage of foreign exchange even the most basic consumer goods disappeared from the shops by 1981. This situation persisted for 3-4 years and a parallel market emerged where consumers often paid excessive prices for basic commodities. During this crisis period per capita income fell by 1.5 percent per annum (see Figure 4.2) according to official estimates, but a more significant income decline is likely because of high black market prices. Consequently many Tanzanians were forced to withdraw into subsistence activities or found other ways to deal with shortages.

In 1983 Tanzania implemented an unilateral economic adjustment program, which emphasized increasing agricultural production, particularly for export, in an attempt to alleviate both food and foreign exchange shortages. It devalued the currency, reduced subsidies, raised real produces prices for food and export crops and allowed limited private trade. Although these changes did alleviate somewhat the shortage of consumer goods and increased agricultural production the measures were not sufficient to fully counter the crisis. Ultimately, pressure from the IMF/World Bank and bilateral donors, the failure of independent national efforts to revive the economy, and the resignation of President Nyerere in 1985, combined to persuade the government to reopen negotiations with the IMF.

The initial reform period 1986 - 1992

After reaching agreement with the IMF and the World Bank in 1986, Tanzania embarked on a more substantial Structural Adjustment Programme (SAP). In general, a SAP has a dual aim of *(i)* balancing national incomes and expenditures and *(ii)* substituting state-based economic interventions by market mechanisms, very much reflecting libertarian ideology (Briggs and Mwamfupe 2000). Adjustment packages typically include both short- and long-term measures. Stabilization programmes aim to produce a short-term effect, their focus is to correct the balance of payment by reducing budget deficits. This is mainly achieved by currency devaluations, import reduction, the removal of state subsidies and the reduction of public expenditure. SAP's are designed to promote change in the longer term; they mainly focus on economic liberalization. They aim to achieve this by trade liberalization; the promotion of private (foreign) investment; the strengthening of export sectors with a comparative advantage (i.e. primary commodities); the privatisation of government industries; and market deregulation. Advocates of SAP's argue that the conditions are set in place to facilitate higher levels of sustainable economic growth, which in time will alleviate poverty. However, it is also generally recognized that in the short term such reforms cause lower or even negative GDP growth and negatively impact on the living standards of the majority of the people (Loewenson 1993; Asthana 1994; Peabody 1996).

The IMF and World Bank supported the Tanzanian government in launching the Economic Recovery Programme (ERP) for the 1986-89 period. This restored donor confidence and there was a second aid boom, which peaked, in the early 1990s. The main targets of ERP were to *(i)* increase output of food and export crops, *(ii)* increase capacity utilization in industry from 25 to 65 percent, *(iii)* restore macro-economic balance, *(iv)* reduce inflation from 30 to 15 percent, *(v)* increase foreign exchange earning from exports from $400 to $630 million and *(vi)* rehabilitate and maintain social services.

The initial reforms did not reach their stated targets (Gibbon and Raikes 1995) and in 1989, the reforms entered a second phase under the Enhanced Structural Adjustment Programme (ESAP) that covered the period 1989-92. ESAP widened the reforms to include institutional reforms and privatisation in the banking system, agricultural marketing, the parastatal sector, and the civil service. Although little progress was made for a number of years per capita income growth was again positive at around 1.2 percent per annum (see Figure 4.2).

Three reasons can be given for the slow pace of reform during this period. First, there still was considerable political opposition to reforms from within the government and simple bureaucratic 'foot-dragging' delayed their realization. Second, there was inadequate institutional capacity for the timely implementation of a complex issue such as economic reform. Third, economic reforms such as downscaling the civil sector and the privatisation or closing down parastatal enterprises are sensitive issues which go against vested interests and have far reaching effects on many people who may lose their job or privileges (Gibbon and Raikes 1995; Bigsten and Danielsson 1999; Bigsten, Mutalemwa et al. 2001; World Bank 2001). Resistance by gatekeepers and other affected parties must therefore be anticipated.

Off and back on the SAP track 1993 - 2003

Political commitment to adjustment further diminished during the second term of President Mwinyi, and the implementation of reforms stagnated. Government revenue fell, large tax exemptions were granted to politically favoured persons, and there was a general feeling that corruption, tax evasion and mismanagement had become widespread, to the extent that, in late 1994 the IMF and even the Nordic donors, suspended their aid programmes. Once again per capita income growth fell and was even negative between 1993-95 (see Figure 4.2).

The economic downturn was, however, short-lived as the course of reform was restored following the country's first multi-party elections in late 1995. The new government of President Mkapa put high priority on implementing economic reform, fighting corruption and mending relations with donors (Hoebink 1997). Since then, considerable progress was made towards stabilizing the economy and reducing budget deficits. Achievements include streamlining the civil service by reducing overall government employment from 355,00 to 270,000 since 1993, privatisation of about two thirds of the parastatal enterprises, and a far-reaching restructuring of the financial system (IMF 2003).

There are now encouraging signs of general improvement in the economic indicators. Inflation dropped from over 30 percent in the early 1990s to 4.6

percent in 2001, the lowest in 15 years, per capita income growth rates have been at around 2 percent per annum for the period between 1995 and 2000, and climbed to 3.8 percent in 2001, the highest level in 25 years. Overall average growth rates have also been more stable than in the past, despite the negative effect of the slowdown of the world economy on commodity prices and tourism (World Bank 2001). Export volumes of principal agricultural commodities have also experienced upward trends (Naschold and Fozzard 2002). At the beginning of the new century, the status of the adjustment program is relatively satisfactory and in 2001 Tanzania is included in the IMF/World Bank *HIPC initiative* that provides debt relief to the world's poorest and most heavily indebted countries. The freeing of resources resulting from debt relief should be used for poverty reduction activities (Gupta, Clements et al. 2002) with education, health and water as priority sectors within the national strategy.

Future prospects are also more promising than at any time since independence. For example the IMF (2001) estimates that the Tanzanian economy will grow at an average of 6 percent p.a. during the period 2001 - 2020. Their projection is based upon the assumption that further improvement in infrastructure and transportation, and normal weather conditions, will allow for agricultural growth of 5.5 percent a year. Investments in privatised parastatal enterprises and in new gold mines are expected to lead to average annual growth rates of 6.5 percent in manufacturing and 8.5 percent in the mining sector. Economic growth will also be supported by a continuation of economic liberalization and public sector reform.

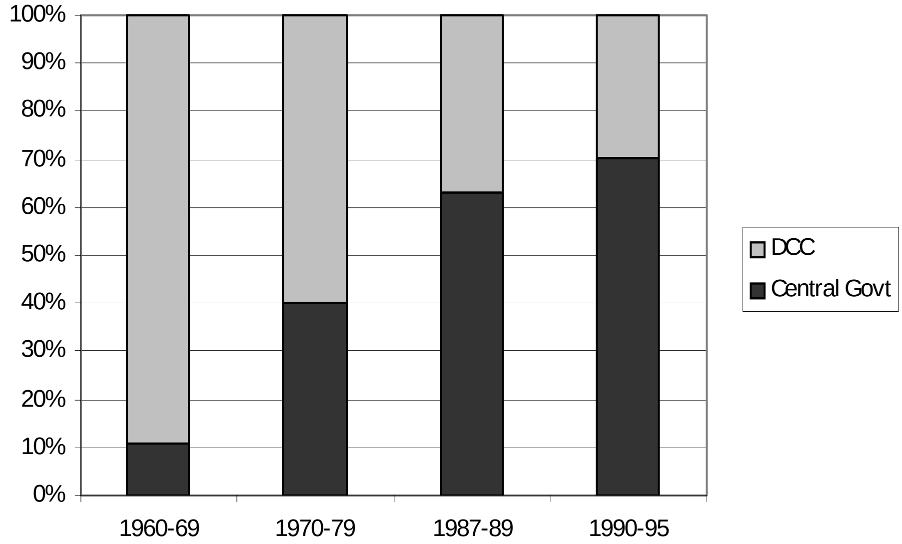
Despite recent, relatively positive macroeconomic developments, the pace at which Tanzania is currently travelling is still too low to have a sizeable impact on poverty reduction. Nevertheless, the Tanzania Vision 2025 aims to halve abject poverty by 2010 and eliminate it by 2025, by achieving sustained growth, at an average of 8 percent p.a. Furthermore, government aims to develop a modern export-led economy and leap into the category of middle-income country. Danielsson (2001) agrees that Tanzania needs such high growth rates to visibly impact on poverty in the medium term, but doubts whether they are realistic given the constraints that face the Tanzanian economy. Judging from Tanzania's past record, achieving such ambitious targets will most certainly be a daunting if not unrealistic task. The persistent poor state of the national economy will also continue to have repercussions for local government bodies such as Dar es Salaam City Council, that rely heavily on state funding.

4.2.3 Relationships between Central and Local Government

The Local Government Finance Act No. 9 of 1982 stipulates that local government revenues can be obtained from both local taxes and central government grants. However, from the 1960's the Dar es Salaam City Council

(DCC) has been becoming increasingly reliant on the latter for its revenue[10] (see Figure 4.3). Although local government dependency on central government finances is also around 75% in the U.K. (Atkinson 2003, p 2345), when the DCC's situation is seen in the light of the weak national economy described above, such dependency is more alarming. The significance of Government grants for DCC in financial terms is evident but the implications of the absolute shortage of funding are stark and dramatic for the DCC and the city's residents. According to Kombe (1994, p. 81) while these grants are intended to cover the recurrent expenditure of the most essential services, they are in fact inadequate to cover all requirements and when, as in 1988/89 only 77% of the approved central funds were actually released to DCC, the situation becomes even worse.

Figure 4.3: Proportion of Central Government grants to DCC revenues



(Derived from: Kombe 1994; Kyessi 2002)

Local autonomy in land use planning and local economic development is reduced in situations where fiscal centralisation prevails and especially when grants are given for specific purposes (Razin 2000). A poignant illustration in Dar es Salaam were the funds that were allocated by the central government to the DCC to conduct land surveys for new urban layouts, but without a commensurate allocation for compensating displaced land owners (Kombe 1994). In this way the production of layouts remained an academic and futile exercise, serving only to frustrate both local government staff and plot seekers,

[10] 2002 financial figures for the 3 municipalities show that central government funding was budgeted at 59% in Temeke and Kinondoni while actual revenues in Ilala were 37%, a slight improvement over recent years.

creating an impression of ineffectiveness both with those residents who had registered for land and farmers whose lands were under threat of acquisition.

The DCC is however not entirely dependent upon central funding. Revenue collection is also a responsibility of the DCC itself but this is an area in which their own performance has been far from satisfactory. Several sources are available for local revenue collection, such as the development levy (in 1993 an amount of Tsh 250 per adult to be paid annually), property tax (an annual tax payable by all property owners and including those in informal areas), market fees, business licences and building permit fees amongst several others. In the case of the development levy and the property tax Kironde (1999) estimates that in 1993 less than half of the potential revenue was actually collected. The DCC's financial problems are also attributable to it expenditures. In this regard Kironde (ibid, p. 116) points to irregularities related to vehicle purchases, excessive salaries and allowances of councillors.

Not all shortcomings in the DCC's service delivery are the result of financial constraints. Other factors mentioned were the poor quality of local councillors, corruption and resident apathy (ibid, pp. 117-118). Several other contributing factors are embezzlement and poor accounting, the long-term and structural shortage of professionals and technical assistants within many departments, lack of vehicles and other equipment, regular Central Government interference in DCC responsibilities such as plot allocation, poorly motivated staff with a lack of innovative ideas and approaches (Kombe 1995). The combined effect of these problems has been a decline in amount and quality of local government service delivery, including those functions related to urban land management such as land surveys, development control, plot allocations, layout preparation and development and infrastructure provision (Halfani and Sendoro 1990, cited by Kombe 1995). Under such circumstances it is, as Eriksen (1997) suggests in his discussion of District Planning in Kogoma, perhaps ironic that urban plans continue to be made, though he also notes that the making of development plans is an inherent feature of nation-states "*..or that it is a system that is a legacy of the days when there were resources available, and that it has been retained simply by government's inertia or in expectation of better days to come.*" (Eriksen 1997, p. 268). As the next section shows, the roots of urban planning in Dar es Salaam have been imported from the planning traditions of developed countries but, despite its failure the prospect for creating a planned and liveable city has not yet been abandoned.

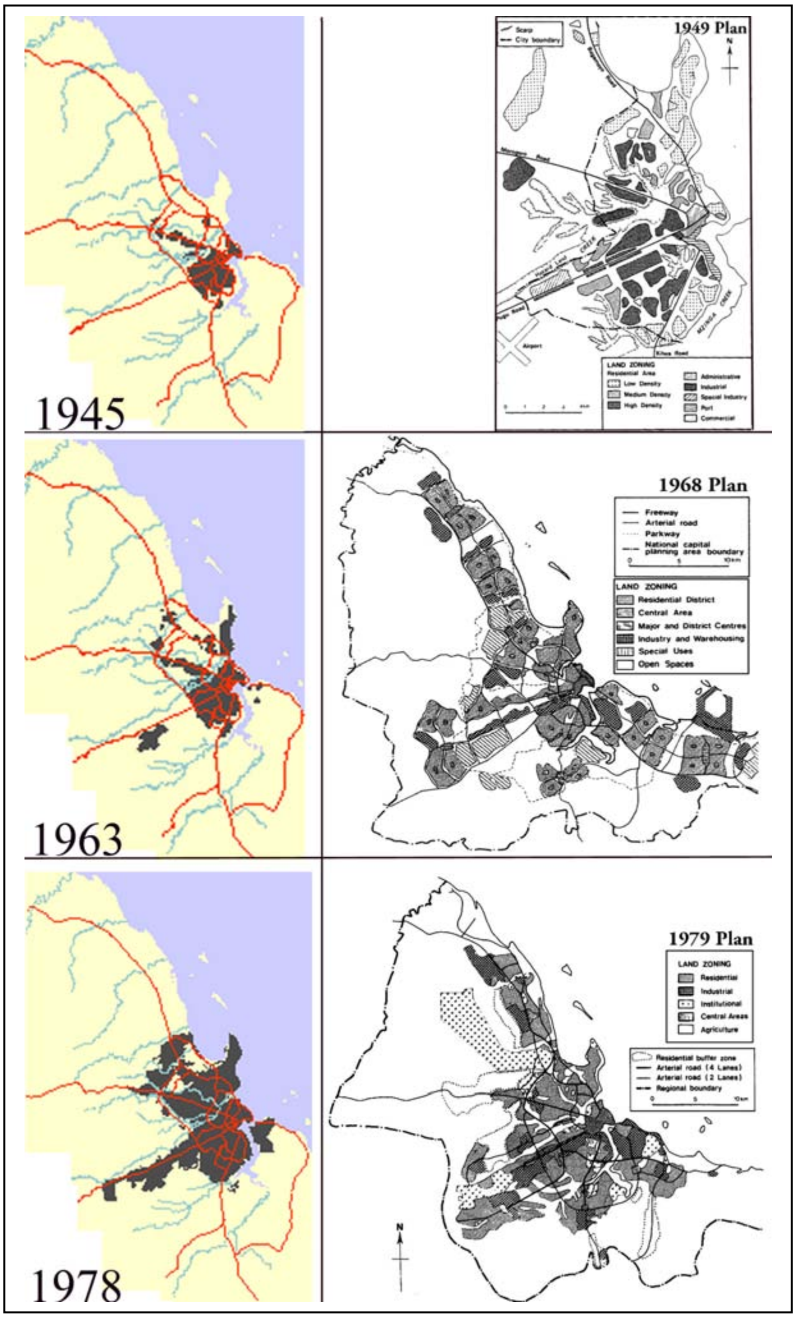
4.2.4 Urban planning and the management of informal development

This review of urban planning in Dar es Salaam commences with the first attempt at a Master Plan that was made for the British administration in 1949 (see Figure 4.4). Although the Germans had also prepared some plans for the city, it was in their time still rather small and relatively easy to oversee and manage. However, by 1948 Dar es Salaam's population had risen to more than 69,000 and the need for a general development framework was recognised by the British colonial government, though their primary concern was with the needs of the European residents and somewhat less with the Asian and African residents.

The 1949 Master Plan

In 1949 the city's first Master Plan was prepared by Alexander Gibb and Partners. It was a typical example of British colonial planning practice being built upon imported town planning ideologies, assumptions, values and mechanisms to the extent that a high level of motorised transport, industrialisation and a well developed private sector were more or less taken for granted (Alexander 1983). Proposals advocated racial segregation such that *........" low, medium and high density zones will be occupied in the main by Europeans, Asians and Africans"* but they also recognised that many Africans would settle in peri-urban settlements that were organised along traditional lines in which high building standards would not apply (Schmetzer 1982). All in all the 1949 plan devoted a disproportionate amount of attention to the planning of the low density areas and most of the detailed proposals in plan dealt with modernization specifically directed at the needs of the European elite (Armstrong 1986b; Armstrong 1987b). The lack of concern for the needs of the African residents is reflected by fact that one page, out of a total of 160 pages in the Plan document, was devoted to the needs of the 14,000 residents of Ilala, who were largely of African origin (Armstrong 1986b; Armstrong 1987b). Nevertheless, some general proposals for African zones were made to reduce densities, protect road alignments and provide communal water standpipes. Given the bias toward the needs of the Europeans it is surprising that, according to Leslie (1963) by 1952 the worst of the city's slums were under control and the British Colonial Development and Welfare Fund were able to concentrate their efforts on the construction of new layouts and resettlement. However, despite the attempts made to improve conditions Leslie (ibid) also noted that there was at the time little economic basis for the rapid population growth that was taking place, providing an early indication of the future importance of urban poverty as a policy issue in the period after independence in 1961.

Figure 4.4: Growth of Dar es Salaam and Master Plans 1945-1979



(Sources: Uisso 1975; Armstrong 1987b; Briggs and Mwamfupe 2000; Masanja 2002)

The 1968 Master Plan

In the post-colonial period two Master Plans for the city were produced, both were financed by foreign donors and heavily dependent upon imported planning expertise (Armstrong 1986b). The first plan was from 1968, shortly after the Arusha Declaration which marked the birth of Tanzania as a socialist state and the nationalisation of land, infrastructure and industry, all of which placed significant demands on the government’s role in urban planning. The plan itself was based upon a substantial amount of data collection and technical studies in keeping with the systems approach that prevailed in western town planning of the day and looked forward to the year 1989 (Armstrong 1986b; Armstrong 1987b). But its proposals were formulated at time when the young nation was struggling to develop economically in accordance with its identity as a self-reliant socialist state while having to contend with the city’s population growth running at about 10% per annum (Sutton 1970). The 1968 plan was criticised from the outset for *i)* underestimating the rate of population growth; *ii)* containing an investment plan that was at odds with national plans that rested on socialist principles; *iii)* the hostile attitude to squatters and *iv)* for its over-ambitious concepts and proposals in terms of funding, manpower and the administrative capacity to implement them (Armstrong 1987b).

Initially, the central government was determined to address the housing problem and a substantial squatter clearance and resettlement programme was adopted in order to do so. Some clearance projects were undertaken in Dar es Salaam under this policy, however, it was abandoned by 1969 when it was realised that the net effect was a reduction in housing stock and that the new houses were not affordable for the intended beneficiaries, low income groups (Mghweno 1984; Mghweno 1999).

In the 1970’s the slum clearance policy was replaced by a substantial Sites and Services and squatter upgrading programme (Magembe and Rodell 1983; Mghweno 1984; Materu 1986; Kironde 1991). Although other Tanzanian cities also benefited from this programme, more than half of the sites provided or upgraded were located in Dar es Salaam. Two phases of the programme were eventually implemented with the aid of external funding. A third phase, initiated in 1985, was only partially implemented because it depended on local finance for implementation but this was not forthcoming (Mghweno 1999). There were also technical problems. Disputes over land ownership between existing land holders and the allottees of new plots were common (ibid) and some plans for squatter area upgrading were even prepared in the office on the basis of outdated topographic maps, without prior field inspection and without establishing contact with the local communities[11].

The 1979 Master Plan

The third and final Master Plan for Dar es Salaam, which could be considered as an updated review of the 1968 plan, was produced in 1979. It too was produced by a foreign planning consultant based in Canada and it was financed by the Swedish government, reflecting the continued reliance on western expertise for such large urban planning projects (Alexander 1983; Armstrong 1986; Armstrong 1986b). In this case, however, the consultant had some considerable experience in Tanzania, having been involved in the preparation of Master Plans for the new national capital Dodoma and that for Arusha in the mid 1970's. By this time, there was somewhat of a crisis in urban planning which was being criticised for being technocratic and ineffective in guiding development. Further, 1979 marked the beginning of a major economic crisis period (see Section 4.2.2) and this did not go unnoticed in Dar es Salaam, though it was not very apparent in the scope and ambition level of the plan itself.

The 1979 plan was based on discussions between the planning team and a broad range of institutional stakeholders. Although it is still based on similar scientific analysis techniques its proposals were in general more pragmatic, exhibiting a greater concern for managing on-going changes, practical programmes and the implementation and control of development. Although it also aimed to provide a framework for Dar es Salaam's development over a 20 year period, surprisingly little specific attention was given to the problems associated with a rapidly growing population within a nation with an exceptionally weak economy. It is therefore hardly surprising that much of the envisaged planned development has either not occurred or that it has deviated substantially from what was intended.

One of the reasons given for the failure of Master Plans was the reliance on foreign planning consultants who were considered to be insensitive to the local circumstances but the shortcomings in urban planning methodologies and legislation have also been identified as contributing factors (Materu 1997). Criticism of Master Plans is not limited to those of Dar es Salaam, as Nnkya's description of the preparation of the Moshi Master Plan of 1974 clearly shows:

> *"Like commandos, one planner and an engineer arrived in Moshi and within a month they had claimed to have acquired*

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[11] Although it is not certain if it was common practice for the planners at the Ministry to prepare layout plans in such a manner, during a visit to this office around 1989 staff who were involved in delineating possible plot boundaries on topographic maps of 1982 did mention to the author that it was usual to do so before going to the site.

> *sufficient knowledge about the people and their socio-economic environment, so that they could prescribe how land would be used and developed over the next 20 years."* (Nnkya 1999, p. 138)

Given that Moshi's Master Plan was discussed and reviewed by national and local government staff and politicians and was approved without formal, extensive participation of neighbouring rural landholders it is hardly surprising that a significant amount of resistance was raised when attempts were made to implement the plan. Further, as Materu (1997) points out, simply replacing foreign planning consultants by locally trained consultants without addressing the legal framework will not lead to better planning. To say nothing of the fact that many local planners have either been trained abroad or have an education that is steeped in western planning methodology based upon the comprehensive rational model of planning that is geared toward the production of blueprint spatial plans (Nnkya 1997, p. 22). Given such criticisms of the planning system it could be said that modification of the urban planning process was overdue.

The 1999 strategic urban development plan

The reform of Tanzanian urban planning started to take shape in the early 1990's, although after years of economic hardship aided by government mismanagement, living conditions in Dar es Salaam had deteriorated substantially. Initially, senior planners within the Ministry of Lands, Housing and Urban Development (MLHUD) sought financial aid for preparation of the city's fourth master plan, in keeping with their western planning education and following the previously established practice. However, the general failure of the master planning was by this time well recognised and aid for a new master plan was not forthcoming. When funds did become available it was under the proviso that stakeholders would collaborate and support a new way of urban planning and management under the auspices of the Sustainable Dar es Salaam Project (SDP). Not only has the SDP generated a Strategic Urban Development Planning Framework for Dar es Salaam, which was released in 1999 (SDP 1999), it has also led to a significant amount of capacity building under planners and other stakeholders and quite radically altered the planning process itself. The implications of these changes are discussed in Section 4.2.5.

The strategic plan differed quite substantially from its predecessors in content and focus (see Table 4.2). All of these plans placed considerable emphasis on the physical environment and the improvement of transport networks to facilitate intra-urban mobility, but some differences are also apparent. The

Table 4.2: Comparison of City Wide Plans for Dar es Salaam, 1949-1999

Aspect	1949 Master Plan	1968 Master Plan	1978 Master Plan	1999 Strategic Urban Development Plan
Main consultant	Gibb & Partners, U.K.	Project Planning & Assoc, Canada	Marshall, Macklin, Monaghan Ltd, Canada	Local & foreign consultants supported by UNCHS & donors
Planning area	84 km^2	404 km^2	448 km^2	1350 km^2
Plan period	20 years	20 years	20 years	20 years
Data & method	Very limited surveys more emphasis on design	Elaborate socio-economic survey & African city comparison	More rigorous, approach; increased detailing of neighbourhood level plans, guide-lines & budgets	Pragmatic approach combining data & analysis with consultations & participation & use of an EMIS[12]
Participation	Very limited; consultants prepared the plan but were also employed to create & run the first planning department	Limited to planning officials & some key staff of other agencies	Wider participation & representation in preparing draft & final plan & agreeing on implementation	Stakeholder driven: start with a City Consultation (1992: 205 participants) & extended through cross-sectoral working group activities on critical issues
Investment programme	Not given specific attention in the plan	Details provided for the first 5 years but not based on realistic assessment of fund provision	Two 5 year phases & one 10 year phase. Phase 1: Detailed investment plans for 47	Four periods: 1999-2000: urgent funded projects based on working : 2001-05 short-term plan: densification & new development near to services; 2006-10

[12] EMIS is a GIS based Environmental Management Information System that was conceived early in the Sustainable Dar es Salaam Project (SDP) & ultimately provided a basis for storing key data from working groups & for the analysis of options for city expansion. The SDP approach aimed to overhaul the whole urban planning & management procedures, build local capacity for planning, create a new strategic plan for the city & operationalise it through action plans.

Aspect	1949 Master Plan	1968 Master Plan	1978 Master Plan	1999 Strategic Urban Development Plan
Investment programme (cont)			projects but source of funds not identified & not practical in terms of local economic situation	mid-term plan: coordinated utility provision & control haphazard develop-ment; 2011-19 long-term plan: development control & enforce-ment of regulations
Housing	Racial segregation & "boys towns" Neighbourhood units & *cordon sanitaire*	Neighbourhood units Reduce densities in squatter areas, increase in low density areas, slum clearance 10-cell[13] as planning unit	Neighbourhood units Recognition of slum & squatter areas Site & service areas introduced Affordability Residential buffer areas (i.e. designated future squatter areas)	Key issue in several working groups of SDP i.e. City Expansion Vision; Upgrading unplanned Settlements; Managing urban renewal. Strong element of community based initiatives with government support
Industry	Segregated; mostly concentrated around harbour area & railway line.	Dispersal of light industry & concentrate heavy industry in harbour area & along Pugu Road	Along lines established in 1968 plan with further dispersal of light industry.	Support to formal & informal business; Improvement of public utilities; roles of key agencies defined
Transport	Radial pattern	Ambitious plan including 6 lane freeways, 2nd ring road etc.	More pragmatic than 1968. Piecemeal improvement of main arterials & some road widening	Improve existing network & some new roads; traffic management, CBD car parking, public transport services; non-motorised transport important

[13] A 10-cell is the lowest level of political representation & administration & is based upon the idea of having a person to represent groups consisting of 10 houses each.

recognition given to informal housing that was already evident in the 1979 plan (Armstrong 1987b) has been further extended in the recent Strategic Plan, which has adopted, for the most part a pragmatic, problem driven approach that recognises the needs of all citizens and interest groups, not only those of the elites and professionals.

Although a 20 year time frame is still adopted in the strategic plan, the plan itself provides only a general framework for managing the city's physical development. The neighbourhood as a main planning concept that was particularly evident in the 1968 plan has now been abandoned and emphasis has been given to creating a general concept for accommodating further urban expansion (see Figure 4.5). Simultaneously a series of projects aimed at the critical problem areas identified through stakeholder consultations and working group activities are identified. Nine critical issues form the basis of the planning process[14]: *1)* Servicing city expansion; *2)* Upgrading unserviced settlements; *3)* Solid Waste Management *4)* Managing surface water run-off and liquid waste; *5)* Traffic management and air pollution control; *6)* Managing open spaces, hazard lands and urban agriculture; *7)* Managing informal trading; *8)* Managing urban renewal; *9)* Managing building materials and coastal resources (SDP 1999).

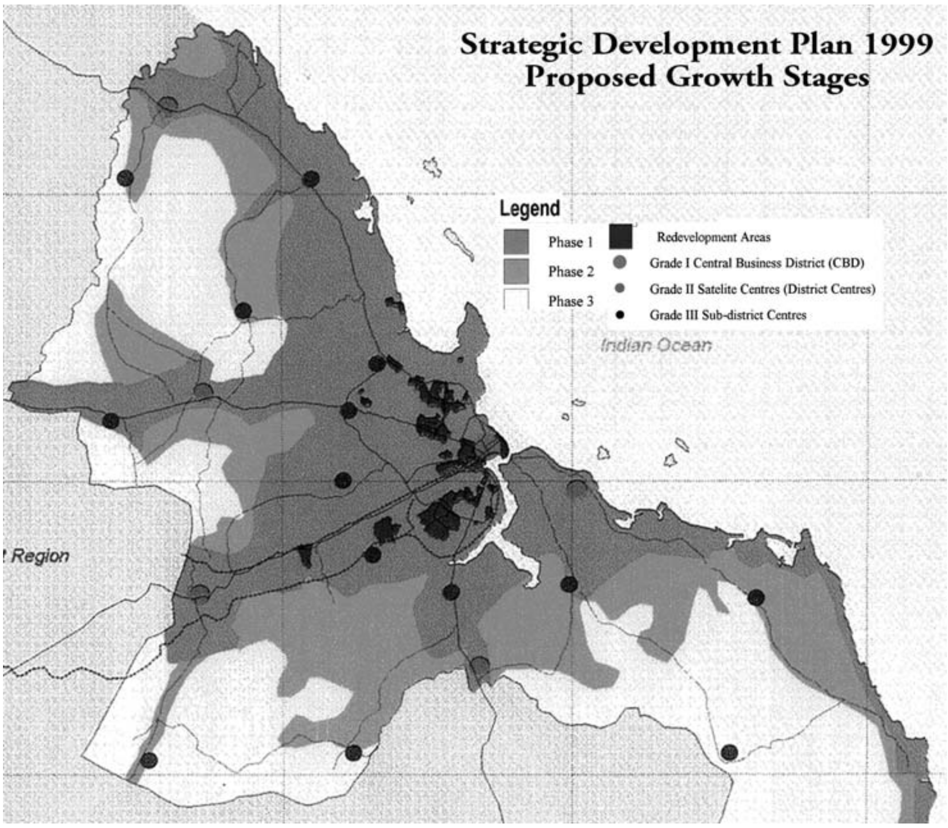
All working groups have created action project proposals, some of which were already being implemented prior to the production of the strategic plan, providing a practical illustration of the parallel lines of planning at strategic and action levels that is discussed by Davidson (1996) and reflecting the new pragmatism in urban planning that is judged by performance rather than the production of grand concepts for development. However some of the underlying ideals of planning may not have been rejected entirely in favour of short term results.

One area in which this can be seen is that of development control. Whereas, the strategic plan seems on the one hand to place less emphasis than its predecessors on the control of development and the proliferation of unplanned settlements seems to be more or less accepted as a *fait accompli*, there are some indications that the plan makers see this as a temporary departure from planning principles. The vision for city expansion is based on a phased programme of integrated infrastructure renewal and provision that will allow the focus in Phase 3 (2011-2019) to be on development control in serviced areas coupled with the strict enforcement of planning regulations (SDP 1999). Given the exceptionally poor state of much of the urban fabric, the expected rate of urban

[14] A working group on Land Information Systems was also started in order to support other working groups requiring detailed plot based data but the progress of this group was slow due to a lack of human resources, technical expertise, and a clear and achievable goal and it was abandoned after some time.

growth and the major resource constraints that must be contended with it seems likely that the ability to establish effective development control over large parts of the city by this time is still somewhat ambitious. Moreover, it remains to be seen how effective the new planning procedures will be over the longer term.

Figure 4.5: Proposed stages for urban growth, 1999 Strategic Plan



(source: SDP, 1999)

4.2.5 Revised procedures and structures for urban planning

The basis of the revitalisation of urban planning in Dar es Salaam has been the establishment of new procedures and frameworks for urban planning and management and the rehabilitation of the role of the local government authorities as a key agent in the process. This process has been driven by the efforts of internal and external agents and is clearly linked to international programmes such as the Urban Management Programme (UMP) and the programmes such as UN-Habitat’s Sustainable Cities Programme (UNCHS 1996).

Reforming Tanzania's urban planning system has not been without difficulties and much energy and many resources have been devoted to developing the capacity and local institutions in the process. For this study the changes that have been introduced via the Sustainable Dar es Salaam Project (SDP) were most significant. The SDP commenced operations in 1991 and introduced a style of planning that combined strategic and action planning activities along the lines described by Davidson (1996) and discussed previously in Chapter 2. The major stages in SDP activities at strategic and action levels are shown in Figure 4.6.

Two so-called city consultations were key activities at the strategic level. The first in 1992 acted as a kick-off meeting to inform and gain the support of stakeholders, and identify priority issues for working group activities. The second city consultation in 1996 marked the beginning of the 2nd phase of the project that focussed on the strategic plan development. At the action planning level operations were based around the formation and activities of nine issue based working groups, each consisting of a coordinator and representatives of relevant stakeholders. Working group were formed and commenced operations in 1992 generating and managing demonstration projects that would tackle high priority issues even before a general city development strategy was formulated, an approach recognized as having some advantages in such situations (Davidson 1996). The working group coordinators met throughout the project in regular coordination meetings chaired by the National Project Coordinator. Although SDP operated initially as a semi-autonomous project, independent of central or local government authorities this was not seen as a desirable and permanent situation. The complexity of the project structure and the lack of direct embedding in either a central or local government body led to some criticism from local planners, managers and political representatives[15].

By 1997 significant improvements had been made within the management of DCC and the projects operations were transferred to their new home. Even before this transfer was made the progress of the SDP was being evaluated. On the basis of his examination of numerous progress and evaluation reports Gelink (1996, pp. 45-47) reported a mixture of successes and problems within SDP's activities. Positive elements he noted included significant stakeholder participation and involvement of community groups, the preparation of an

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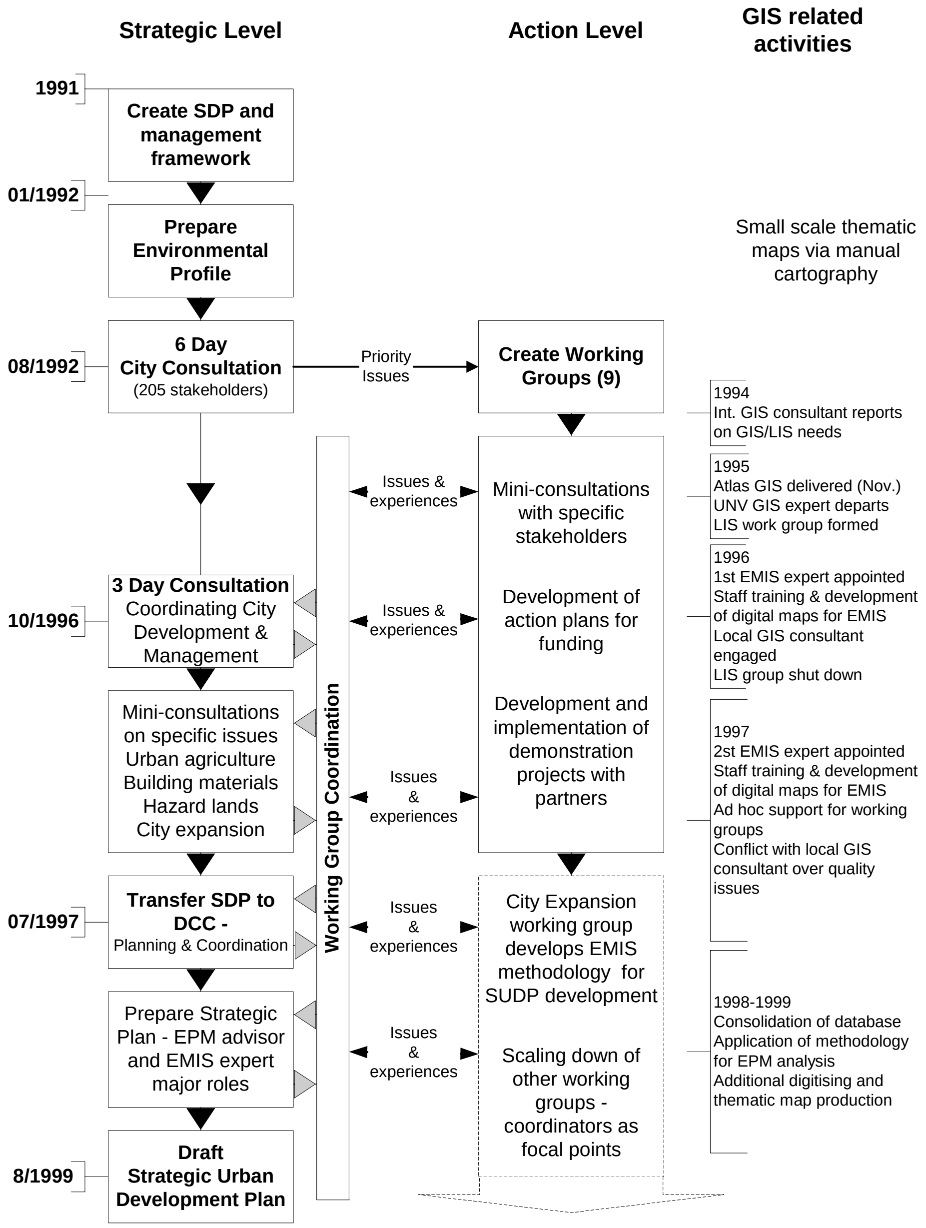
[15] The SDP was deliberately established as an independent project as it was thought that a degree of autonomy was needed to avoid conflicts between central and local government actors and the problems of their administrative systems that were a contributing factor in the city's environmental degeneration. Over the years the project drew heavily on professional staff seconded from both levels of government, after a lengthy period of negotiations with their organisations (Notes based on conversations with SDP's Chief Technical Advisor in 1994).

Figure 4.6: Schematic overview of SDP activities 1991-1999



environmental profile and city wide stakeholder consultation, the preparation and execution of numerous action projects and improved coordination between local organisations. A number of problems were however also noted such as the low level of ministerial desk officers that led to poor communication to senior officials, lack of guidance for the Steering Committee, lack of funds, information and communications both within the SDP as well as between other stakeholders, insufficient commitment from key decision makers, the frequent lack of technical expertise, bureaucratic procedures, dependency on foreign funding and the weak capacity of the city council that was expected to ultimately assume responsibility for the planning activities developed under SDP.

Other authors have also commented on some of the problems within the environmental planning approach propagated by SDP. Halla and Majani (1999) for example have commented on professional conflicts on the main purpose of the SDP's activities between 3 main parties involved in the process: *i)* those professionals who adhere to the traditional view of planning that is established within the 1956 Town and Country Planning Ordinance and who regard the SDP as *"..being wasteful in terms of both time and resources and thereby an interference in with their routines and bureaucratic procedures of the day-to-day city administration."* (ibid, p. 348); *ii)* those professionals who were willing to embrace the SDP's new collaborative planning approach and thereby put aside pre-conceived notions of the content and form of the strategic plan; and *iii)* experts who advocated the development and use of an Environmental Management Information System (EMIS) that would be GIS based and provide a solid analytical basis for strategic planning. These conflicts point to ideological differences and struggles for power within the planning community that are inherent when multiple views of planning practice are active within a setting as a result of the diffusion of innovations as discussed in Section 2.1.1. The conflict surrounding the use of GIS also points to the need to consider socio-technical issues when introducing GIS into organisations (Reeve and Petch 1999). For this study it is especially pertinent to examine how GIT has been introduced and adopted within the SDP and other related agencies as this is an important element in the research context that can influence the design of new GIT based methodologies.

4.3 Adoption of GIT for urban planning and management

The adoption of GIT by urban management organisations in Dar es Salaam is a comparatively new phenomenon and like the urban planning system itself, it is highly dependent upon concepts and technologies imported from the most developed countries. Although several local professionals acquired knowledge and skills in the use of GIT since the late 1980's via overseas education and training, most GIT applications have developed in the course of the 1990's. This was often an incremental process whereby IT applications supporting general office functions preceded the adoption of more specialised software such as GIS, following similar patterns found in UK local governments (see for example Campbell and Masser 1995). As is often the case, GIT was introduced via foreign experts who are familiar with the technology and have come to rely on its functionality (Calhoun, Drumond et al. 1987). Turkstra (1998) describes the introduction of GIS into municipalities in Latin America as falling into 3 stages:

Stand-alone – introduction of technology with the development of attribute databases, and digital maps and data conversion as main activities;

Intra-sectoral data integration – after the development of successful data conversion programmes and the creation of databases and software that address operational level functions, attention turns to support for higher level decision making of a managerial or strategic nature. This introduces issues such as data aggregation, normalisation and explicit attention for organisation issues;

Inter-sectoral data integration – this stage implies a corporate view of information needs and information systems with inter-departmental and inter-organisational data sharing via agreements and protocols that will facilitate combinations of data to be made for administrative or analytical purposes.

The adoption of GIS by agencies involved in urban management in Dar es Salaam appears to be following the same general line described above and several opportunities for GIS applications now exist (Sliuzas 1993). Some illustrative examples of the different settings are shown in Table 4.3. In each organisation the introduction of GIT has been a component of an internationally funded aid project and foreign expertise has played a significant part in both advising on specifications and requirements and in implementation aspects. Although the Survey and Mapping division of the MLHSD has the mandate for national mapping and has photogrammetric laboratories for many years, it was not until the Urban Sector Engineering Project commenced an urban mapping project for 9 main cities and towns in Tanzania in 1992 that GIS facilities for digital map production were installed. Within the same ministry several other GIT initiatives were established. In the Land Registration section a small pilot that had been instigated by one professional with foreign GIS training was expanded in the mid 1990's to include cadastral mapping and deed registration. Though as the actual ownership was not confirmed via fieldwork the usefulness of the deed data is perhaps questionable[16]. Around 1998, a standalone GIS, consisting of ArcView software, digitiser and plotter was installed at the Master Plan section of this ministry, in response to repeated staff proposals for the introduction of GIS.

[16] In 1995/96 the LIS working group within SDP investigated the ownership of 735 plots in Kijitonyama and found that for 60 plots there was no legal ownership information while more than 1000 people were claiming to own the remaining 675 plots (Gelink 1996, p. 50).

Table 4.3: Selected urban GIT activities in Dar es Salaam in the 1990’s

Organisations and their human & technical resources	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**
MLHUD										
Land Registration - 1 GIS/LIS expert 3 assistants, Dbase (phase 1), Micro-station (phase 2)	Phase 1 – pilot Maps only via manual coordinate entry from survey sheets					Phase 2 maps (as in pilot) & deeds but actual ownership not validated				
Survey & Mapping Division - 6 CAM experts 4-9 assistants, PUMATEC, ArcView, ILWIS, etc	Mapping units and survey equipment			Computer Aided Mapping since 1993 under USEP activities. Hardcopy 1992 topo maps at scale 1:20,000 and 1:2,500 since 1994 and digital data since 1995						
Urban Planning 3-4 GIS users ArcView									Use unknown	
SDP/DCC										
Specifications by 3 International. Consultants					LIS & EMIS					
LIS Work Group - 4-5 SDP staff with relatively low skills, Dbase						LIS Pilot				
Environmental Management Information System (EMIS) - 1 GIS manager (several changes over time & lack of experience) 1-2 assistants (low skills), Atlas GIS – not suitable for analytical needs							Base mapping & ad hoc support for working groups. Later analytical support & visualisation for EPM process			
TANESCO (electricity supply) 3 Engineers & 1 assistant: all with limited skills, AutoCAD & customer database for billing						Phase 1 – Digital maps & customer billing			On going but status unknown	
UCLAS (Univ of Dar es Salaam) GIS Centre with numerous skilled staff and technical resources for GIT				First GIS lab		GIS Centre for training & consultancy services in GIT applications				

(based partly on Gelinck, 1996 and personal observation)

Within the SDP, GIS did not initially have a high priority however its adoption was foreseen early on in the project and acting on the advice of 3 different foreign advisors a configuration based on Atlas GIS software was installed and has since been used as a general purpose mapping tool for working group operations, the preparation of display and presentation materials and in the production of the Strategic Plan. Form the outset GIS activities within SDP have been plagued by a variety of technical and human resource constraints such as inappropriate software lack of sufficient in-house expertise in systems development, database design and applications development (Gelinck 1996). Such issues and the lack of a stable and pre-defined EMIS concept, that GIS was intended to be a component of, are reflected in the lack of a sound information strategy within the project and considerable data quality problems that may affect long term sustainability of the GIS database (Masser and Sliuzas 1999). Despite these criticisms it should, however, also be noted that the GIS unit has provided valuable spatial information services to working groups and has been instrumental in the production of the Strategic Plan.

The other non academic GIT user shown in Table 4.2 is TANESCO, a national parastatal organisation for energy supply, which adopted GIT as a component of improved management systems for tackling non-technical losses due to illegal connections and poor customer billing with an existing computerised system. In the pilot phase of this project large scale topographic maps produced by MLHUD were scanned to provide a background for network data, pointing to the difficulty of establishing effective coordination, cooperation and data sharing between fledgling GIT users, a shortcoming that has also been pointed out by Gelinck (1996).

Seen in the light of the 3 stages of GIS adoption described above, the lack of such inter-organisational cooperation on GIT issues was not surprising. All GIT users were relatively small, standalone operations that were generally in the initial stages of development and were therefore pre-occupied with their own internal priorities and requirements. Although the benefits of cooperation have been recognised by various parties, for most users the development of GIT applications was not the main thrust of their activities. Rather it was seen and used as a tool to support the achievement of other goals such as the production of thematic maps as a part of a planning process (SDP) or improved revenue collection (TANESCO).

4.4 Conclusions related to the policy context

Several conclusions can be drawn related to the planning context in Dar es Salaam on the basis of the above discussion.

The national economy, though showing some signs of improvement over recent years is still relatively weak and therefore potentially vulnerable to future shocks and decline.

The adoption of measures such as SAP’s and public sector reform has not been without consequences for many residents of Dar es Salaam and for Tanzanians in general and it has been the poor who have been hardest hit. The effects of high rates of inflation, devaluation, economic liberalisation and the privatisation of many industries and services have had significant impacts on the daily lives of many households and their survival strategies.

The poor state of the national economy and the weak public sector performance at both central and local level has contributed to a decline in local service provision in all sectors.

The systems for urban planning and management are undergoing major reforms that are based on a shift from blueprint style master planning and physical layout planning toward a combination of strategic planning and action planning that is based on principles of stakeholder participation. The long-term achievements of these changes remain to be seen but pragmatically, they could hardly be less effective than the systems they have replaced. On the contrary many positive signs have already been observed at both planning levels.

The adoption of GIT by a small but growing number of urban management related organisations is very much a component of the reform process. The diffusion of new planning approaches and GIT in Dar es Salaam therefore provide a relevant setting in which to explore and develop the potential of GIT-based tools for improving the capacity of local organisations and communities in managing informal settlement, the subject of the empirical components of this study details of which are given in the remaining chapters.

Chapter 5

Data sources and research methods

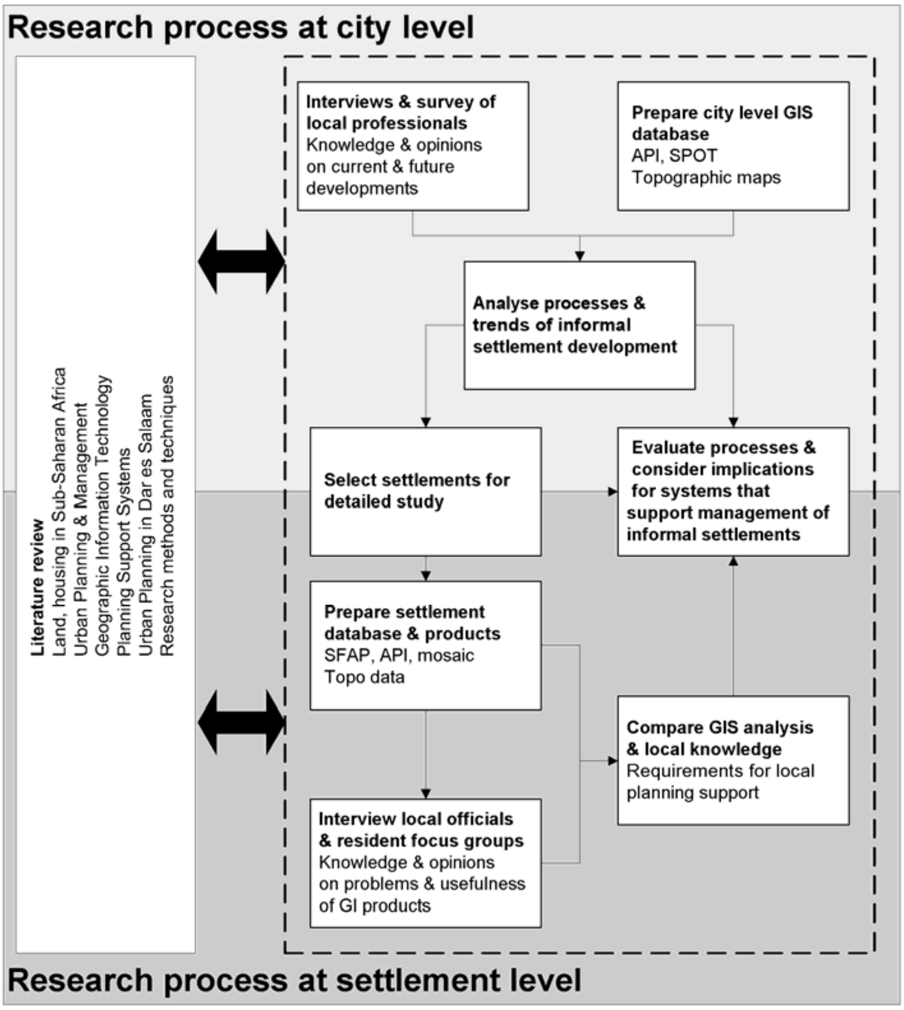
The methodology used at both the strategic and action levels is discussed in this chapter. At the strategic citywide level, an understanding of macro processes of settlement formation and consolidation was required. At this level, the severe resource constraints within the DCC require strategic decision making to prioritise the selection of settlements for specific kinds of planning interventions that are intended to influence their future development in a particular manner. Typical instruments that may be used are upgrading or relocation (see Chapter 2) and the focus in this research was on creating information support for this selection process. The second level concerns the requirements for planned intervention in a specific informal settlement. This level looks more closely at administrative and planning processes in 3 different settlements. The data collected was used to contrast information derived from GIT with the views of residents and professionals familiar with these areas, and to determine whether GIT based tools may provide appropriate support for settlement planning, regulation and administration. At both levels, the research was primarily focused on the physical aspects of settlement development. The basic structure and stages of each level is shown in Figure 5.1. Ultimately the findings of the two levels result in recommendations for the further improvement of the methodology and implications for its practical implementation.

At both levels the methodology incorporated quantitative and qualitative techniques for the capture and analysis of empirical data. GIT based methods were used for processing spatial data while various qualitative techniques were applied to collect data from relevant stakeholders at each level. At the citywide level the primary focus of the qualitative data collection was on the professional interest groups while at the settlement level the interests and knowledge of community groups and residents were also explored. Detailed descriptions of methods used for spatial data collection and extraction at the citywide level and the settlement level are provided in this chapter. Before doing so however, a description of the basic spatial data sources that are used in this work is presented.

5.1 Existing sources of spatial data

The data required to describe and analyse physical development processes were derived from a variety of sources comprising multi-spectral satellite data,

Figure 5.1: Research process and linkages between the citywide and settlement levels



vertical and oblique aerial photography, and extracts from a large scale topographic data set of the main part of the city (see Table 5.1). The spatial data available had variable spatial extent, as shown in Figure 5.2. Although most of the well consolidated urban area was covered by the large scale, urbanisation had already penetrated into the fringe areas and in several cases it was necessary to combine data derived from large scale sources with that derived from small scale sources in order to create a more complete dataset for analytical and explanatory purposes. Such combinations were required with land use data and for the creation of a Digital Elevation Model (DEM) over the study area for the citywide level. The procedures developed for the combination of data are described in section 5.4.

Table 5.1: Spatial data sources used in the two levels of research

Data source	Level City	Settlement
SPOT images PAN (10 m) and XS (20m), May 1998	■	
Vertical Aerial Photos, Panchromatic		
1982, scale 1:12,500	■	
1982, scale 1:63,000	■	
1992, scale 1:12,500	■	■
1992, scale 1:54,000	■	
Small format aerial photographs (SFAP), colour		
1998, 35 mm, high oblique, 500-800m altitude	■	
1999, 35 mm, low oblique, 500-800m altitude		■
Digital topographic data - selected layers: buildings, public buildings, contour lines, roads, rivers		
1:2500 (derived from 1992 aerial photographs)	■	■

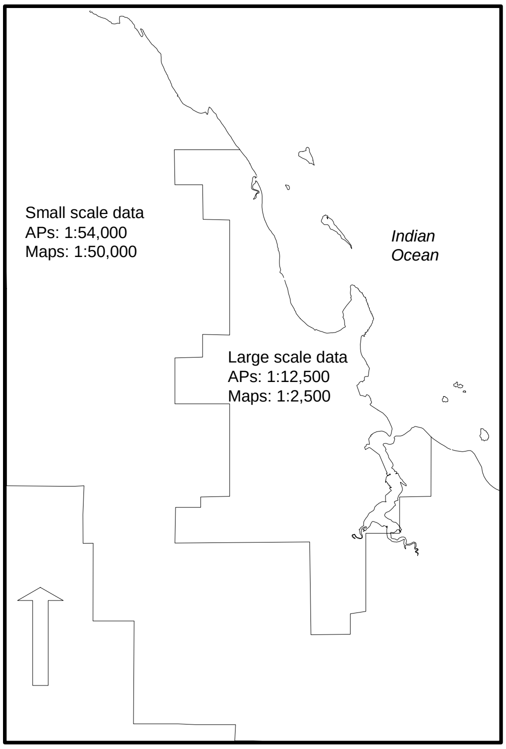
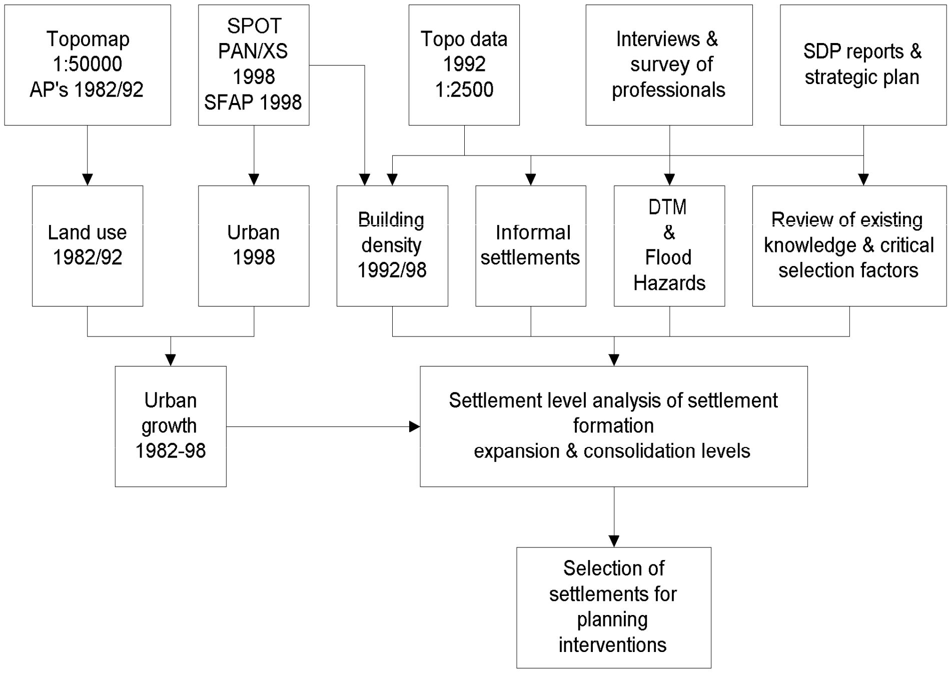


Figure 5.2: Extent of spatial data

5.2 Research process at the citywide level

The main focus at the citywide level was on urban growth and the physical development processes in informal settlements. Most of the methods adopted are based on GIT and directed toward the capture, storage, processing and presentation of spatial data concerning the physical state of informal settlements at various points in time (see Figure 5.3). The first stage of the process involves the analysis of urban growth over the period 1982-1998, based upon data extracted from aerial photographs and SPOT imagery.

Figure 5.3: Detailed research process for the citywide level



Informal areas delineated in the land use study form the basic spatial entity for this analysis. With the aid of two local urban planners who were studying at ITC each informal area was named (see section 5.2.1 for details). Thereafter, other data collected or extracted on terrain slopes, landforms and indicators of spatial accessibility was aggregated to the settlement level. This included data on physical consolidation levels extracted from topographic data from SPOT, terrain characteristics, susceptibility to flooding and access to main services. The resulting settlement database was then used to demonstrate how such data could be used in a multi-criteria evaluation to help select and prioritise appropriate planning interventions for each settlement.

In chapter 4 the context in which debates on planning issues take place and decision making occurs was presented. If the context is considered sufficiently in PSS development it is supposed that the support tools will have a better chance of adequately reflecting local policies and norms and that this should therefore increase the likelihood of their adoption. Emphasis in this work was given to the context of the policy issue and certain characteristics of some key actors in the policy process, who were considered to be potential users of the methodology developed here. In this case the users were taken to be the type of senior professionals that could be involved in policy formulation processes related to informal development and who will therefore be required to consider what type of planning intervention is required for a given settlement. However, as little was known about their understanding of informal urban development issues in Dar es Salaam, one aim of this research was to establish the extent of to which local professionals have shared knowledge and opinions on the physical dimensions of informal settlement development in the city. The opinions of such professionals are important as they may act as “social gatekeepers” and, with their distinctive values, attitudes and role orientations (Knox and Masilela 1990, p. 10), help to set the agenda and ultimate direction of policy development related to informal settlements. Before examining the survey of these professionals detailed descriptions of the spatial data processing are provided, starting with the main spatial data sets.

5.2.1 Preparation of basic spatial data sets

Creating multiple land use data sets

This research required the creation of 3 separate temporal *snapshots* of land use for 1982, 1992 and 1998 that have a similar spatial extent. The production of multiple land use data sets over a period of time is common practice in urban planning, but one that is not unproblematic. The production of these land use snapshots involved the use of three different sensors (i.e. vertical aerial photographs, SFAP and SPOT), several different scales of aerial photography and the interpretation work of a number of persons over a considerable period of time. Details of the production process are provided below.

The land use data for 1982 and 1992 was created via interpretation of several sets of aerial photographs with scales varying from 1:63,000 – 1:12,500. The two data sets were a product of land use interpretations covering the extent of the large-scale data set using aerial photographs at scale 1:12,500 and a later interpretation of small-scale photographs of the remaining study area (see Figure 5.2). Kyessi (1990) created the initial interpretation of 1982 from 1:12,500 scale photographs. His land use classification was later slightly modified by Hakuyu[17] (see Appendix A for details of Hakuyu’s classification), who also made the initial land use data of 1992 (Hakuyu 1995). Hashim (1999) subsequently expanded the 1992 data using small-scale photographs to cover the urban fringe area, while the author completed the fringe area in 1982. Given

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[17] Kyessi’s original land use classification system included a combination of housing types and several density classes for planned residential and informal settlements. Hakuyu later found that the delineation and classification of various density classes was problematic due to the difficulty of consistently applying delineation and classification rules spatially, temporally and across different interpreters. By reducing the number of classes and simplifying the density classification Hakuyu was able to create land use data sets for 1982 and 1992 that were more consistent and that could serve as a basis for further extension.

the smaller scale of photography used in the fringe areas it was necessary to reduce the complexity of the land use classification to accommodate for the lack of detail. The original 2-digit classification system was therefore reduced to 9 main classes and delineation was carried out based upon a Minimum Mapping Area (MMA) of 1ha.. The classifications used for 1982 and 1992 are shown in Table 5.2.

Table 5.2: Main categories of land use and urban development

Class	Aerial photos 1982 & 1992	SPOT 1998
Residential		
Planned residential	■	■
Informal settlement	■	■
Other urban		■
Industrial	■	Not applicable
Commercial	■	Not applicable
Institutional	■	Not applicable
Recreation	■	Not applicable
Non-urban		
Vacant and agriculture	■	■
Ocean & estuaries	■	■
■ = used class		

Although a similar classification system and rules were applied in this work, the data was found to contain several inconsistencies. These have been introduced due to problems arising from data migration from one GIS environment to another and small variations due to georeferencing, interpretation, classification, delineation and digitising differences between the various researchers. Variation in classification procedures both between interpreters or for a single interpreter over time, should be expected and if substantial, may undermine the quality of any GIS analysis and therefore the ability to monitor development effectively . In order to improve the temporal consistency of the data, a comparison of the 1982 and 1992 data sets was undertaken to identify potential classification conflicts by looking for unlikely change situations (i.e. areas changing from an urban land use to vacant).

Wherever unlikely changes were identified, the original photographs were re-examined and the validity of the change was established and, when necessary, the land use code was modified in the relevant data set. Having removed major inconsistencies from the 1982 and 1992 data, the latter was displayed over a fused SPOT XS/PAN image of May 1998 and a more generalised delineation of urban land in 1998 (the classes used are also shown in Table 5.2) was carried out by visual interpretation and on-screen digitising (Hashim 1999). Given the lower spatial resolution of the SPOT images it was decided to further simplify the classification, concentrating efforts on mapping the extent of planned and informal residential areas. Additional information for delineation was obtained by referring where possible to SFAP images of November 1998 that were available for several parts of the city, predominantly in the southern and western regions, that were believed to be major growth areas. The latter proved to be particularly useful in areas of very low-density settlement where it was sometimes difficult to distinguish between built-up areas and bare sand due to their rather similar spectral signatures and the inadequate spatial resolution of the imagery. This working method was found to be relatively fast and provided sufficient consistency for the level of detail required for citywide studies.

Delineation and naming of informal settlements

In this study, the informal settlement was a basic entity in terms of strategy development and it was therefore essential to identify the extent of each settlement and name it appropriately. This is typically a task that requires local knowledge. Although some information on settlement extent and names was available from the work of Kyessi and Hakuyu the larger study area required some additional names to be allocated. In order to do this the land use map of 1992 was printed at scale 1:20,000 and shown to 2 local planners who were studying at ITC at that time. Each informal area shown on the map was examined sequentially and the following questions were discussed: *i)* Does the delineated area consist of one or more settlements and in the latter case, what are the boundaries of the settlements? *ii)*What is the correct name for each delineated settlement area?

For a few settlements it was apparent that some boundaries were not always completely clear and that the same area may be known by several names. However, in such cases, after some discussion agreement was reached on approximate boundaries and on the 'commonly' used name. As some informal settlements consist of several polygons and the naming is required for 3 separate settlement data sets for 1982, 1992 and 1998, names were allocated by creating a polygon map of localities and then overlaying this with the settlement polygon data. The map of the 1998 informal settlements with their names is shown in Appendix B.

Creation of a the Digital Elevation Model

The physical environment in the study area was described in terms of its major landform types and a Digital Elevation Model (DEM). The source data used was also a combination of previously existing data sets and new material. Landform data of the main urban area was originally produced by Kyessi (1990) in consultation with a geomorphologists studying at ITC. This data set was expanded by Hashim (1999) to cover the current study area utilising the smaller scale photographs of the urban fringe area. The landform classes themselves are rather generalised (see Table 5.3) but show the main geomorphology of the area. The study area is divided into 3 main landform classes, namely a relatively flat coastal plain dissected by numerous river valleys and a more hilly region to the west and south east of the study area (see Figure 5.4). The coastal plain, which varies in width from approximately 2 km. to more than 10 km., also contains several small swamps, some of which are seasonal in nature (Temple 1970), and several locations where sand and gravel mining occurs.

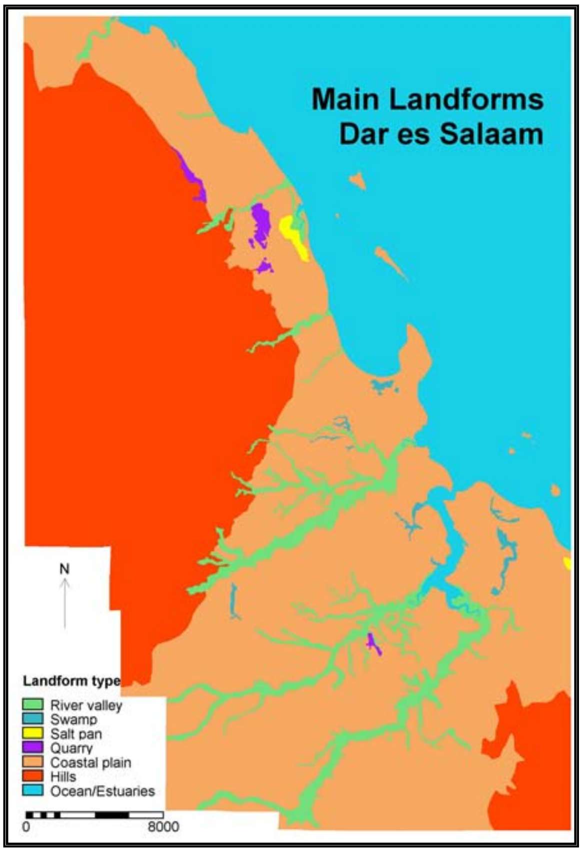
Table 5.3: Landform classification

Class	Description
River valley floodplain	Mainly broad river valleys generally defined by relatively steep embankments.
Swamp	Natural depressions forming swamps and marshes, and in wet season possibly forming lake-like water basins.
Salt pan	Low lying lands near estuaries developed as salt pans
Quarry	Sites used for the extraction of earth and rock materials for construction purposes.
Coastal plain	Generally rather flat or gently sloping or undulating land located between the hills and the coastline. The plain is dissected by several rivers and contains numerous depressions.
Hills	More elevated land located predominantly to the west and south east of the study area. Maximum elevation in study area is 205 m above mean sea level. Hills are deeply cut by erosion and dissected by numerous streams and rivers. Large relatively flat ridges also exist and attract both small farmers and urban development.
Ocean/Estuaries	Areas of permanent water.

(adapted from Kyessi, 1990)

Although the landform map provided a useful basis for examining some aspects of physical suitability for development it is rather generalised and as a result some important details could not be shown (Kyessi 1990, p.38). For example the steep slopes found along many of the river banks and in the hills are not visible, yet such steeply sloping land may be very unsuited for development. Steps were therefore taken to create a DEM for the study area.

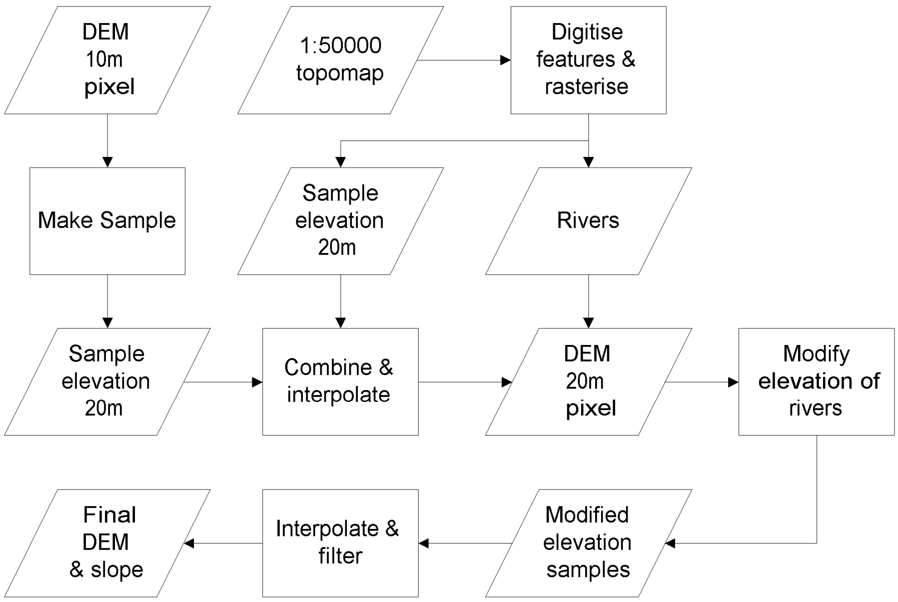
Figure 5.4: Main landform types in Dar es Salaam



A DEM covering the urban core, with a pixel size of 10 x 10m and a minimum elevation interval of 10 cm, was previously derived from the 1:2500 topographic data (Sliuzas, Brussel et al. 1999). The source data for this DEM were contour lines with a 2-metre interval, a set of spot height measurements and additional elevation measurements obtained from various topographic features such as roads and rivers. Technically these data were considered useable for planning analysis and conceptual engineering applications, but their limited spatial extent meant that they did not provide information of the fringe areas that were essential for urban monitoring (Sliuzas and Brussel 2000). The only elevation data available for the fringe area were contour lines at an interval of 20 metres, as shown on 1:50,000 topographic maps. Although the very different sources of data was a major constraint a process was developed to create a DEM covering the entire study area (see Figure 5.5). This method sought to preserve as much as possible of the detail available for the urban core area yet allowed a reasonable combination with the more limited and less precise data available for the urban fringe area. The goal was to provide data on terrain slope that includes both the relatively coarse terrain structure of the hills, without comprising the detail required to identify and define the relatively small but steep riverbanks found in the urban core area.

Various methods were tested for generating the final elevation and slope data, however, due to difference in precision between the small and large scale data it was not possible to utilise all known elevation points in the interpolation procedure. The best result was achieved by combining a set of sample points extracted from the 10m DEM at a regular 50 grid with the 1:50,000 contour and spot height data (see Appendix C).

Figure 5.5: Flowchart of process to create DEM from two sources with different accuracy



Even this best result contained some anomalies due to the poorer performance of the interpolation algorithm in situations where the density of elevation sample points is very low, as typically occurs in relatively flat terrain. This was particularly evident in the relatively flat, coastal plain in the urban fringe where the 20 m contour lines were the main source of input data. Ultimately, information on terrain slope was considered to be more important for eventual planning decisions than information on terrain elevation per se. Although the elevation of a specific site may have some consequences in terms of the cost of water supply it is the slope of the land that has more significant impact on a given site's potential for development. In general terms it can be assumed that increasingly steep slopes will have higher servicing costs for water supply, drainage and road construction, and there may also be increasing risks associated with landslides.

A slope percentage map can be readily derived from the elevation map, however the elevation data was such that slope values show great variability over small areas. Some of these differences were due to anomalies in the interpolation algorithm used to create the elevation data and some further processing was required to improve the result and reduce these effects through the use of an averaging filter that also served to improve the interpretability and usefulness of the slope data. By applying a 5x5 majority filter to the derived slope percentage map and averaging this output with a 3x3 filter, many of the anomalies were removed and the map was easier to interpret.

Creation of other spatial data sets

Several other topographic data sets were created for the study area in this research (see Table 5.4). Most often these data were created by digitising features from the 1:50,000 topographic maps, however some features have been derived from aerial photographs and administrative maps obtained from the DCC. Road centrelines were originally digitised by the author and were subsequently improved using data produced by Amer for his PhD research (Amer and Jong 2002) who also provided data on bus routes and bus stops for the city. One important data set used was that of building centroids in 1992. This data was derived from the 1:2,500 digital topographic data and consists of a point and a related attribute table that contains data on the type of building (either public or private) and its roof area in m^2. The building centroid data was used to generate data on the density of settlements according to the procedure discussed below.

Deriving density data for informal settlements from aerial photographs

Measures of density are typically one the most important parameters related to housing that are used by planners (Acioly and Davidson 1999, p. 6). Planning standards for residential areas commonly utilise density in the form of the number of houses per hectare, plot sizes, and plot ratios as criteria to classify specific neighbourhoods. Such standards are typically applied in prescribing development criteria for new formal development. Conceivably they could also be used as a basis for a housing monitoring system. However, the adoption of such criteria for monitoring implies that the relevant data on actual house numbers, building floor areas, plot sizes etc. are available or can be collected.

In cities such as Dar es Salaam this type of data for planned areas is rarely available and for informal settlements such criteria are even less applicable as invariably almost no plots will have actually been surveyed and the lack of regular structure in most areas inhibits the counting of houses. Given that the construction process is known to continue in even the oldest informal areas (Kyessi 1990; Hakuyu 1995), a reliable and efficient means of monitoring consolidation levels is needed which does not the have the same shortcomings as the traditional planning criteria. In order to gain professional acceptance the variable should be relatively easy to systematically collect, easily verifiable and robust and be easily comprehensible to both professional

Table 5.4: Overview of spatial datasets created for the study area

Data set	Source	Created by	Description
Land use 1982	1:12500 AP's 1:63000 AP's	Kyessi 1990 Sliuzas 1999	Land uses (see Table 5.2 for classification) Harmonisation and integrity checking by Sliuzas
Land use 1992	1:12500 AP's 1:54000 AP's	Hakuyu 1995 Hashim 1999	Land uses (see Table 5.2 for classification) Harmonisation and integrity checking by Sliuzas
Land use 1998	SPOT XS & SFAP	Hashim 1999 Sliuzas 1999	Land uses (see Table 5.2 for classification) Harmonisation and integrity checking by Sliuzas
Building	1:2500 digital topo-data	Visser 1999 & adapted by Sliuzas	Building centroids 1992 – roof area and private/public.
Road	1:50000 topo map 1:20000 city map	Sliuzas 2001 Amer 2002	Centrelines of roads – classified into primary and secondary roads
Bus route	DCC + local planners	Amer 1995 Kifle 1998 Amer & de Jong 2002	Location of bus-routes as modified by Amer
Bus stop	Local planners	Amer 1995	Location of bus-stops
DEM	1:2500 digital topo data & 1:50000 topo maps	Sliuzas 1999 & this thesis	Digital elevation model covering the complete study area (20 x 20 m pixel)
Landform	1:12500 AP's 1:54000 AP's	Kyessi 1990 Hashim 1999	Major landforms (see Table 5.3 for classification)
River	1:50000 topo map	Sliuzas 2001	Streams – divided into main rivers and streams
Coastline	1:50000 topo map	Sliuzas 2001	Coastline
Edge	Aerial photos	Sliuzas 2001	Boundary of study area (excluding coastline)
Municipal boundary	DCC	Sliuzas 2001	Boundaries of municipalities adjusted to coincide with roads where necessary
Ward boundary	DCC	Hakuyu 1995 Sliuzas 2001	Boundaries of wards adjusted to coincide with roads where necessary

and non-professional stakeholders. A density indicator that is based on the counting of buildings or the measurement of the proportion of land occupied by buildings has some appeal as it can be easily derived form topographic maps if and when available.

The adoption of digital topographic mapping has created a possibility to derive data on roof area for each building included in the digital database. Although planning criteria such as plot ratio and floor area ratio are based on the size of the building footprint, the roof coverage can be used as surrogate that can be quickly derived from the digital database and then used in combination with other spatial data for analysis purposes. For example, such data can be used to estimate population of settlements on the basis of roof area via building sampling strategies (Dangol 1998). Having established at least one potentially interesting use of roof area data, Visser was able to refine the methodology for converting essentially CAD type vector files of buildings into a GIS format allowing building size to be computed for every building within the mapping area (Visser 1999).

As a result of this process, each public and private building included in the 1992 topographic database was represented as a geographic centroid with an associated roof area. This data can be readily combined in GIS environment with other spatial entities representing specific aspects of the same geographic region for analytical purposes. In this research administrative units and settlements were the major entities utilised in this way. The Percentage of Roof Coverage (PRC), which provided a measure of the level of physical consolidation of a settlement in 1992 was computed in the following manner:

$$PRC = \frac{\text{sum of roof area}}{\text{area of settlement}} * 100$$

The PRC is a gross measure of density that includes private and public spaces which are used for access and gardens but excludes open spaces and other non-residential land uses larger than 1 ha that have been excluded from the settlement delineation. Large cemeteries and seasonal swamps and undeveloped river valleys were therefore excluded from the settlement area in the calculation if they contained no permanent buildings.

The development of an effective monitoring of development based on the PRC relies on the regular mapping of the urban area. However, experience shows that the required citywide mapping was not possible at a frequency that was appropriate to the city’s rapid development. The most recent coverages being

1992, 1982 and 1975, of which only the latest is digital.[18] In order to be able to make some assessment of density changes in some of the informal settlements an alternative source of data was required. For this study, SPOT4 satellite imagery was used as a *second-best* option for citywide monitoring.

Deriving density data for informal settlements from SPOT imagery

Satellite systems such as SPOT or IKONOS, which are capable of off-track viewing, offer the theoretical opportunity to capture images of the city every 6, or 1-3 days respectively. However, the applicability of these systems is constrained by their spectral and spatial characteristics, cost considerations associated with purchase and processing and their inability to penetrate cloud cover.

In the current context, it is important to realise that even the system with the highest spatial resolution, IKONOS which captures 1 m panchromatic and 4 m multi-spectral data, is inadequate to provide roof area data which is directly comparable with that extracted from the 1:12500 aerial photography. The cost of IKONOS images is also prohibitive if their sole purpose is for strategic development monitoring. In contrast, earth observation systems such as SPOT offer more affordable products but at a much lower spatial resolution, 10 m panchromatic and 20 m mutli-spectral for SPOT4. The lower spatial resolution of the SPOT4 system means that it is impossible to identify and measure the size of objects, such as swahili houses, which are much smaller than the pixel size. Therefore individual pixels will almost always represent mixed surfaces, with spectral reflectance being a composite measure of reflectance from more than one type of surface.

Despite this restriction, such images have been used for various types of change detection and monitoring and, in situations where alternative data sources are not readily available, may provide a useful ancillary technique. The use of traditional classification algorithms for deriving urban land use data from MSS images is, however, known to be particularly troublesome (Gorte 1998). While land cover data of large, heterogeneous surfaces may be effectively extracted from Multi-Spectral Scanner images like those of SPOT4, such surfaces are rare in urban environments. Typically urban areas have a very high degree of surface heterogeneity that is associated with having a great mixture of artificial and natural surfaces, including many that may be less than one pixel in size. The

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[18] In 2001 a new aerial photographic coverage of the city was made as part of the preparation for the Census 2002. These photographs were at scale 12:500 and may be obtained in digital form from the SMD. Although the frequency of coverage remains low, it is significant that the latest images are in digital form and now cover the wider urban fringe area at a large scale but they were not made according to topographic mapping specifications and therefore cannot be used for regular database updating.

problem is therefore associated with the complex many-to-many relationship that exists between land cover and land use, which is a reflection of the fundamental differences between the two concepts and the heterogeneity and complexity of urban areas. However, some new techniques for image processing and classification are being developed to address this fundamental shortcoming.

In recent research with SPOT XS images of Dar es Salaam, a two stage classification method developed by Gorte (1998) was applied to classify urban development into 3 density classes (Sliuzas, Brussel et al. 1999; Sliuzas, Gorte et al. 2000). This method separated the classification of land cover and land use into two distinct stages and utilised an image segmentation procedure for the final classification of land uses. Gorte's original method was modified in two ways for the current application. First, the 2nd classification stage was used to classify urban density rather than urban land use per se. Second, as attempts to segment the image into meaningful regions based upon texture were not fruitful an alternative means, using a 5x5 pixel kernel, was applied. The use of this kernel has the effect of reducing the spatial resolution of the final output to 1ha, which is also the MMA of the 1982 and 1992 land use data. In the final product 3 density classes were created based on sample areas.

Although some misclassifications were recognisable, the first visual impression was that the method provided a better classification of the urban area than standard pixel based classification systems. Despite some observed problems of over-estimating the extent of low density areas (Sliuzas, Gorte et al. 2000), when used in combination with the visual interpretation of settlement extent, the result suggested that an estimate of density variations could be obtained. However, in order to be useful as an instrument for monitoring density changes the method must produce data that are valid and comparable with that obtained from via the PRC method. Several methods that have been used to assess the validity of this density data are discussed below.

Assessing the validity and usability of the 1998 density classification

In determining the validity of the data some comparisons were made between the 1992 PRC data and the 1998 density classification. First some pixel level comparisons were made between the 1992 and 1998 data. These results showed that the data gave a general indication of density but might not be very reliable for pixel level comparisons. Following this a settlement level indicator of consolidation was created and evaluated by making some comparisons between calculated density levels and classified density levels for several sample areas.

To assess comparability with the 1992 roof area data a set of samples were created from several built-up areas that were believed to be relatively stable[19] in terms of physical development over the period 1992-1998. These areas included some informal areas that had already reached very high densities in 1992 (Manzese, Tandale, Keko, Mtoni) as well as some planned areas of varying density that were also fully developed in 1992 (Upanga, Msasani peninsular, City centre). The expectation was that these areas should not have substantially changed over the period 1992-1998 and that the 1998 density classification should therefore be highly correlated with the 1992 PRC values that had also been computed for 100m pixels. An overview of the roof area statistics for class is shown in Table 5.5 and Figure 5.6 shows the scatter plots for each class.

Table 5.5: Characteristics of relatively stable sample pixels (100 x 100m) to evaluate density estimation using 2-stage classification system

	Class based on 2-stage method				
	Low density	**Medium density**	**High density**	**Bare soil**	**Vacant or agric.**
Total pixels	**277**	**115**	**209**	**8**	**60**
Average % roof coverage	10.6	20.0	40.7	18.4	8.0
Mode	8	19	41	0	8
Min	0	0	0	0	0
Max	41	66	89	38	16
Cum 25%	6	14	38	na	8
Cum 75%	14	29	50	na	11

No of pixels in sample = 669

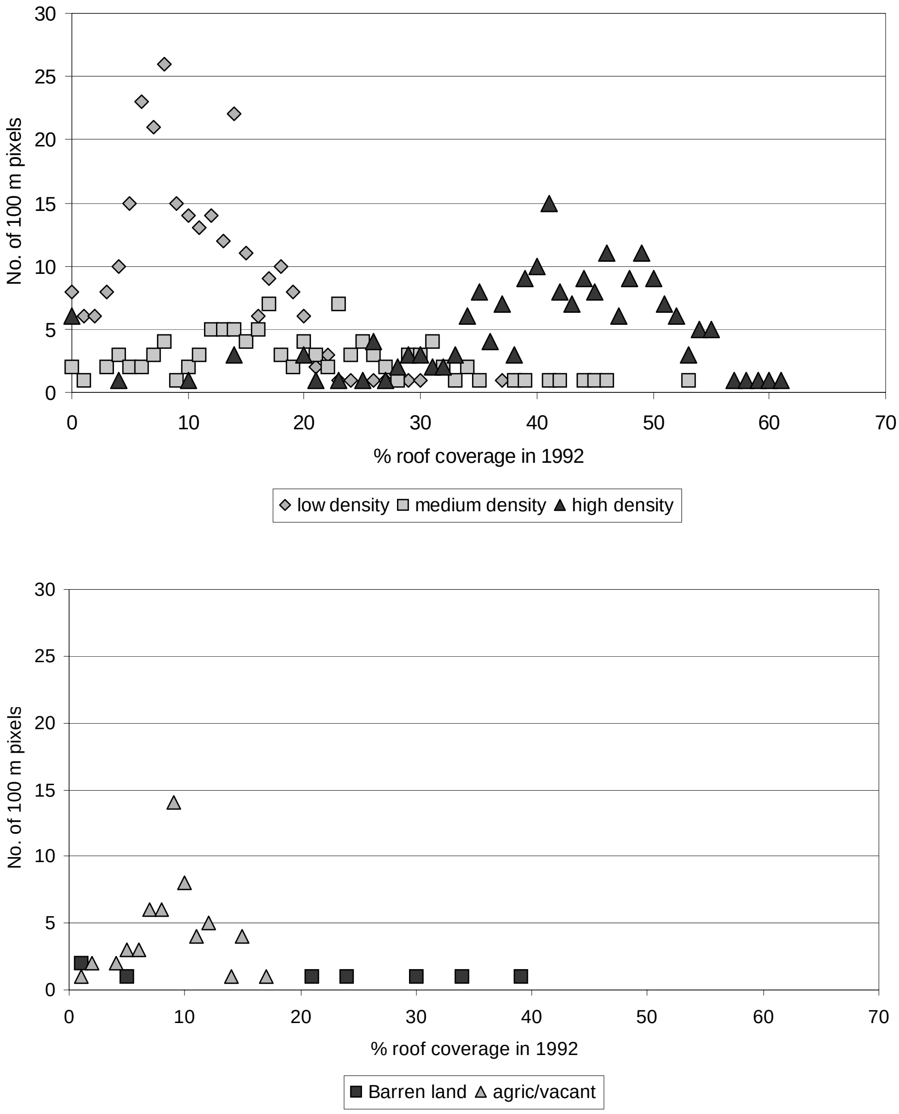
Although the average roof cover of the 3 density classes, 11%, 20% and 41% for low, medium and high density classes respectively, was in accordance with the expected trend of increasing density two problems were also evident. The range of values for each of the 3 density classes clearly overlap and there was also some confusion between the 3 built-up (density) classes and the 2 non-built up classes of bare soil and vacant/agriculture (see Figure 5.6), and in particular with the agriculture and low density classes.

Although such inter-class confusion could lead to problems when pixel based analysis of change is required, if an aggregate measure of settlement density is required the effects should be much less as many of these misclassifications tend to negate one another. A settlement based analysis is also more relevant for

[19] The delineation of relatively stable areas is based upon the author's local knowledge. Within such areas it is believed that relatively little new development occurred in the period 1992-1998.

policy and decision making as pixels are a relatively small and arbitrary spatial unit that is moreover relatively meaningless for decision making. The method to create a measure of settlement density is discussed next.

Figure 5.6: Comparison of 1992 roof coverage (per pixel) in relatively stable sample areas by density and use



The objective was to create a means of measuring the aggregate density for each settlement. The indicator should be able to be applied for both the 1992 and

1998 situations and if necessary in future situations should relevant data become available. The indicator developed was referred to as the Settlement Consolidation Index (SCI) and it was derived from the pixel based density classification. The SCI was based on the assumption that building construction in each settlement proceeds until such time as all pixels representing the settlement belong to the high density class. Each pixel belonging to an informal settlement was awarded a score of 1, 2 or 3 points if its density was low, medium or high respectively.

The SCI is calculated in the following manner:

$$SCI = \frac{(((a+b)*0)+(l*1) + (m*2) + (h*3))*100}{(a+b+l+m+h) * 3}$$

where:

a = the number of pixels classified as vacant/agriculture

b = the number of pixels classified as bare soil

l = the number of pixels classified as low density

m = the number of pixels classified as medium density

h = the number of pixels classified as high density

The value of SCI could therefore theoretically range from 0, if a settlement was completely undeveloped, to 100 if it was fully covered by high density development, the ultimate result of the consolidation process. In practice however, extreme low values were not likely to occur. A value of 0 is not possible because it would be the equivalent of having a settlement without buildings. A score of 33 would be obtained if a settlement consisted of pixels that were all in the low density class, but lower values were also possible as some vacant land may occur within a settlement and was especially likely within newly developed settlements.

To enable a SCI value to be calculated for 1992 it was necessary to convert the 1992 pixel based PRC values into 3 density classes that were comparable with the 1998 density classes. The class boundaries were based on the 75 percentile of roof coverage data in stable areas and are shown in Table 5.6. To gain insight into the validity of the classification a pixel level comparison was made between the 1992 and 1998 classifications in areas considered as informal in 1992.

Results of the comparison are given in Table 5.7, which shows that in 10% of all pixels an unlikely change, involving a reduction of density (i.e. from high to low, or low to unbuilt) occurs. This is a relatively low figure that is quite acceptable given the very different sources of data used. Also, at the settlement level the occurrence of such unlikely changes may be compensated for by pixels in which erroneous consolidation is identified as having taken place. This result supported the use of the two data sets to produce acceptable comparative data on the settlement consolidation process. The discussion of the actual changes and the further use of this data is the subject of Chapter 6. The discussion here now turns to the capture of data related to professional views concerning informal settlements and the role of planners and administrators in general.

Table 5.6: Boundaries for classifying 1992 Percentage Roof Coverage data

1992 PRC values	1992 density class
0 %	Vacant
1-15%	low density
16-30%	medium density
>30 %	high density

Table 5.7: Pixel based comparison between density/use classes in areas identified as informal in 1992 (units are in pixels of 1 ha)

	CLASS 1998					
CLASS 1992	Barren or agric vacant	& Low density	Medium density	High density	Water	Total
Vacant	86	255	65	13	0	419
Low density	206	1404	1002	162	3	2777
Medium density	10	155	699	512	13	1389
High density	3	6	156	869	6	1040
Total	305	1820	1922	1556	22	5625
unlikely changes	557		% unlikely	10		

5.2.2 Exploring the planning context: Interviews and the survey of urban professionals

In order to develop information systems that are intended to support policy making and decision making related to informal settlements it is necessary to consider the existing opinions and views of key agents in these processes. For the citywide level the research deliberately focussed on exploring the views of professionals involved in the local urban planning setting. Although participatory approaches to planning are also favoured at this level, it is believed that professional views will be a powerful force in the analysis and debates about strategic issues concerning Dar es Salaam’s future.

A two-tiered approach was adopted in exploring the existing professional knowledge and opinions. Initially semi-structured interviews were held with 3 senior urban planners working at the Sustainable Dar es Salaam Project (SDP), the Ministry of Land, Human Settlements Development (MLHSD) and the University College of Lands and Architectural Studies (UCLAS) were interviewed in order to obtain an impression of current ideas and opinions about the planning system, the changes that had been introduced at the SDP throughout the 1990's and the availability and use of information in local urban planning. A fourth interview was held with the Head of Photogrammetry from the MLHSD's Survey and Mapping Division (SMD), the primary source of spatial data in Tanzania, to obtain information on the current status of digital mapping and the expected developments in the near future. These interviews created a better understanding of current activities in mapping, urban planning and the current thoughts about planning systems in Tanzania to be obtained. Subsequently a questionnaire was formulated to illicit statements of knowledge or opinions about the state of informal settlements and responses to informality from a broader group of professionals. A preliminary version of the questionnaire was scrutinised by a local academic, Prof. Kombe, familiar with the subject of the research, who also helped compile a list of possible respondents. The final questionnaire contained 14 questions grouped into 3 main categories:

Questions 1-5 concerned the general status of informal settlements and the recent experience of the respondent in such settlements. Responses to these questions can be compared to the outcomes of the analysis of spatial growth and densification of informal settlements.

Questions 6-11 concerned data requirements and the role and mandate of the public sector in informal settlements planning and management. Responses to these questions are used to gain insight into what data professionals believe to be important and how they view the capability of local administrative officers in guiding and managing informal settlements.

Questions 12-14 concerned issues of resources, priorities and norms. The responses to these questions provided a basis for developing an information system that can provide support for selecting and prioritising settlements for various planning interventions.

A local assistant with an urban planning background helped in the delivery of the revised questionnaire and a covering letter explaining the purpose of the research by hand to 46 potential respondents. Where possible, at the time of delivery an agreement was made for the collection and or return of the questionnaire. Of the questionnaires that were distributed, 27 (59%) were subsequently completed, and collected within one week of distribution. Later attempts by the local assistant to recover more of the questionnaires were unsuccessful. The majority of the respondents were urban planners (see Appendix D for details) but the participation of persons with other backgrounds was considered important, as the complexity of many urban problems requires a multi-disciplinary approach. In general at local government level, the work of the City Planner is closely related to that of the Engineer and the Land Officer and the views of these professionals is therefore also relevant in the current setting. All respondents had a background in urban planning, urban land management, engineering or surveying.

Although not a large number, the respondents were all senior staff with several years of experience in their profession in this city and were therefore assumed to be knowledgeable on the state of informality in the city. Their views, if perhaps not representative of all such professionals could be expected to carry significant weight in policy and decision making processes and are therefore worthy of study. The outcome of this survey is discussed in the following chapter. This chapter continues with a discussion of the selection of the detailed case studies and methods used to collect spatial data and context related data for this level.

5.3 Research process at the settlement level

Given the number and variety of informal settlements within the city it is impossible to examine each settlement in detail. Just as the constrained resources of the DCC require choices to be made, in this research 3 settlements were examined in detail. The purpose of these cases was twofold. First, they were intended to provide more insight into the speed and extent of development processes in informal settlements. Second, they were to provide a basis to examine how professionals, administrative officers and community groups could benefit from the use GIT based support for the planning and management of such settlements.

5.3.1 Selection of settlements to use as case studies

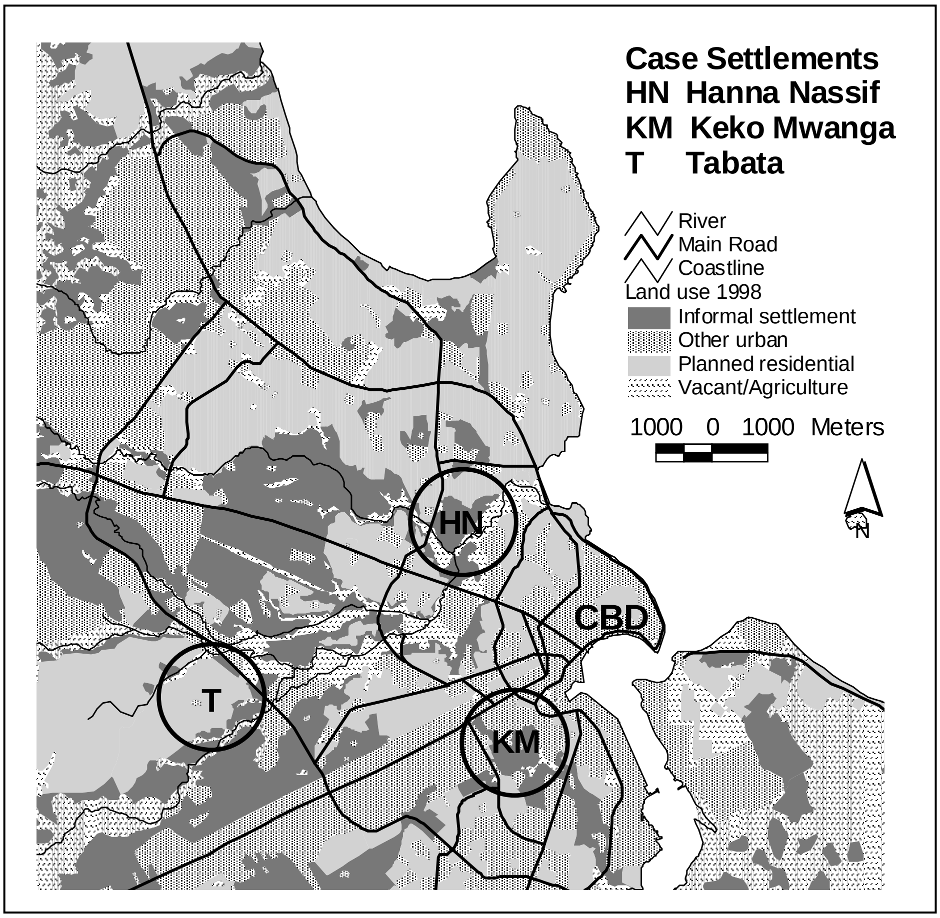
The principle of replication (Yin 1989) was used as a guide for the selection of 3 case study settlements. The three case studies shared some common characteristics but they also have some features that set them apart and provide possible avenues for exploring differences in their physical structure and also possible differences in the behaviour or responses of the stakeholders that were to be examined. The characteristics of each settlement for the various selection criteria are shown in Table 5.8. Their location is shown in Figure 5.7 and aerial photographs of each settlement are shown in Appendix E.

Table 5.8: Comparison of 3 case study settlements per selection criteria

Criteria	Hanna Nassif	Keko Mwanga	Tabata
Age	Est. in 1960's	Es. in 1960's	Est. in 1980's
Development history	One of the oldest informal areas, developed on former sisal plantation.	One of oldest informal areas, development closely linked to harbour and industrial activities.	Relatively new settlement, rapidly developed after closing of rubbish dump in early 1990's.
SCI 1998	High SCI = 82	Very High SCI = 91	Moderate SCI = 52
Location – Km to CBD	4.5 km	2 km	8 km
Part of CIP	Forerunner of CIP – upgraded 1994-1998	Not upgraded	Yes – upgrading under CIP since 1996
CBO	Yes – Hanna Nassif Community Development Association – HNCDA	No – Mtaa leaders elected & committees formed but no formal CBO	Yes – Tabata Development Fund – TDF
Socio-economic profile	Predominantly low income	Predominantly low income	Mixed middle and low income
Physical problems			
Road access	Yes	Yes	Yes
Flooding	Yes	Yes	Yes
Water supply	Yes	Yes	Yes
Overcrowding	Yes	Yes	In parts
Documentation	Yes	Yes	Yes
On 1992 maps	Yes	Yes	Yes

The two informal settlements Hanna Nassif and Keko Mwanga differ in that the former has been the subject of a recent Community Infrastructure Project (CIP) and has a well established CBO that was also a pre-requisite for upgrading to occur. The Tabata settlement has developed more recently than the other case settlements but it has also benefited from recent upgrading. The Tabata area was also a mixture of formal and informal development, providing an interesting comparison with the situation in Hanna Nassif and Keko Mwanga that both consist almost exclusively of informal development. The membership of the Tabata Development Fund (TDF), the CBO managing the upgrading effort also reflects this mixed background. The TDF's mixed composition could potentially result in different response patterns to the envisaged community management support tools. Recent documentation was also available on various aspects of the physical and socio-economic situation in each of the case settlements. This was an important aspect given the limited possibilities for new empirical work to be carried out on socio-economic issues in each area.

Figure 5.7: Location of the 3 case settlements



5.3.2 Creation of basic spatial data sets

The basic spatial data used in this part of the study consists of selected layers of the 1992 digital topographic maps, scale 1:2500, some of which were also used at the citywide level. The available layers included buildings, roads, rivers and drains, contour lines and spot heights. This data is the typical product of urban mapping in Tanzania and it is also a common mapping scale for urban areas generally. Such maps of Dar es Salaam are produced sporadically but utilised intensively in various kinds of planning work, including settlement upgrading. However, the lack of regular updating limits the usefulness of the data over time, especially when data is needed for projects in fast growing urban areas such as informal settlements. In order to bridge this temporal data gap, the technique of Small Format Aerial Photography (SFAP) was adopted to provide a basis for updating topographic maps and as a means to create photo-mosaics of informal settlements that could serve as support tools for community upgrading and settlement management. The process for production of a SFAP mosaic is described briefly in the following section.

Creating SFAP mosaics of informal areas

Abbott (2001) proposed that photographic images form an important input into settlement upgrading approaches based on GIS and a key component of this research was the ability to create updated photo-mosaics of such settlements. The mosaics served as a source of data for analytical purposes and as a visualisation tool facilitating the work of local officials and residents in discussions on development related issues. Aerial photographs were preferred for this purpose, as they are generally found to be more easily understood by laypersons than topographic maps, due to their more natural representation of reality. In principle enlarged vertical aerial photographs could also be used if they are of a fairly recent date. However, in fast growing informal settlements they will be quickly outdated and as such their usefulness as a management tool will therefore rapidly diminish.

For this research the author made a series of low oblique SFAP images of Hanna Nassif and Keko Mwanga on 3 December 1999[20]. The images were made with a handheld 35 mm Nikon camera fitted with a 35 mm lens, from a Cessna aircraft that was circling the target area at an altitude of approximately 800m. The door of the aircraft was removed to improve the camera angle and flexibility during photography. These images were subsequently processed with the ILWIS GIS software in a manner that allowed the production of aerial mosaics of comparable accuracy to the 1992 topographic data.

The adopted method was based on using a direct linear transformation that included the possibility to extract data on terrain elevation extracted from a DEM of the target area. Appendix F summarizes the processing method in a flowchart and provides examples of products. These processing steps can be easily learnt and an operator with relatively little experience would require 2-4

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[20] No systematic SFAP coverage of the Tabata area was made for the production of a mosaic, because the decision to include Tabata as a study area was made at a later time when it was no longer possible to undertake such work due to resource constraints.

hours to georeference and resample a single image. This method surmounted the problems related to low geometric accuracy encountered in earlier attempts to extract data on informal housing for other settlements in Dar es Salaam from SFAP , making it a potentially suitable method for generating spatial support tools in situations where settlement upgrading is occurring or envisaged and existing maps or aerial photographs are either very outdated or too expensive to produce for small areas and at short notice. To determine the usefulness of such mosaics some additional surveys of professionals and community groups were required and the procedures for this aspect of the work are discussed in the following section.

5.3.3 Exploring the planning context at settlement level

As this research was focused on the development of tools that can provide support for planning and regulating informal settlements, it was necessary to identify the problems that stakeholders recognised in specific settlements, to define their spatial information requirements and, in this particular research, assess the usefulness of the SFAP mosaic as a tool for planning and management at settlement level.

In order to do this a combination of methods involving primary and secondary data sources was used (see Table 5.9). In exploring the general planning context within each settlement, secondary sources were the main source of information for Hanna Nassif and Tabata, as both settlements were well documented via the ongoing CIP activities. As no such project had been established in Keko Mwanga, a limited amount of primary data acquisition was necessary. Although some recent studies had been carried out in Keko Mwanga (Kombe and Kreibich 1988; Kombe 1995), the situation in this settlement was generally less well known and it was therefore important to gain a more detailed first hand knowledge of this area and establish a personal relationship with the community and its leaders. The following section provides details of the primary data capture initially carried out in Keko Mwanga. This is then followed by a description of the enquiries that were made to investigate the usefulness of the SFAP mosaics that concentrated more on the Hanna Nassif and Tabata settlements.

Table 5.9: Overview of methods used to explore the planning context and the usefulness of SFAP mosaics as a support tool for settlement planning

Methods to explore planning context and development problems	Hanna Nassif	Keko Mwanga	Tabata
Literature sources	Yes	Yes	Yes
Focus group		Yes	
Socio-economic survey	Yes (secondary)	Yes (primary)	Yes (secondary)
Interviews with local officials & Mtaa leaders	No	Yes	No
Methods to establish usefulness of SFAP			
Formal interviews with local officials & Mtaa leaders	No	Yes	No
Informal discussions with local officials and leaders	Yes	Yes	Yes
Workshop with CBO	Yes	No	Yes
Survey of academic planners involved in upgrading projects	Yes – general enquiry not related to a specific settlement		

Primary data capture in Keko Mwanga

The methods used to collect data in Keko Mwanga concentrated initially on the official administrative officer and community leaders, and thereafter emphasis was placed on community members. First, the opinions of the local officials, the Ward Executive Officer (WEO) and 2 Mtaa leaders were obtained via a structured interview held at the WEO Office on 28 March 2000. As one of the Mtaa leaders was not able to communicate in English, a local research assistant, with an urban planning background, conducted the interview in Swahili. The author was present throughout the interview in order to clarify uncertainties expressed by the respondents and pose additional more specific questions as required. Subsequently, the Mtaa leaders helped to organise an exploratory focus group session with 16 persons (9 men and 7 women) who represented the views of local residents from the 2 Mtaa's that form Keko Mwanga. The focus group was held on a Sunday afternoon at the local primary school that is centrally located in the study area. This time was suitable as it was not a normal working time for most residents and it therefore allowed both employed and unemployed persons to participate.

The focus group approach was selected as it provided a fast and efficient manner to get a preliminary feel of the resident's views on local problems and priorities in a sphere of trust and meaningful interaction (Morgan and Krueger 1993). The objective of the focus group session was:

- to develop an initial understanding of living conditions and house occupancy
- to gain an insight into the main priorities of male and female residents
- to explore the ability of residents to understand and utilise the SFAP mosaics for discussing and localising specific issues

As several factors can influence the quality of focus group interviews some effort was made to minimise the risk of poor quality responses within the groups. In Table 5.10 the main steps taken to address these factors is summarized. However, even though much care was taken to maximize quality in these groups, it must be realised that the settlement cannot be assumed to have *"..a unitary set of values and interests"* (Edwards 1997) nor that those participating in the workshop fully represent the diversity of interests likely to be found within the area. The results of these sessions are therefore only indicative of possible issues and priorities and more extensive research is required to identify all significant social groups within the settlement and analyse their interests and priorities.

Some additional data was later collected via a sample survey of households in June 2001. A group of ITC Professional Masters students carried out a fieldwork exercise in Keko Mwanga under the author's supervision that aimed at creating a more detailed picture of some of the socio-economic characteristics of the residents and gaining more insight into some specific problems such as flooding and water supply. Details of the data collected and maps of the sampled houses are shown in Appendix G.

The general socio-economic household survey was designed as a stratified random sample based upon the number of buildings located in 12 predefined "blocks", 3 belonging to Mtaa A and 9 belonging to Mtaa B. Initially 120 buildings were selected, representing a 5% sample per block. However, as Swahili houses quite normally consist of more than 1 building (Wells, Sinda et al. 1998) and given the need to improve the understanding of socio-economic conditions of owners and tenants, all buildings associated with the sampled building were also included in the survey.

This approach brought the total sample size to 311 buildings, accommodating 400 households with a total population of 1300 persons. Local assistants were employed to carry out the surveys in person. However, due to time constraints posed by the absence of competent adults at many sample houses during the day, the procedure was modified. Ultimately the assistants distributed forms (in Swahili) to the relevant houses and explanation was given, where possible, of what was required. At a pre-arranged time the assistants returned to collect the completed forms and asked additional questions if required. This procedure worked well though in some cases several visits were required to obtain the completed forms. A different approach was adopted to examine the flooding situation.

Table 5.10: Summary of steps taken to maximise quality of focus group outputs in Keko Mwanga.

	Quality control factors	Quality control approach in Keko Mwanga study
1	Clarity of purpose	Objectives limited to 3 subjects
2	Appropriate environment	Keko Mwanga school: familiar and easily accessible Convenient day and time for employed and unemployed Refreshments provided Gender balance sought Mtaa leaders only present for introduction and review sessions
3	Sufficient resources	Not a major issue for a single session
4	Appropriate participants	Equal number of men and women sought from each Mtaa – for expediency Mtaa leaders identified participants leading to possible bias in responses reflecting their own network of acquaintances. Both gender groups were mixed in terms of age.
5	Skilful moderator	Two local planners with some experience with focus groups were used as moderators.
6	Effective questions	Limited to a short individual questionnaire and a group discussion phase. Individual assistance was given to clarify questions.
7	Careful data handling	Use made of visual media: keyword cards and summary sheets for prioritising. Translations of Swahili responses were prepared immediately after the focus group. Use of SFAP mosaic as a common settlement visualisation tool.
8	Systematic and verifiable analysis	Limited descriptive approach. Seek immediate clarification and consensus on meaning in sessions.
9	Appropriate presentation	Oral and written reporting.
10	Honouring the participant, the client and the method	Open and frank introduction on the purpose and implications of the meeting with adequate time for personal introductions and questions. Straightforward approach with simple familiar tools.

(based upon Kreuger, 1993)

From the focus groups the approximate location of flooding issues was known and the survey of flooding problems aimed at building a more detailed picture of the extent and severity of the flooding problems. The survey was also based on a sample that was made by drawing a series of lines perpendicular to the main stream bordering the settlement at an interval of approximately 200 m. Interviews were held at the first 3–4 houses intersected by these lines. Additional interviews were held at several locations near the school where focus group participants had stated that storm water frequently collected due to local sink formations in the terrain.

The third issue examined in the fieldwork was that of water quality, which is particularly important, as contaminated surface water and drinking water is a major source of water borne diseases and health problems for the community. For this topic field surveys were made to establish the location of water taps and shallow wells. The taps are privately owned but many residents buy buckets of water from the tap owners while the wells are often used for washing and cleaning. Water samples were taken from 17 locations consisting of 7 taps, 4 shallow wells and from 6 locations distributed along the stream.

Throughout this work in Keko Mwanga extensive use was made of the SFAP mosaic as a communication tool both in office discussions and in the field during discussions with local leaders and residents and for navigation and orientation. This experience reinforced the view that such a mosaic could indeed have considerable value in settlement upgrading and management issues and in order to examine this potential in a more structured manner a specific enquiry was carried out.

Exploring the potential usefulness of SFAP mosaics

Two other groups were considered for assessing the usefulness of the SFAP mosaics: *i)* planners and engineers with experience in recent upgrading projects in Hanna Nassif or Tabata and *ii)* members of the CBO's for these two settlements. The professional's views were sought as it was expected that they would be in a position to provide suggestions on how such a mosaic could be used in a technical sense. The views of the CBO's were equally important as they have a key role in current upgrading projects. It was believed that the mosaic could quite readily used by them with little explanation and that it would provide them with a useful tool in both horizontal and vertical communication processes.

Two questionnaires were prepared, one for the professionals and one that could be used as a basis for a workshop with CBO representatives in Hanna Nassif and Tabata. A preliminary version of the questionnaires was discussed with an Architect/Planner who had played a substantial role in the Hanna Nassif project, at the University of Dortmund in February 2002. Revised questionnaires were then prepared and distributed to 5 planners and the consultant engineer who had worked in Hanna Nassif project.

In order to acquire data from the two CBO's it was necessary to organise 2 separate workshops, both of which were facilitated by planners from UCLAS. The first meeting was held with 15 persons (9 men and 7 women) from the Hanna Nassif CBO on March 22, 2002. A similar meeting was held with Tabata's CBO on June 14, 2003. Although this process has taken place over a considerable length of time and has involved the use of different assistants there is little reason to doubt the validity of the responses. Both facilitators had extensive experience in Tabata and Hanna Nassif respectively and enjoy substantial trust within each CBO. Also, in the intervening time no similar studies have been carried out in Tabata that may influence the results obtained there. Although no workshop was carried out within the Keko Mwanga community the focus group, decribed previously, provided some insights into the usability of the mosaic and discussions with the mtaa leaders in 2000 and again in 2001 have provided several opportunities to explore similar issues in a less formal manner.

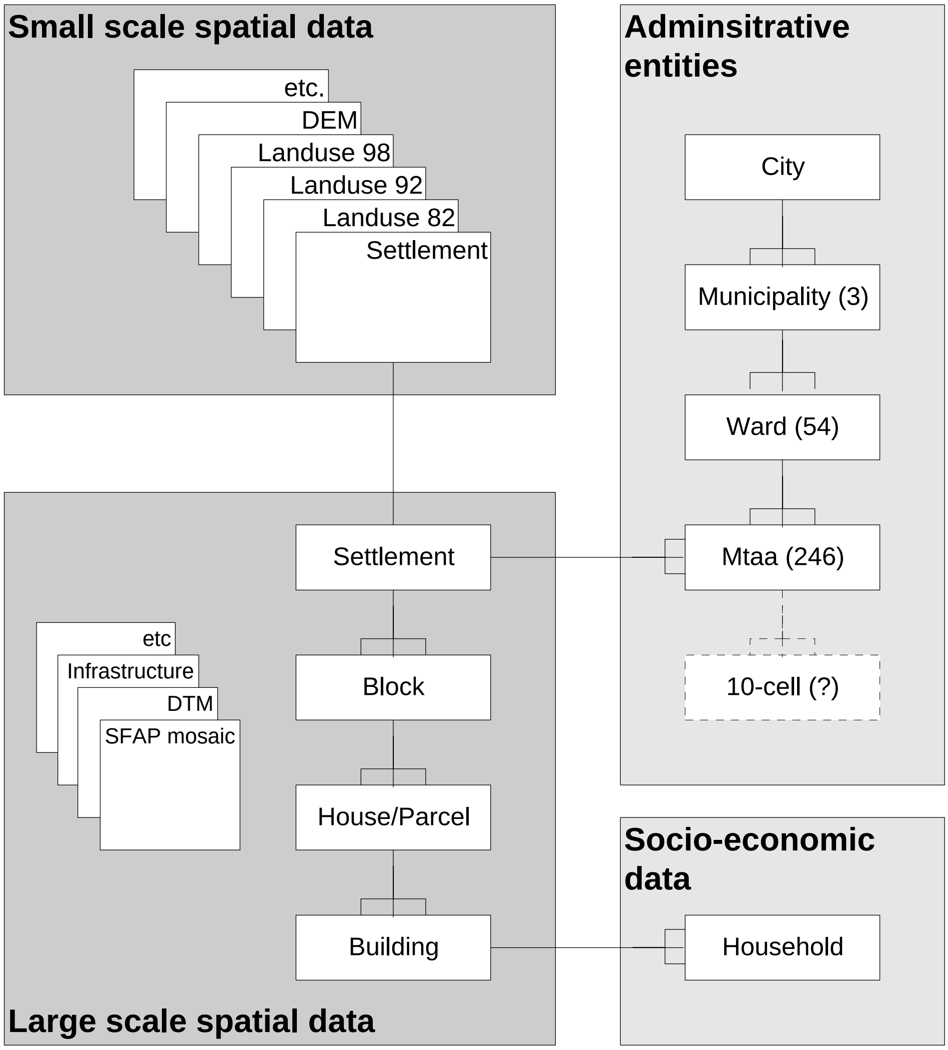
5.4 Overview of the data model for the two spatial levels

In order to be able to manage the data acquired and used in this research it was useful to prepare a data model that shows the major entities and their relationships. Figure 5.8 shows 4 main groups of data. The administrative entities show how the city is subdivided in a hierarchical manner consisting of 4 main levels. The lowest level (10-cell) is shown in a dotted line as it is a management unit that was carried over from the era of one-party rule by the CCM and it has since ceased to function well in some areas, especially those in which rival political parties have established considerable political support.

The main link between the small scale and large scale data sets was the entity *settlement*, one of the two basic physical entities identified in Chapter 3. Although conceptually this is one entity it was included in both datasets as 2 distinct representations because each had a different accuracy.

The small scale data also contained a series of vector and raster datasets representing different topographic features or thematic layers such as land use or landform. The large scale data set included the SFAP mosaic and various topographic and thematic datasets. The most important of these was the *building*, which formed the core spatial data set within informal settlements (Abbott 2001; Abbott and Douglas 2001; Abbott 2003) and has an important relation with the households that form the community. An individual *building* may be occupied by a number of *households* and, as the Swahili house frequently consists of multiple building units (Schmetzer 1982), groups of buildings may together form a *house*. The entity *block* was introduced as a result of fieldwork activities in Keko Mwanga. Although it does not exist in local administration systems it was considered a practical means of dividing the settlement into spatial units of manageable proportions. Based on the experience in this work the relationship between *settlement* and *Mtaa* is shown as 1 to many, however, it is quite likely that in some settlements this could in practice be a many to many relationship.

Figure 5.8: The major spatial entities and their relationships



Understanding these relationships was important as they formed the basic structure of the main spatial databases. In the course of the analysis carried out in this research many additional spatial data sets were generated in the small scale or large scale databases. Details of these processes are given in Chapter 6 and 7 respectively.

5.5 Concluding remarks

This chapter has provided details of the methods used for collecting and preparing the data needed in the course of this research. A distinction was made in the discussion between two types of methods, those related to spatial data processing and preparation and methods that were primarily concerned with the collection of data about the problem setting and the planning context. The processing of spatial data was done at two different levels. At the citywide level of analysis most data was extracted from small scale maps, aerial photographs and satellite images. However, for the creation of the citywide DEM and the creation of the 1992 density data use was also made of spatial data derived from large scale topographic datasets and then integrated with small scale datasets. The acquisition of data on the planning context was also done at 2 levels, with separate surveys and techniques used at each level. In the following chapters this data is analysed and discussed in order to provide answers to the research questions and ultimately to evaluate the feasibility of implementing the methodology for planning and regulating informal settlements.

Chapter 6
Strategic support for managing informal development

At the strategic level, managing informal urban development is concerned with several types of activities: ascertaining the extent and state of informal settlements; selecting settlements for specific types of interventions; assigning priorities amongst the settlements for interventions; monitoring of further development in all settlements in order to assess the performance of intervention measures and also in order to be able to reassess the priorities for intervention in the light of ongoing developments. Although a variety of stakeholders may be expected to participate in such decision processes, as the discussion in Chapters 2 and 3 on urban planning processes and Planning Support Systems showed, the perspective of the professionals is adopted in this chapter. Professionals were expected to be key agents in the process as they are normally responsible for collating information, guiding the participation process, analysing the situation and preparing proposals for the consideration of political bodies. This view was supported by the experience of the SDP working groups, all of which had a coordinator drawn for the professional staff of the DCC or a central government body.

The chapter begins by examining the results of the survey of professional opinions and attitudes to informal settlements. Their views are then contrasted with data on physical development collected in the process of this research. Thereafter a PSS type multi-criteria application for selecting and prioritising interventions that is based on data on the priorities of the surveyed professionals is developed and applied in order to demonstrate the potential applicability of such a system.

6.1 Reviewing the opinions and attitudes of local professionals

The professional opinion survey that was described in Chapter 5 had two main objectives. First to establish to what extent local professionals shared a common view of the status and trends of informal development in the city. In particular questions were posed on the sources of information, their own personal views and respondents were asked to identify those settlements that they had visited for either professional or personal reasons in the 15 months prior to the survey (i.e. since January 1999). Respondents also provided information on their opinions regarding density levels in settlements. Second, their views were sought on a number of other related issues such as future roles of local and community level agents, norms and selective demolition and resettlement as a policy response with a view to creating a DSS model that could assist in the selection and prioritisation of settlements for intervention.

6.1.1 Density of existing settlements and expected growth

The responses revealed a strong consensus on the current status and likely future development of informal settlements. The average estimate of population in such areas was 70%, which was hardly surprising given that many respondents cited the work of Kyessi (see for example Kyessi 1994) as a source. What was surprising, however, was that some members of the LGO and UCLAS groups gave population estimates as low as 20% and 30% and some even expected that the proportion of informal development would decrease in the next 10 years, contrary to the overriding expectations of the majority who anticipated further increase.

To develop a more detailed picture of current and likely future developments at settlement level respondents were asked to: *i)* classify the density in informal settlements which they had personally visited since January, 1999, using a 4 class categorical scale: density well above acceptable levels, density just above acceptable levels, density just below acceptable levels, density well below acceptable levels; *ii)* identify existing informal settlements which they expect will have the highest growth in the next 5 years.

Some general observations can be made on the basis of the response to these 2 questions. There appeared to be considerable ambiguity about the number of settlements and their names. Given that recent topographic maps have not been widely distributed this ambiguity was expected to also extend to the location and extent of such settlements. Some official planning documents were vague about their exact number (SDP 1992; SDP 1999), stating only that they were in excess of 42. However, the combined responses of this survey included references to more than 100 settlement names. While this was partly attributable to the ambiguity between fringe villages and urban informal settlements, a distinction that is sometimes made (SDP 1999; Kyessi 2002), there was considerable evidence of variation in the knowledge base of the respondents and different interpretations of the location, extent and names of informal areas. In itself this was not completely surprising, as mental maps are known to differ between individuals. However, such ambiguity is a potential source of confusion and error in consultative processes, as different stakeholders may mistakenly believe themselves to be discussing a specific settlement’s problems when they are in fact thinking of and referring to different areas. The potential for miscommunication in such a process is therefore very high, and it would be advisable in any such process to take measures to ensure that there is a shared understanding and spatial view of the objects under consideration.

A summary of the numbers of settlements referred to by each group is provided in Table 6.1. The response on density levels in recently visited settlements is shown in Figure 6.1a. Only 14 settlements were mentioned by at least 4 professionals with a strong preference for the older more established settlements in the central sector such as Manzese, Tandale, Hanna Nassif, Keko, Ubungo and Buguruni. The opinions expressed on density in these older areas tended to be quite uniform while more variation existed in views on density in fringe settlements.

Table 6.1: Basic data on responses related to knowledge on existing settlements in Dar es Salaam.

	Groups			**Total**
	LGO	**CGO**	**UCLAS**	
Settlements with highest growth in next 5 years?	**n = 7**	**n = 7**	**n = 12**	**n = 26**
Total no. of settlements mentioned[21]	33	25	40	98
No. of different settlements mentioned[22]	28	21	20	47
% of all different settlements mentioned	60	45	43	100
Average cases/respondent	4.7	3.6	3.3	3.8
Informal settlements visited since January 1999	**n = 7**	**n= 7**	**n = 10**	**n = 24**
No. of settlements mentioned[22]	69	37	74	180
No. of different settlements mentioned[23]	47	24	44	78
% of all different settlements mentioned	60	31	56	100
Average cases/respondent	9.9	5.3	7.4	7.5

(LGO = Local Government Officer, CGO = Central Government Officer, UCLAS = Academic staff of University College of Lands and Architectural Studies).

Several factors are likely to have contributed to the variation in responses. First, a precise, common definition of the location and extent of settlements appeared to be lacking, a factor that is likely to be more significant for more remote areas that are less frequently visited. Second, density is never uniform over entire settlements and the variation in newer settlements may be considerably higher than that found in older, more consolidated settlements. Further, it can be concluded that comparatively recent personal exposure to a settlement was not the only factor influencing an opinion concerning the likelihood for future growth. This was well illustrated by Kimara, which was mentioned by 9 persons

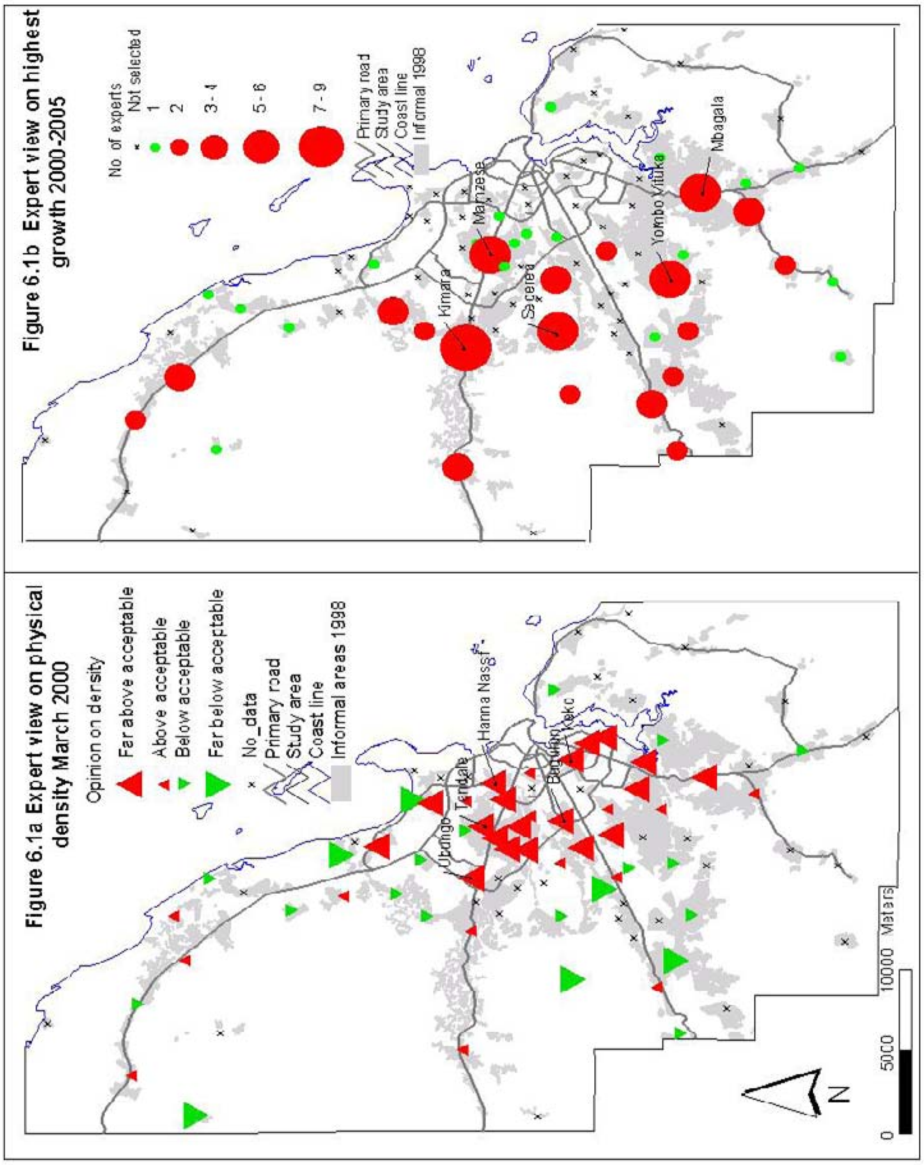
21 This number includes some double counting as several settlements were identified by more than one respondent.
22 This number refers to the number of settlements mentioned by at least one respondent. A settlement mentioned by more than respondent is counted once only.

as being a likely growth area, yet only 4 of those persons listed the settlement as one that they had visited in the previous 15 months for either professional or personal reasons. This could be an indication of the importance of secondary sources for opinion formation by the professionals, but it could equally represent perceptions or opinions that were based on outdated information or that were purely speculative in nature. More specific research would be required to establish this.

All but one of the settlements expected to have the highest growth in the period 2000-2005 were located in the urban rural interface of the city (see Figure 6.1b). There was a clear preference for settlements to the south (Mbagala, Yombo Vituka) and west (Kimara, Segerea) of the main city, particularly amongst academics from UCLAS. Three main factors were identified by the respondents as most influencing growth: good accessibility to improved roads and public transport, relatively low land prices and the availability of sufficient land (i.e. still at relatively low density). Although Segerea and Yombo Vituka are not located on main roads both had recently been provided with mini-bus services. Manzese on the other hand was a surprise inclusion as a growth area. At the time it was already a highly consolidated settlement, with significantly less scope for further *swahili-style* development than other growth areas. Manzese does however have excellent bus services and it has for many years been a major market area for the city as a whole (Sporrek 1985). It was perhaps this important market function, with the many opportunities that it creates for business and employment that was expected to provide a basis for further growth, despite the relative scarcity of vacant land, an indication of which is already provided by the emergence of some 2 storey buildings in Manzese.

Overall the responses indicated that the recent experience of the senior professionals and experts tended to be concentrated in the older and more centrally located settlements. At the same time the opinions expressed on the development density in these areas was more similar than their views on the more remote and less accessible fringe settlements. There were some indications that the spatial definition of fringe settlements was more “fuzzy” than that of other areas, while perceptions of density also showed a greater range of variability. While not conclusive these findings point to general deficiencies in the spatial extent and content of information about informal development. While such deficiencies were not, in themselves, surprising given the scale of informal development in Dar es Salaam, they do indicate that information on informal settlements was either generally lacking or perhaps poorly disseminated and absorbed, despite the activities of the SDP working groups over several years. The frequent inadequacy of information for urban policy making is also noted in developed countries (Dandekar 1988) and is in itself not an argument for inaction. This is one of the aspects that received further attention in the investigation of attitudes toward interventions and professional roles.

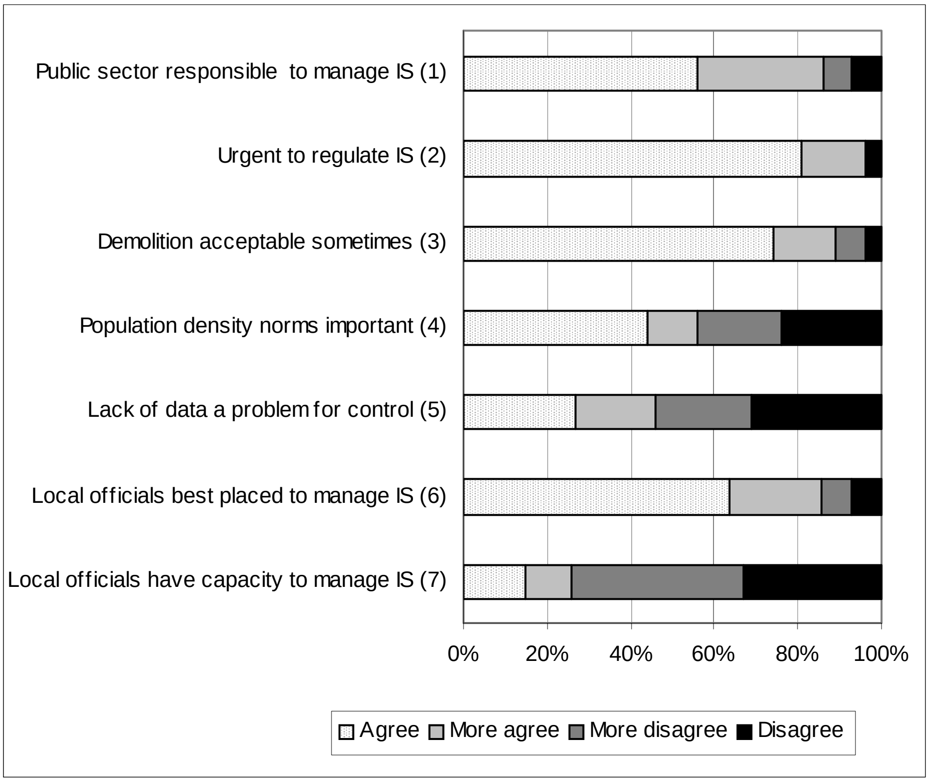
Figure 6.1: Expert views on density and growth of informal settlements



6.1.2 Attitudes to interventions and professional roles

More insights into opinions on informal development were sought by requesting individual responses on a fixed, 4 class Likert scale to 7 statements related to the management of informal development (see Figure 6.2). In addition to responding via the fixed scale, many respondents also added explanatory remarks as requested.

Figure 6.2: Professional views on statements about informal settlements.



The responses to statements 1, 2 and 3 confirm that generally local professionals strongly supported public sector intervention in informal settlements and were willing, if necessary to demolish houses to provide access or community facilities. Further, there was overwhelming support for urgent regulatory action in the settlements. In contrast, opinions were divided on the value of population density standards and the significance of the lack of data as an inhibiting factor in establishing effective control over informal development. Even amongst those supporting population density standards there was no consensus on what may be an appropriate level of density in such areas. Suggested density levels ranged from 120 to 300 persons/hectare, while some stated that it would be preferable and easier to establish a norm for housing density, with a density of 40 houses/hectare being suggested as a useful limit[23]. Those in disagreement with Statement 5 frequently expressed the view that other factors such as the lack of political will, corruption, and the lack of technical, financial and human resources were major barriers more important than any lack of data. In the view of some of these data sceptics, site visits and media attention were an adequate means to develop a *"feel"* for the situation, and one would also assume, provide a basis for basic policy decisions related to housing. However, given that the frequency of site visits by senior professionals has been shown to be rather low and covering the settlements only partially, and given also the complexity and diversity within such informal communities, the validity of this view is questionable.

Lastly, Statements 6 and 7, related to professional attitudes toward the capacity of two specific actors, the Ward Executive Officer (WEO) and the Mtaa leader, both of whom operate at the lowest level of local government. The responses suggested that while the potential of these actors was generally recognised because of the daily and direct contact with residents, there was little confidence in their ability to actually manage informal development. The cited barriers included: inadequate knowledge of relevant laws and regulations; inadequate technical and administrative skills; subject to local political influence; general lack of a sense of responsibility amongst community; low literacy rate of Mtaa leaders; the current financial benefits for Mtaa leaders attached to their role as witnesses of land transactions, issues that are examined in more detail in Chapter 7.

6.1.3 Views on tools, data and selection criteria

The survey also provided data on the types of tools and data that are required for managing informal settlements and on criteria that they considered important for determining the priority for intervening in informal settlements. This data has been used in the development of a GIT application for strategic discussion and decision making that is discussed at the end of this chapter. As open ended lists were used a variety of responses were received and it was necessary to classify responses into a more limited number of categories by combining responses on the basis of similar content (Kumar 1996, p. 118). The summarised responses for the 3 questions are shown in Figure 6.3.

The use of GIT and other equipment was considered very important by LGO's and UCLAS staff, with base maps and aerial photographs being mentioned most frequently. The UCLAS group, which included 5 land surveyors, placed a lot of

[23] Previous studies in occupancy rates in informal areas of Dar es Salaam indicate that this would be equivalent to approximately 400 persons/ha, well above the levels suggested by other respondents.

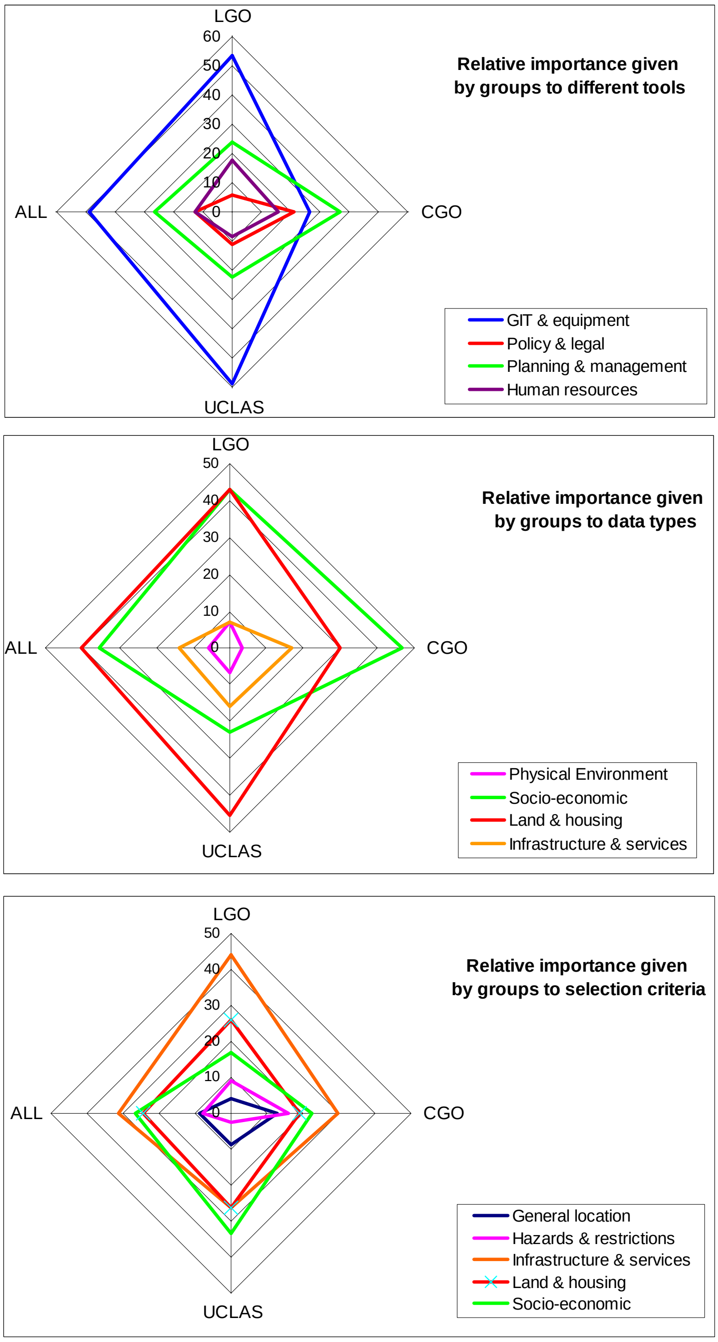
importance on GIS, GPS and other terrestrial survey equipment while LGO's mentioned the use of computers and were more concerned with issues such as transportation. CGO's on the other hand identified planning and management tools and in particular socio-economic surveys to be most important. Of the 3 groups, CGO's also gave more importance to policy and legal tools, reflecting their different role in general policy making related to urban development, while human resources issues were more pronounced for both LGO's and CGO's than for the academic respondents.

The responses related to data requirements were more uniform, with data on the socio-economic status and, land and housing being dominant. Surprisingly, one academic even maintained that data on the community structure and the willingness of the CBO to participate was the only information needed for managing informal settlements. In general however both categories of data were considered important, though the surveyor's bias toward land and housing issues was again evident within the UCLAS group. The relatively low importance placed by all 3 groups on data regarding infrastructure and services was however surprising, particularly in the light of their responses for important selection criteria.

For analysing the issue of possible selection criteria an additional category (General Location) was added to those used for discussing data requirements. Figure 6.3 shows that the 3 professional groups expressed slightly different priorities, but more importantly, the significance of infrastructure and services has increased significantly for all groups and, particularly for the LGO's. Further the CGO's gave more importance to hazards than other groups, reflecting central government policy concern on the issue of hazardous lands. Overall there was a strong emphasis on practical and immediate issues, with only one academic suggesting that priority for intervention should be determined by the importance for city development strategy.

In all groups, but particularly amongst the academics, the role of a strong and supportive CBO was the single most important criteria mentioned. This emphasis being probably the result of the recent experiences of many professionals in community infrastructure projects being promoted via SDP working groups such as the projects in Hanna Nassif and Tabata. Other important individual criteria in order of overall importance were: high density development, low level of infrastructure and services, potential access to trunk roads (most especially for LGO), and proximity to the CBD (but not for LGO's who preferred proximity to municipal offices).

Figure 6.3: Opinions of professional groups concerning tools, data and selection criteria



6.1.4 Implications of survey findings

The professional survey indicated that those involved in urban planning and management shared similar opinions and values concerning the state of informal development in the city. In general they were also convinced of the urgent need to guide and regulate such development, and of the leading role of the public sector in these efforts. However, the results also provided evidence that first hand knowledge of the development status of the city's many informal settlements was limited to relatively few areas, with local government officers generally having the widest knowledge base. As the availability of *"..a good shared information base"* is one of the requirements for effective planning systems (Davidson 1996, p. 451), the implication is that decision making on interventions in informal areas may currently be based on insufficient information and, therefore, potentially limit the effectiveness of whatever development guidance and control mechanisms may be operating. While first hand knowledge is never the sole source of information for decision making, in a situation where there is infrequent mapping and monitoring, its importance in policy development is likely to be more significant.

However, given the relatively large number of settlements in the city and the comparative isolation of many (in part due to a shortage of vehicles for public officials), knowledge of the state of many settlements may be both limited to a few individuals and be relatively outdated. The survey showed that the settlements located in the fringe areas tend to be visited less frequently than those that are closer to the city centre. The relative lack of knowledge about the more isolated fringe areas is of concern, as many of them were also expected by the local professionals to be major growth areas in the next 5 – 10 years as the older more centrally located settlements become saturated and low-income households looking for affordable developable land are increasingly forced to look in more remote locations where the supply of land is less constrained. Further, the survey also showed that the responding professionals shared relatively traditional views about data requirements and criteria for prioritising interventions, with physical development, land and spatial aspects being strongly favoured, while the importance of CBO's has also been clearly established via recent SDP projects in several settlements.

In the next sections of this chapter, data acquired on the spatial development of the city and its informal settlements is presented and analysed. Following this, a MCE approach is used to demonstrate how the data derived from GIT could be utilised in selecting settlements for various types of interventions.

6.2 Analysis of urban development from 1982-1998

The GIT based analysis of urban development in Dar es Salaam covers the period 1982-1998 using the 3 land use snapshots for 1982, 1992 an 1998 that were described in Chapter 5. Maps and statistics of the general urban development over the two periods are provided together with a more detailed examination of the development of the informal settlements.

6.2.1 Urban expansion 1982-1998

Comparison of the 3 land use data sets indicates a substantial increase in the urban area, particularly over the last 6 years (see Table 6.2 and Figure 6.4). This data shows that the rate of urban expansion has increased considerably in the second time period and, moreover, that this increase was largely due to the expansion of informal development. New planned residential areas have been developed but at a lower level while non-residential growth, which was low in the period 1982-1992 declined even further. Much of its growth was due to the expansion of quarries and sand mining in urban fringe locations, activities that are very much linked to the extraction of building materials for housing.

Table 6.2: Main urban land uses and growth rates 1982, 1992 and 1998

	Area in Ha.			**% Annual Growth Rate**	
Main land uses	**1982**	**1992**	**1998**	**1982-92**	**1992-98**
Planned residential	4325	5839	6622	3.0	2.1
Informal settlement	5193	8251	13880	4.7	9.1
Other urban					
Industry	1935	2654		3.2	
Commerce	286	286		0.0	
Institutional	3834	3922		0.2	
Transport	820	863		0.5	
Recreation	471	445		-0.6	
Total other urban	7346	8170	8345	1.1	0.4
Total urban	16864	22260	28847	2.8	4.4

6.2.2 Urban expansion 1982-1992

Three main land uses contributed to urban expansion in the period 1982-92, namely informal settlements, industry, and planned residential areas. Figure 6.4 shows how new industry was developed in several locations around the city, with the largest developments occurring in the valleys of the Msimbazi and Ubungo Rivers and at Mbagala, in the south. The expansion of planned residential development was primarily to the north in the Mbezi Beach area, an urban development envisaged in the 1979 Dar es Salaam Master Plan.

Figure 6.4: Land use change 1982-1992

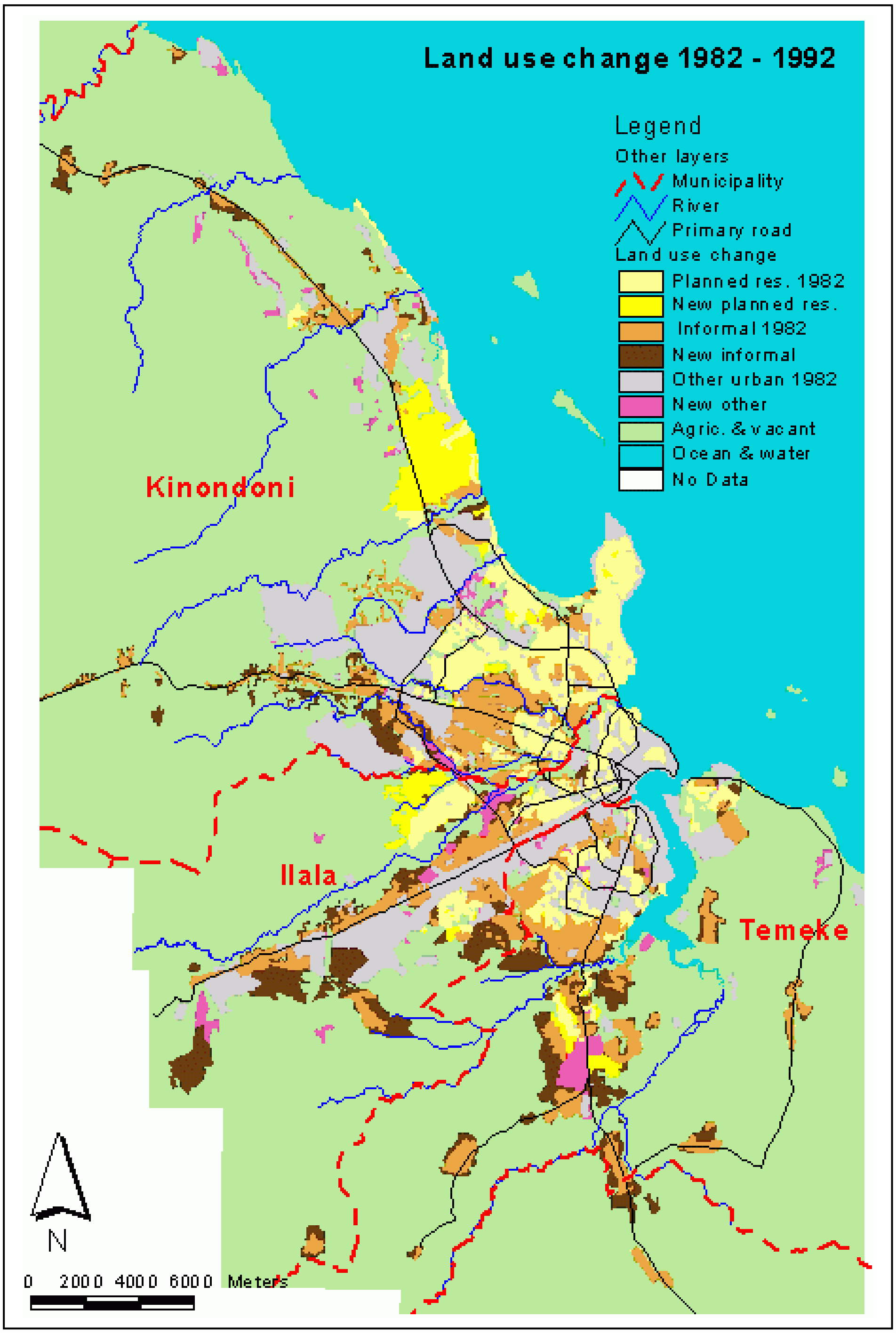
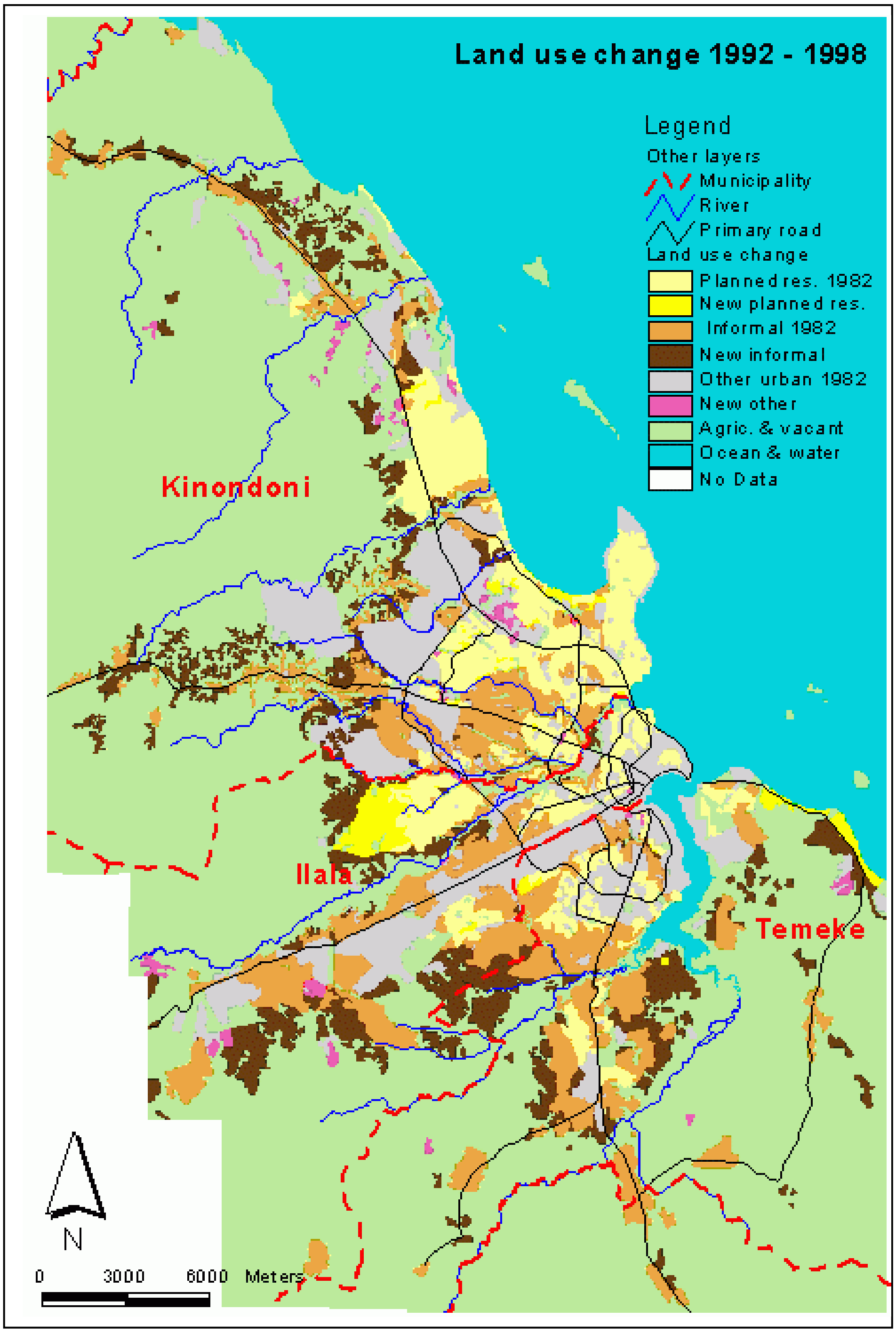


Figure 6.5: Land use change 1992-1998



However by 1992 the Mbezi Beach area was still only partially serviced with basic infrastructure and its development was proceeding very slowly[24]. Some plots of land were being developed. Especially plots located close to Bagamoyo Road, the principal road to the north, and those along the coast or the limited number of smaller access roads were favoured locations for development. In the less accessible areas only scattered construction occurred.

In contrast, informal development in this period was very substantial, comprising 57% of all new development. Unlike the planned residential development, informal development occurred throughout the city but with significant concentrations to the west and south of the previously built up area. Extensive growth was also evident to the south-west and east of the airport, at Mbagala, in the Mabibo External area and in the hills along Morogoro Road, the main road to the west of the city. In addition to the expansion processes, several studies have provided clear evidence that construction within existing settlements has continued through to the present (Kyessi 1990; Hakuyu 1995; Dangol 1998). In the following period the dominance of informal growth became even more pronounced.

6.2.3 Urban expansion 1992-1998

The rate of urban expansion between 1992 and 1998 was almost double that of the previous decade. There was also a major qualitative distinction between the two periods with around 85% of the growth in the latter period being attributable to informal development. Aside from a fairly substantial planned development in the Segerea/Tabata[25] area, to the west of the Nelson Mandela Road and north of the Mzimbasi River, planned residential development largely took the form of infill developments on relatively small pieces of vacant land, in the Msasani Bay area along the old Bagamoyo Road. In the latter part of the period an increasing amount of house construction and other development also occurred in the Mbezi Beach area, referred to previously as an area with infrastructure deficiencies, in response to major infrastructure improvements carried out under the USEP from the mid 1990's. It was also in this period that the coastal lands to the south of the city were facing increasing development

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24 Analysis of the roof coverage data shows that in 1992 most of the Mbezi beach area that the average roof coverage was 11.5%, with scattered development over the subdivision area. Approximately 28% of the area had no construction while 56% had less than 5% roof coverage (based on 100 x 100m pixels).

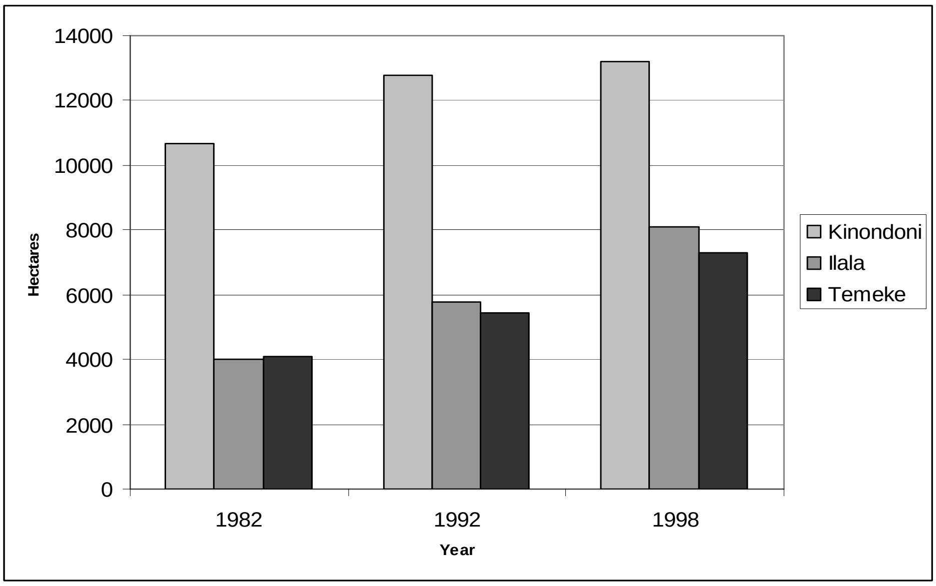
25 Although plots in Segerea and Tabata had been allocated for several years their development was hampered because of infrastructure problems, as in the Mbezi Beach area, and a significant air pollution problem caused by almost permanent burning of rubbish at the nearby Tabata dump, located downwind of the area. The closing of the dump due to a court order in 1991 has been one factor contributing to the rapid expansion of development there.

pressure (see Fig 6.5), though poor infrastructure and the lack of a short cross-harbour connection has restricted accessibility and probably prevented more significant growth. Spatial differentiation in development was further revealed by comparing the cities three municipalities.

6.2.4 Different development processes of the 3 municipalities

At the time this research was conducted the city of Dar es Salaam was divided into 3 municipalities, Kinondoni, Ilala and Temeke (see Figure 6.6), which were then further divided into 52 wards[26]. Of the 3 municipalities Kinondoni had by far the largest share of the city's urban area (see Figure 6.5), though its urban growth rate over the period 1992-98 was only 0.6% p.a., compared to 5.8%p.a. and 5% p.a. for Ilala and Temeke respectively. Further urban expansion in Kinondoni was more restricted by the hilly terrain to the west and north west, whereas the other municipalities have less pronounced limits imposed by the terrain, and it is therefore likely that they will continue to attract an increasing proportion of new growth. Moreover, the indications are that their growth may be dominated by informal development.

Figure 6.6: Urban growth by municipality 1982 – 1998



This can be seen by examining the mixture of urban land uses within each municipality (see Figure 6.7). More than the other municipalities Kinondoni contains a substantial area of planned residential development (29% of its urban

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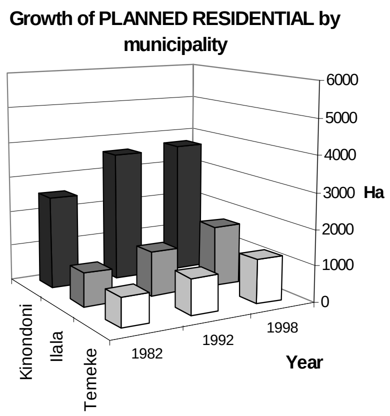
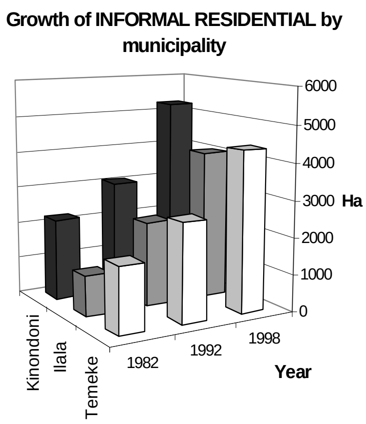
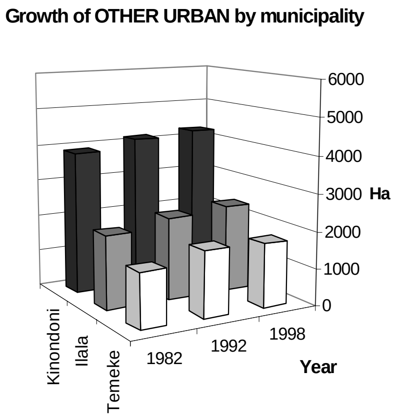
[26] Recently then number of wards has been increased to 72.

area), including several large neighbourhoods in which middle and high income groups are concentrated and, in addition, there are several large institutional uses (such as the University of Dar es Salaam and a number of large military bases) and several large industrial areas. Ilala municipality also has a considerable amount of planned residential development together with two important business areas - the CBD and Kariakoo – and several large industrial areas. The recent development of Temeke and to a slightly lesser extent Ilala, however, has become dominated by informal development. By 1998 the proportion of urban land occupied by informal settlements in Temeke was 60% and 58% in Ilala compared to only 34 % in Kinodoni.

Figure 6.7: Urban land use changes at municipal level, 1982-1998







The extent and distribution of informal settlements has potentially important implications for municipal management strategies. If, as a result of decentralisation initiatives, the financial capacity of municipalities becomes increasingly dependent on local revenues which are typically based upon taxes and levies derived from formal development via taxes on land and business activities, then Temeke in particular may be faced with considerable financial difficulties if its local tax base cannot be broadened. Ilala, is in this regard probably slightly better off than Temeke because of the concentration of formal commercial and business activities in the central business districts that fall within its boundaries and therefore strengthen its potential tax base.

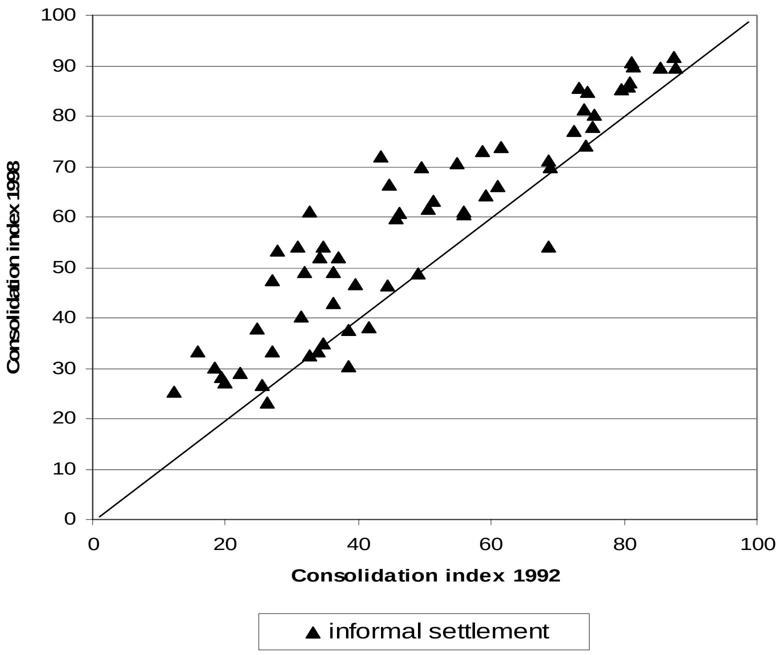
6.2.5 Densification of informal settlements

As the discussion in chapter 3 showed, the expansion of informal settlements is only one part of their development process. Incremental construction that gives rise to settlement densification is also an important aspect of informal development that has been considered in this analysis. Although a thorough examination of the densification process requires similar data for at least 2 time periods this was not possible in all settlements because of the incomplete coverage of the 1992 topographic data.

Despite this data gap an examination of densification was made for those areas covered by both data sets but, in order to compare the data, it was necessary to create a measure of density in 1992 based on the Settlement Consolidation Index (SCI) described in Chapter 5. For each settlement the 1992 SCI was computed from the classified 1992 roof coverage data and in this manner a figure of aggregate settlement density was available for both 1992 and 1998. Figure 6.8 shows that, as expected, the building density increased in most settlements over this period. The slight reduction in density in several settlements was attributable to expansion processes that have led to an overall reduction in density (e.g. Kawe’s SCI value fell from 68 to 54 and Changanyikeni’s SCI fell from 26 to 23; see Figure 6.9).

If some allowance is made for measurement errors in the data then it is reasonable to assume that, barring the effects of expansion, the density in even the most mature and consolidated settlements has continued to increase. This view is also supported by observations made on the basis of several earlier studies in specific settlements (Bruijn 1987; Kyessi 1990; Hakuyu 1995; Dangol 1998). The pattern which has emerged was one in which the more mature, centrally located settlements have the highest densities, and that densities fall gradually with increasing distance from the CBD (see Figure 6.9).

Figure 6.8: Comparison of the 1992 & 1998 Settlement Consolidation Index



In Figure 6.10 the rate of expansion for all settlements is compared to the rate of densification. Although the incomplete 1992 data prevented a full assessment some observations can still be made. Several of the older settlements such as Manzese, Tandale, Mtoni appear to have been quite stable in terms of their spatial extent and density since 1992, but in many other settlements measurements indicate that quite substantial densification has been ongoing. In areas such as Mabibo, Yombo Kipawa, Mbagala, and Msasani the SCI value has increased by between 10 to 20%, while in other areas such as Kijitonyama, Ubungo, Kigilagila, Yombo Dovya have experienced even higher densification. Even Jangwani, a relatively small settlement located in the river valley near to Kariakoo, experienced high densification although it does not appear to have the growth potential of other larger areas to the south and south west. The continuing consolidation of those areas that were already settled in 1992 is also clearly seen in Figure 6.11, which shows the absolute change of the SCI values for those parts of the settlements that were already informal in 1992 (i.e. excluding the 1992-98 expansion area). The density in the older part of Kawe now appears as stable, its SCI value having increased slightly from 69 to 71 while Kawe's overall SCI in 1998 had dropped to 54 due to considerable expansion at a much lower density.

Figure 6.9: Density levels in informal settlements in 1992 and 1998

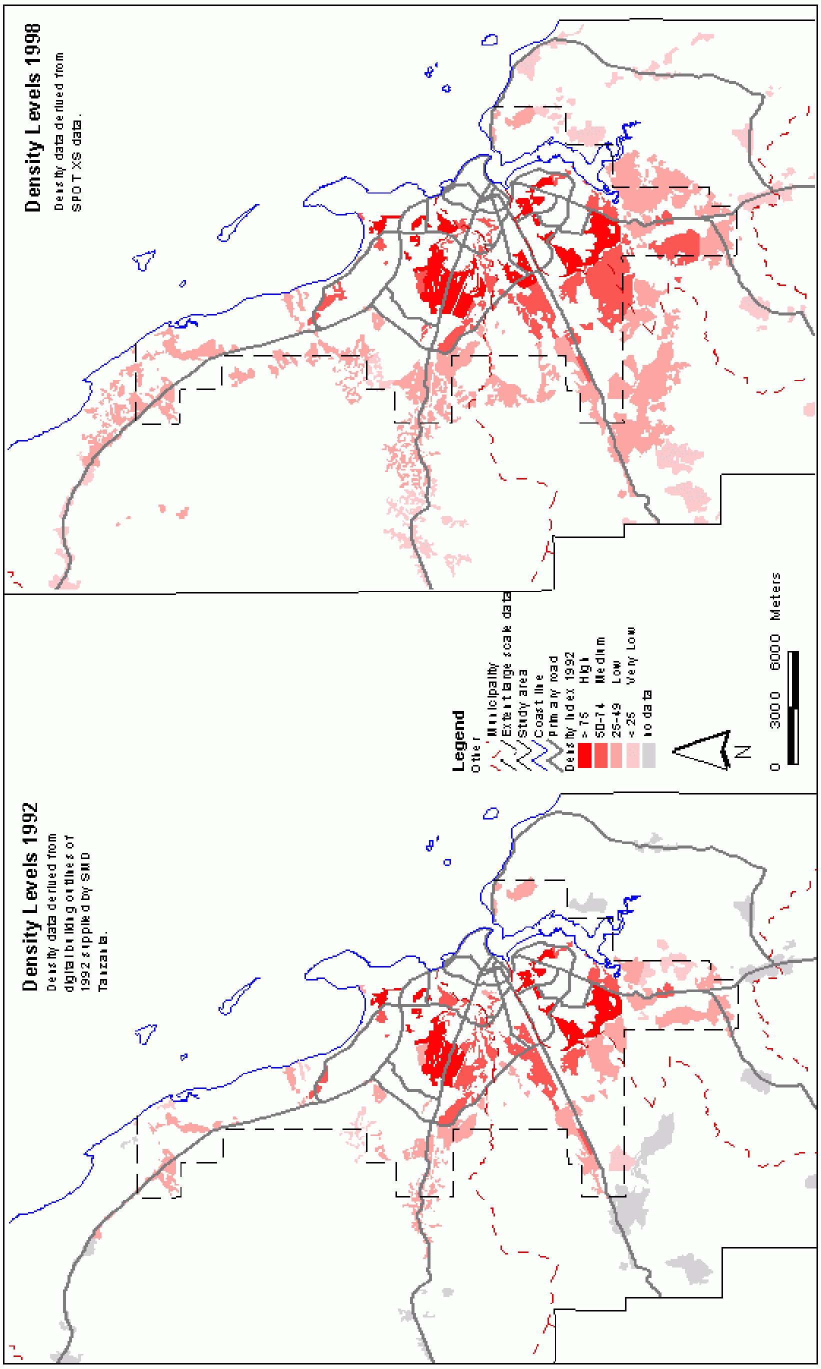


Figure 6.10: Expansion and densification of settlements 1992-1998

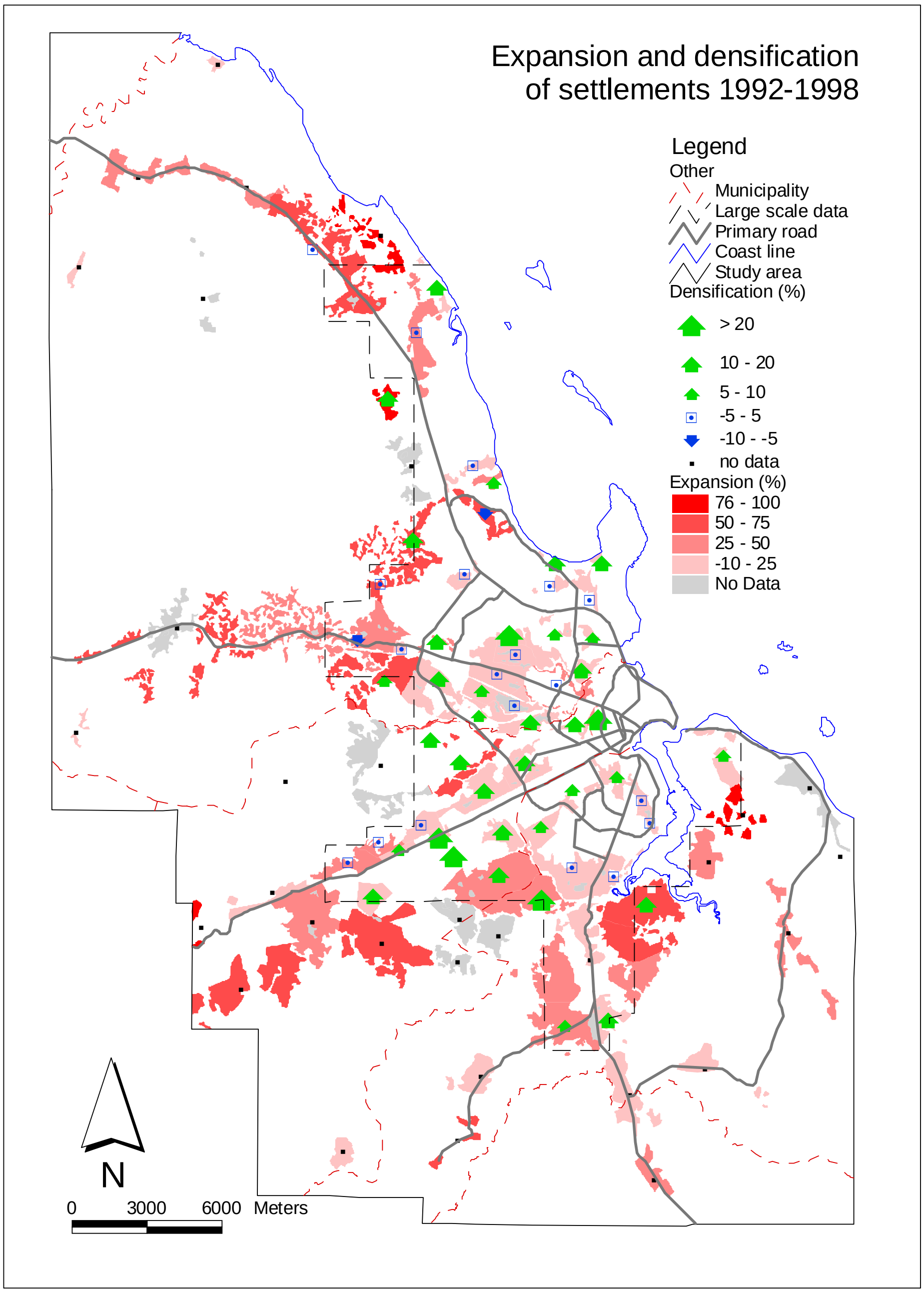
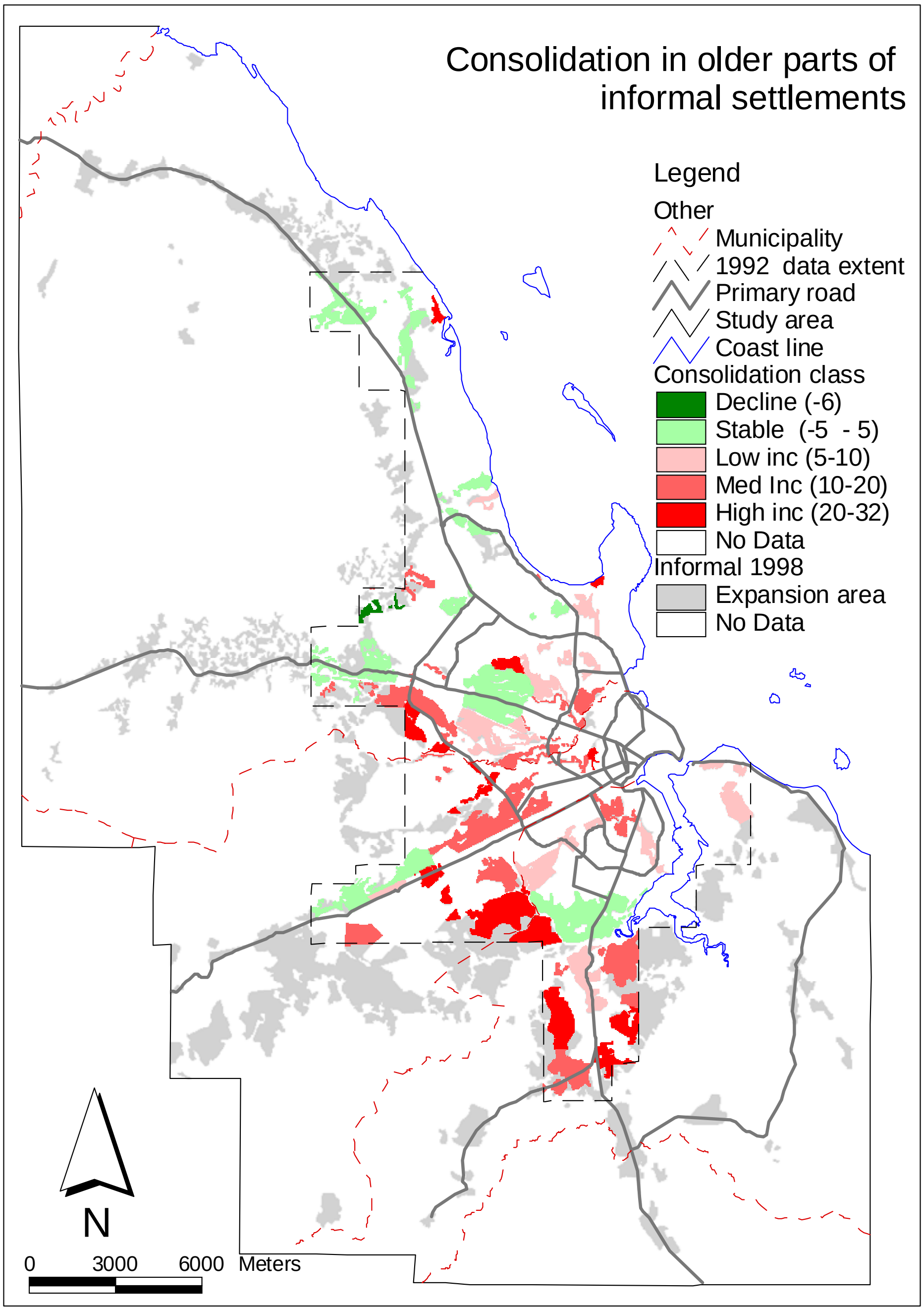


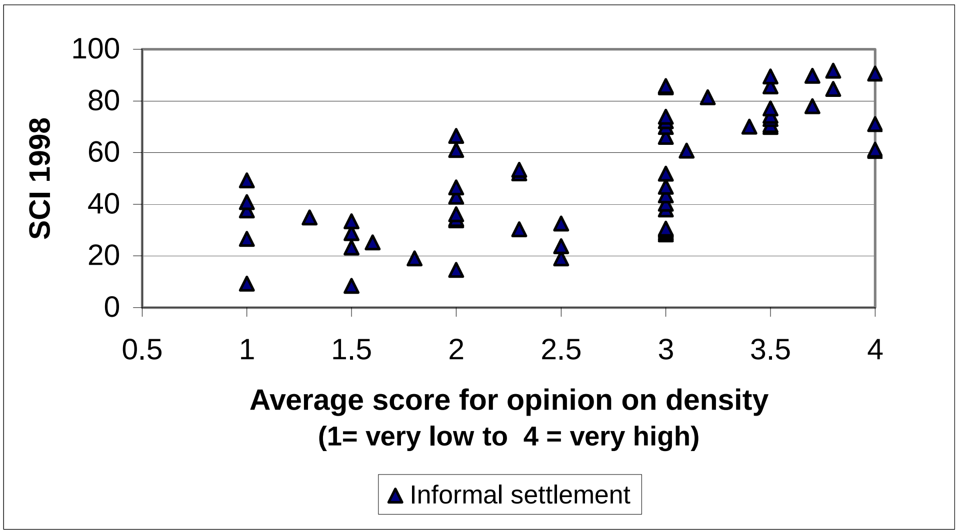
Figure 6.11: Consolidation in areas settled in 1992



Perhaps more concerning, is the evidence that densification also continued in the Hanna Nassif settlement which was the location of an important Community Infrastructure Project that started in 1995. The SCI values for Hanna Nassif increased from 73 to 86 between 1992 and 1998, and it was ranked as the settlement with the 8th highest density in 1998. Such increases in density in settlements that are undergoing infrastructure improvement point to a continuing inability to manage development within the settlement, that could in time, undermine the positive effects of improved infrastructure.

Furthermore, a comparison of the 1998 SCI values with the professional opinions on density (see Figure 6.12) showed that there was considerable variation in the opinions of local professionals about the density in each settlement. This is an indication that there may well be little consensus amongst professionals concerning the state of development in such settlements and point to a need for more objective data on both the state of physical development and the rate of development within these settlements.

Figure 6.12 Comparison of 1998 SCI values with expert opinions



6.2.6 Some implications for strategic information provision

The above analysis of urban development, and the expansion and densification of informal settlements in Dar es Salaam demonstrates some of the considerable technical capabilities of GIT for studying urban development. Without the aid of some type of systematic mapping and monitoring systems policy makers and planners have to rely more on professional opinions, but these have been shown to be less than complete and possibly unreliable in many respects. The adoption of GIT provides the capability to systematically study urban development at a strategic level, thereby providing a more objective basis for opinion formation and the development of management strategies.

GIT also provides functions to combine various datasets through overlay operations that can generate additional information, for example for the city's municipal bodies. For local government authorities the provision of spatial data at municipal or ward level is of particular importance, as these levels are closely related to local political representation and they are also of central importance in terms of policy implementation, which is becoming increasingly decentralised and based upon community partnerships. In this respect, the adoption of GIT by agencies in Dar es Salaam should explicitly consider not only how the technology can contribute to the provision of urban base maps, but perhaps more importantly, how it can be used to improve the supply of information on major development processes such as informal development to key local actors.

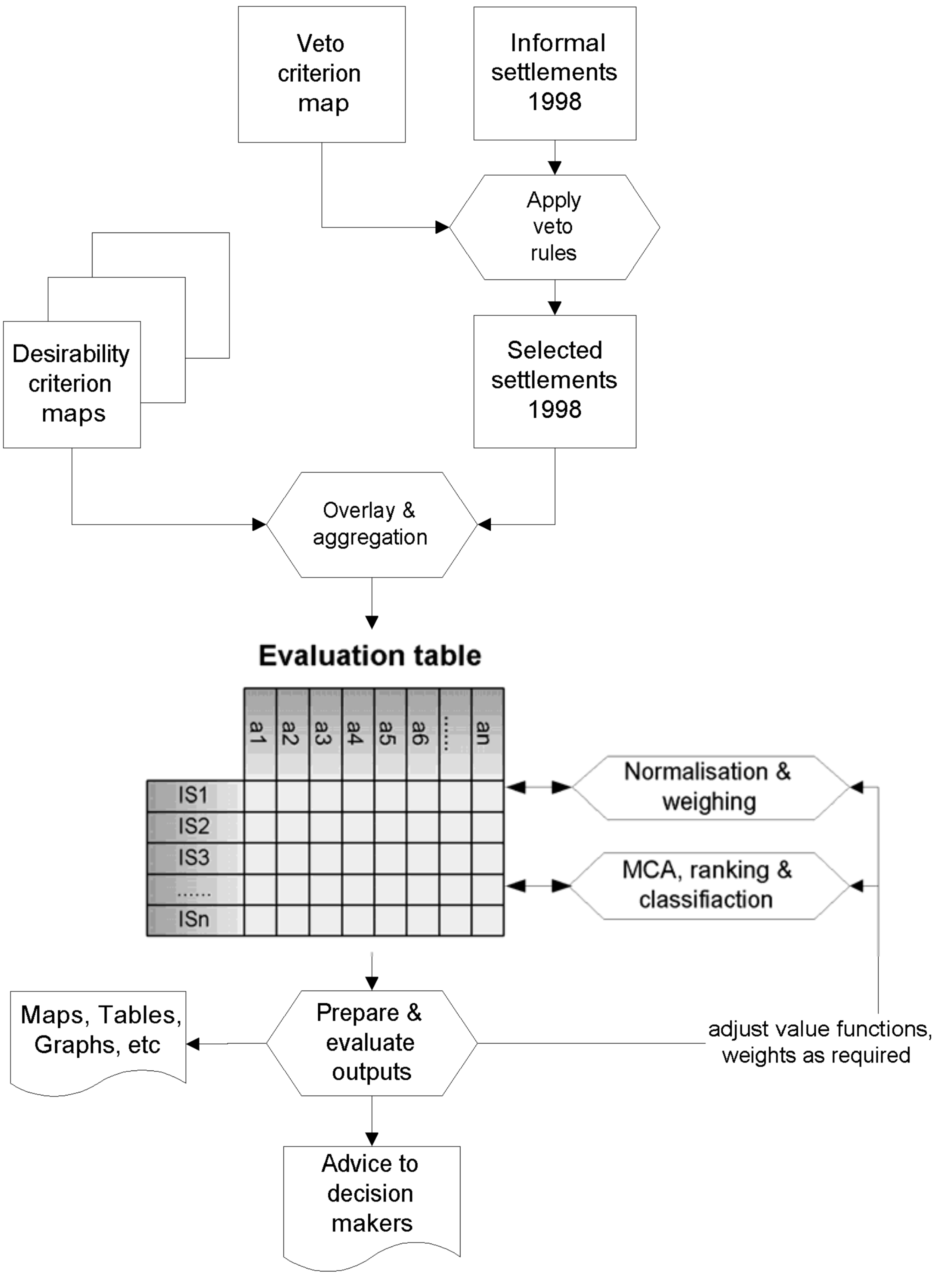
Given that improvements in the economic situation and that of human and technical resources are likely to be relatively slow, it is evident that informal development will continue to be the major form of urban development for at least several decades to come. Regular information on the informal development processes and tools that may enable planners and communities to better manage the development of individual settlements are requried. The settlement level issues are addressed in detail in the following chapter, while the remainder of this chapter demonstrates how the type of physical data collected in this research could be used for strategic decisions such as selecting settlements for different types of management interventions.

6.3 Strategic decision support for intervening in informal settlements

In chapter 3 attention was given to Baross's generic models of formal and informal development (Baross 1987; Baross 1990) and 3 main alternative courses of intervention in informal areas were discussed: upgrading, clearance and resettlement, and guided land development (GLD). Together with a fourth option, "do nothing", they represent the main alternatives available for the DCC if it were to be considering a systematic strategy for managing informal development. This section examines how the data collected in this study could be utilised to support the development of such a strategy. Although limited, the data can be used to make an initial assessment of the appropriateness and priority for adopting a particular intervention instrument in each settlement.

Using a multi-criteria evaluation (MCE) method (see Figure 6.13) several physical and spatial characteristics of each settlement were calculated and stored in an evaluation matrix. Thereafter, each criterion was normalised on the basis of a value function that was designed to reflect the preferred conditions for each criterion associated with each of the intervention instruments. Several examples serve to illustrate how this was executed.

Figure 6.13: General procedure for Multi-Criteria Evaluation



6.3.1 Criteria utilised in the MCE procedure

In the procedure 12 criteria were utilised (see Table 6.3). These criteria addressed, where possible, the expressed views of the urban management professionals discussed earlier in this chapter. The professional survey revealed that data on the lack of services and infrastructure and data on development density were considered almost equally important for selecting settlements for intervention. However, at the time this aspect of the research was conducted no details of service and infrastructure levels were available for all settlements and the collection of such data was beyond the scope of this work. Nevertheless, the incorporation of this or any other criterion into the scoring system can be easily performed and priorities recomputed if required. No attempt was made to build alternative models for representing each groups preferences for selection criteria. Although in practice such approaches can be used to examine conflicts between stakeholders (see for example Sharifi, Toorn et al. 2002), the low numbers of respondents for 2 of the groups and the lack of an opportunity for verification of their responses did not warrant such an approach.

6.3.2 Examples of normalisation and value functions

Three of the criteria described concern distance decay functions derived from the proximity to main roads, bus routes and to important employment and commercial locations. For these criteria the desirability of selecting a settlement for intervention was assumed to decrease as the distance to these locations increased. In general those settlements that were closer to a primary road were considered to benefit from easy vehicular and pedestrian access and they were also considered to have a better access to trunk infrastructure such as water supply. Similarly, those settlements located closer to the CBD, employment areas and local markets were considered to have more economic potential than more distant settlements. The actual values were calculated in the following manner:

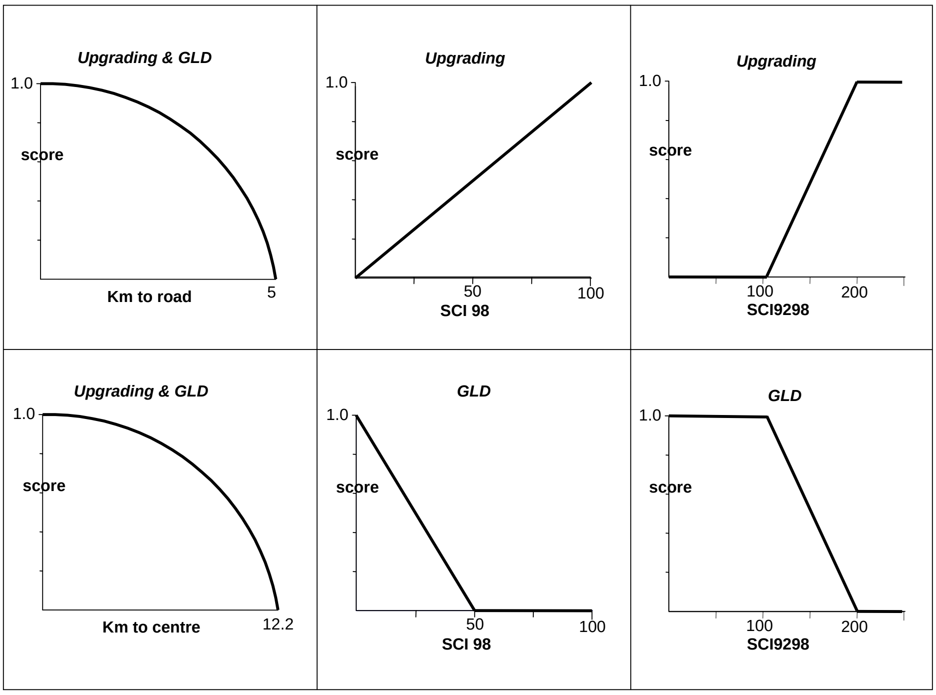
> Calculate average distance *(d)* between settlement and beneficial location(s) and take the square of this value (d^2)
>
> Identify the maximum value d^2 - $Max(d^2)$
>
> Compute the score *(S)* for each settlement:
>
> $S = 1 - (d^2 / Max(d^2))$

In this way the rate of decay increases until the maximum distance of any of the settlements is reached (see Figure 6.14). The same procedure was also used for public transport routes.

Table 6.3: Definition of criteria and raw values for priority determination

Group	No	Name	Criteria	Description
Location	1	Cendis	Distance to CBD, markets, industry	Distance in metres from centres – a weight (factor 10) was applied for crossing the harbour ferry, and main rivers are barriers that can only be crossed by road.
Land & Housing	2	Ha98	Size of settlement	Size of settlement in Hectares (raw data range 4-680 Ha)
	3	Hadif	Settlement growth	Absolute increase in settlement area between 1992 and 1998 (raw data range 0-50 Ha)
	4	SCI98	Density 1998	Settlement Consolidation Index (SCI) derived from SPOT data represents degree of consolidation (raw data range: 5.9 - 91.7; theoretical range 0-100)
	5	SCI9298	Consolidation rate	SCI98/SCI92*100: those settlements with no 1992 data received a value of 120 which was the average for all settlements with full data
Hazards	6	Flood	Susceptibility to flooding	River valleys and swamps selected from landform dataset – can be used to eliminate specific areas from further analysis (veto criterion)
	7	Rivdis	Distance to main river	Distance to main river from any cell classified as river valley – used to differentiate between settlements in river valleys
	8	Cstdis	Distance to coast	Distance to coast from any cell classified as river valley– used to differentiate between settlements in river valleys
	9	Slope	Steep slopes	Slope of land (%) derived from DEM – can be used to eliminate specific areas from further analysis (veto criterion)
Services	10	Prddis	Proximity to primary roads	Distance to primary roads – assumes that access to settlements is important and that infrastructure is available via primary roads. Includes a distance penalty factor –see Cendis above.
	11	Ptrdis	Proximity to bus	Distance to bus routes including a distance penalty - see Cendis above
Soc-Econ.	12	CBO	Presence CBO	If a registered Community Based Organisation is active in the area. (Source: Kyessi 2002)

Figure 6.14: Examples of value functions used in normalisation process



The two other criteria illustrated in Figure 6.14 relate to the physical development of each settlement. As these examples show, the manner of normalisation depends on the requirements of specific intervention instrument under consideration. For example, the desirability of settlement upgrading was considered to increase in a linear fashion with settlement density *(i.e. S = SCI98/100)*. This was in contrast to the GLD case for which high density was considered to be disadvantageous. For GLD a maximum threshold value of 50 has also been applied, reflecting the preference for settlements that have not yet reached very high density levels. The criterion of densification rate (SCI9298) was treated in a similar manner, with higher densification rates being considered to be more urgent for upgrading, reflecting the need to engage in improving living conditions. However, for the GLD option, high densification rates were considered to be undesirable, on the basis that they indicate a highly dynamic development process that could be difficult to manage to the degree required to introduce a limited form of planning for the settlement's further development. Value functions were created in a similar manner for each of the utilised criteria. Details of the normalisation process are given in the following section in which details of the weighing process and evaluation are described.

6.3.3 Combining criteria to determine intervention priorities

For each of the intervention options a separate MCE procedure was developed. To illustrate the basic approach details of the normalisation process and weighing factors for the upgrading option are given in Table 6.4. Similar details for the GLD and resettlement options are provided in Appendix I.

Table 6.4: Normalisation and weights for settlement upgrading option

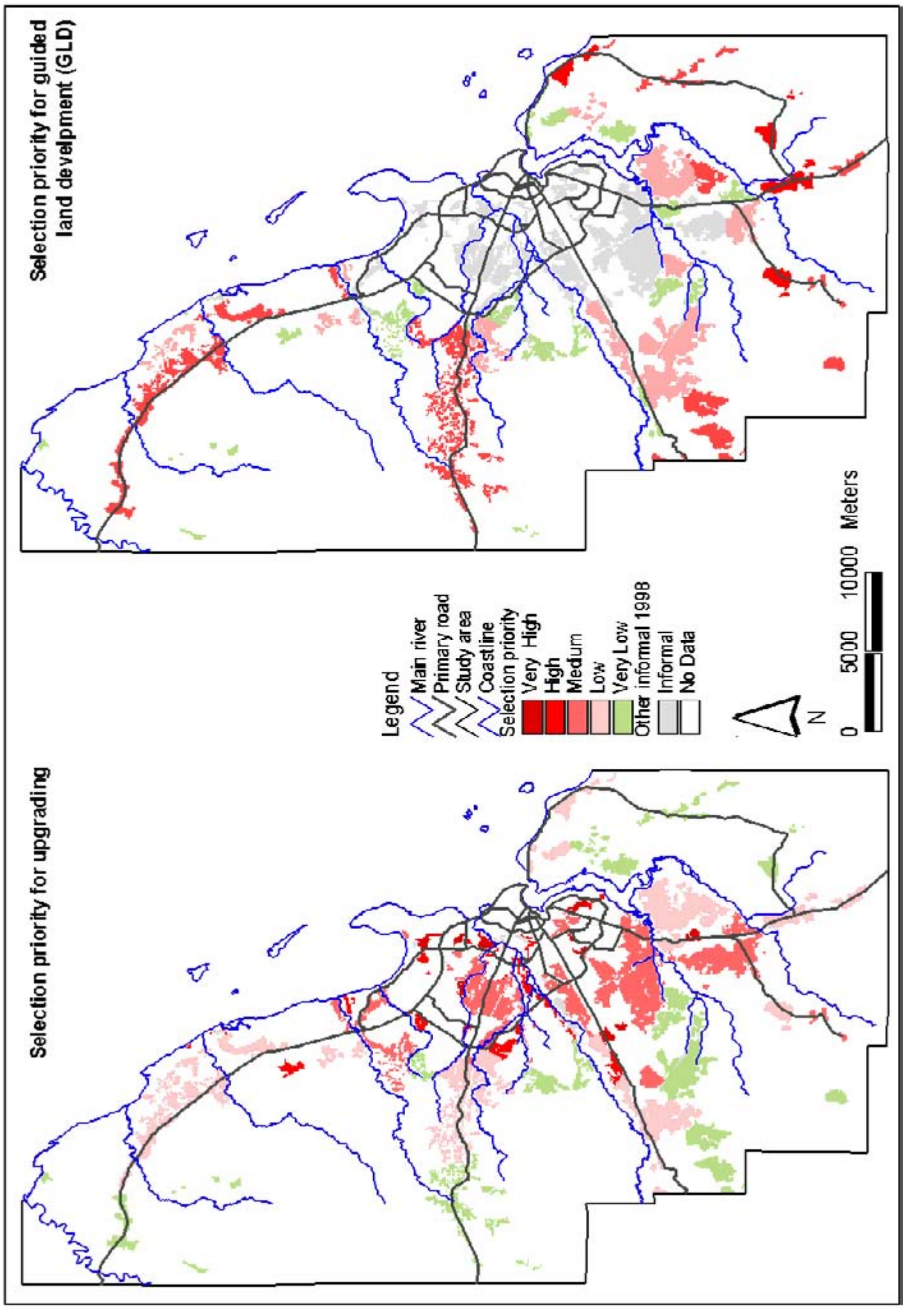
No	Criteria	Justification for normalisation	Calculation of value function	Weight
V1	VETO Landform	Existing policy prohibits settlement in river valleys. Resettlement is the preferred option.	Select settlements for which landform is not river valleys and not swamp.	-
C1	SCI98	Preference for settlements with higher densities that represent a high demand for services & infrastructure & poorer living conditions	C1 = SCI98 / 100	10
C2	SCI9298	Preference for settlements with rapid densification: i.e. high population pressure & increased load on existing services and infrastructure	C2 = if (sci9298 < 15) then 0, else SCI9298 / 100	15
C3	Hadif	Preference for settlements that are expanding: i.e. development pressure and increasing population	C3 = if (hadif < 10) then 0, else (1–((50-hadif)/50))	10
C4	SlpeGT15	Preference for settlements that have relatively low slopes. i.e. less area > 15% slope	C4 = ((1–slpeGT15) /100))	15
C5	Prddis	Preference for settlements in close proximity to roads for accessibility and infrastructure delivery	C5 = 1– (d^2/Max(d^2))	30
C6	Cendis	Settlements closer to employment & commercial areas preferred: i.e. economic opportunities	C6 = 1–(d^2 / Max(d^2))	20

The options upgrading and GLD were considered to be complementary interventions, with the former giving priority to high density settlements and the latter to low density settlements. This is confirmed by an examination of the maps of the classified priorities (see Figure 6.15). For both options it was also necessary to consider the impact of community organisation on the prioritisation as community participation is now seen as an essential pre-requisite for this type of intervention (Kyessi 2002). The MCE data was used to rank the settlements in terms of priority for upgrading and GLD, and then the data on the presence of CBO's provided by Kyessi was used to modify the selection to extract those with a CBO. Table 6.5 shows the 10 highest ranked settlements for the two intervention options (for the ranking of all settlements see Appendix J). In 4 of the 10 settlements with CBO's that were ranked highest for upgrading activities have already been instigated i.e. Kijitonyama, Hanna Nassif, Tabata and Buguruni (Kyessi 2002) while in another (i.e. Mabibo) some preliminary initiatives for improvement were being discussed both internally and with the support of planners and students at UCLAS. The GLD option was more exploratory in nature. Although GLD has been the subject of recent discussions on urban land management practices (see for example Kreibich and Olima 2002) to date no such interventions have been developed in Dar es Salaam. A similar analysis such as the one executed here could however serve as a basis for a more in-depth investigation and analysis of the potential for developing and applying such an approach in practice.

Table 6.5: Priorities for upgrading and GLD and the effect of the CBO requirement

Rank	Upgrading	CBO + Upgrading	GLD	CBO + GLD
1	Kipawa	Kijitonyama	Chamazi	Changanyikeni
2	Kigilagila	Hanna Nassif	Kongowe	Mtongani
3	Chang'ombe	Mbagala Kizuani	Yasemwayo	Kimara
4	Kijitonyama	Kunduchi	Mjimwema	Mbagala Kibonde Maji
5	Shimo la Udongo	Tabata	Mizimbini/Mkize	Ubungo Kibangu
6	Mikoroshoni	Msasani Village	Bunju	Mbagala Kuu
7	Hanna Nassif	Manzese	Tegeta	Mtoni Kijichi
8	Kinondoni	Mabibo	Changanyikeni	Yombo Vituka
9	Mbagala Kizuani	Mbagala Kiburugwa	Boko	Kigamboni
10	Jangwani	Buguruni	Pugu Kajiugeni	Mbagala Mission

Figure 6.15: Priority for upgrading and Guided Land Development



What this analysis does clearly show is the impact that a specific policy could have on the MCE results. In final prioritisation for both options the presence of a CBO was introduced as an ex-post veto criteria by only considering settlements having an official CBO for prioritisation. If the presnce of a CBO is taken to be an essential pre-requisite for any intervention, as current policy developments would suggest, there were substantial repercussions. Many settlements that qualified for interventions on the basis of other criteria were disregarded in the final screening stage. However, were this requirement to be made widely known within an open public discourse, the emergence of CBO's in more settlements would probably be stimulated, thereby reducing the distributive effect of this one criterion. Furthermore, if the funding for intervention fails to grow commensurately with the growth of CBO's there is also a danger of disillusionment in some settlements that have founded CBO's in order to meet funding criteria. Having done so, many may find that this factor no longer provides the opportunities that were available when the community planning approach was first adopted.

The situation with the potential resettlement areas was tackled in a slightly different manner, but here too the starting point was that in a situation with widespread informal development in hazardous areas and limited funding, priorities must be set for resettlement policies. Priorities for resettlement were evaluated for those parts of settlements located on potentially hazardous land (i.e. river valleys and relatively steep slopes). A total of 640 Ha was considered as being potentially hazardous land. The MCE process led to the identification of several large contiguous areas which with a relatively high risk (see Figure 6.16). Table 6.6 shows the major locations ranked according to the calculated resettlement priority and it is evident that the Msimbazi and Sinza Rivers contribute significantly to the resettlement problems. Although this result concured well with the earlier study of Dawson (1996) and the SDP working group on hazardous lands, the creation of such a priority list says nothing about the actual capacity to resettle residents of such areas, their willingness to move nor the availability of suitable relocation sites. The analysis does however provide some basis for structuring and guiding further study of these and other issues and in this way it could contribute to the public debate on what is a sensitive but important issue.

Figure 6.16: Priorities for the resettlement option

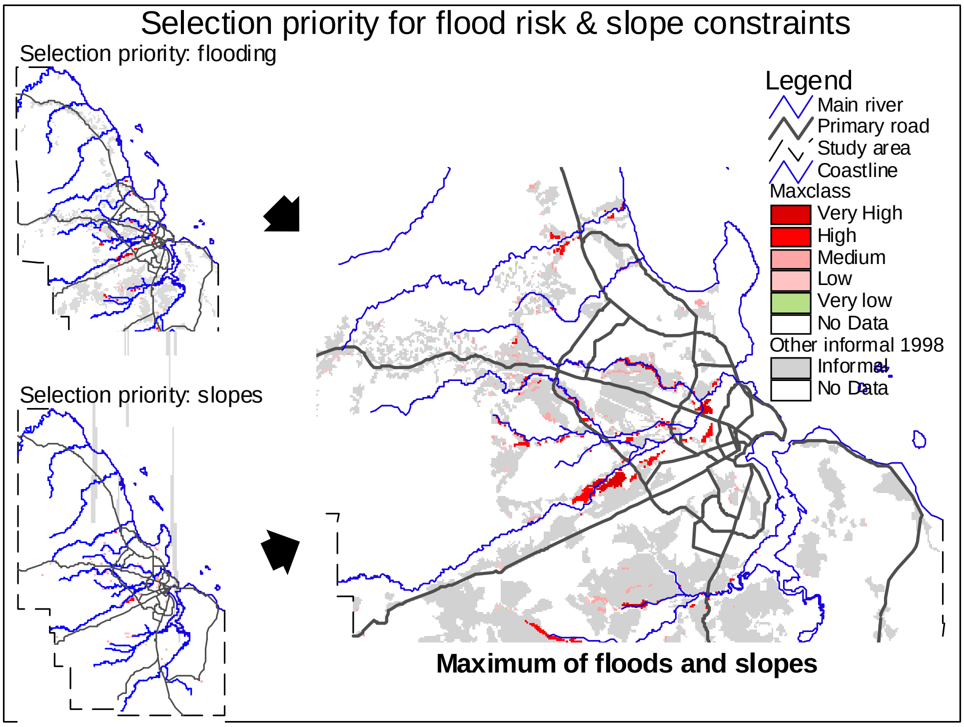


Table 6.6: Largest areas for resettlement ranked in decreasing order of priority

Rank	Name	Source of hazard	Ha
1	Magomeni	Msimbazi River	26.2
2	Tandale	Sinza River	12.0
3	Vingunguti	Msimbazi River	46.3
4	Yombo Dovya	Mzinga River	16.8
5	Tabata	Msimbazi River	16.6
6	Kijitonyama	Sinza River	2.4

6.3.4 Examining the sensitivity of the MCE procedure

MCE procedures such as the ones used in this research maybe a useful means of comparing options but they are not unproblematic. Malczewski (in press, p. 34) mentions limitations such as the interdependence of criteria, inaccurate and imprecise input data the inherent subjectivity in the standardisation and weighing procedures. Users of MCE outputs need to be aware of these problems and transparent MCE procedures that rely on relatively straightforward weighted linear combinations (WLC) of criteria, such as the ones described above, are therefore often preferred above more computationally sophisticated but less transparent methods that use so-called Artificial Intelligence (AI) methods such as fuzzy logic or neural networks (ibid p. 42). Certainly, in the Tanzanian context, where there are considerable problems with data, where technical expertise may be frequently in short supply and where there is a need for an inclusive and transparent style of planning involving multiple stakeholders with a high degree of community involvement, it is difficult to imagine that there would be strong support for AI methods.

Nevertheless even though it is more appropriate to this context, the outputs of WLC procedures should be scrutinised carefully and a sensitivity analysis should be used to assess the robustness of the MCE output. Sensitivity analysis can be carried out to determine the effects of uncertainty that are related to the scoring systems for each individual criterion and the priority given to each in the WLC stage. In this case the sensitivity of the ranking for upgrading to changes in criteria weights in the WLC stage were examined. Herwijnen, M. v. (1999). *Spatial decision support for environmental management*. PhD, Faculty of Economics. Amsterdam, Free University of Amsterdam.

A series of 12 new computations was made for the ranking of settlements for upgrading. In each new computation the weight attached to one of the criteria was increased by the value 5, or 10, while holding all other weights at their initial level (see Table 6.4 for the original weighing factors). The new ranking of settlements for each of these computations is shown in Table 6.7. The output showed that some factors were more sensitive to weight changes than others. The least sensitive criteria were distance to the city centre (cendis), slope (slpeGT15) and distance to primary roads (prddis). Changes to the weight factors for these criteria had little or no affect on the overall ranking of settlements. On the other hand, the 3 factors that are concerned with settlement expansion and consolidation (Hadif, SCI98 and SCI9298) were found to be more sensitive to changes in weights.

Table 6.7: Sensitivity of upgrading priority to changes in criteria weights

Prddis+10	Prddis+5	Initial Rank	SCI98 + 5	SCI98 +10
Kipawa	Kipawa	Kipawa	Kipawa	Kipawa
Kigilagila	Kigilagila	Kigilagila	**Chang'ombe**	Chang'ombe
Chang'ombe	Chang'ombe	Chang'ombe	*Kigilagila*	**Shimo la Udongo**
Shimo la Udongo	**Shimo la Udongo**	Kijitonyama	**Shimo la Udongo**	*Kigilagila*
Mikoroshoni	*Kijitonyama*	Shimo la Udongo	*Mikoroshoni*	Mikoroshoni
Kijitonyama	Mikoroshoni	Mikoroshoni	*Kijitonyama*	**Kinondoni**
Hanna Nassif	Hanna Nassif	Hanna Nassif	Hanna Nassif	Hanna Nassif
Kinondoni	Kinondoni	Kinondoni	Kinondoni	*Kijitonyama*
Mbagala Kizuani	Mbagala Kizuani	Mbagala Kizuani	Mbagala Kizuani	**Jangwani**
Jangwani	Jangwani	Jangwani	Jangwani	*Mbagala Kizuani*

Cendis+10	Cendis+5	Initial Rank	SCI9298 +5	SCI9298 +10
Kipawa	Kipawa	Kipawa	Kipawa	**Kigilagila**
Kigilagila	Kigilagila	Kigilagila	Kigilagila	*Kipawa*
Chang'ombe	Chang'ombe	Chang'ombe	**Kijitonyama**	**Kunduchi**
Kijitonyama	Kijitonyama	Kijitonyama	**Kunduchi**	*Kijitonyama*
Shimo la Udongo	Shimo la Udongo	Shimo la Udongo	*Chang'ombe*	**Jangwani**
Mikoroshoni	Mikoroshoni	Mikoroshoni	**Jangwani**	**Mabibo External**
Hanna Nassif	Hanna Nassif	Hanna Nassif	*Shimo la Udongo*	*Chang'ombe*
Kinondoni	Kinondoni	Kinondoni	*Mikoroshoni*	**Makongo**
Mbagala Kizuani	Mbagala Kizuani	Mbagala Kizuani	**Mabibo External**	*Shimo la Udongo*
Jangwani	Jangwani	Jangwani	*Hanna Nassif*	*Mikoroshoni*

Hadif +10	Hadif +5	Initial Rank	SlpeGT15 +5	SlpeGT15 +10
Kipawa	Kipawa	Kipawa	Kipawa	Kipawa
Chang'ombe	**Chang'ombe**	Kigilagila	Kigilagila	Kigilagila
Mikoroshoni	**Mikoroshoni**	Chang'ombe	Chang'ombe	Chang'ombe
Mbagala Kizuani	**Shimo la Udongo**	Kijitonyama	Kijitonyama	Kijitonyama
Shimo la Udongo	*Kigilagila*	Shimo la Udongo	Shimo la Udongo	Shimo la Udongo
Kijitonyama	*Kijitonyama*	Mikoroshoni	Mikoroshoni	Mikoroshoni
Hanna Nassif	**Mbagala Kizuani**	Hanna Nassif	Hanna Nassif	Hanna Nassif
Kigilagila	*Hanna Nassi*	Kinondoni	Kinondoni	Kinondoni
Kinondoni	*Kinondon*	Mbagala Kizuani	**Jangwani**	Jangwani
Magomeni	**Magomeni**	Jangwani	*Mbagala Kizuani*	Mbagala Kizuani

(**bold text** = settlement with a higher rank; *italics* = settlement with a lower rank)

The sensitivity of each criteria was dependent upon the variability of its values that can be examined via descriptive statistics that are shown in Table 6.8. The least sensitive criteria all have relatively high average scores and quite low standard deviations. The more sensitive criteria, on the other hand tend to have lower mean values and higher standard deviations, while at the same time the range of their values was also greater, extending from 0 to 1. The overall rank of any settlement that had an extreme value for a given criteria with a high variability changed considerably when weight factors were adjusted.

Table 6.8: Statistical description of values in each of the 6 selection criteria for upgrading

	Criteria					
	SCI9298	**SlpeGT15**	**Hadif**	**Cendis**	**Prddis**	**SCI98**
min	0	0.6	0	0	0	0.06
max	1	1	1	1	1	0.92
mean	0.15	0.97	0.24	0.89	0.89	0.46
SDev	0.20	0.07	0.33	0.18	0.20	0.24

The variable sensitivity of different criteria should be borne in mind when determining and assigning weight factors as it can have a substantial effect on the final ranking and therefore ultimately influence decisions concerning interventions and thereby the living conditions for many residents. Furthermore, such sensitivity is also a reminder of the need to improve and maintain the quality of data on the physical development of each settlement if such an MCE approach is to be used, as unreliable data that may be used in highly sensitive criteria could lead to erroneous decisions. However, as the earlier analysis showed, the adoption of a veto criteria such as a requirement for a settlement to have a CBO can have even more substantial effects on the ranking and decision making.

6.4 Conclusions and design requirements for strategic support

This chapter has shown that there is a need to improve the supply and distribution of information on informal development to organizations that have a mandate to manage such settlements. The focus taken here was on the government view, as represented by the group of senior professionals whose knowledge and opinions were the subject of survey.

Although there is currently general consensus amongst senior professionals on the scale of informality and the need for public sector involvement in managing such development, this research showed that the individual first hand knowledge of these professionals was often limited to a relatively small number of settlements. Furthermore, their views on the density in many of the settlements differed considerably from estimates of density derived from the spatial data available. As the rate of expansion of informal settlements has been increasing, particularly in the more remote fringe areas of the city, the need for improving the supply of spatial data for monitoring physical expansion and densification processes and policy development is therefore increasingly important.

Even with the limited data produced in this research from existing topographic data, aerial photographs and satellite images, it was possible to generate a useful information base for making strategic decisions concerning the intervention options related to informal development. The MCE procedures developed in this research should be seen as a starting point for the development of an operational planning support system. The above analysis was made on the basis of limited physical data and many assumptions, fro example about infrastructure provision. Further refinements should be made to address these data gaps and answer many of the questions that have not been addressed in this work (see for some examples Table 6.9), as their inclusion will require the MCE procedures to be modified, possibly leading to different assessments of priorities for each option. Finally, the procedure would be improved by the inclusion of data that would enable the cost implications of each intervention to be included so that the financial constraints would be integrated in the assessment of options and the possible trade-offs between them.

6.4.1 Design requirements for the strategic level

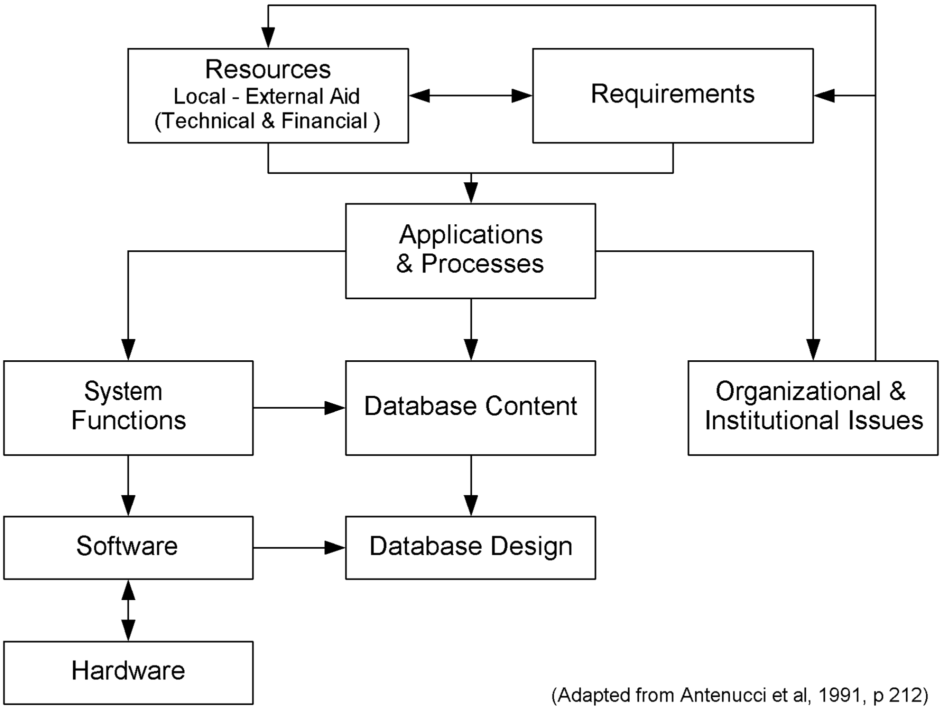
Several approaches may be adopted in designing spatial information systems, including methodologies based on detailed analysis of data and data processes that are frequently based on functionalist views of organisations and information systems concepts that are based on current practice and that therefore do not specifically address the need for change (Grimshaw 1995, p 137). Reeve and Petch (1999) also point to many shortcomings of the traditional life-cycle approach to systems development. They see it as an example of a “blue-print” planning approach (ibid, p 78) that, like the Master Plans of urban planning, have been found to be inflexible and ineffective in implementation.

Antenucci et al (1991, pp 211-213) describe several components that must be considered in the design of a GIS and in their philosophy it is the applications that should drive system design and guide the examination and decisions related to other components (i.e. system functionality, database content, database design, software, hardware, and organizational and institutional issues). Although this is a sound approach that is particularly appropriate for an incremental system development strategy, some adjustments are required for the situation in Dar es Salaam (see Figure 6.17).

Table 6.9: Some examples of questions requiring further attention

Criteria	Questions related to operationalisation of the criteria
Location and state of settlements	Has the spatial extent of individual settlements been accurately determined? What temporal resolution would ensure an adequate, minimum level of physical data to support policy analysis and decision making? Are there relevant standards for assessing the development density? Can the settlement be defined as a spatially coherent community unit which also conforms to existing local government units (Wards and Mtaa's) and accepted conceptions of settlements? Should all houses in river valleys be relocated or other options possible in some locations?
Lack of services and infrastructure	Which services and infrastructure should be considered in more detail; water, sanitation, electricity, roads, public transport, primary health care, education, public safety (police and fire)? How should the services levels for these services and infrastructure be measured? Are all of the above equally important or do some have higher priority? Is it necessary and possible to consider not only the location of all services, but also their capacity and quality? What are acceptable standards for assessing the level of service provision?
Socio-economic status	What is the population profile of each settlement and how does this affect specific preferences? What is the poverty profile of each settlement and how does this affect preferences and affordability?
Existence of supportive CBO	Does the CBO enjoy adequate resident support and have effective participation to adequately reflect resident interests? Does the CBO operate on democratic principles? Are there multiple CBOs functioning within the settlement? Is the resource capacity of the CBO and the residents adequate to enable effective participation in the planning and implementation of improvements and their subsequent operation and maintenance?

Figure 6.17: Design philosophy for GIS development in Dar es Salaam



(Adapted from Antenucci et al, 1991, p 212)

The adaptations made to the model of Antennucci et al (ibid) concern the specific attention that is given to the available resources and the inter-connections between organizational issues, requirements and resources. Financial support is always a key issue for GIS projects (Reeve and Petch 1999, p 160) but the additional emphasis given to the available resources here is due to the highly constrained resource situation in this setting.

As the discussion of the local context in Chapter 4 showed, the technical, financial and human resources at both central and local government level are very limited. In addition, external sources can add to available resources via projects (Calhoun, Drumond et al. 1987; Cartwright 1991) such as occurred within the Sustainable Dar es Salaam Project (SDP) that has introduced GIS into the strategic planning process. But the SDP approach of increasing financial resources to buy hardware and GIS software without well defined requirements, adequately trained human resources and insufficient attention to technical and institutional issues is a risky one (Masser and Sliuzas 1999). More than a decade ago Taylor (1991) cautioned the GIS community and users in developing countries about being over optimistic about GIS adoption in developing countries. His warning is espceially vaild for the SSA region, and his appeal to focus on the ‘use’ that is to be made of GIS and not the technology itself, is in accordance with the application driven approach adopted here.

In Table 6.10 the most important requirements are examined in the light of the applications that formed the basis of this research. The application at the strategic level should allow the monitoring and analysis of physical development processes of all informal settlements and enable the preparation of prioritised proposals for intervention in each settlement. The main beneficiaries of the system will be professionals with expertise in urban planning at local and central government level. Other users could include professionals from other agencies, policy makers, CBO representatives etc.. Although it is not envisaged that all of these stakeholders would have direct access to the data and analytical and decision making tools, they are all potential suppliers of data and users of the products and outputs of the system.

The application should be based at local government level, in keeping with the trend of decentralisation of responsibility to municipal authorities (Rakodi 2001; Rakodi 2003). However, this does not mean that the local government has the capacity to autonomously develop such a system. Much of the data potentially required for this application comes from other agencies (e.g. basic topographic data from the Surveys and Mapping Division, data on infrastructure connections from DAWASA and TANESCO etc). Therefore the development of such a system will almost certainly have implications for these organisations too.

The usability of digital topographic data for this research was, for example, hampered by the lack of polygon topology for the building data and numerous errors in elevation data, which required considerable work to correct (Sliuzas and Brussel 2000). Were the local government to become a regular user of such data, their requirement for building polygon data would need to be considered explicitly by the SMD, the data supplier. Furthermore, based on observations of the SDP’s use of GIT (Masser and Sliuzas 1999) it is questionable that the local government authorities have the capacity to create and maintain the necessary information infrastructure to deal exclusively with strategic information handling on a permanent basis.

Table 6.10: Applications and requirements for strategic information

Applications & processes	
Item	**Description**
Create & maintain settlement level data sets	Create a multi-temporal database consisting of basic topographic layers & aggregated data that should be capable of updating at 5 year intervals
Analyse urban change processes	Analysis of land use change, settlement growth & densification processes
Analysis & evaluation of planning interventions	Preparation of spatial criteria for evaluation purposes Application of weighted overlay methods
System functions	
Item	**Description**
Data input	Digitising, , data conversion from standard formats (e.g. dxf), satellite data, spatial data to be georeferened & compatible with 1:25,000-1:50,000 data
Data storage	Spatial data in vector & raster formats; Multi-temporal storage of attribute data
Spatial analysis & modelling	Spatial & attribute queries; Spatial overlays (with point, line & polygon features), distance calculations, Weighted Linear Combination; Advanced image processing (only if satellite images to be used)
Output & visualisation	Tables, charts & maps in hardcopy & softcopy; Scope for attribute & spatial queries; Possibility to simultaneously visualise multiple data sets in multiple windows or frames
User specifications	Single user systems, but outputs should be sharable with other users
Database content	
Item	**Description**
Images	Georeferenced aerial photos & satellite images, multi-temporal
Topographic data	Basic topographic data sets: roads, main water courses & water bodies, built up area, contour lines, DTM, buildings (including attributes of size & function)
Thematic data	Hazardous areas, landform, land use, administrative areas, infrastructure networks, social facilities, census tracts & population data (if available), settlement boundaries with aggregated data of basic characteristics such as population, area, density, service levels etc.

Given that such an application is more of an ad-hoc research type activity (Masser and Ottens 1999) that is geared toward the handling of semi-structured decisions of a strategic nature (Grimshaw 1995), it would not normally require the creation of a permanent work unit. In this instance the possibility to engage a local research organisation to conduct such monitoring and analysis tasks on behalf of the local government could be a useful alternative arrangement.

The above requirements and applications form a part of the proposed concept for spatial information support which is presented in Chapter 8 together with the requirements and applications at settlement level. The components dealing with software, database design and hardware are not considered here as they can best be addressed at a later stage, if and when implementation is considered. Further, in Chapter 8 some of the organisational and institutional issues that are beyond the scope of this research but which will require future consideration are also addressed.

Chapter 7

Managing informal development at settlement level

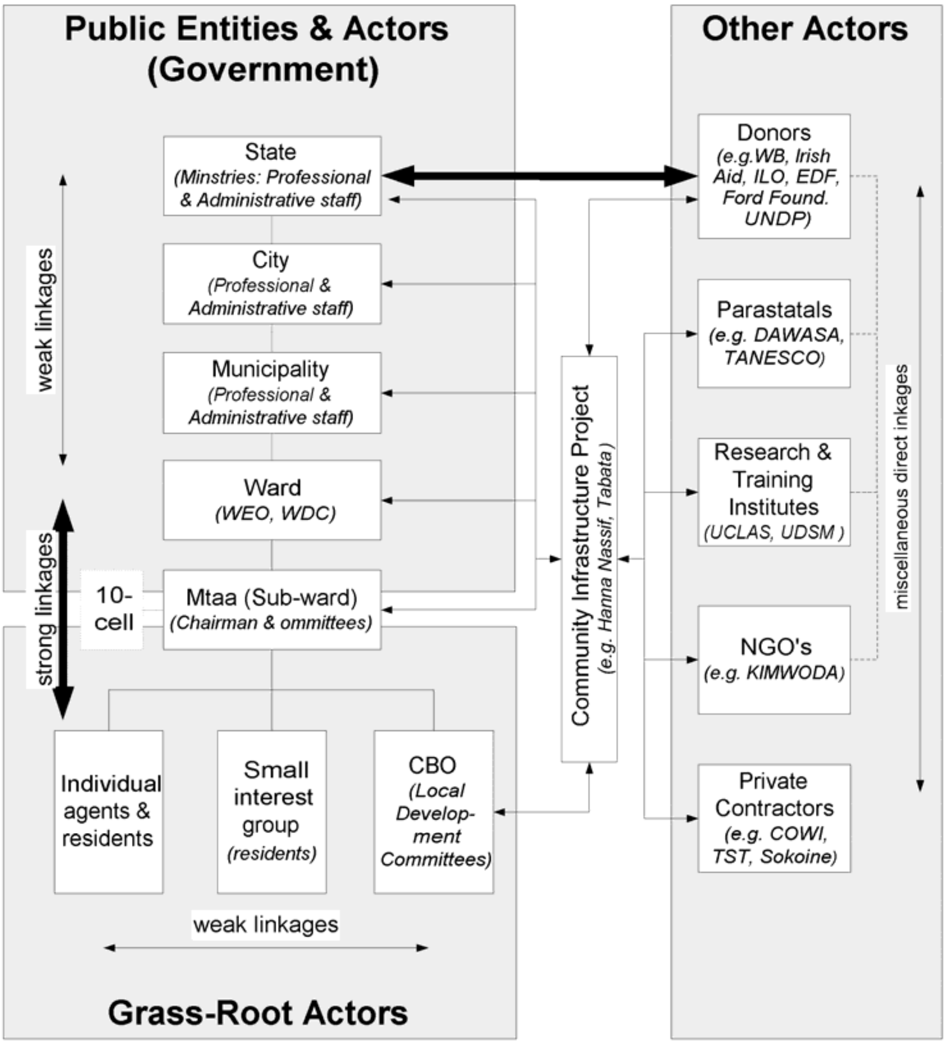
This chapter examines the use of GIT in managing informal development at the level of individual settlements. The discussion is based in part on recent work carried out by other researchers (such as Kombe and Kreibich 1988; Kombe 1995; Kombe and Kreibich 1997; Kombe and Kreibich 2000; Kyessi 2002) and in part on new studies carried out for this research in three settlements, Keko Mwanga, Hanna Nassif and Tabata (see Chapter 5). It provides a description of some typical management problems and current practices of both grass-root actors and formal actors that interact at this level and the capacity of their resource base. It also considers the potential use of GIT based methods to support the grass-root actors and the formal actors in their ambition to improve both the routine management and the upgrading of such settlements, including an examination of some financial considerations related to GIT adoption at this level.

7.1 Actors, issues and linkages at settlement level

The actors involved in managing informal settlements include both grass-root actors, both central and local government bodies, several semi-government agencies, NGO's and some external bodies. Figure 7.1, which is based on the recent work of Lupala (2002) shows how these actors are linked both vertically and horizontally. An adaptation made here was the positioning of the Mtaa (sub-ward) and 10-cell level actors on the boundary of the formal and grass-root actor groups. Although Mtaa leaders have an official status within the formal administrative system that is specified in Government Notice No.3 of 7 January 1994 under the Local Government By-Laws, they are in many ways in a hybrid position, on the interface between the formal and grass-root institutions.

Mtaa leaders differ from the strictly formal actors in a number of ways. Unlike the Ward Executive Officer, who is a full-time, employee of the local government, often with no personal tie to the Ward in question, Mtaa leaders are residents of the Mtaa they represent, they are elected for a period of 2 years by other residents of the Mtaa to perform certain community management duties and to represent them in Ward level discussions (see Section 7.1.2 for a detailed discussion of their duties). Further Mtaa leaders receive no formal salary for their work, but it is common practice for them to sanction land and property transactions and for this service a surcharge of 10% of the sale price is made to the Mtaa office (Kombe 1995, p 121). Although Kombe did not indicate how these funds were used it is apparent that some of these funds form allowances for Mtaa leaders and their staff, such as the Mtaa secretary and other residents who are members of various Mtaa committees.

Figure 7.1: Actors and linkages in informal development



(adapted from Lupala 2002, p. 267 and including additional actors see Table 7.6)

Of these committees there is usually a Local Development Committee (LDC) that was most important for this research. There were therefore quite strong parallels with the CBO system that also depended on the voluntary commitment of residents and usually also incorporates such a committee structure. The close parallels between the Mtaa role and the CBO role contains a potential for conflict but in practice it seems that the Mtaa structures can be combined effectively with CBO based structures. In particular the CBO system of creating housing clusters (Kyessi 2002, p 343) is a useful mechanism that is somewhat similar in scale to the former 10-cell system that is a remnant of the former Chama Cha Mapinduzi (CCM) party structure and which has become less effective since the introduction of a multi-party political system.

The recent work of Kombe, Kyessi, Kreibich and Lupala has established that the Mtaa level is of growing importance in managing local development and that its importance is increasingly recognized by higher level formal actors. But to understand and enhance their role it was necessary to look more closely at their role in managing informal development in relation to the other actor groups. In this research emphasis was given to the following groups: grass-root actors, Mtaa actors, Ward and Municipal level actors, and others.

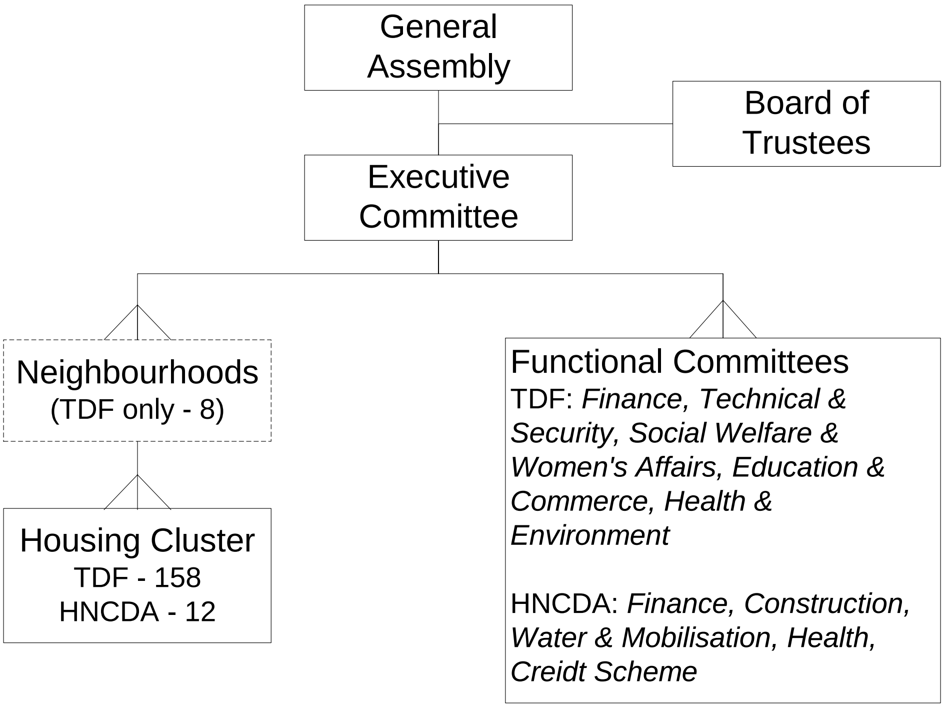
7.1.1 Community based (grass-root) actors

Work on informal and peri-urban development in Dar es Salaam has focused on the role of local (grass-roots) actors, their capacity for self-regulation and identified numerous linkages with formal actors. The term grass-root actors is preferred to informal actors for several reasons that are related to the manner in which they engage and participate in the management of development. For example Kombe (1997) has shown that local leaders, land owners and community based organizations all make important contributions to land management and guiding development, in effect filling the void left by the deficits of the formal land management and development control systems (Kombe and Kreibich 2000). Moreover, there is also evidence that the decisions taken by such actors are recognized by official bodies such as the Ward and Mtaa levels and even by the police and the courts, that are sometimes required to resolve conflicts between land owners. This recognition is important as it provides a form of legitimacy to the grass-root actors that effectively sanctions their role and provides them with a basis to further establish their authority with respect to other grass-root actors in matters of local development.

The relative strength of the linkage between grass-root actors and the lower levels of the formal system is shown in Figure 7.1. In contrast, the work of both Lupala and Kombe has shown that the linkages between the lower and higher levels of the local government system are rather weak. Further, it has been shown that although many grass-root actors such as local leaders have contributed much to the resolution of common problems, it has been difficult to establish a sustained and coordinated approach to settlement improvement that considers collective interests alongside of those of individuals and small groups. Hence the horizontal linkages between the grass-root actors may also tend to be rather weak (see Figure 7.1).

Operational CBO's existed in 2 of the 3 settlements examined in this study, Tabata and Hanna Nassif. The structure and workings of both the Tabata Development Fund (TDF) and the Hanna Nassif Community Development Association (HNCDA) have been described by Kombe (1995) and Kyessi (2002) and their work forms the basis of this discussion which draws on their efforts but extends it by concentrating on issues of information requirements.

Figure 7.2: General structure of CBO's in Tabata and Hanna Nassif



(adapted from Kyessi, 2002)

The HNCDA and TDF have similar organisational structures (see Figure 7.2) that have evolved to address the specific problems and priorities of each settlement. A major difference between the TDF and the HNCDA was the greater number of housing clusters within the TDF, where each cluster has an average size of 1.08 Ha and an average population of only 87 persons. In contrast Hanna Nassif's 12 clusters cover on average 4.2 Ha with an average population of 1670 persons. This difference can be accounted for in several ways. Whereas Hanna Nassif area is a well established and intensively developed settlement, the Tabata area has developed more recently and it comprises a mix of formal development, consisting largely of single family detached houses, and informal development. Although it was not clear from

Kyessi's work why the TDF opted for relatively small clusters he does state that communication and information dissemination within Tabata does seem to work well, despite some reservations regarding poor transparency and accountability (Kyessi 2002, p 162 & p 191). The relatively small cluster size could stem from the former 10-cell system that was based on groups of 10-20 houses, while the larger cluster size adopted by the HNCDA could simply reflect the difficulty of defining small, readily identifiable clusters in a settlement that is generally more congested and more haphazardly developed than Tabata. In addition, Kyessi (ibid, p 275) refers to the participation of many 10-cell leaders in many HNCDA activities, pointing to the close collaboration between formal and informal actors, and with their support fewer clusters may have been necessary to implement the community activities.

Further, each CBO has created a different set of committees in response to its own needs (see Figure 7.2 and Table 7.1 for a brief description of TDF's committees and their basic information requirements). Some slight differences exist between the committee structure of each CBO, although both the TDF and the HNCDA were established as part of the Community Infrastructure Project (CIP) and therefore both have a strong emphasis on improving infrastructure in each settlement (i.e. TDF: water supply, road maintenance, drainage, solid waste. HNCDA: drainage, road maintenance, water supply).

Although the infrastructure issues are important determinants of the physical living conditions in any urban area, there are also many concerns that are related to the private development made by individual landowners that need also to be considered. Discussions held with CBO representatives in Tabata and Hanna Nassif (described in Section 5.4.3) revealed that there were common concerns with the lack of control over private construction that results in encroachments on roads and footpaths and boundary disputes between neighbours. More importantly, both CBO's report that the upgrading process that they have instigated had in some ways aggravated such problems. The effects of infrastructure improvements were stated to be rising property prices and rents; increased construction, especially in favourable locations and on areas that have benefited from improved drainage; and signs of an influx of wealthier households into the area (i.e. gentrification) were also mentioned.

Interestingly gentrification was seen by the CBO members as having both positive and negative effects. On the positive side the wealthier residents brought more resources and invested in their property and may have established small local businesses. These actions tended to have a stimulating effect on neighbouring property owners. However, it has also been found that many new residents did not identify with the community in the same manner as older residents and they may not support the activities of the CBO. In time, if gentrification is rapid, and new residents do not become members of the CBO, the effectiveness of the CBO in managing settlement improvements could therefore be undermined.

Table 7.1: TDF committee tasks and information requirements

Committee	Tasks	Information requirements
TDF Executive	Formulate & plan activities, programmes and projects Overall co-ordination of projects Prepare budgets & proposals for General Assembly Liaison with external actors	Extent of CBO area, neighbourhoods & clusters Location & ID of member's house(s) Names and residences of committee members and neighbourhood and cluster representatives
Finance Committee	Managing revenue collection, use & control of finances Monitoring finances of water project	Itemised details of incomes & expenditures and assets
Technical & Security Committee	Managing construction activities & operational aspects of water supply Managing physical assets of TDF	Nature & location of all physical assets, plant & equipment (including water network)
Health & Environment	Tree planting Environmental cleaning Selling mosquito nets Managing local health education	Location of planted trees Location of waste collection points
Social Welfare & Women's Affairs	Organising social activities	Nature, location & availability of resources for social gatherings
Education & Commerce	Sensitising & mobilisation of community members Managing commercial enterprises	Names & residences of committee members & representatives Nature & location of non-residential activities

(adapted from Kyessi, 2002)

Such issues are good examples of the need for the CBO to build and maintain a solid support base amongst the individual households within the settlement. Without such support, the CBO will cease to be an effective agent in the development process in the post-improvement phase when operation and maintenance of infrastructure become more important than their improvement per se. However, the managing of informal settlements is not carried out by CBO's in isolation and, as Kyessi (ibid, p 343) suggests, there is considerable scope for reciprocity between CBO's and actors at the Mtaa level. He found that while CBO's have more know-how and were generally more efficient in providing basic infrastructure than local governments, they lack formal authority over the local population and it was here that the linkage to the Mtaa level was important. Consequently, he noted that successful CBO initiatives ensured that Mtaa leaders and representatives were directly involved in CBO based projects via steering committees. In order to better understand how CBO's and Mtaa level actors can assist each other the role of the Mtaa level was also examined in some detail.

7.1.2 Mtaa level actors

The main actors at the Mtaa level were the Chairman and his staff that consistsed of a secretary and 5 committee members (residents) who were all elected by the residents for a 2 year term. Generally it was expected that these persons would participate in various committees that are intended to assist in the management of the Mtaa, as specified in the Mtaa Chairman's duties (see Table 7.2). The use of a committee structure at Mtaa level was similar to the committee systems found within CBO's discussed above. The structures were in fact so similar that both in Tabata and in Hanna Nassif the Mtaa chairmen and also many 10-cell leaders liase closely with the CBO's and relied on the CBO committees rather than establishing a duplicate system. However, in the case of Keko Mwanga, where no active CBO existed at the time of the research, the area was divided into two Mtaa's (A & B), and each chairman was assisted by 6 persons (4 men and 2 women) that participated in four committees related to Education, Security, Environment and Health, and in which some 10-cell leaders also participate.[27]

Although Kyessi reports that the role of the Mtaa leaders was very important in both Tabata and Hanna Nassif, there were indications that they may be less effective in Keko Mwanga. During an interview, the two Mtaa leaders of Keko Mwanga stated that they were responsible for 7 main tasks, far less than the 13 listed in Table 7.2, and moreover, that they were unable to perform 5 tasks adequately (see Table 7.3). They also expressed the need to establish a small, permanent office within each Mtaa[28] for their use and they felt that the local property rent collected from the residents by the municipal council should be used appropriately and as much as possible for improving the Keko area.

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[27] Recent research in Tungi and Yombo Dovya, 2 settlements in fringe areas without CBO's, has shown that the Mtaa leadership was very active and was assisted by 8 informal sub-committees for water management, constriction, health and environment, conflict resolution, education, business, credit and markets in which 10-cell leaders and interested residents participated in local planning and management (Kyessi 2002, pp 296-297)

[28] By June 2002 each Mtaa chairman had rented a small office for their daily use which was staffed throughout each day to facilitate their visibility within the Mtaa and resident access. This was seen as a very positive development that was relatively easy to achieve but also one that has given them additional presence and credibility within the community.

Furthermore, some differences were apparent in the knowledge and skill levels of the two Mtaa leaders. Whereas the Chairman of Mtaa ‘A’, had completed secondary education and was the owner of a small guesthouse, Mtaa ‘B’ Chairman, had only primary education and was currently unemployed. Although both expressed their desire to fulfil their duties, Mtaa ‘A’s chairman was clearly better able to articulate his concerns and contribute to the discussion of the Mtaa management issues than his colleague in Mtaa ‘B’.

Table 7.2: Duties of the Mtaa Chairman

No	Description of duty
1	Keep a register of all Mtaa residents and other important information as regard the development of the Mtaa in general and information of all births and deaths
2	Supervise security issues relating to the area
3	Arbitrate in small quarrels and misunderstandings which do not need to be sent to courts
4	Mobilize and encourage the payment of taxes and other dues
5	Supervise health issues in the area which include implementation of regional and district health campaigns against communicable diseases
6	Supervise cleanliness in the area
7	Co-operate with Town, Municipal and City Councils in controlling acts of harassment and violence
8	Ensure that school age children are enrolled in schools and to co-operate with school officials to control absenteeism
9	Encourage adult education
10	Mobilise and supervise Mtaa residents in self-help schemes
11	Lead and mobilize other residents of the area to take part in national celebrations and public rallies prepared by the government or council
12	Represent the Mtaa in the Ward Development Committee
13	Execute and other duty as directed by the Town, Municipal or City Council

(based on: Government Notice No. 3 of 7/1/1994)

Table 7.3: Performance of tasks by Mtaa Chairmen in Keko Mwanga

Task	Adequate Performance	Why (not)	Time spent (1 = most)
Security	No	Unable to solve many problems	1
Monitoring education quality and attendance	No	Not enough facilities – rooms and equipment	2
Environmental cleaning	No	No space for waste collection points; poverty – collection of solid waste fees.	3
Represent the community: visitors, ward level meetings etc.	No	Lack of funds.	4
Property tax motivation	Yes	Able to improve performance	5
Health quality	No	No medical facilities in the area. Overcrowded pit latrines; as many as 3 houses/30 persons share one latrine.	6
Property sale registration	Yes	very rare	7
General comment: Mtaa Leader is more a less a full time job but no salary is paid. They are often called out in the night for disturbances.			

(based on interview 28/3/2000)

Irrespective of the differences between the two leaders, the lack of facilities, resources, managerial knowledge and skills was clearly a major handicap for both men and was in stark contrast to their extensive list of duties. Neither Mtaa leader had even seen a map of their area let alone had possession of one. Yet they were held to be responsible for maintaining quite substantial detailed records of resident households and other important information regarding the development of the Mtaa in general. The general lack of data in the case study areas was in keeping with previous findings in other wards (Heholt 1996) and the experiences of the author in Tandale[29] and elsewhere in the city.

[29] In 1998 an enlarged aerial photograph of 1992 of Tandale was provided to the WEO in return for his assistance in a training exercise. This was the sole spatial data available at the office and in 1999 he reported that he had made extensive use of it in preparing for a local election and in resolving conflicts between neighbours.

Despite the problems that the Mtaa leadership was confronted with within the settlement such as building congestion, poverty, illiteracy, unemployment and over-crowding, both Mtaa Chairmen had a positive opinion about the living environment within their settlement. Although this positive view of the area was not shared by the Ward Executive Officer (WEO) of Keko, it is an important reminder that the views of residents may be very different from the views and opinions of professionals and other outsiders.

7.1.3 Ward and Municipal actors

The Mtaa level is formally responsible to the Ward level, where the principal actor is the Ward Executive Officer (WEO), who is appointed by the city council to which the Ward belongs. The WEO is a salaried civil servant who manages a small staff of administrative and technical assistants. For example Keko Ward employed 15 such assistants for the following fields of concern: education (1), accounting (2), agriculture (3), livestock (1), commerce & business licences (1), public health and environment (5), general administration (2). The affairs of the Ward were managed through the Ward Development Committee (WDC) and, in principal through a series of sub-committees dealing with major issues such as health, education, agriculture and security. Although the committee structure was similar to that found at Mtaa level or within CBO's, many of these committees have been found to function poorly due to resource deficits and the WEO therefore often concentrates on routine administrative tasks (Kyessi 2002). Mtaa leaders are however members of the WDC and this establishes a mechanism that should ensure a strong linkage between the Mtaa and Ward levels.

In March 2000, the Keko WEO indicated that he was involved in 9 major activities, including a role as Secretary of the WDC, all of which in his view were being performed satisfactorily (see Table 7.4). His apparent satisfaction was somewhat surprising because of the fact that there was no annual budget for the Ward's activities and he had no specific knowledge of the properties within the ward and the amount of property tax levied from the owners[30]. Plans and proposals that may be developed at Ward level must be submitted to the Municipal Planning Department for technical scrutiny and consideration for funding.

Municipalities, however, have limited capacity to respond to such proposals. As was discussed earlier in Chapter 4, the Municipalities have been substantially under-funded and have inadequate resources to implement projects without external assistance. Gelink (1996, p 36) for example, interviewed the section

[30] Although both the Mtaa leaders and the WEO were active in stimulating the payment of property taxes, the actual payment is made at the Temeke Municipal offices and they therefore have no direct knowledge of the scale of these payments.

heads of the DCC's Urban Planning Department (i.e. Town Planning, Surveys and Mapping, Land Development, Valuation, Architecture) and found that the functioning of all sections was severely constrained by shortages of funds, basic equipment and stationery, poor office management and record keeping and a lack of transport. A more recent investigation of the situation in the Lands and Planning Departments of the city's 3 municipalities by Lupala (2002, p 22) showed that the situation had not changed greatly by 1999 (see Table 7.5).

Table 7.4: Performance of tasks by WEO Keko

Task	Adequate Performance	Time Spent (1 = most)
Administration: supervise all activities in Keko	Yes	1
Supervise collection of revenue	Yes	2
Enforce all by-laws	Yes	3
Secretary to Ward Development Committee	Yes	4
Justice of the peace	Yes	5
Ad hoc duties as required by Municipal Director	Yes	6
Report to Municipal Director	Yes	7
Returning officer for national elections	Yes	8
Supervise and co-ordinate all projects in Keko	Not yet active	9

(based on interview 28 March 2000)

Another indication of the poor capacity for land administration in informal settlements within the Municipalities was obtained in the research of Heholt (1996). His work examined the potential use of the Mtaa chairman and 10-cell leaders to undertake basic house and population registration in the Kilimahewa Mtaa, Makurumla Ward, Kinondoni Municipality. This fully informal Mtaa covered an area of 18.6 Ha. The survey that was performed in November 1995 showed that even with a relatively short explanation, most local leaders were capable of performing such a registration adequately. Moreover several deficiencies in official data were identified.

Table 7.5: Resources available in Lands and Planning Departments

Item	Ilala (no.)	Kinondoni (no.)	Temeke (no.)
Technical manpower	16	16	17
Land officer	4	3	3
Land assistant	1	1	2
Valuation officer	1	2	2
Valuation technician	0	0	1
Town Planner	3	3	3
Land Surveyor	3	3	3
Survey technician	3	3	3
Architect	1	1	1
Transport	-	-	-
Studio Equipment	-	-	-
Layout plans	Some	Some	Some

(source: Lupala, 2002, p 22)

The survey showed that only 70% of the properties within the Mtaa had been issued a revenue number[31]. The large number of unregistered properties was particularly surprising because the Kinondoni Land Officer had indicated that his staff had updated the house registration only 2 months earlier, providing a clear indication of the ineffectiveness of the municpal lands office in land administration within informal settlements at that time. Further, the survey provided evidence for the inaccuracy of population data from the 1998 census. Where as the population of the Mtaa in 1988 was said to be 4,548 (991 households, 4.6 pers/hhld), the 1995 survey results showed a population of 7608 (2215 households, 3.3 pers/hhld). The 1995 population figure is more than 30% higher than what would be expected in the area if the 1988 population was correct and had grown at a rate of 4.5% p.a., lending some credence to claims by local professionals that the 1988 census figures were unreliable and significantly less than the actual population.

[31] A revenue number is a unique identification number that is assigned to each house in the city by the relevant land officer at municipal level. It is used by the municipality for the collection of the annual land taxes and development levies and is usually painted on the door or wall of the house in question.

Given such problems and constraints it is hardly surprising that community based planning and development has been adopted as the main strategy for managing informal settlements, as only limited support can be expected from the municipal level given the disparity between their capacity and the scale of informal development. The creation of a Community Infrastructure Programme (CIP) within the Dar es Salaam City Council (DCC) has arisen as result of this recognition. The list of possible actors is however not yet complete as several other actors can at times also play a role in such settlements.

7.1.4 Other actors

The involvement of other actors in managing informal settlements is to a large extent dependent on their specific functional mandate and moreover their involvement is often on a project basis. Public utility agencies like DAWASA and TANESCO that are responsibe for the provision, operation and maintenance of specific utility networks and services, (i.e. water and sewerage, and electricity respectively) are not generally concerned with other development issues unless these conflict with their specific interests. Therefore, whereas some individual households may have some contact with agencies such as DAWASA and TANESCO for their individual water and electricity connections, most routine daily management issues are dealt with via the linkages between CBO, where one exists, the Mtaa and the Municipality.

However, the initiation of action planning projects such as settlement upgrading often brings in additional actors with additional resources to enable capital improvements to be made but it may also greatly complicate the management framework and linkages. Table 7.6 provides an overview of typical roles that such actors have played in 3 different community based infrastructure improvement projects in Dar es Salaam, including 2 of the case studies in this research. Such a large number of actors is a challenge for any project structure as each will have its specific interests and strategies.

In addition to the many actors listed in Table 7.6, there are also many connections with the levels discussed previously, and often many linkages with other CBO's. Some projects have also attracted considerable interest from foreign CBO's and local governments via international CIP networks. There are, for example many inter-community exchanges of knowledge and experiences between the various CIP projects, and the award of the Dubai International Award to the CIP in 1998 has attracted much international attention to the projects and Dar es Salaam and brought many foreign visitors to the city to learn from their experiences.

Table 7.6: Roles of other actors in selected informal settlements

Actor	Tabata	Hanna Nassif	Buguruni
Parastatals (i.e. semi-government authority)	DAWASA, TANESCO: Policy guidelines, network design, technical supervision and monitoring	DAWASA: member of project steering committee	DAWASA: Policy guidelines, network design, technical supervision and monitoring
Central Government	MLHSD: updating base maps Ministry of Water: Policy guidelines and verification of water quality	Incidental: linkages generally rather weak	Min. of Health & Min. of Community Development, Children and Women's Affairs: policy guidelines, permits and standards
Private contractors	Water tank specialists: con-struction of water tanks, pumps and networks	COWI consultant and TST Engineering employed to design roads and drains and oversee construction	Planning, design & implementation of some improvements
NGO's	Municipal Development Programme: knowledge and training	KIMWODA: collection of solid waste	PLAN: mobilisation, funding, technical support and training Poverty Africa: micro-finance
Research Institutes (UDSM, UCLAS, etc)	Knowledge and skills, labour (staff and students), training	Knowledge and skills, labour (staff and students), training, several staff employed as consultants to manage specific elements of the project	Evaluation studies for VIP and solid waste management, focus groups and training
Donors	Irish Aid, World Bank, UNDP	Ford Foundation, ILO, UNDP, UNCHS, UNV, LIFE, EDF – providing funding and technical expertise	PLAN International

(adapted from Kyessi 2002)

7.2 Resource and capacity issues at settlement level

From the previous section it is clear that no single actor group is capable of independently dealing with all issues and activities relevant for managing an informal settlement. Although local professionals generally were of the opinion that the local actors were best placed to manage such settlements, they also had serious doubts about their capacity to do actual do so (see section 6.1.2), a view that was consistent with the opinion of the Mtaa leaders in Keko Mwanga about their ability to perform their tasks (refer Table 7.3). It was therefore relevant to examine what local resources were available and could potentially be mobilised at settlement level. This was primarily done by examining the contributions of different actors in the Hanna Nassif and Tabata CIP projects, which were considered to be illustrative of the potential that may be utilised elsewhere in the city and, where relevant, referring to findings from recent investigations by or under the supervision of the author in Keko Mwanga.

In both CIP projects the community has contributed in several ways to the upgrading process. Their contribution consisted primarily of the following components (Kyessi 2002): *i)* paid and voluntary labour in construction, operations, maintenance of new infrastructure (including roads, deep well based water supply systems and drainage networks); *ii)* organisational capacity in mobilisation of residents; *iii)* information: collection of basic information and local knowledge of problems etc.; *iv)* light equipment for excavation and construction activities; *v)* land for public access (roads and footpaths) and community facilities; *vi)* financial contributions through CBO membership, donations and user charges for infrastructure etc..

In particular, the provision of labour by residents can be very substantial and important, both in terms of implementation as well as in developing a sense of project ownership by residents through their direct participation in the improvement process. As Table 7.7 shows residents of both upgraded settlements were able to contribute their labour for infrastructure developments. However, in Hanna Nassif, where labour inputs were paid via a community contracting system, inputs were much higher and, in contrast to Tabata where most labour was voluntary, most labour was provided by males.

Unfortunately the financial details provided by Kyessi (ibid) for both projects were incomplete and did not allow a full comparison to be made. But the available data showed that the CBO’s were able to generate some revenues via membership fees, a 10% levy on community contracts, service charges for water and, in the case of Hanna Nassif, a road toll that was temporarily applied

Table 7.7: Comparison of upgrading projects in Hanna Nassif and Tabata

Aspect	Hanna Nassif	Tabata
Project period	Phase I: 1994-1996 Phase II: 1996-1999	1996-1999
Main Priorities	Road improvement Storm water drainage Community Water supply via deep wells and kiosks (2nd phase)	Community water supply via deep wells and kiosks Road improvement (2nd phase)
Labour contribution	Phase I: 14,430 person days of paid labour by 511 persons (65% male)	Water supply system: 460 person days of voluntary labour by 168 persons (80% by women)
External Finances	Total TSh 1,160 million (US$ 1,657,000) (I: $ 603,000; II: $ 1,054,000	All capital costs and technical assistance paid by external donors Estimated requirement for road improvements US$ 1,150,000
Community finances	Revenues as of 1999: Membership CBO: TSh 890,000 Road Toll: TSh 7.2 mill. Other: TSh 970,000 Expected CBO contribution Phase I: TSh 8 mill. Actual CBO contribution: TSh 540,000	CBO expected to cover operating and maintenance costs Revenues from water supply system: Annual income: TSh 25 mill. Annual operating expenses: TSh 11 mill. Annual operating surplus: Tsh 14 mill.

(source: Land Value Consult and Management Services 1996; Kyessi 2002)

on the main access road[32]. Indeed the revenue figures from Tabata's water supply system showed that a considerable operating surplus could be generated even when prices were held at comparatively low levels (i.e. TSh 1/litre versus TSh 5-10/litre from water vendors). Despite these positive signs the ability of a CBO to generate sufficient revenues to cover more capital intensive improvements was however questionable. In Phase I of the Hanna Nassif project, for example, the community was expected to contribute TSh 8 million

[32] The Hanna Nassif road toll was operated successfully by the HNCDA between Februrary 1997 and May 1998 but was abolished by order of the DCC.

(approximately 2% of the total costs) toward the project, but in reality only TSh 540,000 was provided. Although it remains to be seen whether community contributions toward road improvements in Tabata can be collected, some problems can be anticipated as road improvements have less immediate benefits to many people than the improvement of water supply systems and it is also less easy to regulate, quantify and charge for improved accessibility, as the experience in Hanna Nassif showed.

The resource situation in Keko Mwanga was very different from that found in Tabata and Hanna Nassif. Although residents were faced with similar problems and have expressed similar priorities for improvement, as Keko was not included as a CIP project area there were no external financial sources to draw upon to make structural improvements in the area and the opportunities for internal revenue generation were also limited. There were no opportunities for settlements to generate revenues without some form of coordinated action such as the community water supply systems operating in the CIP projects. Although Mtaa leaders typically ask a fee of up to 10% of sale price for processing land transactions, and small fees were also levied for the handling of minor conflicts, such funds were used to pay for witnesses and committee members (several examples of the workings of Mtaa leaders in informal land transactions and conflict resolution can be found in: Kombe and Kreibich 1988; Lupala 1999) and therefore do not lead to the generation of a community development fund.

The property registration system is important for the generation of resources for the local government because it forms the basis of a flat rate property tax that in principle is payable by all house owners in the city (see Table 7.8 for the tax rates applied). It is raised from the community members after properties are identified and marked by municipal land valuers. The tax is however paid to the municipality and the funds are not directly available for community use, but the amount collected is to a large extent dependent upon the initial registration. In section 7.1.4 the failure of the Kinondoni municipality to register all properties in an informal settlement was described. Whereas the study in Kinondoni showed that 70 percent of properties were registered (Heholt 1996), the survey of a sample of properties carried out for this research in Keko Mwanga (see section 5.3.3 for details) showed that approximately 50 percent of all properties had been allocated a registration number (Figure 7.3 shows how the revenue number is painted on the house's door during the registration process).

In addition to contributing to their settlements in terms of manual labour and financial contributions, some residents were also a source of technical or managerial knowledge and skills. Typically informal settlements are not mono-functional residential areas; rather they include a variety of small businesses such as guesthouses, convenience shops and perhaps even some light industries. For example, a survey carried in Hanna Nassif in 1998 identified a total of 340 small enterprises, of which 180 were small shops (UCLAS 1998). Similar activities were also found in the 2 other cases settlements. The 1996 community profile prepared in Tabata revealed 192 small businesses including 81 shops, while Kombe and Kreibich (1988, p 98) note that in addition to a growing number of shops and businesses in Keko Mwanga, 17 of the 32 households that they interviewed were engaged in some form of home based petty trading. Such activities are important for private household income generation and also add to the potentially available knowledge and skills within the community that can be drawn upon, for example through the work of CBO's.

Table 7.8: Property tax rates in Temeke Municipality in March 2000

Activity type	Rate (TSh p.a.)	Rate (US$ p.a.)
Temporary house	10,000	12.50
Temporary house + business	14,000	17.50
Permanent house	20,000	25.00
Permanent house + business	30,000	37.50

(source: interview with WEO Keko, 28 March 2000)

Figure 7.3: A house with two property registration or revenue numbers

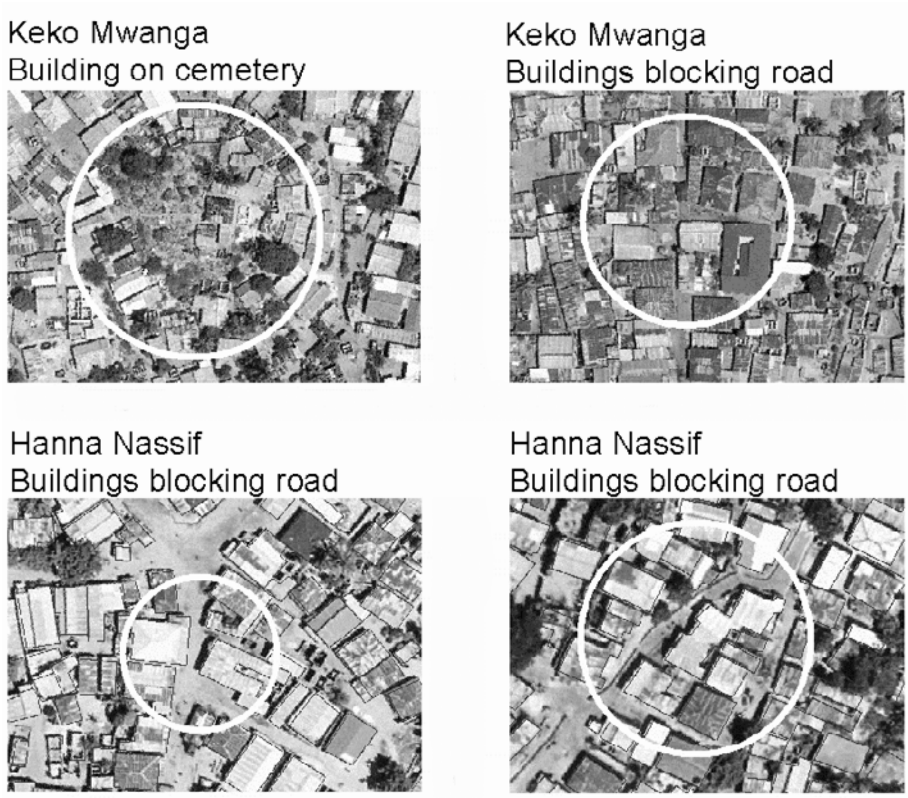
(top – old no.; bottom: new no. issued in June 2001 - source: UPLA PM students, June 2001)

Another potential resource derives from the existence of residents with professional knowledge and skills throughout many informal settlements in Dar es Salaam. As the formal land delivery system has been totally inadequate for many years, even relatively wealthy, professionals have often been forced to live in informal areas (see for some examples the case studies described by Kombe 1995; Kyessi 2002; Lupala 2002). Although this mixing of socio-economic groups is less prominent in Hanna Nassif and Keko Mwanga, it was certainly a factor of importance in Tabata's CIP project where technical personnel and retired professionals who reside in the project area have played an important role within the CBO's Technical Committee, working closely with external consultants to ensure that community needs were considered (Kyessi 2002, p 192).

An important resource that many residents in informal settlements do control is land, although there is always a potential for conflict between private and community interests related to its allocation and use. The processes of informal development and self-regulated informal land management in Dar es Salaam have been well documented in Hanna Nassif, Buguruni and Ukonga Majumba Sita (Kombe 1995), Keko Mwanaga and Rangi Tatu (Kombe and Kreibich 1999), Nyantira, Mbezi, Changanyekeni and Kimara (Lupala 2002). These studies have shown that although most land in such settlements was held in private holdings that were not formally recognised, informal recognition has by and large become an accepted means of regulating land transactions. At least in the initial stages, private land development (i.e. subdivision, building construction and use) was also subject to a fairly high degree of social regulation in which community interests were often balanced against the interests of individual land owners. In the early stages of development in Keko Mwanga and Hanna Nassif, for example, private land owners were encouraged by fellow residents to donate private land for the construction of social facilities such as sport fields, cemeteries, schools, religious buildings and roads (Kombe and Kreibich 1988; Kombe 1995) and similar practices have been recorded in some of the newly developing peri-urban settlements (Lupala 1999; Lupala 2002).

Over time however, the informal land regulation institutions may become less effective, as settlement populations grow and the pressure on urban land increases, especially under the poor economic conditions that were experienced in Tanzania from the late 1970's through to the 1990's. The practice of room rental in informal areas is widespread and population densities can reach more than 400 persons/ha, even in the most densely settled areas without sewerage services. In Keko Mwanga the signs of an increasingly commercialised, over heated land market have been observed (Kombe and Kreibich 1988). According to Keko Mwanga's Mtaa leaders the number of land disputes within the area has increased considerably and at the same time their ability to deal with such disputes has decreased. As a result, land that was once donated by residents for cemeteries was being gradually encroached upon for house construction (see Figure 7.4). This figure also shows some examples of private encroachment on roads in Hanna Nassif and Keko Mwanga. In the most advanced stages of informal settlement development such encroachments seem to become more common place. Community and Mtaa leaders were aware of these problems but lack the instruments to deal with them effectively. Such cases were often referred to higher administrative levels or even to the courts, but these processes take time and should be used as a last resort.

Figure 7.4: Examples of private development encroaching on public land



The importance of protecting public space in informal communities is well recognised in Dar es Salaam and elsewhere. The CBO's in Hanna Nassif and Tabata have indicated their desire to have all public land surveyed and clearly demarcated as a means of reducing such conflicts and preserving the little public space that remains in their settlement. Such an approach was also advocated for informal settlements in Blantyre, Malawi as a means to secure public land for service provision. This approach adds road surveys to the groupwise or block-wise registration that is often advocated as a low cost alternative to individual titling in informal settlements (Fourie 1999, p 39), and in doing so provides a legal description of public rights of way that could be used in resolving conflicts related to road encroachment if requried.

The above discussion underlines the importance of land as a resource at settlement level. However, the significance of land is subject to change over time and needs to be seen in relation to the stage of development of a specific settlement. When housing densities are still low and vacant land is seemingly freely available, it often receives inadequate attention from community leaders. But it is at this stage that the basic spatial structure of an area is often established and subsequently public access routes are defined through the spatial behaviour of residents and visitors, whether travelling on foot or in vehicles. Previous longitudinal studies of such movement patterns in Tandale by the author have shown that many remain visible and functional into the stage of advanced settlement consolidation . Despite the resilience of many movement patterns, the examples of encroachment discussed above also show that such patterns, however well established they are, may still be threatened by private development actions in the absence of effective local regulatory mechanisms related to land.

7.3 The usefulness of GIT based SFAP mosaics in managing settlements

Given the importance of land management issues at settlement level, there is a need for tools that can be used by actors at the grass-roots and lower administrative levels to manage land development. The capacity constraints at municipal level are such that these local actors are, almost by default, in the best position to take more responsibility for local land management and physical planning issues. In this research the potential usefulness of the SFAP mosaics for local land management has been studied. The results of these investigations are described below. First the opinions of representatives of two CBO’s (HNCDA and TDF) concerning the usefulness of the SFAP mosaics is described. This is followed by the examination of the opinions and experiences at the Mtaa level in Keko Mwanga, where copies of the mosaics have been available with Mtaa leaders since April 2000. Finally, the opinions of several professionals who have been involved in the Hanna Nassif project are examined, providing an overview of the spatial data needs of the main user groups at settlement level.

7.3.1 Reactions from CBO members

Representatives of both HNCDA (15 persons: 6 women and 9 men) and TDF (7 persons: 1 woman and 6 men) examined the SFAP mosaics and discussed their potential usefulness for the execution of their tasks. Both CBO’s were reasonably satisfied with the performance of most of their tasks related to land management and development (see Table 7.9), but there were some tasks, such as the implementation of a plot survey in Hanna Nassif, and the construction of sewerage systems and a tree nursery in Tabata, with which they were dissatisfied. Further, both groups expressed several concerns that indicated a growing development pressure in each settlement, citing property price increases, initial signs of gentrification and an increase in small commercial activities within each settlement (see Table 7.10). In fact both CBO's presented a very similar picture of the issues in each settlement.

Table 7.9: CBOs' perception of performance of land management and development related tasks in Hanna Nassif and Tabata

Hanna Nassif : Task	Performance	Problems
Preparations for plot survey	Poor	Abandoned due to technical and financial constraints
Location of water kiosks	Good	
Construction of roads	Satisfactory	
Construction of drains	Good	
Construction of water kiosks	Good	

Tabata: Task	Performance	Problems
Provision of water via deep wells & community kiosks	Satisfactory	Competition with other water suppliers (DAWASA & vendors)
Establishment of other community projects (e.g. tree nursery, vegetable garden etc)	Poor	Low resident awareness; Lack of management capacity for community projects
Construction of roads	Good	All suffer from maintenance problems, inappropriate use and management, lack of funds.
Construction of drains	Good	
Construction of water kiosks	Satisfactory	
Construction of sewers	Very poor	
Solid waste management	Good	Residents not prepared to pay
Tree planting	Satisfactory	Low awareness on environmental management issues

Table 7.10: CBO's view of development issues in Hanna Nassif and Tabata

Issue	Hanna Nassif	Tabata
CBO's ability to guide & manage development	Increased	Increased
Physical development	Increasing	Increasing
Evidence for increased development	Newly drained areas are now fully built up	Many new residents, traffic congestions increasing, less vacant plots
Has upgrading caused increased development pressure?	Yes: Land value increases Higher rents and house prices Increase in petty trading and small businesses	Yes: Land value increases Higher rents and house prices More small businesses (bars, clubs shops)
Specific locations affected by new development	Along improved roads and near schools there are some large houses and some with commercial activities	Along main roads commercial activities, along access roads commercial and residential and infilling in unplanned areas
Community discussions on development pressure	Increase in plot sales is noted (i.e. capitalisation of improvements)	Tabata is seen to be a fast growing and attractive area due to the recent improvements
Expected impact of pressure	New residents have no affinity with HNCDA history and role New residents wealthier & build better houses & shops which improves the area's standing & motivates others	Lack of knowledge of TDF's role seem to cause more boundary conflicts. Number and quality of services (shops, dispensaries, etc) increasing & construction of better houses
Need for development control	Boundary conflicts	Boundary conflicts & ability to manage improvements.
Action taken to address problems of increased development	Inform newcomers of the importance of drains for community	Working on creating by-laws for management of existing services. Intervene to stop new houses blocking access roads in unplanned areas
Most common conflicts	Plot boundary conflicts Disposal of solid waste and grey water onto road	Informal development blocking access roads and irregular layout. Plot boundary conflicts Multiple allocation of plots in planned areas. Environmental nuisance due to commercial activities (e.g. bars and clubs)

Although some of these signs reflect the positive contribution of upgrading to the local economy, there were also concerns that pointed to the ineffectiveness of both CBO's in managing the further development, which was in line with the doubts expressed by local professionals in the ability of local actors to effectively manage informal settlements (see Section 6.1.2). In both settlements boundary conflicts were of growing concern. Though sometimes associated with the arrival of newcomers who were unaware of the settlement's history and especially of the details of the recent improvement programmes and their role in protecting and maintaining these capital improvements, some long standing residents in Hanna Nassif have also been known to behave in a manner that is not conducive to the protection of the local environment and the improved infrastructure[33].

The use of spatial information by the two CBO's has, however, been slightly different (see Table 7.11). In Tabata, Participatory Rapid Appraisal (PRA) methods including sketch maps of transect walks were used during the mobilisation phase at the outset of the project (Mwalukasa 2001). These sketch maps provided the technical support team with information that was transferred to topographic base maps in the initial stages of the project. New base maps showing the 1997 development state were produced for the project. Somewhat surprisingly, although the TDF members stated that they used the topographic map in several ways, including for house registration, it has not been updated, even by approximate sketch mapping techniques[34]. The maps were however still available at TDF offices, where those TDF members with technical skills in map reading were able to utilise them and also to instruct others in their use.

On the other hand, in Hanna Nassif, topographic maps were updated and utilised by the technical staff and, as was noted in the previous section, residents were unable to read the maps and technical drawings. Nor, apparently, was any attempt made to provide the CBO staff with basic training in map reading and provide them with a settlement map for their use. In June 2001, when the CBO received the SFAP mosaic of the settlement its members were not in a position to utilise it in their daily work[35]. However, when pressed by the workshop facilitator those present were able to suggest several uses that were similar to many of the suggestions made by TDF members (see Table 7.11).

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[33] Opinion expressed by the project manager in Hanna Naasif and HNCDA leaders.

[34] The sketch mapping techniques referred to here were used in an earlier study in another of Dar es Salaam's informal areas, Manzese, (Sliuzas, 1998), and have been adopted since by several local researchers as a suitable approach for rapid base mapping in settlements which already have been developed to a considerable extent.

[35] The mosaic supplied to the HNCDA was mounted behind glass in a frame and some CBO members commented that they considered it to have purely decorative value. More recently it has been learnt that the mosaic has been removed from its frame and that it is now frequently utilised by CBO members and visitors.

Table 7.11: CBO perceptions on the usefulness of the SFAP mosaic

Issue	Hanna Nassif	Tabata
Does CBO have maps or air photos	Yes: in June 2001 CBO received a framed copy of the Hanna Nassif SFAP map but it has never been used.	Yes - Topographic map sheet 1:2500, of 1992 updated to 1997. It has not been updated since it was made.
Use of maps and air photos by CBO	CBO has no knowledge of how to use SFAP or maps Suggested uses are: *i0* locate all improvements & facilities – water kiosks, fire hydrants, waste collection points; *ii)* locate debtors for follow-up; *iii)* facilitate planning of road/drain improvements; *iv)* informing visitors about area and project	Map is used in several ways by the committees. *I)* infrastructure construction – show route of drains, water pipes; *ii)* solid waste management – locate collection points; *iii)* house registration for property tax – avoid double counting; *iv)* loans management – locate debtors house; *v)* boundary conflicts – demarcation of site;
Best scale	Some at 1:5000 and also largest scale possible is best so that all important details can be seen.	< 1:2500 not useful. 1:2500 for overview and preferably 1:1000 for detailed work
Improvements needed	Mark all important features: roads, CBO, school, drains, kiosks, fire hydrants waste points etc	Add legend with objects that can be identified. Define roads by edges and mark drains clearly. Add access footpaths
Copies needed by CBO	1:5000 – 20 copies for site work 1:1500/1:1000 – 10 copies for office work	Several copies may be needed depending on use
Updating frequency	5 years	New photos every 6 months and new map every 3 years
Willing to contribute to cost	Yes probably but depends on total cost	Yes probably but depends on total cost

Despite the different experiences and skill levels in handling spatial data products, both CBO's were of the opinion that large scale mosaics could be utilised and they were also able to express some content improvements that could be made, that were along the same lines, though less detailed, as many of suggestions made by the professionals. Both CBO's were, however, unwilling to commit themselves to a cost contribution, being unaware of the amount required.

7.3.2 The use of the mosaic at Mtaa level in Keko Mwanga

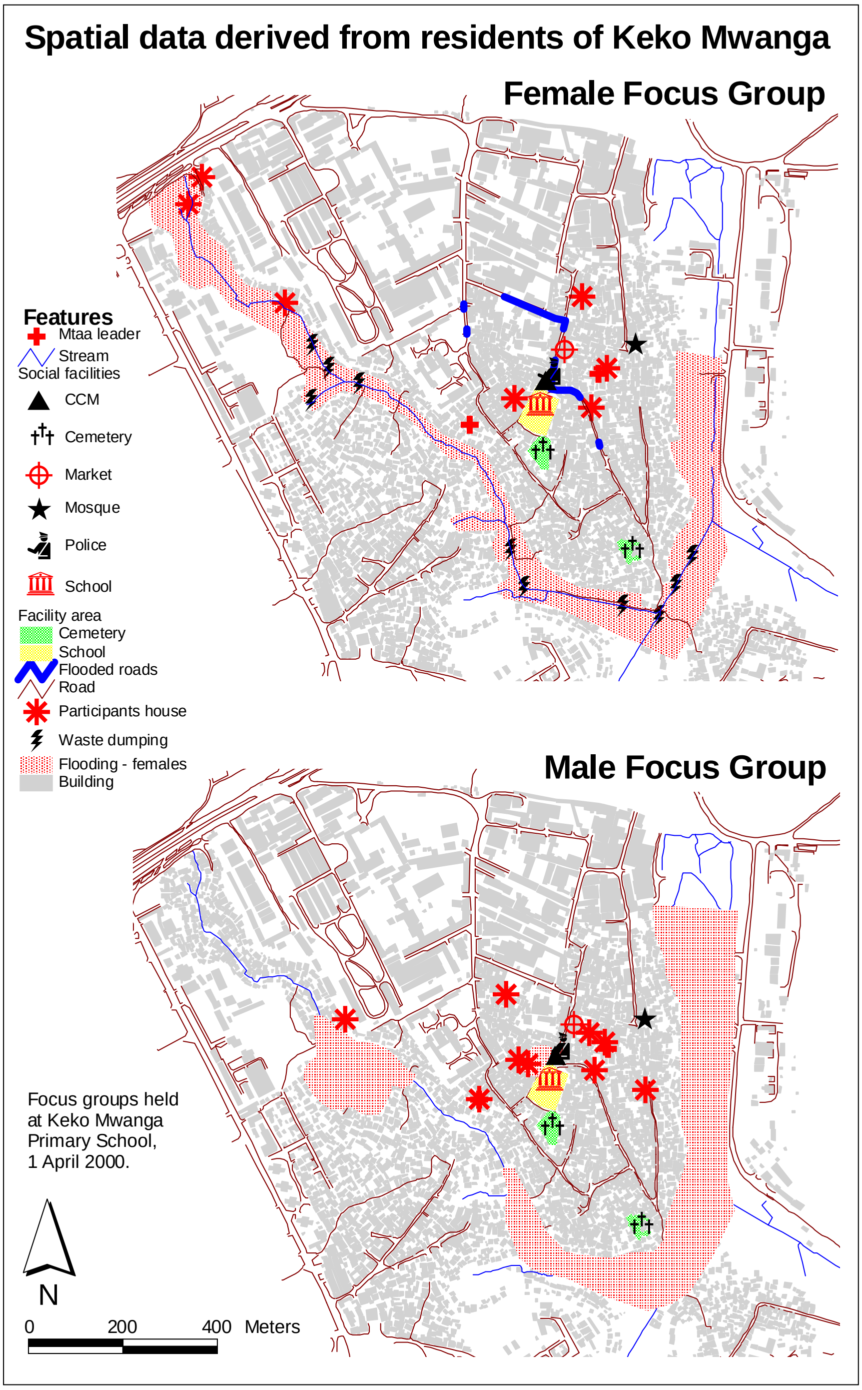
The second group for which the use of SFAP mosaics was examined was at the Mtaa level. For this group data was derived from several activities: an interview with Mtaa leaders and a focus group with residents in 2000 and, in 2001, some additional work was carried out by ITC students as a part of their studies (see Section 5.4.3). The most important findings of these activities are presented below.

The spatial data availability in Keko Mwanga was found to be very similar to that found in Hanna Nassif and Tabata. Although the WEO had seen copies of the 1992 topographic maps of Keko Ward, these were not made available to his office and subsequently the work of Keko's Ward Development Committee in which all Mtaa leaders participate, were conducted without such an aid.

A small experiment was conducted with the WEO and the Mtaa leaders to ascertain their ability to read topographic maps with their ability to read the SFAP mosaic. Although all three men were able to identify a series of well known objects on the topographic map, the two Mtaa leaders could only approximately identify the location of their own houses. All three remarked that when viewing the SFAP mosaic the process of feature identification was easier, and both Mtaa leaders were also able to accurately identify their own house. Although the SFAP mosaic was found to be easier to interpret and use than the map, several suggestions for its improvement were made. Their suggestions were in line with the comments made by CBO and professional users (see previous sub-sections) and were related to the addition of important local facilities and street names etc. that would aid in orientation when interpreting the image. Nevertheless, even without these elements, the Mtaa leaders observed that the mosaics could be a useful communication tool in the execution of many of their primary tasks.

In order to further test its usefulness as a tool for communication and settlement management a focus group was organised for local residents at the Keko Mwanga primary school (described in section 5.4.3). Two separate groups consisting of 9 men and 7 women were asked to identify their own houses, to identify and delineate problem areas within Keko Mwanga and to discuss and prioritise the main problems facing residents in the settlement. Both gender groups could quite easily identify their own houses, the locations of several community facilities and several locations related to specific environmental issues (see Figure 7.5), but there were some differences between the views of the two groups. The women identified several waste dumping sites and they also delineated sections of roads that were subject to flooding, in addition to the flooding occurring along the stream. Further, the 2 gender groups also had different perceptions of the area affected by flooding along the stream.

Figure 7.5: Focus group maps of problems in Keko Mwanga



Different explanations may be possible for such differences. There were, for example, some indications that the male and female groups had slightly different views about problems and priorities within the settlement (see Table 7.12), though both groups were able to justify their selections and had a good understanding of the effects of certain problems. The relatively high priority given by women to road condition and access was explained by their complex daily activity patterns and the necessity for interaction with services that were only available outside of the settlement e.g. some non-food consumption goods, health services, etc. As women are typically more involved in such activities than the men they may tend to place more importance on the poor condition of the roads.

The distribution of the participants' houses over the settlement was also different (see Figure 7.5), and this could also have had a bearing on their experiences and their perceptions of localised problems such as flooding. Whereas none of the male participants had houses in the north-west part of the settlement (Mtaa A), 3 of the women involved were living in this area and, as a consequence the 2 groups delineations of the flooded area were quite different here. Nevertheless, for both genders flooding was an important issue. Not only were they able to delineate substantial areas affected by periodic floods, but they also suggested several factors that contributed to the problem. According to those present, flooding was aggravated by the failure of the local government to maintain the drainage channel in the river valley and the construction of industries in the valley that include plot demarcation walls that cross the stream and block the flow of water.

A survey of flooding levels and duration carried out in the settlement in June 2001 showed that flood water could reach depths of more than 1 metre and last for as long as 3 hours (see Figure 7.6). Furthermore, this survey confirmed the resident's view that the retaining walls associated with 2 industries in the river valley, to the east of the settlement, were major contributing factors to the flooding problems. However, it cannot be denied that house construction close to the stream and in the valley has also contributed to the flood problem. In some cases, the stream's natural water course has been canalised and redirected to create a larger house site (see Figure 7.7). Such practices, and the widespread dumping of solid waste in the stream, also aggravate flooding and require the adoption of measures to mitigate the impact of flooding. The construction of walls around house entrances, elevated pit latrines and raised floor levels are commonly found in those locations that are susceptible to flooding and are a good indicator of such hazards (see Figure 7.8).

Table 7.12: Gender perceptions of problems in Keko Mwanga

Rank	Men	Women
1	*Unemployment* (especially youth)	*Flooding:* Problem in wet season
2	*Poor housing:* Building congestion & poor accessibility, No proper streets & irregular building layout.	*Poor roads & lack of public transport:* Many potholes & drainage problems prevent buses from entering; no access paths in some area
3	*Flooding:* Especially in valley area due to industry building across the drain.	*Poverty and resulting insecurity:* Lack of economic activities (especially for women); lack of surplus for investment in local development
4	*Lack of health facilities:* No government clinic in area; high incidence of malaria due to drainage problems.	*Lack of health facilities (hospital):* Coughing & malaria very common problems; maternity services far away
5	*Poor solid waste collection:* Solid waste not properly collected and removed from area	*Housing congestion:* Congested and chaotic environment, sub-standard buildings
6	*Mixed and conflicting land uses:* Keeping of livestock & some businesses (e.g. bars, clubs) not compatible with residential area. Some nearby industries cause pollution problems	*Insufficient capacity of primary school:* Not enough capacity for demand; illiteracy high amongst women
7	*Insufficient capacity of primary school:* Insufficient rooms & facilities means not able to enrol all eligible children.	*Poor solid waste collection:* Solid waste is scattered over area
8	*Poor sanitation systems:* No proper drains & discharge of pits etc to roads & valleys causes health problems	*Unreliable piped water supply:* No proper pipe network, close to pit latrines.
9	No bridge to Keko Magurambasi: Limits access in wet season	
10	No playground	
11	*Poor water supply:* Piped water expensive & unreliable; Pipes of poor quality & leaking causing health problems.	
12	*Poor public transport:* Buses do not serve area itself as roads are in poor state.	

(source: focus group 1 April 2000)

Figure 7.6: Flood risk and duration according to field surveys

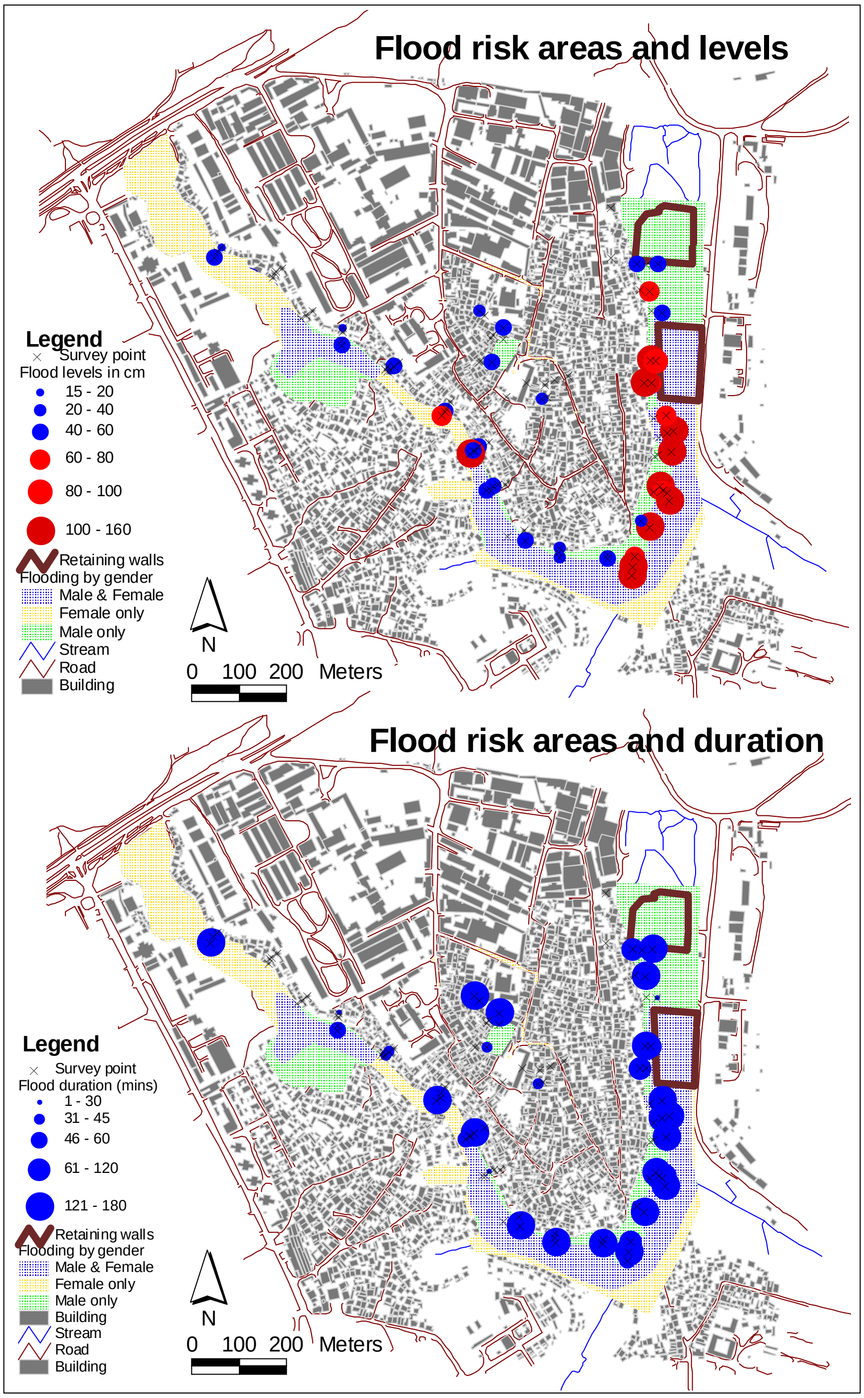
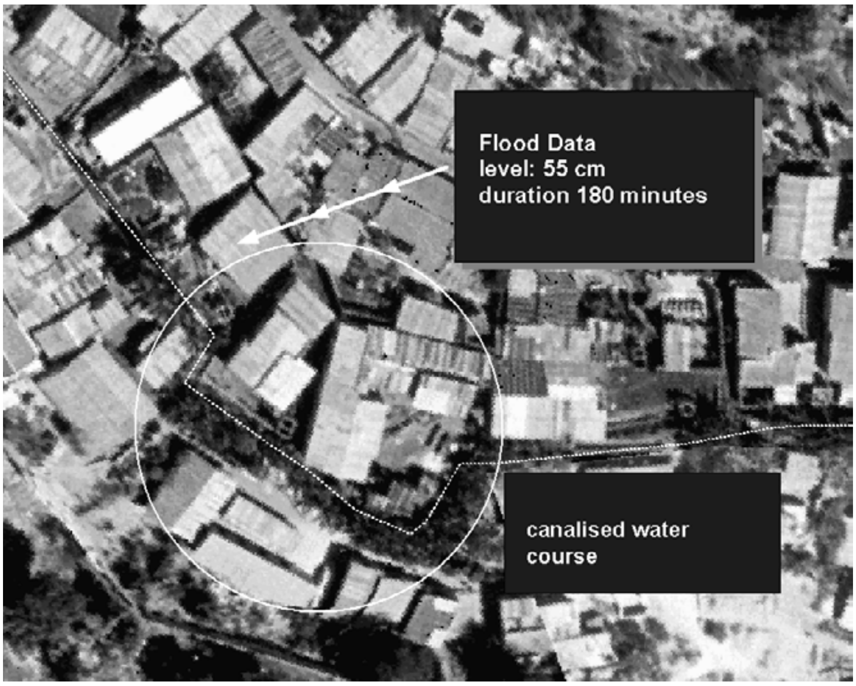


Figure 7.7: Water course modified for construction in Keko Mwanga



The construction of houses in Keko valley is consistent with behaviour found in other settlements and even in the main river valleys that was highlighted in Chapter 6 and which occurs despite official policy that opposes such development. In the particular case of Keko Mwanga, the valley is not easily accessible nor can it be seen from any of the nearby main roads, a characteristic that may tend to lessen the degree of external control over house construction in such valleys. The Mtaa leaders also confirmed that they were unable to exercise any control over such construction, and furthermore, the limits to the Mtaa level controls will also be determined by the actions of higher authorities. Given that local government officers have allocated several industrial plots in the valley it is unreasonable to expect that a policy of preventing house construction in the vicinity will be likely to have much success[36].

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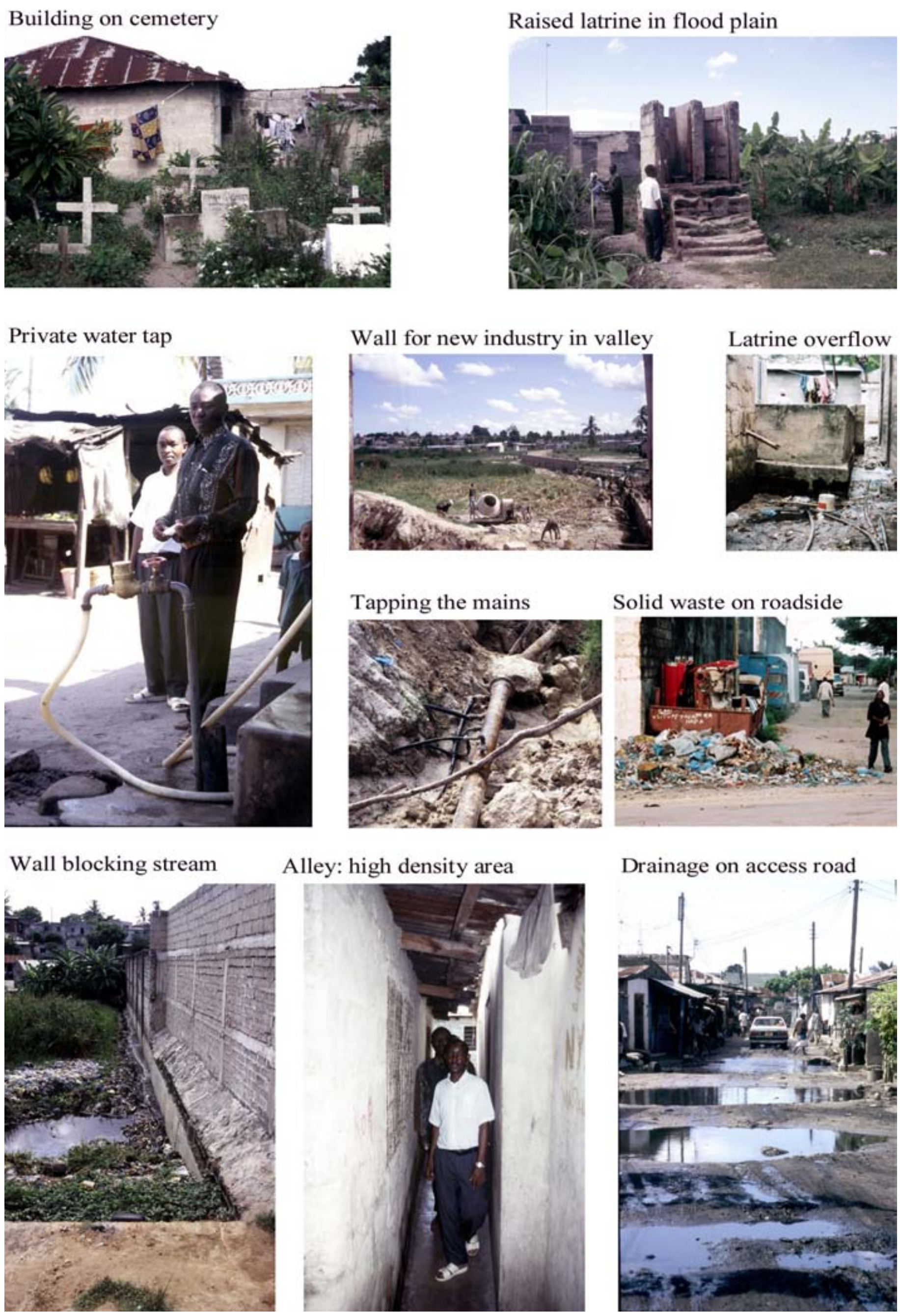
[36] In 2001 a new large retaining wall was under construction in the valley to the east of the study area as preparation for a new industrial development. The community did manage to attract some media attention for this development and protested against the double standards being applied with regard to river valley developments and used the media attention to also highlight the flooding problems caused by the obstruction of water flow by such industries.

Figure 7.8: Ground photographs made in Keko Mwanga



7.3.3 Reactions of urban planning professionals

The role of professionals in settlement management was identified in the previous section and to gauge their views concerning the potential usefulness of the SFAP mosaic several senior professionals who had been involved in technical support and management of the Hanna Nassif project in varying capacities were approached (see Table 7.13). Their positions have given them all a good insight into both technical and managerial aspects of the project, which has involved contributions from 15 different stakeholders (see Table 7.14), including the HNCDA.

Table 7.13: Respondants to questionnaire on SFAP use in Hanna Nassif

No.	Position	Role	Period
1	Project leader	Overall management and co-ordination	1997-2001
2	Project manager	Full time position based in project area	1993-1996
	Project consultant	Part-time advisor on planning and engineering	1996-2000
3	Project manager	Part-time overall project management	1997-2000
4	Training advisor	Initially DCC employee but took post at UCLAS in early 1990's and was training advisor to SDP	1992-1996 & 1999
5	Consultant engineer	Technical backstopping for ILO on survey, design and construction of roads and drains	1991-1996

Spatial data has been an important component of the Hanna Nassif project, but it has been primarily utilised by technical experts. The responses show that spatial data was required and used by the technical team at each stage of the upgrading process but that there were also several deficiencies encountered (see Table 7.15).

At the start of the project, the best available topographic map were 1:2,500 scale machine plots[37] dating from 1982. Even when the 1992 topographic maps became available they also required some updating as many changes had already occurred and these maps also contained several omissions and errors (Sliuzas and Brussel 2000). The scale of the maps was also not ideal for most of the technical activities. Although the topographic maps could be quite easily enlarged to the required scale of 1:1,000, even at this scale such maps were found to be unreadable by the residents who were unfamiliar with such an abstract representation of surface features.

[37] A machine plot is an intermediate product in map production that shows information derived directly from aerial photographs i.e. prior to field verification.

Table 7.14: Main stakeholders in Hanna Nassif CIP project

Organization or group	Main Roles
CBO (HNCDA)	Beneficiaries: Owner of project – Mobilisation of residents – Manage community contracts – Contribute labour
ILO/ASIST	Executing agency (Phase I), Associated agency (Phase II) – Financial support – monitoring and technical backstopping
UNCHS –(SDP), UNV	Associated agencies – Technical support
DCC	Implementing agency – City Chairman was chair of Steering Committee – provide technical support – Support for capacity building
Kinondoni Municipality	Stakeholder – Enforcement of laws & regulations
WEO	Stakeholder – Beneficiary
Mtaa leaders	Stakeholder – Mobilisation
DAWASA	Water supply and technical support
EDF	Financial support for construction materials
COWI Consult	Consultant engineers: design roads, drains and water supply system
UCLAS – Technical Support Team	Executing agency – planning work, supervision of construction, mobilisation& sensitisation of residents, local capacity building
National Income Generation Programme (NIGP)	Financial support
UNDP	Financial support
LIFE	Financial support
Ford Foundation	Financial support

Other deficiencies noted in the spatial data content were: the need for improved elevation data for terrain analysis and storm water run-off analysis - the 200-300mm level accuracy of the 1:2,500 maps was useful for a preliminary analysis and design (for an example of how GIT could have been used in Hanna Nassif for terrain and run-off analysis see: Ramroop 1995), and the lack of data on the location of sub-surface water pipes. The latter issue was a major problem during road and drainage construction as, although there is no area wide network, several individual households have made private connections via shallow, plastic pipes but without adhering to proper construction methods. Consequently many pipes were broken or damaged during drain construction, leaving their owners without water and with additional costs for repair work.

Table 7.15: Uses and deficiencies in spatial information in Hanna Nassif

Nr	Project stage	Collection, use or management of spatial information	Deficiencies in spatial information, effects and solutions
1	Project identification phase	Walk through area with residents to identify flood prone areas and road conditions	Outdated 1982 machine plots at scale 1:2500 used initially. No contour information was available.
2	MOBILIZATION (sensitisation and awareness)	Standard 1:2500 maps used and rough version made at 1:1000. Settlement divided into zones for sensitisation meetings. One zone 40-60 people	Approximate updating of buildings required. Zones were not mapped systematically and residents were not able to read maps effectively creating difficult to map problem areas accurately
3	Design and planning (Technical)	Maps at scale 1:2500 used but were too small for effective use. Sections were enlarged to 1:1000. A line & level survey was carried out with DCC surveyors along roads, footpaths and known low-lying areas. Project area divided into surface water catchments	Detailed contour information not available. Lack of information on location of existing water pipes so this was ignored and had to be dealt with later. With SFAP the design proposals may have been easier to discuss with residents
4	Construction	Maps at scales 1:1000 used extensively with details at 1:100 and 1:50 where required	Residents unable to read maps and detailed engineering drawings. Lack of information on water network leads to many pipes being cut during drain construction
5	Operation and Maintenance	Maps at scale 1:1000 showing improvements made. Used to allocate sections to be maintained by various groups	Not able to provide an overview of how the settlement is being transformed and what further steps need to be taken.

Notes:

Stage 1: Pre-CBO, Mtaa leaders and 10-cell leaders approach DCC for assistance with flooding etc. DCC approach ILO, UNCHS, UNDP etc. Main interest of ILO to transfer labour based methods for infrastructure improvement from rural to urban areas

Stage 2: The Project Manager for Phase I, who had a full-time position in the project, expressed very strong positive opinions about the scope for utilising the SFAP image map in the community mobilisation stage. He considered it useful for house registration, delineation and identification of housing clusters and zones for sensitisation, participatory identification of flooding areas and possible drainage routes and outfall locations based on residents' knowledge of storm water flows; identification of excessive densities and road encroachments; protection of drainage paths; distribution of water kiosks (Phase II)

Stage 4: Construction includes - Phasing of construction; Allocating community contracts; Monitor construction progress; Locate labourers

Useful suggestions were received concerning the scale and content of the mosaic (see Table 7.16). The preferred minimum scale was 1:5000, which was considered useful for quick overviews of the settlement and could be included in project reports and also widely distributed amongst stakeholder groups. However, the large scale mosaic and in particular the 1:1,000 scale mosaic was seen by all respondents as most appropriate as it was easy to distinguish all important buildings and objects, including the smallest structures such as pit latrines. In terms of content the suggested improvements were the addition of elevation contours, the names of important community facilities and several different topographic layers such buildings, the definition of road edges and the possibility to identify buildings located on steep land or floodplains.

In general respondents were positive about the usefulness of such mosaics and it was suggested that all stakeholders should have access to at least one copy of the mosaics at the scales shown in Table 7.16, with implementing agencies requiring multiple copies in either hardcopy or digital format depending on their capacity to handle digital data (see Table 7.17). In addition to the stakeholders mentioned by the respondents it is also suggested that the Survey and Mapping Division of the MLHSD, being the source of the 1:2,500 base map data, also be provided with digital versions of the mosaic. An updating frequency of 2-3 years was the general preference of the group, though it was suggested that this could even be as often every 6 months in very dynamic settlements.

One respondent, also raised several concerns related to the practical usability of the SFAP mosaics. These concerns were primarily related to storage requirements and their durability – how would they stand up to daily wear and tear in the CBO office; what he termed the "Neatness dilemma" that related to the reluctance of CBO staff to use such an expensive looking and "neat" product; the cost of production and the need for capacity building for CBO staff to allow them to utilise the mosaic effectively. These are all legitimate concerns, and as the previous discussion showed, such issues were initially apparent in Hanna Nassif. However in Keko Mwanga no such problems have occurred and the Mtaaa leaders have used them intensively in a variety of ways.

Table 7.16: Improvements to the SFAP mosaic suggested by professionals

SFAP Scale	Suggested improvement	How do you expect that this improvement to enhance the usefulness of the SFAP map?
1:5,000	Name some key objects such as schools & indicate main roads	Assist in orientation and guidance of visitors
	Add features to emphasize terrain constraints (flood areas, drainage discharge locations) and shade road reserves	Better definition of problem areas and understanding of spatial relationships in the settlement.
1:2,500	Use different symbols to distinguish between footpaths and roads including definition of road curb	Better definition of access routes for motorised and non-motorised transport. Helpful in planning location of water kiosks and solid waste collection points
	Mark houses on bad land (i.e. steep slopes and flood plain)	Provide clarity to house owners on long-term occupation
	Name some key objects such as schools, CBO office, water kiosks	
1: 1,500	Add contours	Useful in engineering design
1: 1,000	Define housing clusters and location of mtaa and 10-cell leaders	Aid mobilisation and administrative purposes
	Delineate buildings under construction	Aid in management of construction work
	Add property number to each house and property boundaries in the case of surveyed plots	Assist in property tax administration & collection
	Delineate public land and semi-public land (e.g. open space)	Aid in land administration and conflict resolution
	Add dimensions of roads	Record design parameters that could aid in road encroachment conflicts

Table 7.17: Requirements for SFAP mosaics by stakeholder

	Image Scale			
Organization or group	**1:5,000**	**1:2,500**	**1:1,000**	**Format**
CBO (HNCDA)	1-2	1	2	Hardcopy only
ILO/ASIST	1-2	1	1	Hardcopy only
UNCHS –(SDP), UNV	1-2	1	1	Hardcopy & digital
DCC	1-2	1	3	Hardcopy & digital
Kinondoni Municipality	1-2	1	3	Hardcopy & digital (if GIS available)
WEO	1-2	1	1	Hardcopy only
Mtaa leaders	1-2	1	2	Hardcopy only
DAWASA	1-2	1	2	Hardcopy & digital
COWI Consult	1-2	1	2	Hardcopy & digital
UCLAS – Technical Support Team	1-2	2	4	Hardcopy & digital
UNDP , LIFE, Ford Foundation, EDP, NIGP	1-2	1	1	Hardcopy only

Note: Although respondents were asked to also consider the use of images at scale 1:1500 this scale was considered to be less useful than the 1:1000 which was used as the basis for the engineering design and which is more convenient in terms of measurements.

7.3.4 Other uses by local actors, April 2000 – June 2001

Perhaps more important than the ability of individuals to read such mosaics and use it as a means of geo-referencing their local knowledge and integrating it with other technical data (Abbot, Chambers et al. 1998, p 28), is the impact that the availability of such an image can have on the work of actors that are engaged in work in this type of settlement. As Table 7.18 shows, several types of actors have used the Keko Mwanga mosaic in a variety of ways. Many of these uses involved relatively straightforward tasks, such as being able to quickly obtain an overview of the settlement or for house registration. However, more than this, the mosaic, which stayed in possession of the 2 Mtaa leaders provided them with a useful communication tool and an instrument which gave more credence to their role as a focal point for those actors wishing to work in the settlement.

For some though the mosaic could be a two edged sword. In addition to providing a communication tool at the settlement level, it has enabled previously unregistered houses to be identified and registered, bring them into the eye of formal control systems, and could conceivably lead to improved property tax collection or even, in some cases, possibly to the demolition of certain houses. Nevertheless, as Abbot, Chambers et al (ibid, p 29) also note, in order to obtain public services it is necessary to be on the map.

Table 7.18: Uses made of SFAP mosaic of Keko Mwanga, April 2000 –June 2001

User group	Summary of use made
Mtaa leaders and community management committees	As a general communication tool when visitors come to the area as it provides a good overview of the settlement and is useful to highlight specific features and problems. In discussions about a possible school expansion to delineate the expansion area, identify buildings for purchase and estimate the cost of compensation.
Municipal staff (planners and engineers and land officers)	Delineation of flood prone areas and possible need for house relocation—originally the work was to be done using 1992 maps of the area but the mosaic was found to be more up to date and easier to use for orientation and identification of buildings Update of house registration and renumbering of all properties.
WATERAID (NGO)	To identify sites for new bore holes for water supply. The mosaics were used in the field and were borrowed and used to present the results to the WATERAID management.
Solid waste collectors (private/CBO)	To identify sites for solid waste collection. It was also seen to be useful for house identification in the revenue collection process.
Bureau of Statistics	Mosaic used in preparation for new census for the delineation of enumeration units—boundaries were delineated on the mosaic and transferred to their own maps.

(adapted from: Sliuzas 2003)

The importance of basic registrations was also reflected the experiences of both Hanna Nassif and Tabata where the registration of houses and population characteristics were an integral part of the upgrading process (UCLAS 1992; Mwalukasa 2001). Some basic registrations of buildings and population data are also essential building blocks for settlement upgrading and management (Davidson and Payne 2000; Abbott 2001) an aspect that is taken up again in the final chapter, which includes some recommendations for further work that is needed in this area.. The remainder of this chapter, however, examines the spatial data requirements that can be derived from the tasks examined at the settlement level.

7.4 Spatial data requirements at the settlement level

This chapter has provided details of the institutional complexity at settlement level and the requirement for large scale, detailed spatial data in administrative and planning tasks[38]. Although the CBO's in Dar es Salaam were found to have had little exposure to spatial data they were able to identify several possible areas in which it could be usefully applied. For example the studies made with the SFAP mosaics of Keko Mwanga and Hanna Nassif demonstrated that such GIT derived products have the potential to be used in a variety of ways by all actor groups, including CBO's. Unlike traditional topographic maps, such image based mosaics can be easily interpreted by local residents and they are therefore a potentially valuable support tool for the participatory planning practice that has recently become the norm at settlement level.

These mosaics were also more than just a simple visualisation tool (Sliuzas 2003) as their geometric accuracy is generally comparable to the 1992 topographic data and this characteristic means that they could also be used for regular spatial database updating in rapidly growing settlements. The house registration system in particular has been deficient and ineffective, and yet it provides an important dataset both for local administrative functions (Fourie 1998) and for upgrading (Abbott 2001). Both the Ward and Mtaa levels have substantial responsibilities in general administrative matters and in development control yet they were found to lack useful forms of spatial data and their capacity to influence private development was quite limited. Where upgrading projects have taken place, many more actors were involved in creating infrastructure and in the building of local settlement management capacity (Kyessi 2004). Although, considerable spatial data was acquired for the 2 upgrading projects examined here, this data has been primarily collected, used and controlled by the professionals involved in these projects, and little attempt has been made to facilitate the effective use of such data by non-professional groups at settlement level.

In this aspect there were some parallels with PGIS initiatives in the USA in which those responsible for spatial information handling were usually independent of the community itself and the use of spatial information by the target community was often passive (Leitner, Elwood et al. 2000). In Dar es Salaam, however, a much lower level of spatial data infrastructure is available than that found in the USA and recently the active participation of the settlement level actors is seen by some commentators to be a necessary and

[38] Such complexity at the local level is also evident in PGIS research in the USA that reveals that variations in factors such knowledge, stability, capacity and leadership affect levels of community participation and the use of GIS within PGIS efforts - see Ghose, R. and Elwood, S. (2003). "Public participation GIS and local political context: propositions and research directions." *URISA Journal,* 15, (APA II): 17-24.

inevitable component of improved urban management systems at settlement or Mtaa level (Lupala 2002; Kyessi 2003).

In Table 7.19 and 7.20, details of requirements for several tasks related to administrative and planning functions at the settlement level are presented, using the same approach as that adopted for the strategic level at the end of Chapter 6. The importance of the building/house as a basic physical object in both types of tasks is evident and provides a useful a useful starting point for the development of an information system at settlement level. Buildings are one of the basic objects in an urban GIS (Huxhold 1991; Huxhold 2003) and if an appropriate and sustainable method could be developed for settlement based building/house registration, this data could be used both within the settlement by Mtaa leaders and, where relevant, by CBO's, and a variety of other actors such as local and central government, NGO's etc.

The conventional approach in Dar es Salaam that relies on professional and technical staff at municipal level to undertake and maintain a register of all buildings is almost certainly futile in such dynamic environments. Not only is the manpower not available (see the earlier discussion in Chapter 4), but there is also the lack of transport and other material resources to contend with, and furthermore, what data is collected is also not accessible at the settlement level where it could also be used for a variety of local management functions. Fourie (1998) has called for the training and employment of local land technicians to help guide informal development, but the resources to employ large numbers of land administrators are also not likley to be available in the short to medium term.

Some recent research in Dar es Salaam however, has proposed that CBO's and Mtaa leaders be given more authority in the field of urban land management (Kombe and Kreibich 2000; Kyessi 2002) and have even gone as far as to suggest that property tax should be collected by Mtaa leaders and used to create a local infrastructure development fund (Kyessi 2003, p 23) . Although there is likely to be some resistance to such a proposal it cannot be denied that these actors are, as the professional survey described in Chapter 6 indicated, well placed to manage such settlements on a daily basis. In the final chapter some proposals for utilising their focal position at settlement level and involving them in the collection, use and management of spatial data at Mtaa or settlement level are elaborated upon.

Table 7.19: Technical requirements for administrative applications at settlement level

Item	Description
Administrative applications & processes	
Item	**Description**
Create and maintain property register and map	Create a database consisting of buildings/houses (including data on use and building materials for tax purposes) and ownership details: Useful for all formal levels, CBO and service providers
Create and maintain population register	Record details of property owners' households and general details of any tenant households, including details of births, deaths etc.
Create/maintain register of public spaces, facilities improvements	Such as public roads and footpaths, open space, cemeteries, tree planting, water pipes and public taps, waste collection points etc.. Useful for CBO and service providers
Operation & maintenance of improvements	Location and description of infrastructure elements for which maintenance contracts have been issued.
System functions	
Item	**Description**
Data input	Selected features from large scale topography, georeferenced aerial photographs (vertical and/or SFAP mosaics)
Data storage	Spatial data in vector & raster formats. Ward, Mtaa and CBO's to use hardcopy only.
Output & visualisation	Large scale photo maps with annotations; Possibly systems based on overlays to allow Mtaa and CBO staff to create and maintain registers; Hardcopies for all actors; digital formats available for actors with GIS capability.
User specifications	Basically single user systems, but outputs should be sharable with multiple users
Database content	
Item	**Description**
Images	Georeferenced aerial photographs
Topographic data	Basic large scale topographic data sets: buildings (including ID numbers, attributes of ownership, size & function, and preferably occupancy), roads, main water courses & water bodies, contour lines, DTM,
Thematic data	Hazardous areas (if any); easements & legal restrictions, Cadastral boundaries if any, Administrative boundaries, infrastructure networks, social facilities, etc. as required.

Table 7.20: Technical requirements for planning applications at settlement level

Planning applications & processes	
Item	**Description**
Mobilisation & progress meetings	Subdivision of settlement into blocks for the purpose of sensitisation and mobilisation of residents. Blocks could also be used in the property registration system (see Table 7.18)
Design & planning	Prepare proposals & technical designs for infrastructure improvements such as roads, drains & water supply including possible demolition requirements for construction purposes.
Construction	Supervision of construction works, monitoring progress etc.
System functions	
Item	**Description**
Data input	Digitising of administrative boundaries, blocks, buildings, etc. Data conversion from standard formats (e.g. dxf), SFAP to be used to create mosaics if required; ability to import field survey data with coordinate geometry. All data capable of being produced at scales of up to 1:1000.
Data storage	Spatial data in vector & raster formats
Spatial analysis & modelling	Spatial & attribute queries (especially in digital environment); DTM generation and run-off analysis, buffer generation.
Output & visualisation	Tables, charts & maps in hardcopy & softcopy Scope for attribute & spatial queries Possibility to simultaneously visualise multiple data sets in multiple windows or frames
User specifications	Basically single user system for operation by technical project team, but outputs should be sharable with multiple users and data generated building and household surveys should be exchangeable
Database content	
Item	**Description**
Images	Georeferenced aerial photographs & satellite images
Topographic data	Basic topographic data sets: roads, main water courses & water bodies, built up area, contour lines, DTM, buildings (including attributes of size & function)
Thematic data	Hazardous areas, landform, land use, administrative areas, infrastructure networks, social facilities, census tracts & population data (if available), settlement boundaries with aggregated data of basic characteristics such as population, area, density, service levels etc.

Chapter 8

Towards operational spatial information support

This research was concerned with the development of concepts and methods that could be used by various actors at 2 spatial levels to improve their capacity to manage informal settlements, which are a major feature of cites and towns in many developing countries. Appropriate urban planning concepts and methods are particularly important for the countries of Sub-Saharan Africa because this region is currently distinguished by rapid urbanisation and relatively weak economic performance, providing fertile grounds for the proliferation of informal settlements and the concentration of poverty in urban areas. In the following sections the major findings of the methodological and empirical components of this research are highlighted. These are used as a basis for a conceptual model of spatial information provision for managing informal settlements in large, rapidly growing cities such as Dar es Salaam. Further, recommendations are provided for organizational and institutional issues related to the implementation of the methodology.

8.1 Reflections on the three main themes

In each of the themes addressed in this research there were strong connections between the countries of Sub-Saharan Africa and theoretical and technological developments in the more developed countries of Europe and North America. Many connections that were established during the colonial period have proven to be very durable, almost despite their evident shortcomings, and the transfer of ideas and technology to the SSA continues to be an important factor that influences the nature and development of urban planning as a process.

In the field of urban planning many concepts and methodologies have been transferred and adopted without due concern for local environmental conditions, customs and resources. Given the time and resources required to establish local infrastructures for professional education and to establish and develop a critical body of professional knowledge, and indeed a body of critical professionals, it has taken many years to reach a stage in which innovative approaches to urban planning grounded in local experience could be considered. However, even when the required political support is available, it must be realised that like GIS, urban planning systems are inherently socio-technical systems. As such, the reform process will likely involve complex institutional and organizational changes that can be expected to have a big impact on the people who are involved, irrespective of their level and support from all stakeholders should not be assumed (Reeve and Petch 1999).

Although many of the urban planning systems in SSA countries are now being reformed in keeping with the international urban agenda of good governance, decentralisation and urban management approaches , here too much support is provided from external agents in terms of concepts, methods, technology and finances. However, new more pragmatic and realistic attitudes to informal settlements and indeed cities in general, have given rise to innovative approaches for their planning and management that rely on participatory and collaborative planning and implementation (UNCHS 2000; Rakodi 2003).

Increasingly GIT is also in the process of adoption and diffusion throughout the SSA region. The widespread transfer and diffusion of GIT to developing countries such as those in SSA is by no means a panacea for its development problems nor for its spatial information handling problems (Taylor 1991), which are substantial. In itself this diffusion process is in keeping with global trends related to the adoption of IT, and although SSA generally has very low levels of IT use[39], the gradually increasing local availability of GIT does provide opportunities for making structural improvements in information support related to informal settlement management at strategic and local levels.

8.2 Reflections on the Dar es Salaam case

The empirical work in Dar es Salaam, was used in this research to study and illustrate the situation of informal settlement management in SSA cities and the use of spatial information systems at two distinct but inter-related spatial levels. The literature study has shown that many of the cities of this region that developed under the British colonial influence have several common characteristics. Although it is also apparent that there must also be many differences between the cities of the region that are due to their diverse environmental, cultural or economic conditions, the type of incrementally developed informal settlements found in Dar es Salaam are quite common to the region. Further, from the point of view of the use of remote sensing as a data source in this work, much informal housing found in SSA cities consists of single storey buildings with corrugated galvanised iron roofs. Measurements of density in settlements therefore do not need to consider the effect that multi-storey construction would have on the potential living space available in any settlement[40]. The case study itself was executed at two spatial levels, a city wide analysis of informal development that is typically of concern in a strategic planning process, and the settlement level in which the settlements of Hanna

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[39] World Bank figures for 2001 put the number of PC's at 3.3 per thousand population in Tanzania compared with 9.9/thousand for SSA.

[40] On the other hand most informal settlements in Cairo consist of multi-storey buildings that may have up to 6 or more floors, and in such settlements the methods developed here would be insufficient to monitor density changes, though other remote sensing technques that allowed estimations of building volumes to be made could be useful.

Nassif, Keko Mwanga and Tabata were discussed in detail. Findings for both levels are presented below.

8.2.1 Lessons related to the strategic level

The research at the strategic level provided insights into several topics related to substantive concerns of informal development and urban growth, and into the applicability of a variety of methods and techniques that were developed and applied in the course of this research. These are discussed briefly in the following sections.

Substantive issues of informal development processes

The situation in Dar es Salaam is illustrative and quite typical of the general situation in SSA. The city's population has been growing consistently at a rate of more than 4 percent per annum for more than 20 years, and about 70 percent of the population now resides in informal settlements. Moreover, the analysis has shown that the rate of expansion of informal settlements had increased considerably and that the rate of expansion could not be directly attributed to the saturation of the older more established settlements, where physical densification was still ongoing.

Density levels in settlements were generally found to be highest in the older, more centrally located settlements and to decline with increasing distance from the CBD (refer Figure 6.8), a pattern which is very much in keeping with classical theories related to city development, land values and density gradients (see the discussion of several such models in: Turkstra 1998, pp 25-30). Previously, De Bruijn (1987) had hypothesised on the existence of socially acceptable density levels that would act as thresholds and lead to the levelling-off of densities over time. However, the evidence of continuing densification obtained in earlier research by Sliuzas and Kyessi (1990) was reconfirmed by this research. If socially acceptable density levels do exist, then they either have not yet been reached or they are highly volatile and are readily adjusted to the prevailing socio-economic conditions and the changing demands of residents for affordable and suitable living space.

Although the highest rates of consolidation have generally occurred in the younger settlements that are generally located more in the urban fringe (refer Figures 6.9 & 6.10), considerable construction also took place in some of the older settlements, such as Hanna Nassif and Keko Mwanga that were examined here (see section 8.3 below for details of the densification process in these settlements), and there is little reason to suspect that this has not been the case in other mature settlements of the city.

The potential usefulness of improved data on settlement development processes was revealed via a professional survey that showed the lack of a systematic and comprehensive view of informal expansion and densification processes amongst senior professionals. Their opinions about density generally matched the empirical data but there were indications that their familiarity with informal development in the more remote settlements was less than for the more centrally located settlements. As the fringe settlements were found to have the fastest expansion and densification rates, the relative lack of knowledge about these settlements amongst those who might be expected to play important roles in future policy development is of some concern. Moreover, if it is possible to intervene in the development processes of settlements where density levels are still relatively low, more options for intervention may be explored and the complexity and cost of the intervention is likely to be lower.

Methods and techniques for spatial data acquisition and analysis

The analysis of both expansion and densification processes was made possible by the development and application of methods for acquiring compatible data on land use and physical density from a variety of sources (i.e. vertical and oblique aerial photographs, satellite images and digital topographic data), over an extended time period by several persons with basic knowledge and skills with GIT. Although the extraction of land use data from aerial photographs is quite commonly used in urban research (Bibby and Shepherd 1999; Ikhouria and Sotikare 2001) it has not been routinely performed in Dar es Salaam for strategic monitoring and planning purposes.

Also, relatively little analytical use has been made of the digital topographic data that was available for the city from 1994 onwards. This research has shown how such data can be applied in a spatial analysis of informal development, in a manner that can generate potentially useful data for analysis and policy making. In such a setting, where resources are so constrained and reliable data is in such short supply, methods that create added value from costly spatial data sets could be of considerable benefit, particularly where they do not rely on technically or conceptually sophisticated techniques. One benefit, the generation of new information on building density in settlement is an example of a benefit related to a quantifiable expanded capability that is attributable to the use of GIS (Antenucci, Brown et al. 1991, p 66) and that would be otherwise be unavailable to the urban planning community. The DTM that was generated from elevation data is another example of this type of benefit as it creates opportunities for planners to consider terrain conditions in a more comprehensive manner in their assessment of development constraints, potentially problematic informal development and opportunities for intervention.

However useful these examples have been, they have only been made available through a considerable investment in error correction and preparatory processing that was necessary to make the digital topographic data usable for analysis in a GIS environment (Visser 1999; Sliuzas and Brussel 2000). These deficiencies were not overwhelming though and the development of more user oriented data capture procedures and quality control mechanisms by SMD would do much to enhance the usability of their digital topographic data. More importantly, it would facilitate the establishment of a periodic strategic monitoring process (Masser 1986) that would produce useful data on informal development, which will for the immediate future at least remain the dominant form of development.

To some extent the problems encountered in the topographic data set used here were attributable to the relatively immaturity of GIT in Tanzania at this time. Grimshaw (1995, pp 35-37), for example refers to 5 stages of growth[41]: Opt-out, Stand-alone, Linking, Opportunistic and Corporate, that represent increasing degrees of investment and sophistication in IT use within an organisation. Tukstra (1998, pp 242-244) on the other hand uses a similar model based on 3 stages: Stand-alone, Integration and Networking[42], while Reeve and Petch (1999, p. 142) refer to a 4 stage model: Functional automation, Cross-functional integration, Process management and Process redesign. These models are all rather similar and whichever model is applied to the Dar es Salaam situation, most current GIT users would fall at best into first stages: i.e. Opt-Out or Stand-alone or Functional automation, though there is already an awareness of broader issues associated with high levels amongst certain users[43]. The description of the local context and GIT developments in Chapter 4 show how limited in scale and scope the operational experience with GIT has been to date. Although most GIT users were aware of possible benefits of data sharing and the need for standards etc., most users were found to be primarily focussed on their immediate information needs and were in some cases quite pressed to satisfy these due to resource constraints and a lack of clarity about objectives and in some cases technical competence (Masser and Sliuzas 1999).

The development of a method to estimate consolidation levels using density data extracted from SPOT multi-spectral imagery of 1998 was a useful means to accommodate the lack of recent aerial photographs and topographic data. This image was acquired by a special order that was placed in November 1997 at an

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[41] These stages are based on the work of Gibson, C. and Nolan, R., 1974, Managing the four stages of EDP growth. Harvard Business Review, January-February 52, pp 52-58.
[42] This model is based on the work of Nolan, R., 1979, Managing the crisis in data processing, Harvard Business Review, March-April.
[43] A national working group on GIS was established already in the late 1990's and in 2003 for example a workshop on Spatial Data Infrastructure was held in Dar es Salaam to discuss national and international issues of SDI development.

approximate cost of Euro 4,000 (or Euro 4 per sq km of land cover) for the raw data. Although this data was therefore much less costly than traditional aerial photography, its usability was reduced by its lower spatial resolution (20 m pixels for SPOT 4 XS data used here and 10 m for the new SPOT 5 HSG sensor). Moreover it is quite difficult to acquire a cloud free image in this part of the world[44]. In this regard, although the use of SPOT data has been shown to be useful in a technical sense, the cloud cover issue is a major operational constraint.

Alternative data sources such as radar imagery avoid the cloud cover problem and may have some potential in urban monitoring too. Some exploratory research on the usability of ERS images was also carried out in Dar es Salaam and showed some promise, especially when used together with the SPOT data (Sliuzas, Brussel et al. 1999). However, radar data requires more complex processing methods than most optical data and the images are less easily understood and interpreted by non-experts, making it less useful in a participatory setting with non-technical actors. Although data from optical sensors is therefore still preferred, research with newer higher resolution radar satellites such Radarsat which are used for applications in forest monitoring, ocean pollution monitoring, ocean vessel tracking, and target detection (see www.rsi.ca/products for such examples) may well provide better alternatives in the future.

Despite the above reservations concerning the use of SPOT data, it should be noted that the adaptation of Gorte’s 2 stage classification method, that was used here in conjunction with GIS data and a human interpretation of informal settlement extent (Gorte 1998; Sliuzas, Gorte et al. 2000), was able to produce useful density data that could not otherwise have been collected for this area with the available resources. The utility of using higher resolution imagery for similar work could be a subject for further investigation. However, even with the relatively low resolution (20m) of the SPOT data, the derived density data was of sufficient accuracy to be utilised in a multi-criteria evaluation of alternative strategies for settlement intervention.

Multi-Criteria Evaluation methods and decision support

MCE approaches are closely related to overlay analysis techniques in GIS and the development of spatial MCE applications is therefore a logical development in GIS applications for urban planning. In this research a prototype MCE

[44] The May image was on request for about 6 months and it was the first to meet the specifications of < 10% cloud cover. Subsequent attempts to identify a cloud free image from the SPOT archive have until December 2004 been unsuccessful, an indication of the cloud cover problem.

application was developed incorporating criteria that were based on several physical and spatial characteristics of each settlement. Even with this relatively small data set it was possible to discriminate between settlements on the basis of their potential suitability for various intervention measures that might be considered by local authorities: upgrading, guided land development and relocation.

This demonstration of a method with the available data illustrated the principles involved and showed that there is scope for further development of the prototype. This prototype would form a useful basis for developing an operational MCE approach in close cooperation with local actors. In addition to the sort of data already used, criteria could be developed on the basis of data on infrastructure provision that might be obtained from service providers such as DAWASA and TANESCO, and disaggregated socio-economic data from the recent Census. Alternatively, rapid appraisal methods such as that used by Kyessi (2002) might also be utilised. Whatever the source, however, problems should be anticipated related to the availability of data at the required spatial unit (i.e. informal settlement) and with their temporal correlation. Further, as settlement development is a dynamic process, the additional data should ideally be available in a uniform manner for several time periods and if possible related to the dates of the physical data snapshots. Given the resources available for such work in Dar es Salaam, however, pragmatic approaches that rely as much as possible on available data may offer the best chance of sustainability and acceptance by decision makers.

8.2.2 Lessons at the settlement level

The issues investigated at the settlement level were mainly related to the roles of actors and their need for spatial data, both for settlement administration purposes and in action planning projects that aim to improve one or more aspects of the settlements, such as infrastructure provision.

Substantive and procedural issues of informal development and management

The poor state and lack of basic infrastructure and unregulated construction were important physical development issues in the 3 settlements studied. These issues are also known to be important in most informal areas of the city as infrastructure provision and maintenance has been at a low level for several decades (SDP 1992; SDP 1999; Kyessi 2002). Currently community based approaches to infrastructure upgrading are a main feature of the reforms aimed at making urban planning and management processes more effective. Participation is not only aimed at improving coordination between stakeholders. It is also a means to involve and engage residents in the creation and management of their living environments. Furthermore it is an important component of the urban management paradigm (Webster 1994) that, amongst other concerns, also promotes a more active role for grass roots actors such as CBO's in all stages of the planning process and in the implementation, operation and maintenance of infrastructure improvements.

To be successful such infrastructure projects also depend on strong links with the lowest levels of local government (Ward and Mtaa) and on the technical and financial support of municipalities and a considerable number of other actors, including the donor community. Gaining and maintaining the support of all actors is therefore an essential ingredient in successful projects and future operations and maintenance. Although still comparatively weak in terms of its available resources, it is at the Ward and Mtaa levels, where the local government is closest to the residents, that greatest need exists for creating the capacity to more effectively manage informal development and it is here that innovative methods and techniques are needed and could be utilised. As it also unlikely and even undesirable to assume that high levels of external support will be sustained indefinitely, there is a need to develop methods that can be operated on the basis of local resources alone.

Methods and techniques for spatial data acquisition and analysis

A variety of methods including interviews, questionnaires, workshops and focus groups, were used to collect data from several important actor groups concerned at this level. Although the methods were not uniformly applied in each settlement, the data obtained complements the findings of other recent work at this level in Dar es Salaam and is therefore reliable.

Tools and methods that can enhance communication processes between all actors on settlement problems and future development are required. To date no spatial information has been made systematically available to actors at the settlement level. Yet this level is very much concerned with local development issues including the management of private development and the protection of public spaces from encroachment. Mtaa leaders have responsibilities in this area, but so also do CBO's where they have established a degree of authority within the settlement.

The research found widespread support from all actor groups for the use of large scale image maps as a communication and settlement management tool. All groups preferred image maps at a scale of 1:1,000 that, with some additional annotations and enhancements, could be used in a variety of ways for technical, communication and general management issues. Scales of up to 1:5,000 were primarily seen as providing a basic overview of settlement structure but have otherwise more limited technical value. Given the high building densities in some settlements, images with a smaller scale (e.g. 1:10,000) would be essentially useless at settlement level but could be appropriate for more strategic work. Although this study looked specifically at the use of SFAP image maps, similar products could also be derived from the aerial photographs that are generally produced every 10 years or so in Dar es Salaam. The SFAP method can provide a useful alternative to field surveys for settlements in situations where upgrading is taking place or when the available aerial photographs and maps have become very outdated due to the expansion and densification process. Furthermore, in the course of a project the SFAP method could be repeated at critical phases of the project and for general monitoring and evaluation.

This study has also provided strong evidence to support the case for creating a number of basic registrations in all informal settlements that could be utilised by various actors: the Local Government, WEO, Mtaa leaders, CBO’s and by other actors that may have a temporary interest in such data. The two main entities for the registration are the house and the household. The house is important because of its function as a source of shelter and, in many cases, it also provides space for income generating activities. Moreover, being a fixed, physical object, it can be easily recognised and identified by a suitable unique identifier. The current system of revenue (house) numbers is however inadequate. Numbers are currently issued sequentially within each Mtaa, and especially in fast growing areas a new house may be allocated an identification that is very different from its neighbouring houses, making it difficult to locate when necessary(Antenucci, Brown et al. 1991, pp. 121-123). The typical Swahili house that dominates such settlements also consists of multiple buildings and this should be accounted for in the registration system. A proposal for improving the house numbering and registration system is provided in section 8.3 below.

The household on the other hand is the basic socio-economic unit of the settlement. Each household is also unique and it is the individual household members that create the demand for services and infrastructure within the settlement. Officially Mtaa leaders are required to maintain a population register but in practice this is not done. But such a registration is not only useful for administration and taxation purposes, it is also a basis for analysing demand for services and, in upgrading projects is necessary for considering the settlements socio-economic profile and in studying upgrading options such as relocation that may be required (Abbott 2002b).

8.3 Spatial information support for managing informal settlements

Both modes of urban planning, the forward looking ‘plan making’ tradition and the day to day routine functions associated with the administrative tradition have large and diverse information requirements and therefore encompass many opportunities for utilising GIT (Masser and Ottens 1999). This is particularly true of the more developed countries, where urban development tends to be more orderly and slower, and where much data (including spatial data) is routinely collected and utilised for background studies (analysis), planning studies (policy making) and plan implementation (management) . Especially in the less developed countries with a high degree of informal development and resource constraints, such as Tanzania and other SSA countries, the data situation for both planning levels is often poor. The adoption of GIT should therefore be incremental and, where possible, include the parallel development of information systems that can support strategic planning functions and others that provide more routine operational support (De Bruijn 1990).

Dar es Salaam provided a good setting to examine how GIT could be used for urban planning and management in such a data poor environment. Given the introduction of participatory planning approaches and the gradual adoption of GIT by several agencies, the approach proposed involves multiple stakeholders, as was indicated in the model of a collaborative PSS described in Chapter 3. It aims to provide an information base that can make the planning process and the management of settlements more efficient and based upon data that is as current as possible and agreed upon by stakeholders (Webster 1994, p xiv). However, being highly dependent upon the contextual setting, it will consist of a set of loosely coupled components. When seen together these components can be conceived of as a PSS (Batty 2003), though in this case, one that is directed mainly to the spatial information provision for a wide user community and is not restricted to the needs of local government decision makers alone.

8.3.1 Concept for information support at strategic level

The analysis and application discussed in Chapter 6 demonstrated that a variety of methods could be utilised to monitor the physical development of informal settlements and to analyse and evaluate options and priorities for interventions and resulted in a description of technical requirements for such a system. Ideally such a system should be based at the level that it primarily serves, i.e. the Dar es Salaam City Council (DCC), which due to decentralisation has the primary responsibility for managing strategic planning and coordination activities. The development of an operational information system from these components requires inputs from several actor groups but the information system should be based at the local government level and directed primarily at the information requirements of two working groups that were established under the SDP (refer Chapter 4): City Expansion and Upgrading Unserviced Settlements and that continue to function at city level within the DCC (see Figure 8.1). These working groups would be responsible to an overall steering committee consisting of local and central government officials and key representatives from other major stakeholders. Although the local government level is gaining in importance because of the current decentralisation initiatives, central government remains an important source of revenue for the city and municipal bodies and is therefore also considered as a direct user of the system.

Although the SDP used GIS in the course of the SDP activities and in the production of the strategic plan, the GIS capabilities transferred to the DCC may not yet be sufficient to effectively manage the data and processing entailed in such a system (Masser and Sliuzas 1999). Before committing to such a system it should however, be clear that the necessary resources in terms of experienced GIS experts, software, hardware are available and that there is the required political support (Masser and Campbell 1989). Should a detailed evaluation of the context at DCC reveal that it is not feasible to develop and locate such a system at the DCC, an alternative would be to form a partnership with an academic institution such as UCLAS.

Over the last decade UCLAS has established considerable capacity in both GIT and a variety of application fields including in urban planning and management. Already UCLAS has been identified as a potential contributor to the information system, in particular in the field of remote sensing and land use studies (Figure 8.1), which could be extended to include responsibilities for the overall data management and processing, including the MCE component (shaded area in Figure 8.1). The substantive aspects of their work would be monitored and managed by the working groups on city expansion and on settlement upgrading and the EMIS manager would oversee issues of spatial data management and processing.

Such an arrangement could have several advantages for both partners. It would allow the DCC and the three constituent municipalities to *i)* benefit from expertise that would otherwise be unavailable to them; *ii)* reduce their direct resource commitments to this information system; *iii)* reduce the risk of system failure due to staff changes as UCLAS has a higher capacity in this field. For UCLAS such an arrangement would enable their GIT experts and urban planners to gain operational experience in a challenging application field that would also provide a valuable learning ground for staff and students. This arrangement would in fact extend already existing ties between UCLAS and initiatives introduced under SDP. Additional research activities could utilise the database and further the understanding of urban development processes and the role of GIT as a support tool for strategic urban planning and management. Examples of symbiosis between academic GIS laboratories and local government exist elsewhere and can provide a fruitful basis for the development of practical GIT applications (see for example: Worral 1989; Klosterman 1997; Leitner, Elwood et al. 2000).

Regardless of the actual positioning of the information system, the concept also demonstrates one of its potential weaknesses, namely the institutional complexity, that is recognised as a major bottleneck to be addressed if GIS is to be successful and sustainable (Reeve and Petch 1999). De Man for example discusses the use of GIT as a social process, that produces information that is valued by those using it, and having the potential to have positive and negative influences on collective action and societal learning processes directed at spatial problem solving. In some ways the introduction of a comparatively new technology into a planning system that is undergoing a major reform process, even though it is based on participation is perhaps a risky endeavour. As the urban planning system is itself a dynamic social process, its actors are forming and reforming alliances, seeking new solutions to old problems, and some will almost certainly be suspicious of the technology embodied in GIT. Halla (1999) has already provided some evidence of conflicts between traditional urban land use planners, protagonists of the new participatory planning approaches and developers/users of the GIS based Environmental Management Information System (EMIS), arising in the course of the reform of urban planning in Dar es Salaam. This situation consists of two main elements: an ideological difference within the local planning professionals about the substance and procedural aspects of urban planning, and deficiencies in the strategy for introducing and developing the EMIS component (Masser and Sliuzas 1999).

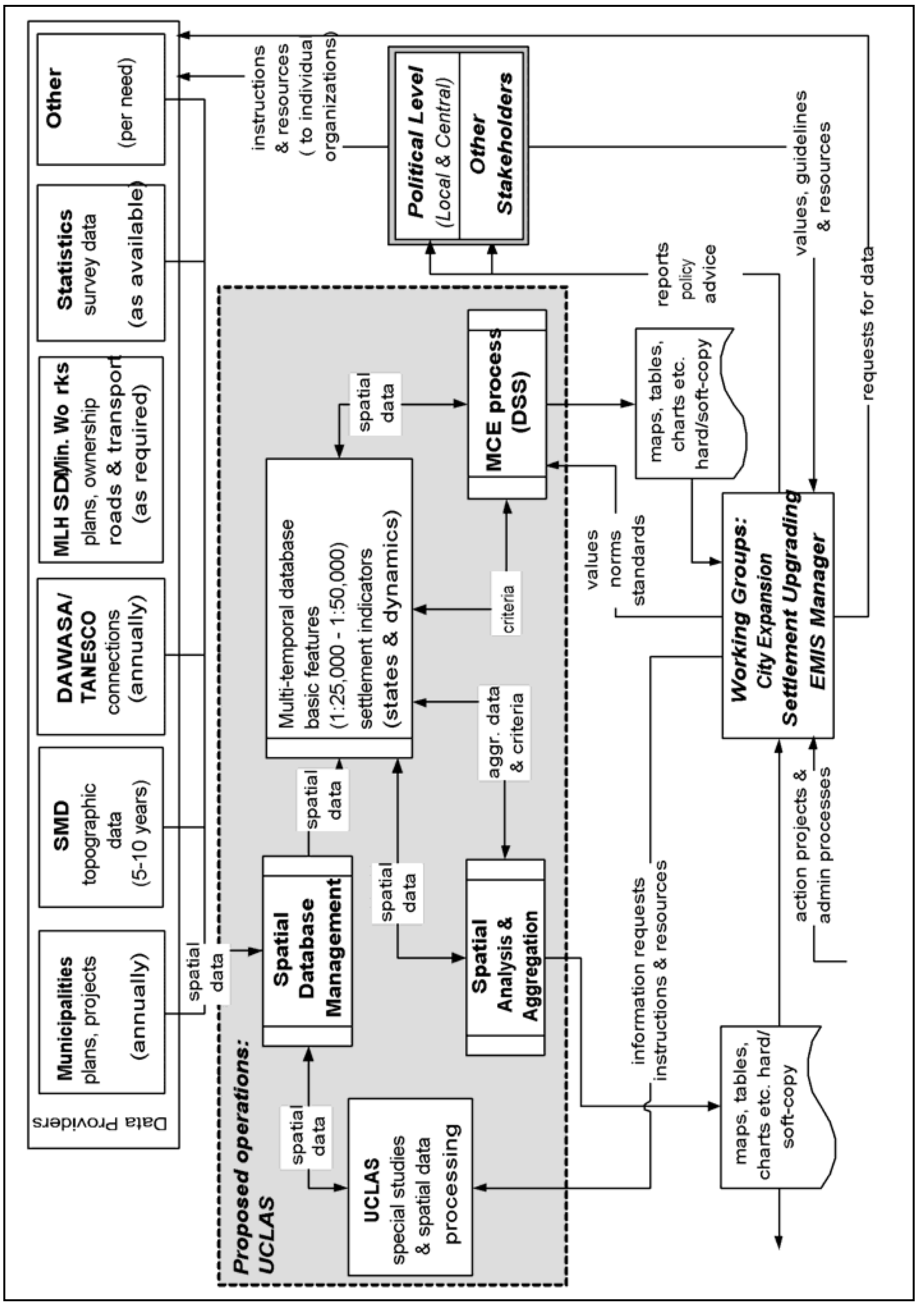
The potential for gaining value from the use of GIT within such a setting has, however, been demonstrated in this study. Though this research was exploratory, rather technical in its approach and relied on a data set that is more limited than ideal, it has nevertheless demonstrated a direction that could be taken for future GIT applications development. The research did ignore the important psychological/sociological aspects of GIT adoption that must be considered in an operational environment. Ideally, such issues should be a part of future work that should be performed with the full collaboration of local actors and allow for more participation of the potential user community in land management and the design and development tasks.

8.3.2 Spatial information support for land management at settlement level

At settlement level land management and development control emerged as key routine type planning issues. The main processes identified previously in Table 7.18 have been used to create a concept for information provision that would support land management functions at settlement level (see Figure 8.2).

Given that the present resource constraints at municipal level are unlikely to change radically, most of the daily management of land and development within informal settlements must be dealt with by Ward and Mtaa level actors working closely together with grass root actors like CBO’s and resident groups within settlements. The scope of their work is indicated by the smaller shaded area in Figure 8.2 and includes both the maintenance of building and household registers as well as the operation and maintenance programme via community contracting, where these are operational. The performance of these tasks should

Figure 8.1: Concept information provision: strategic level



be monitored by relevant Municipal Technical Officers who maintain overall responsibility for managing each process (shown by the larger shaded area) and also registers at municipal level. These registers would initially be in analogue form but, depending on resources could be also in digital format.

An important task that should be managed by the municipal offices is the registration of all public spaces. These include access roads, cemeteries, and any communal recreation spaces (some settlements are known to contain playing fields that are recognized by residents as communal land). Such spaces should be surveyed and clearly demarcated so that local leaders are better able to monitor encroachments[45].

In most cases, all data required within the settlement/Mtaa level should be in analogue form. Large scale, hardcopy maps of blocks or clusters would be annotated to show revenue numbers for each house (see Figure 8.3 for an example of a new numbering system based on blocks and a unique number for each house within each block, and buildings belonging to a house being identified by a letter A, B etc.) and updated according to new approved construction. The house identifier should be linkable to a household register showing details of the owner, the owners household if they reside in the house and any tenant families.

The Mtaa leaders would continue their role in sanctioning property transactions (Kombe 1995), but this should be made subject to certain conditions (e.g. to qualify for a property transfer the property should have a revenue number; any outstanding property taxes should be paid; details of the new owner should be available and recorded; new owners should be made aware of any expectations regarding contributions to settlement level projects; the intended use of the property should be stated – an approval system for any non-residential use may be advisable to combat undue environmental nuisances).

The system implies a bigger role for local leaders. While this will also require additional resources and training, if implemented it could enable communities to gradually build an awareness of the need to balance public and private interests throughout their residents. Similar issues are widespread in these settlements, irrespective of their density level. In most settlements the support required could be obtained from Municipal officers via the formal administrative hierarchy but where upgrading is occurring, technical support for the local leaders could come from the Technical Support Team (as shown in Figure 8.4), that also is a key player in other information handing processes.

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[45] For example, leaders in Malalakuwa settlement recently convinced all but one owner to remove several commercial structures and verandas that were severely restricting access via one the settlements 2 main access roads – discussion with Prof. V. Kreibich, Feb 2004.

Figure 8.2: Concept information provision: settlement level land management function

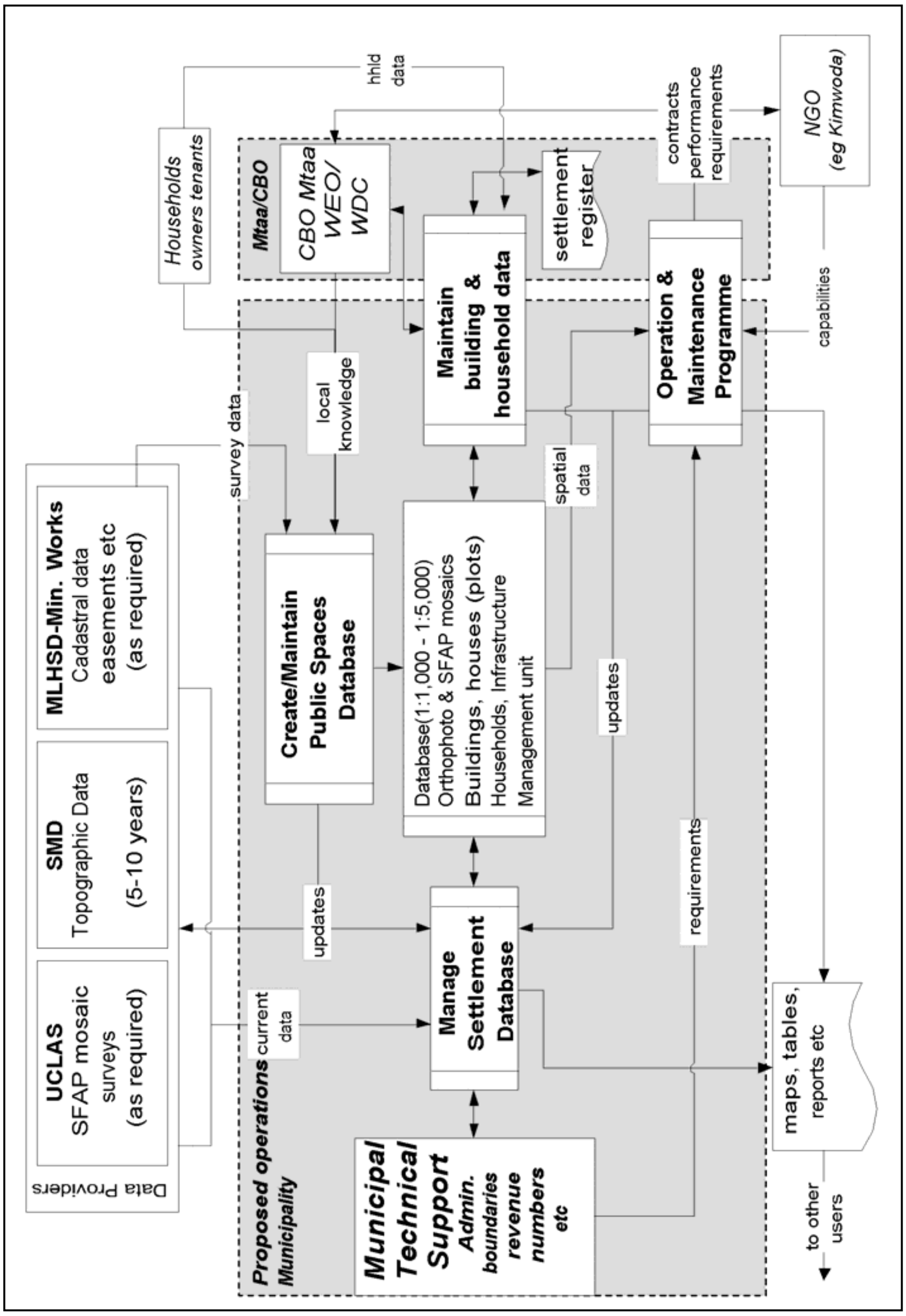


Figure 8.3: Example of block, house and building numbering for Block 79

(Based on a numbering system suggested by Attenucci et al, 1991))

It has been recently proposed that Mtaa or CBO leaders could collect property taxes on behalf of the municipality, and retain some of the funds for use with the Mtaa or settlement (Kyessi 2002; Kyessi 2003). Such proposals may have some merit but will require the establishment of very clear procedures for collection itself and for monitoring the amount collected and the usage of funds. Corruption in land management has been common practice (Kaitilla 1987; Kombe 1994) and decentralising property tax collection to ward level or lower will require the establishment of effective monitoring and control mechanisms to be workable. In action planning projects there are different concerns.

8.3.3 Spatial information support for action planning at settlement level

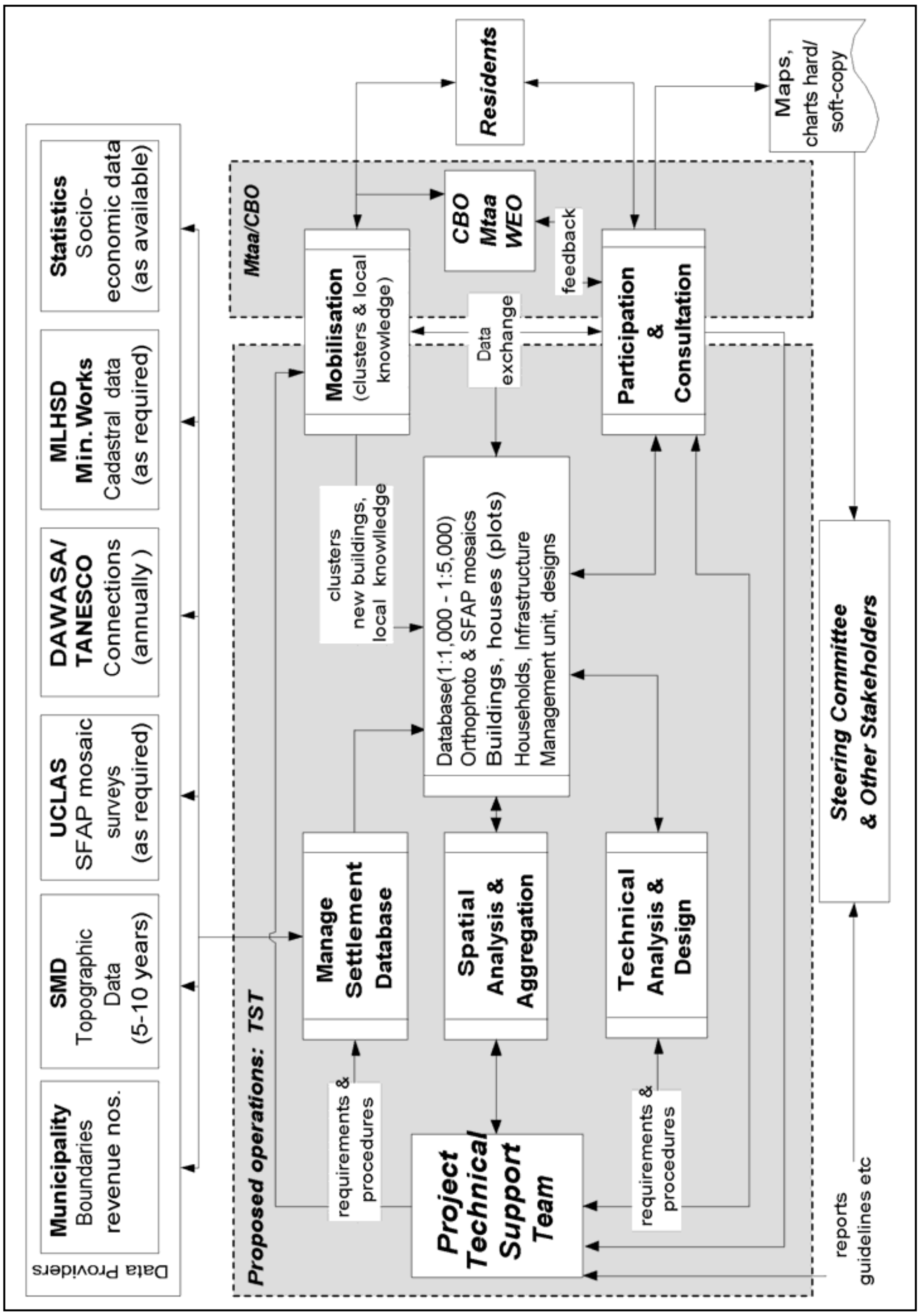
As each action project deals with a specific settlement, the role of the local actors (CBO, Mtaa, Ward) is prominent but it is the Technical Support Team (TST) that has primary responsibility for managing the project in a technical and procedural sense, including the capture, storage and utilisation of the project's information resources (see two shaded areas in Figure 8.4). The TST therefore has direct control over all processes and will facilitate the mobilisation and participation of local actors and the liaison with the Steering Committee and other stakeholders (refer section 7.1.4 for more details of possible stakeholders). An alternative model could be based on UCLAS performing the spatial data processing on behalf of the TST, similar to the proposal for the strategic level. However, given that the processing required is less complex it is envisaged that the TST could perform this task independently, particularly as many issues at settlement level require short response times.

Based on the experience described in Chapter 7, it is suggested that spatial information products that are to be utilised for purposes requiring inputs from residents should as much as possible be based on image based maps. If relatively new vertical aerial photographs are available (say no more than 2 years old in the case of a relatively well consolidated settlement) then enlargements to a working scale of 1:1,000, enhanced with annotations of road names, public buildings etc. would provide a suitable base map for mobilisation purposes. However if suitable photographs are not available, or in the case of a fast growing settlement, the SFAP mosaic technique should be adopted. In this case it is likely that UCLAS could be engaged to produce such a product for the project (Appendix F provides estimates of costs associated with this technique).

Technical analysis and design studies are also primarily the domain of the TST. In addition to the preliminary analysis of the terrain and drainage issues (Ramroop 1995) and the study of environmental issues (Sliuzas 2002) the images and data can also be utilised to generate information on development processes and densities at a detailed level.

This information could be utilised within the project to better understand the micro development processes and provide quantitative and visual evidence to support the concerns expressed at settlement level about the inability of local leaders, whether Mtaa leaders or CBO's, to effectively manage private construction and consolidation. It would also enable the generation of aggregate data that would be a component of the knowledge exchange mechanism between action projects and strategic planning level that was presented in Chapter 3.

Figure 8.4: Concept information provision: settlement level planning functions



8.3.4 Spatial information linkages with the strategic level

Some examples from Hanna Nassif and Keko Mwanga illustrate how this data could be utilised at both spatial levels. In order to examine the consolidation processes at settlement level in more detail roof cover data was generated using a raster data structure (50 m pixels) of each settlement for the two periods 1992 and 1999. Figures 8.5 and 8.6 illustrate the changes in roof coverage that have occurred within both settlements.

Although the general tendency was clearly toward higher densities, there was also some evidence of lower roof coverage in some cells. Informal houses have been found to be subject to both extension well as reduction in size . Such changes are usually an intermediate stage in the housing process, given the remarks made by CBO's and Mtaa leaders concerning ongoing development pressure and, in the case of Hanna Nassif, gentrification processes would suggest that these are likely to be temporary reduction in roof cover density. Along the main road to the west of Hanna Nassif some demolition had taken place in preparation for road widening, and in Keko Mwanga, one large house was purchased by a church group and demolished to provide playing space for children attending their kindergarten.

However, such examples of demolition for public community use were rare and more often change is due to rebuilding by private owners. Chambers (2001) for example showed how in Hanna Nassif land that was previously subject to flooding was rapidly developed after drainage was improved and several large new houses and even a multi-storey guest house have recently been constructed in Hanna Nassif given credence to the appearance of gentrification processes[46], though they do not yet appear to be wide spread.

[46] This information was provided by Prof. Volker Kreibich in a discussion related to this research held in February 2004.

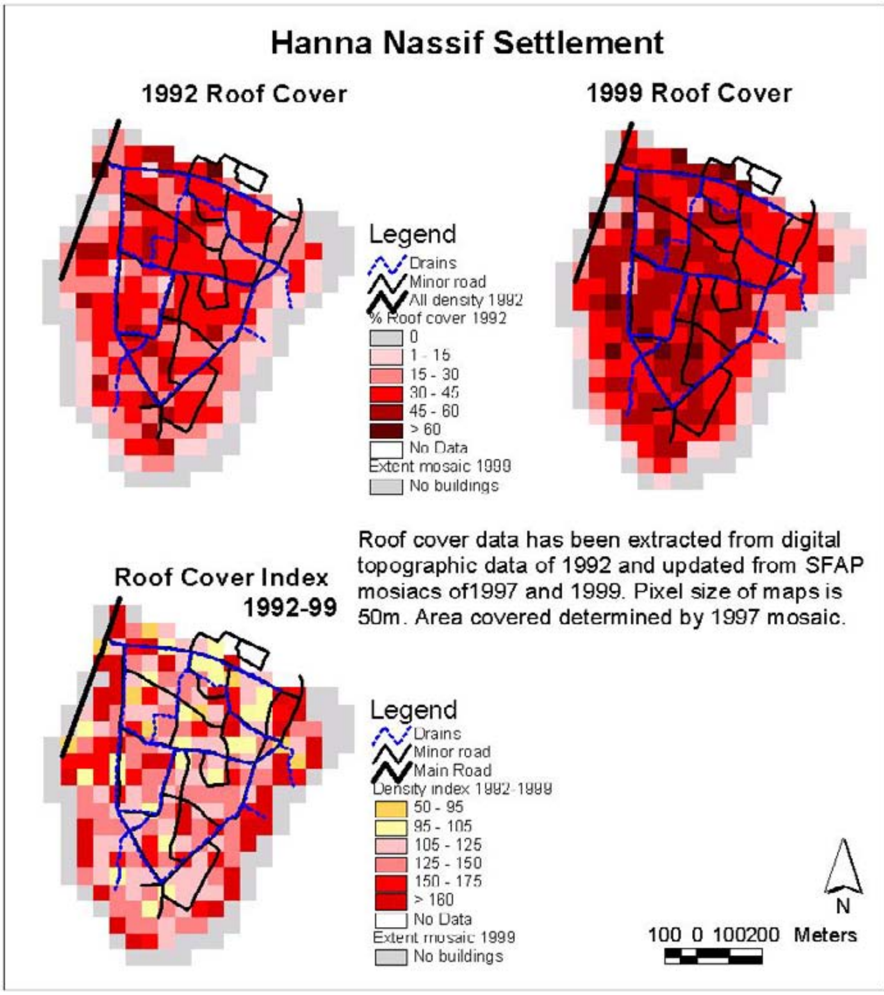
The city wide analysis of informal development discussed in Chapter 6 provided evidence that densification processes have continued throughout all settlements in the city. The comparison of the Settlement Consolidation Index (SCI) for 1992 and 1992, showed that even in the oldest, and most consolidated settlements the construction of additional buildings has taken place. This SCI data was based on a classified density data and was not the optimal approach for examining physical consolidation processes. In addition to producing the density maps at settlement level the updated building polygons of 1999 were used to generate aggregate roof coverage for each settlement. This data was used to compute new values for overall roof coverage in each settlement, which was then compared with the SCI data from the strategic analysis (see Table 8.1).

Table 8.1: Densification in Hanna Nassif and Keko Mwanga, 1992-99

Settlement level roof area data	**Hanna Nassif**	**Keko Mwanga**
1992 roof area (m2)	158,043	131,983
1999 roof area (m2)	216,003	155,047
Average growth rate of roof area	4.6%	2.3 %
Study area (m2)	566,975	343,550
% roof cover 1992 (PRC92)	27.9	38.4
% roof cover 1999 (PRC99)	38.1	45.1
PRC Index 1992-99	136.7	117.5
City wide data on SCI	Hanna Nassif	Keko
SCI92	74.1	81.0
SCI98	81.4	90.6
SCI Index 1992-98	109.9	111.9

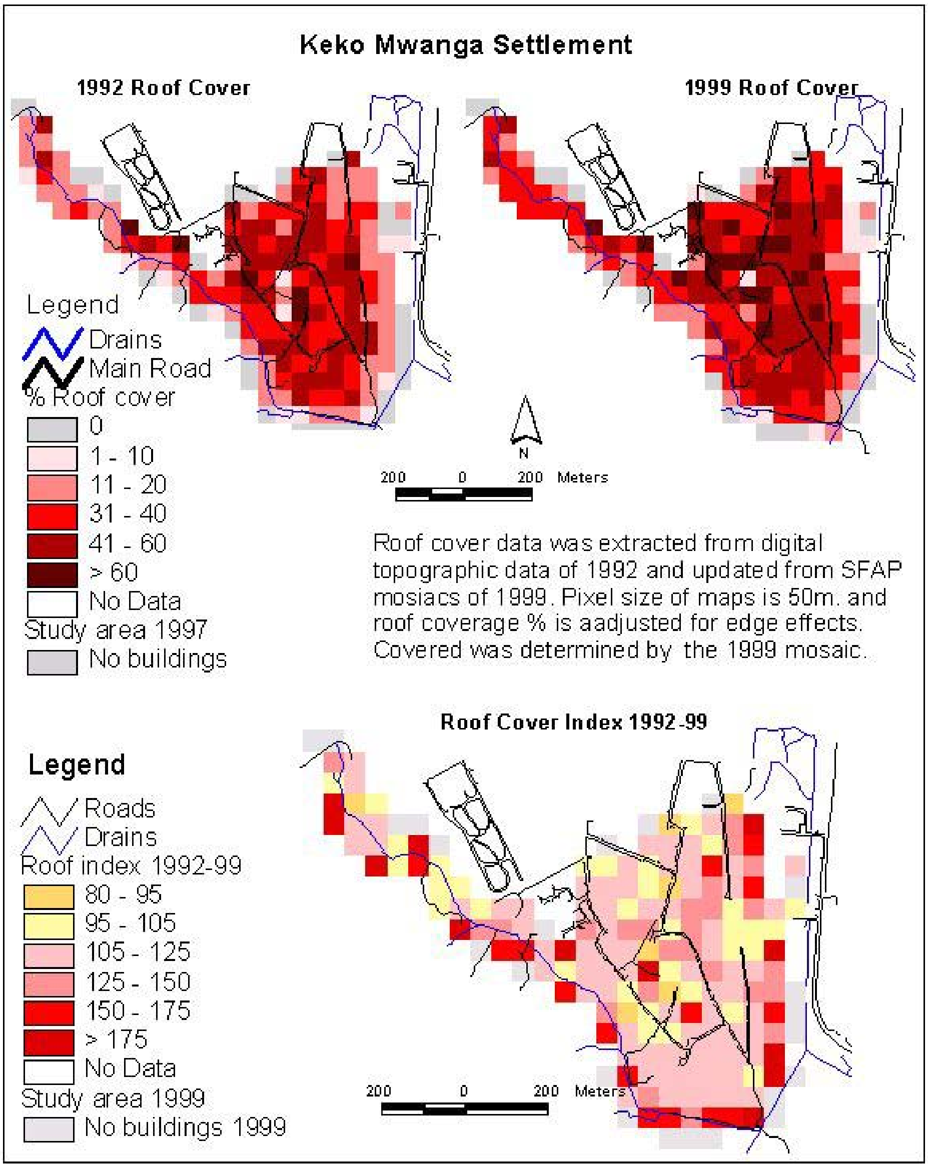
The detailed 1999 roof cover data obtained from the SFAP confirms that both settlements have consolidated further over the period 1992-1999, showing a roof area increase of 37% for Hanna Nassif and 17.5% in Keko Mwanga, but they also revealed a weakness in the SCI method used earlier. Whereas the PRC data showed that the increase in roof area in Hanna Nassif was more than twice that in Keko Mwanga in the same period, the SCI method showed lower consolidation rates and, moreover, it assigned a slightly higher value to Keko Mwanga than to Hanna Nassif.

Figure 8.5: Settlement consolidation, Hanna Nassif 1992-1999.



The SCI method is insensitive to intra-class density changes, because it is based on a scoring system for cells that have been classified into one of 3 density classes (see chapter 5 for an explanation of the SCI scoring system). An increase in roof coverage increasing from 40% to 50% within a given cell would not lead to an increase in SCI value as the cell would be classified as high density in both years, while a change from 25% to 35% produces a SCI increase as the density class would change from medium to high density. Nevertheless, when better data is not available it can provide an indication of density levels and, if satellite images with higher resolutions were to be used, more density classes could be used, making it more sensitive to such situations.

Figure 8.6: Settlement consolidation, Keko Mwanga 1992-1999.



Such detailed data on densification processes can be important as it supports the views expressed at community level and by Mtaa leaders that these settlements, that are amongst the most densely built settlements in the city, were not yet saturated. Furthermore, the high rate of development in Hanna Nassif does suggest that the recent development of the settlement may have been considerably stimulated by the recent upgrading process. Upgrading has not only improved infrastructure and solved some environmental problems in the area, it has also provided a new source of capital for private construction via the community contract system, that has enabled many residents to increase their incomes via paid participation in public works and it has contributed to property value and rent increases (information obtained from CBO's workshops). As most private construction is known to be financed from savings , the implication is that the positive effects of upgrading infrastructure, could quite easily be negated by the further construction of houses by private landowners in the absence of effective development control practices at settlement level.

8.4 Recommendations for future work

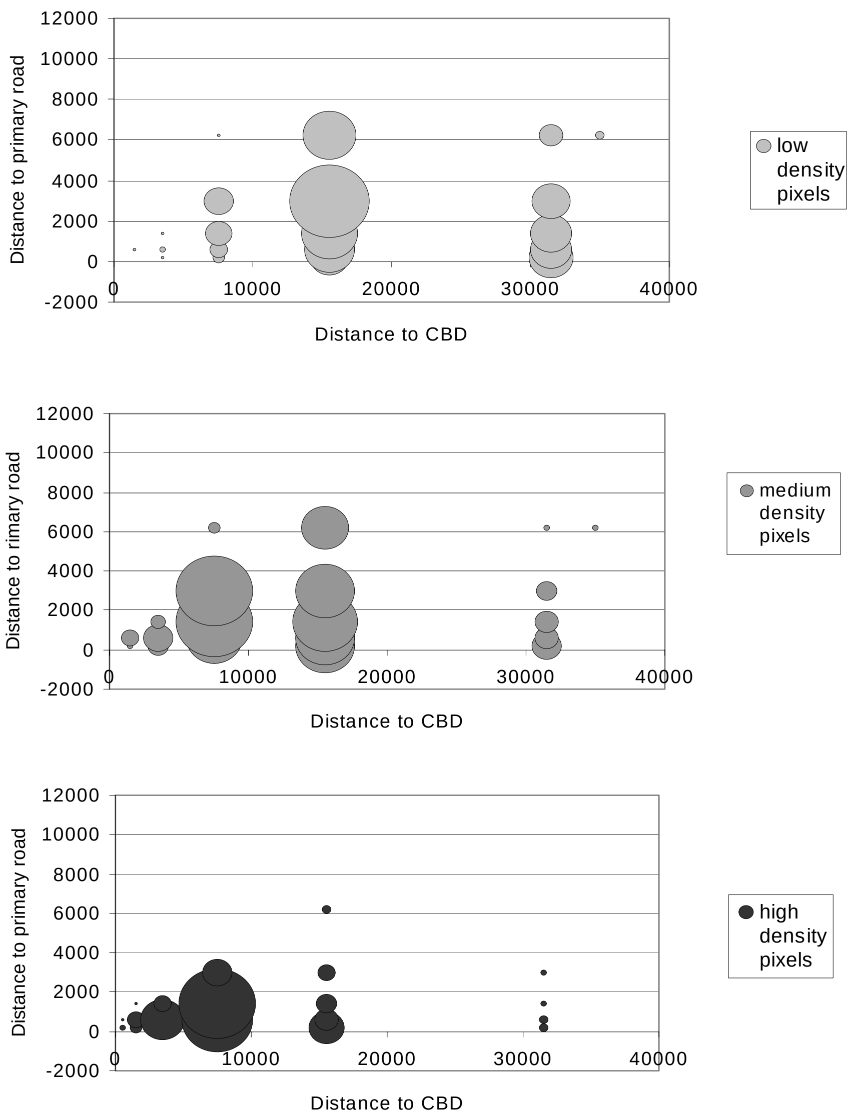
In the course of this research several problems have arisen that were excluded from direct attention due to resource constraints. In this, the final section of this thesis, they will be given some attention, together with some additional topics that have come to mind not so much as problems, but more as opportunities where additional research could further enhance the scope for successful GIT applications in Dar es Salaam and elsewhere in Sub-Saharan Africa. The discussion follows the general approach adopted in the research and looks first at the strategic level. This is followed by recommendations related to settlement level research and is concluded with some observations related to organizational and institutional issues.

8.4.1 Some subjects for further investigation at strategic level

The outputs of this research have been primarily descriptive and a more complete and comprehensive picture of the expansion and densification of Dar es Salaam's informal settlements has been produced that was hitherto available. Although such results and the development of methods to generate such data are useful contributions to the information support systems of urban planning, data capture should serve a purpose (Udy 1994, p 32). For example the density data produced in this research has been utilised to make an estimated population distribution for the city that is used to analyse public health service delivery .

In terms of future policy development, it would be useful to explore more how models of urban growth processes might be built that would enable planners to simulate expansion and densification. Figure 8.7 for example illustrates that the high density pixels tend to be more concentrated close to the CBD and primary roads. However, the relationship between these two factors and density is not straightforward. Other factors such as terrain conditions, infrastructure levels, and employment opportunities etc. probably also influence density in a variety of ways. Moreover, the perceived risk of eviction from a specific location may change over time. This latter point is well illustrated by the substantial house construction in Msimbazi River floodplain, especially close to Hanna Nassif and between Vingunguti and Tabata that seems to have coincided with the introduction of multi-party politics in Dar es Salaam and the associated weakening of the former CCM control system based on the 10-cell structure.

Figure 8.7: Percentage of low, medium and high density pixels in 1998 in relation to CBD and primary roads



New models should seek to identify the key driving forces behind urban expansion and differential densification, and be capable of producing policy relevant outputs on the basis of the relatively limited data that is available in cities like Dar es Salaam. In this light some of the recent work on cellular automata, provide some interesting perspectives for developing tools that may not only simulate growth (see for example Cheng 2003; Cheng and Masser 2003a; Cheng and Masser 2004), but also allow planners to extend the functionality of GIS to include both prediction and prescription (Webster 1993; Webster 1993b) thereby increasing their ability to examine the implication of certain interventions (e.g. the construction of a new road or water network) on urban development and extending the usefulness of the data for scenario development and planning.

A variety of technical issues can also be investigated further. The development of such tools should also be closely linked to the needs of local planners. Much of the MCE work described above was also based on a limited amount of consultation with local professionals. The approach developed showed some promise and applicability, but it also requires further validation and refinement, and ideally the inclusion of additional socio-economic and environmental criteria. This type of work should be done in cooperation with local academics to ensure that result are immediately available locally applicable. Finally, new sensors such as SPOT 5, Ikonos or Quickbird are available and the methods for estimating SCI values based on data extracted from such images should be tested for applicability and replicability.

8.4.2 Some subjects for further investigation at settlement level

The settlement level also provides many opportunities for new work. In this work the 3 settlements examined were already highly developed, while many new settlements are rapidly emerging in the urban fringe. In these new areas, where density is still rather low, opportunities may exist to adopt GIT based approaches and methods that could be useful for increasing public influence over the informal development process along the lines of Guided Land Development. This would entail creating an action research project that would aim to support the roles of local leaders in emerging settlements and enhance their ability as local land managers. If the capacities of the actors can be increased then more influence may be exerted over individual developers in order to create more options for future development. Clearly, such a project requires political and technical support from all levels of government: National, City and Municipal. From a sustainability perspective it would be advisable to operate within the available local resources as a starting point.

Such pro-active research efforts can also be followed in older settlements. The continuing development of already dense settlements with low levels of infrastructure is potentially problematic because of environmental and public health concerns. Here too, the influence and roles of local actors could be enhanced with GIT based tools with support from actors from the formal administrative system. To fully assess how GIT can be used it is necessary to adopt some of the approaches developed here in the actual routine and upgrading work that is taking place in Dar es Salaam, along the lines of the recent work in Cape Town (Abbott 2001; Abbott 2002; Abbott 2002b; Abbott 2003). Only in this way can the approaches be fully tested and adapted to the practical realities of informal settlement planning and management.

8.4.3 Organizational and institutional issues

From what has been learnt during this research, it is clear that organizational and institutional issues will also require attention. Several recent research studies in Dar es Salaam that have also been used in this study, point to the institutional complexity of the participatory mode of planning that is now in vogue in Dar es Salaam and elsewhere in SSA. But we also know that such processes can also generate conflicts as well as counteract them (Halla 1999). Moreover, even the conceptual models described earlier in this chapter have shown that the information systems that are required to manage informal settlements involve many actors. Although most are in the initial stages of GIT adoption successful and sustainable information systems will entail the development of appropriate spatial data infrastructures that can facilitate and strengthen such inter-organisational networks of spatial data suppliers and users. As yet though, little is known about how best to build and maintain an effective Spatial Data Infrastrutcure when the required resources are so highly constrained.

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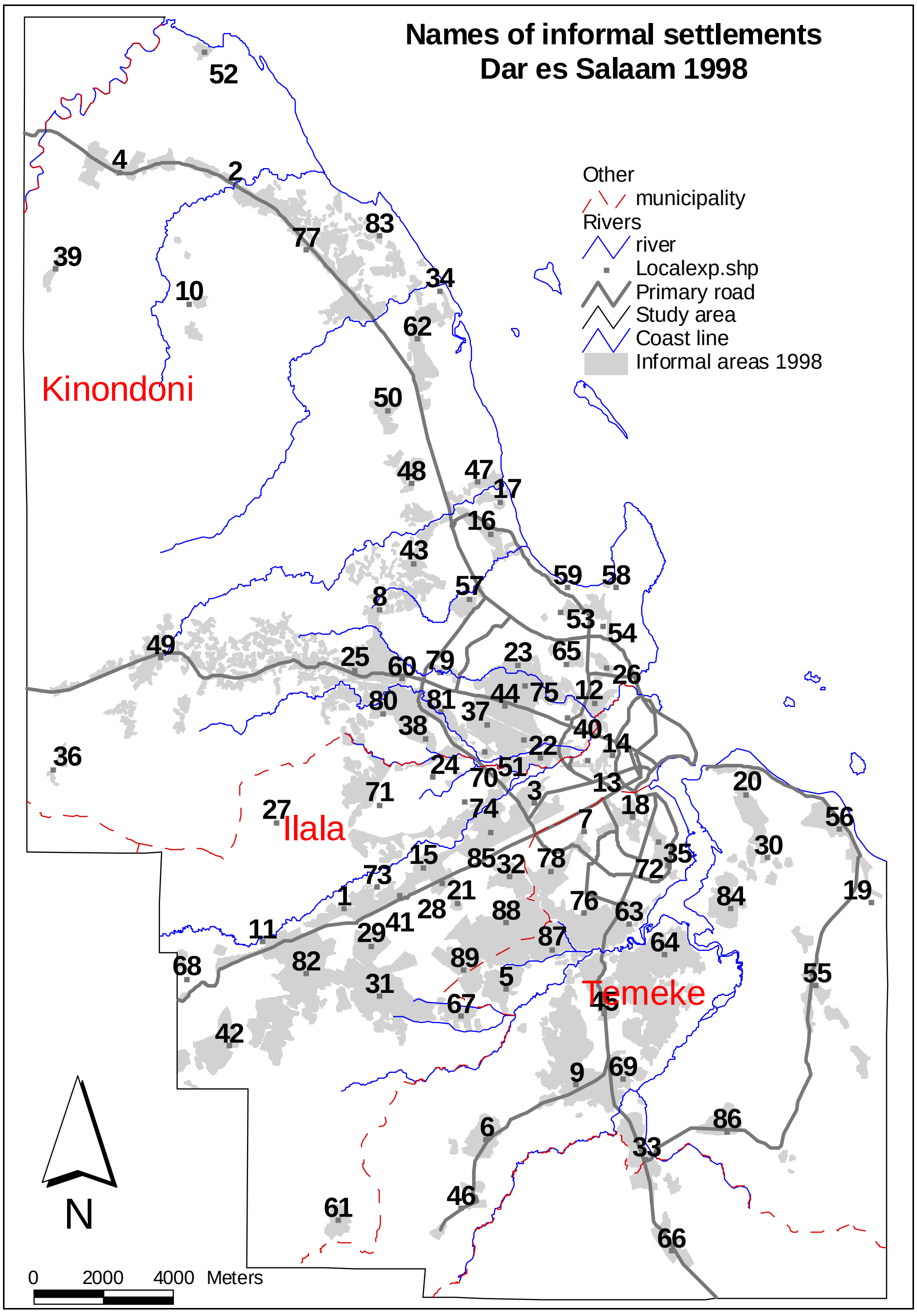
Appendix A: Details of 1992 land use classes of Hakuyu (1995)

Code		Class description
1		Planned residential
	11	High density (>25 dwellings/Ha)
	12	Medium density (12-24 dwellings/Ha)
	13	Low density (6-12 dwellings/Ha)
2		Industrial
	21	Heavy industry
	22	Light industry
	23	Utilities and service installations
	24	Others (open air garages, etc)
3		Commercial
	31	Central Business District (CBD)
	32	Other
4		Institutional
	41	Training
	42	Administration
	43	Community facilities
	44	Other
5		Transport
	51	Road
	52	Railway
	53	Airport
	54	Transhipment and harbour
6		Recreation
	61	Stadium and built-up facilties
	62	Organised open space
	63	Other (cemetery etc)
7		Non built-up and agriculture
	71	Vacant land
	72	Gardens
	73	Water bodies
	74	Agriculture
8		Unplanned Residential
	81	High density (>25 dwellings/Ha)
	82	Medium density (12-24 dwellings/Ha)
	83	Low density (<12 dwellings/Ha)

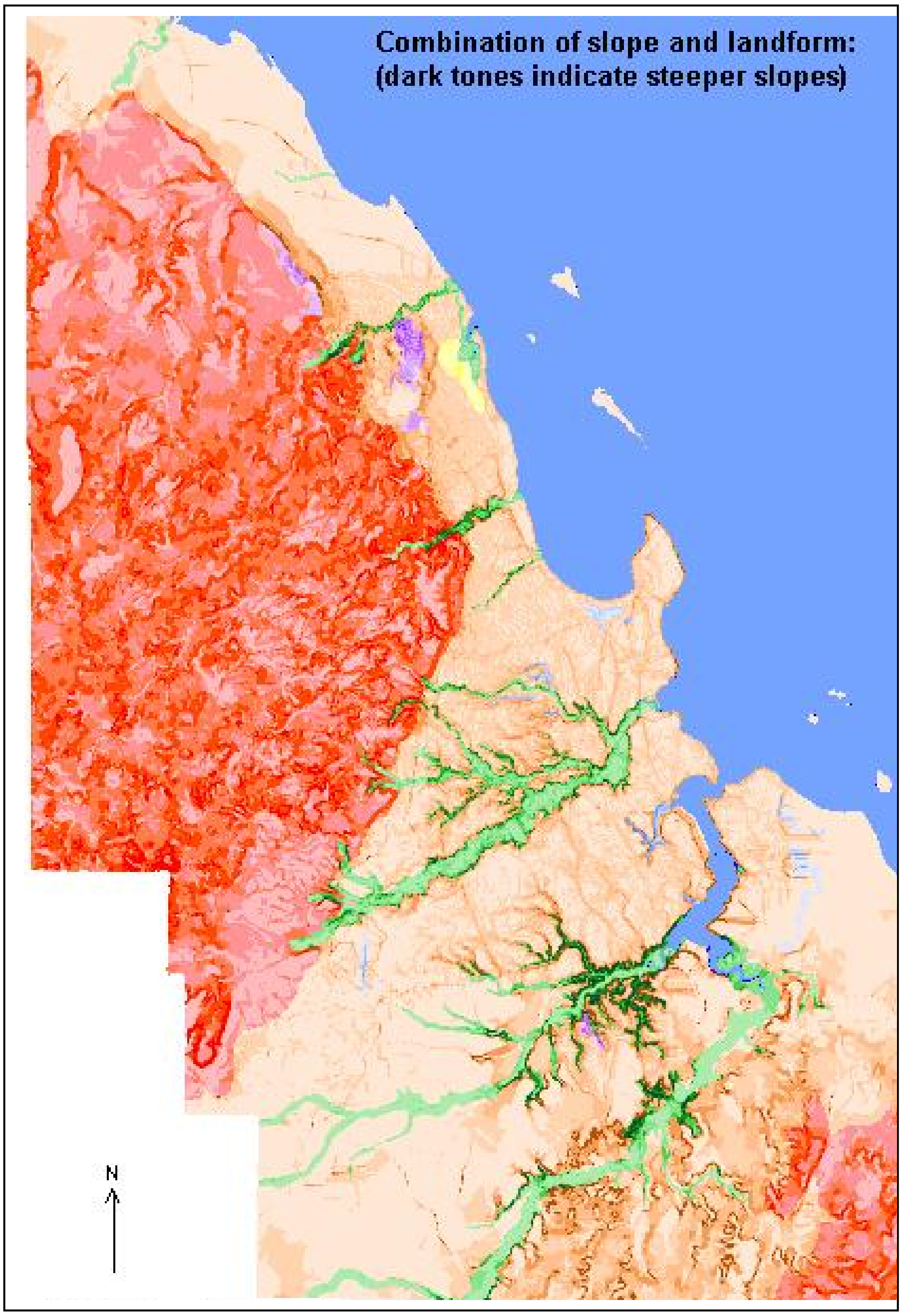
Appendix B: Map of informal settlements 1998



Settlement index

No	Name	No	Name	No	Name
1	Banana	31	Kitunda	61	Msongola
2	Boko	32	Kiwalani	62	Mtongani
3	Buguruni	33	Kongowe	63	Mtoni
4	Bunju	34	Kunduchi	64	Mtoni_Kijichi
5	Buza	35	Kurasini	65	Mwananyamala
6	Chamazi	36	Kwembe	66	Mwandege
7	Chang'ombe	37	Mabibo	67	Nyantira
8	Changanyikeni	38	Mabibo_External	68	Pugu_Kajiugeni
9	Charambe	39	Mabwe_Pande	69	Rangi_Tatu
10	Goba	40	Magomeni	70	Ruhanga
11	Gongo_La_Mboto	41	Majaumbasita	71	Segerea
12	Hana_Nasif	42	Majohe	72	Shimo_la_Udongo
13	Ilala	43	Makongo	73	Sitakishari
14	Jangwani	44	Manzese	74	Tabata
15	Karakata	45	Mbagala	75	Tandale
16	Kawe	46	Mbande	76	Tandika
17	Kawe_Beach	47	Mbezi	77	Tegeta
18	Keko	48	Mbezi_Juu	78	Temeke
19	Kibugumo	49	Mbezi_Luisi	79	Ubungo
20	Kigamboni	50	Mbezi_Salasala	80	Ubungo_Kibangu
21	Kigilagila	51	Mburahati	81	Ubungo_Kisiwani
22	Kigogo	52	Mbweni	82	Ukonga
23	Kijitonyama	53	Mikocheni	83	Uninio
24	Kimanga	54	Mikoroshoni	84	Vijebweni
25	Kimara	55	Mizimbini/Mkize	85	Vingunguti
26	Kinondoni	56	Mjimwema	86	Yasemwayo
27	Kinyerezi	57	Mlalakuwa	87	Yombo_Dovya
28	Kipawa	58	Msasani	88	Yombo_Kipawa
29	Kipunguni	59	Msasani_Village	89	Yombo_Vituka
30	Kisiwani	60	Msewe/Kibo		

Appendix C: Landform combined with slope map



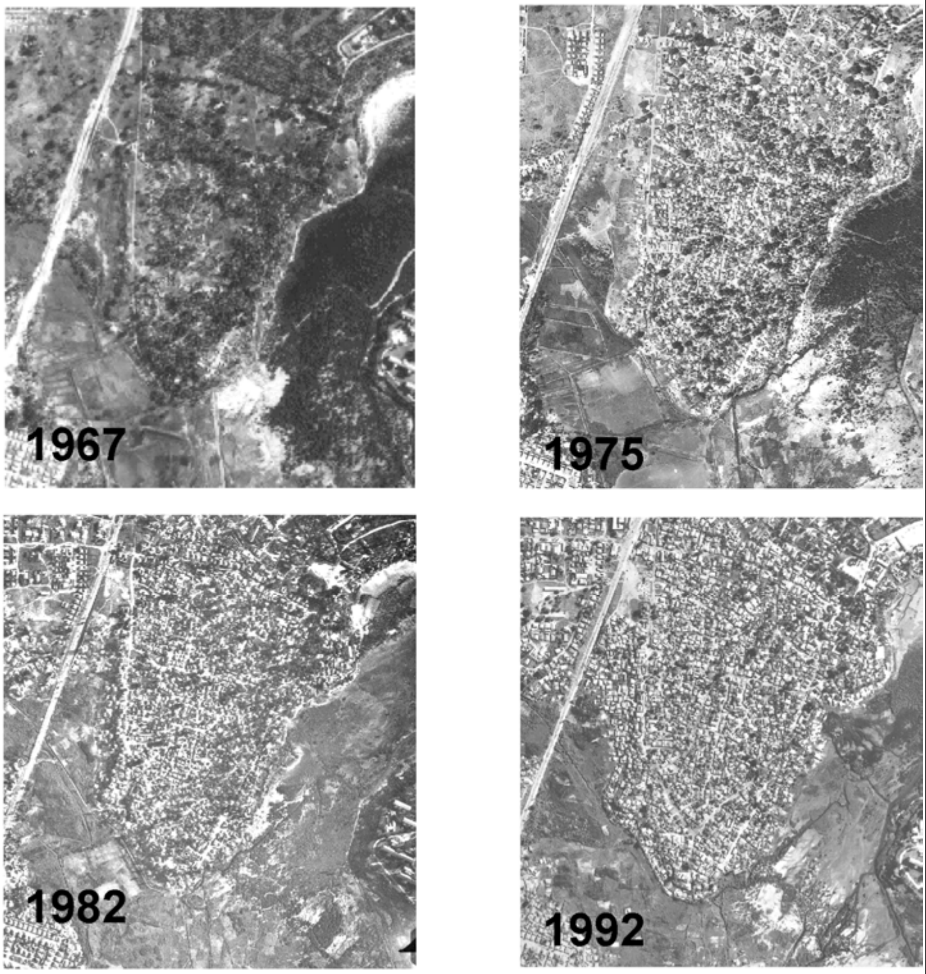
Appendix D: Questionnaire for local professionals March 2000

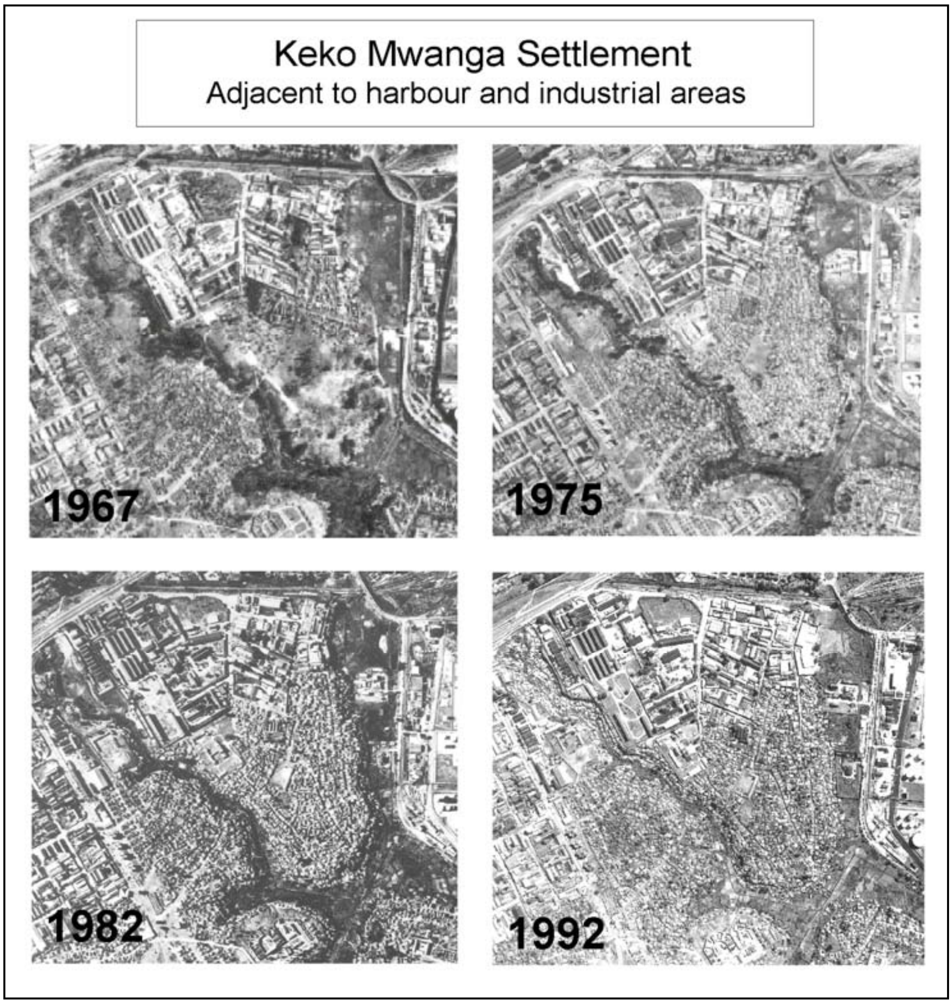
Nature of respondents to questionnaire under UPM professionals in Dar es Salaam, Date of survey: 29/3-10/4/2000.

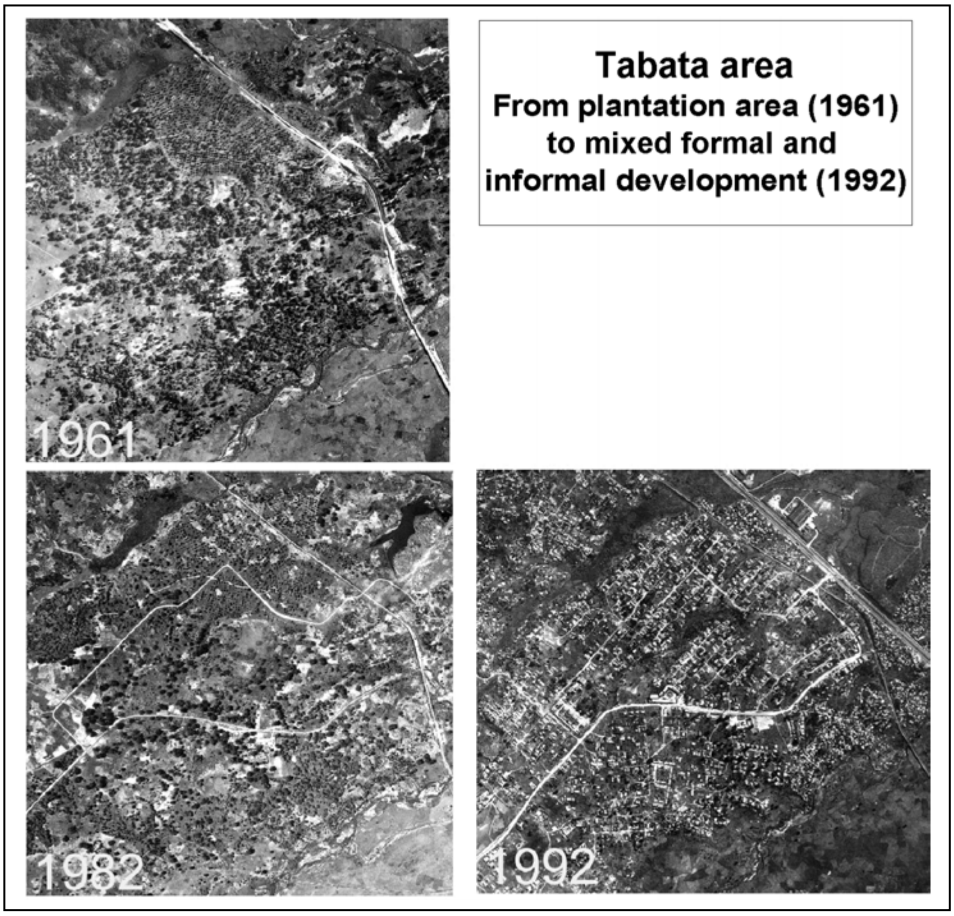
		PROFESSIONAL BACKGROUND					
TYPE OF EMPLOYER	No of forms out	Urban & Rural Planning	Land Manage-ment & Valuation	Engineer-ing	Land Surveying	Total returned	Return rate
Local Government	14	2	3	2		7	50%
Central Government	8	6	1			7	88%
UCLAS	24	7	1		5	13	54 %
Total	46	15	5	2	5	27	59 %

Appendix E: Aerial photographs of case settlements

Hanna Nassif Settlement
From plantation (1967) to highly consolidated
informal settlement (1992)
Source :SMD.

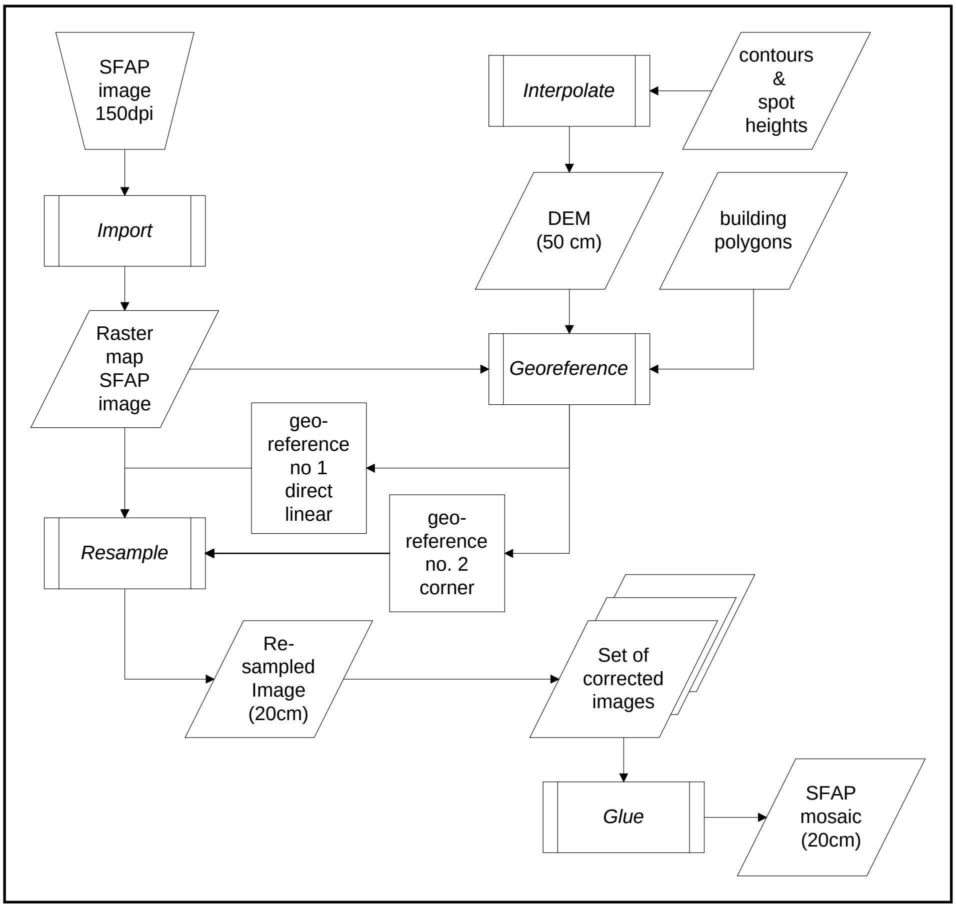



Keko Mwanga Settlement
Adjacent to harbour and industrial areas
1967
1975
1982
1992

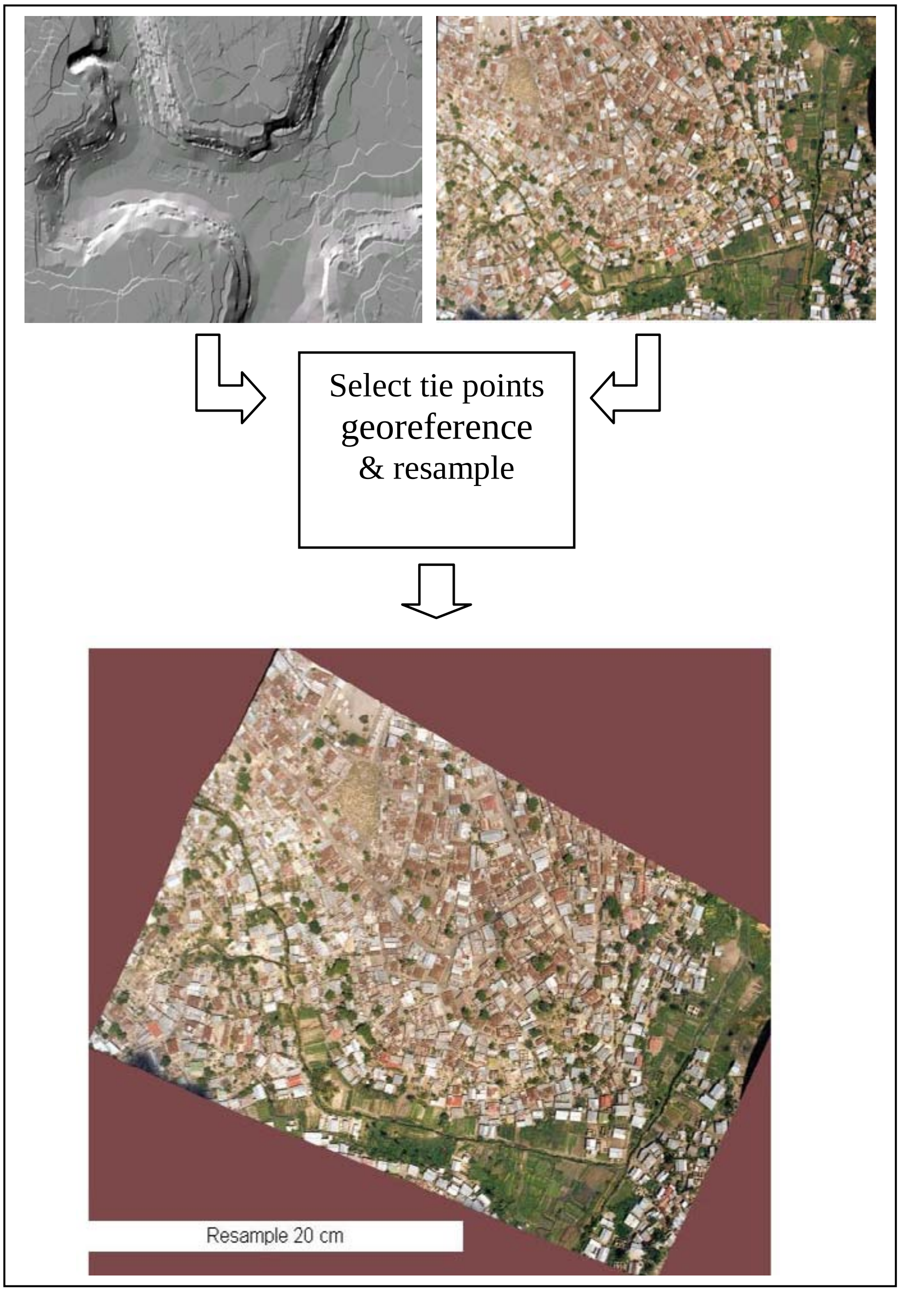

Tabata area
From plantation area (1961)
to mixed formal and
informal development (1992)
1961
1982
1992

Appendix F: Making of SFAP Mosaics

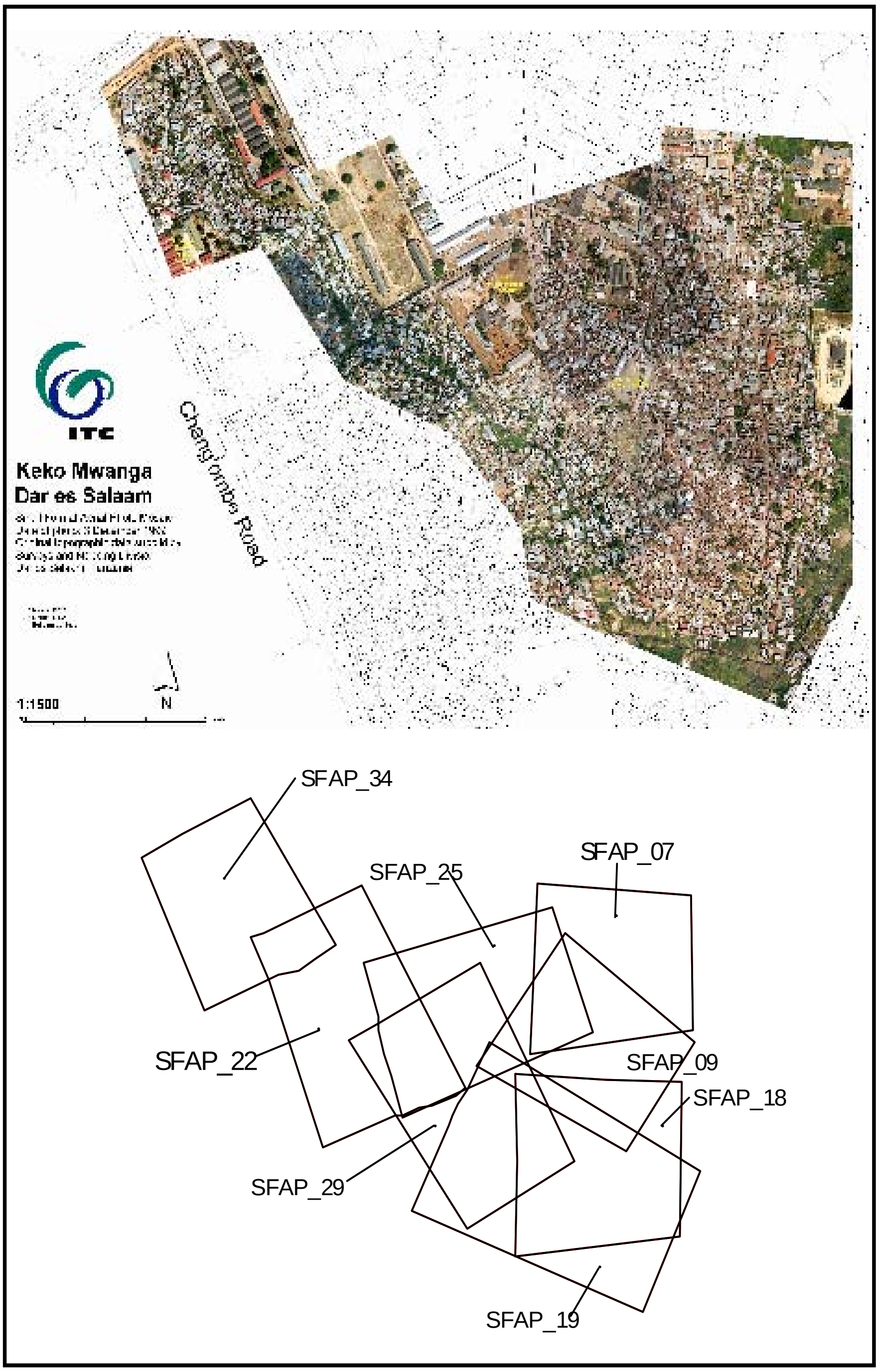
Process for production of a SFAP mosaic



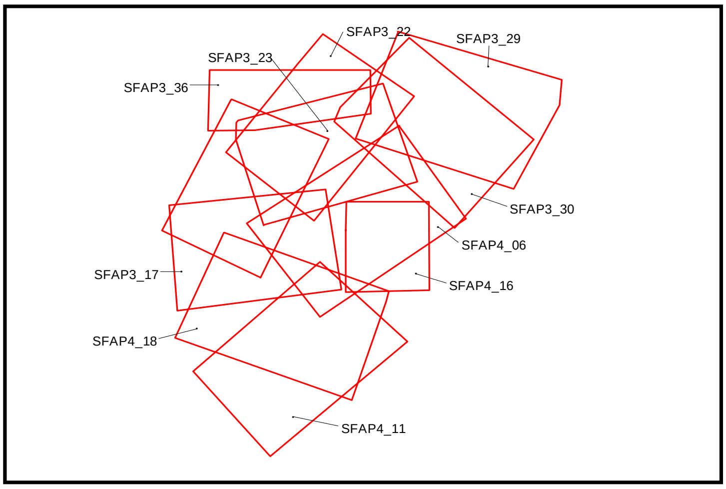
Example of an input image ((SFAP_19), part of the DEM and a geo-referenced image from Keko Mwanga area



SFAP Mosaic with topographic layers and index map of Keko Mwanga



SFAP Mosaic with topographic layers and index map of Hanna Nassif



Financial considerations for SFAP Mosaic production
Basic model: centralised facilities serving users at settlement level
Production costs (SFAP vs vertical aerial photography)
Distribution costs
Training
Estimate of costs for SFAP image map production

Assumptions:
100 ha settlement
within 5 minutes flying time of Dar es Salaam airport
High wing aircraft with removable door available
DEM with min 0.5 m pixel size and digital topographic data 1:2500 available OR facility to collect 10-12 ground control points per used image
Flying height (approx 800 m)
Camera: hand-held 35 mm SLR with 30-50mm lens; Film: colour print
High resolution 35 mm scanner available

Item	**No.**	**Unit**	**Rate**	**Amount US$**	**US$/ha**
Area	100	Ha			
Flying time	1	Hrs	400	200	
Film (5x 36 exp)	5		5	25	
Developing, scanning and printing	180	10x15 cm	1	90	
Processing of mosaic	6	days	100	600	
Sub total production				915	9
Approximate Printing Costs	No.	Type	Rate		
A0+ prints scale 1:1000	20	Colour	40	800	
A2 prints scale 1:2500	20	Colour	15	300	
A4 prints scale 1:5000	40	Colour	1	40	
Subtotal printing				1,140	11
TOTAL COST SFAP				2,055	21
Vertical aerial photographs (for 1500 sqkm, exc printing)	1500	Ha	70	105,000	0.70

Appendix G: Details of primary data acquisition in Keko Mwanga

Household survey in June 2001

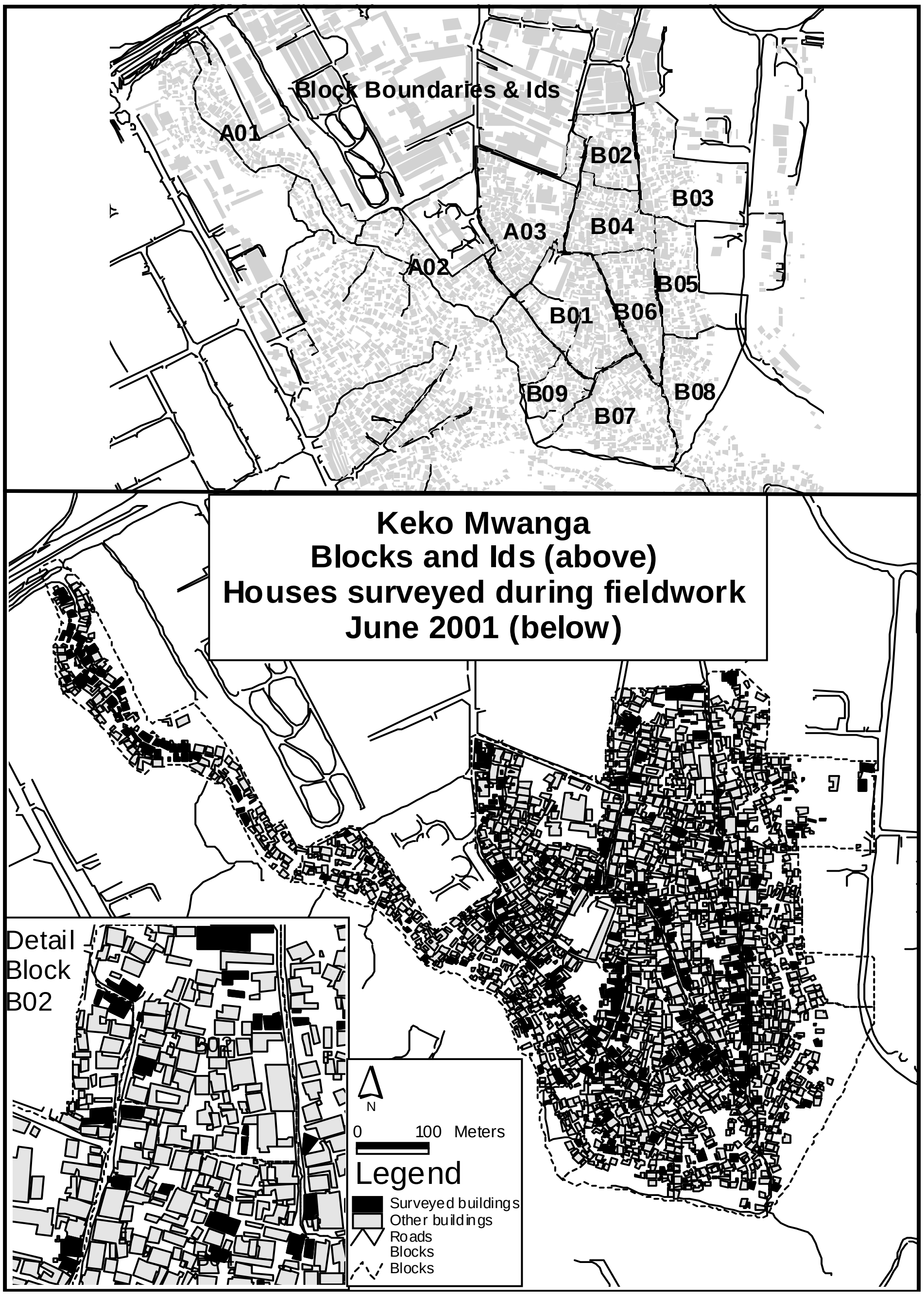
Name of the interviewer	:		**WARD_ID**
Date of interview :			**MTAA_ID**
<u>Start time :</u>		**<u>End time :</u>**	
PROPERTY			
Mtaa ID			
Block Id			
Prop_id			
Owmers name			
Piped water			
Latrine Type	1 Pit 2 VIP 3 Septic 4 Bucket 5 None		
Latrine YoC			
Latrine Users	1 Private 2 Shared		
Space for new			
Access for cleaning	Yes/No		
BUILDING			
Arc_bld_ID			
Bld_no (Temeke)			
Area sqm			
Wall material	1.Mud+pole 2.Sand cement 3.Mixed 4.0ther		
Roof material	1. CGI 2. Other		
Roof quality	G good F fair P poor		
Floor material	E earth C cement		
No. of floors			
Year constructed			
No. of rooms	(living +		

	bedrooms)
Main function	1 Residential 2 Industry 3 Commercial 4 Education 5 Police 6 Market 7 Cemetery
Secondary function	1 Residential 2 Industry 3 Commercial 4 Education 5 Police 6 Market 7 Cemetery
Electricity	Yes/No

HOUSEHOLD				
Bld_id				
HH_id				
Name of head				
Type of tenure	1 Owner	2 Tenant		
Year of occupation				
Sources of water	1 Own tap	2 Public tap	3 Well	4 Vendors
Waste disposal	1 Pit	2 Burn	3 Collected	
Annual Income (TSh)				
Expenses Water	Monthly expenditure			
Expenses Food & clothing				
Expenses Transport				
Expenses Education				
Expenses Medical				
Expenses Savings				
Expenses Housing				
Expenses Social				
Expenses credit				

PERSONS					
Head_id					
Person_id					
Relation to head	1 self	2 spouse	3 child	4 other relative	5 other
Year of Birth					
Education	1 Tertiary	2 Vocational	3 Secondary	4 Primary	5 None
Literate	Yes/No				
Occupation					
Secctor	1 Formal	2 Informal			

Map of blocks and buildings selected for surveys in Keko Mwanga



Appendix H: Professional views on intervention criteria

	LGO			CGO			UCLAS			TOTAL		
CRITERIA	**no**	**score**	**%**	**no**	**score**	**%**	**no**	**score**	**%**	**no**	**score**	**%**
General locational factors	**1**	**4**	**4**	**4**	**16**	**13**	**3**	**18**	**9**	**8**	**38**	**9**
Near CBD				2	8	6	2	12	6	4	20	4.6
Near activity eg Univ. Dar							1	6	3	1	6	1.4
Location				1	6	5				1	6	1.4
Near LGA offices	1	4	4							1	4	0.9
in the near fringe				1	2	2				1	2	0.5
Hazards & other restrictions	**2**	**9**	**9**	**5**	**20**	**16**	**1**	**5**	**2**	**8**	**34**	**8**
poor living environment				1	5	4	1	5	2	2	10	2.3
hazard free	1	4	4	1	5	4				2	9	2.1
terrain and habitability				2	7	6				2	7	1.6
flood prone	1	5	5							1	5	1.2
on road reserves and power easements				1	3	2				1	3	0.7
Service factors	**11**	**44**	**44**	**8**	**37**	**30**	**12**	**55**	**26**	**31**	**136**	**31**
poor services & infra.	2	10	10	3	14	11	5	24	11	10	48	11.1
access to trunk roads	4	18	18	2	11	9	1	4	2	7	33	7.6
access to water	2	4	4	1	6	5	2	6	3	5	16	3.7
poor accessibility							2	10	5	2	10	2.3
% children not at school	1	4	4				1	6	3	2	10	2.3
access to community services				1	4	3	1	5	2	2	9	2.1

	LGO			CGO			UCLAS			TOTAL		
CRITERIA	**no**	**score**	**%**	**no**	**score**	**%**	**no**	**score**	**%**	**no**	**score**	**%**
high morbidity rate	1	5	5							1	5	1.2
refuse production	1	3	3							1	3	0.7
access to power supply				1	2	2				1	2	0.5
Land and housing factors	**6**	**26**	**26**	**5**	**24**	**19**	**12**	**55**	**26**	**23**	**105**	**24**
High density	2	9	9	2	10	8	6	28	13	10	47	10.8
land available - low density	1	6	6	1	3	2	1	5	2	3	14	3.2
High dev. pressure							2	10	5	2	10	2.3
high room occupancy	1	6	6			0			0	1	6	1.4
relatively orderly development				1	6	5			0	1	6	1.4
high population						0	1	5	2	1	5	1.2
housing quality				1	5	4			0	1	5	1.2
high owner occupancy			0			0	1	4	2	1	4	0.9
unregistered land	1	3	3			0			0	1	3	0.7
relatively haphazard development						0	1	3	1	1	3	0.7
many land transactions	1	2	2						0	1	2	0.5
Socio-economic factors	**3**	**17**	**17**	**10**	**28**	**22**	**16**	**70**	**33**	**29**	**115**	**26**
community organised & supportive	2	12	12	4	14	11	8	37	18	14	63	14.5
potential for investments							3	13	6	3	13	3.0
low income				1	1	1	2	11	5	3	12	2.8

	LGO			CGO			UCLAS			TOTAL		
CRITERIA	**no**	**score**	**%**	**no**	**score**	**%**	**no**	**score**	**%**	**no**	**score**	**%**
ability to pay	1	5	5	1	3	2				2	8	1.8
resource base				2	5	4				2	5	1.2
potential for partnerships							2	5	2	2	5	1.2
willingness to pay	0	0	0	1	4	3	0	0	0	1	4	0.9
Cost/benefit							1	4	2	1	4	0.9
good governance				1	1	1				1	1	0.2
Other factors	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**6**	**3**	**2**	**6**	**1**
maps available							1	3	1	1	3	0.7
important for city development strategy						0	1	3	1	1	3	0.7
Total awarded scores	**23**	**100**	**100**	**32**	**125**	**100**	**46**	**209**	**100**	**101**	**434**	**100**

Appendix I: Details of normalisation and weights for GLD and resettlement

Table: Normalisation and weights for GLD option

No.	Criteria	Justification for normalisation	Calculation of value function	Weight
	VETO Landform, Slope & Density	Existing policy prohibits settlement in river valleys and settlement on steepest slopes is undesirable. If already high density then do not consider for GLD	Select settlements for which landform is not river valleys and not swamp and slope < 15% Or SCI98 <50	-
C1a	SCI98	Preference for settlements with lower densities where there is still sufficient space available for limited re-planning of layouts etc.	C1a = (SCI98-50)/50	Inter-mediate product
C1b	SCI9298	Preference for settlements that have not been experiencing rapid densification as these are likely to be more difficult to manage for GLD	C1b = if (sci9298 > 200) then 0, else, if (SCI9298<100) then 1, else (200-SCI9298) / 100	Inter-mediate product
C1	SCIall	Combination of SCI98 and SCI9298	C1 = C1a * C1b	50
C2	Hadif	Preference for settlements that are expanding as this is an indicator of development pressure and increasing population	C2 = if (hadif < 10) then 0, else (1 –((50-hadif)/50))	10
C3	SlpeGT15	Preference for settlements that have relatively low slopes. Percentage of settlement > 15% used as criteria	C3 = (1–(slpeGT15/100))	10
C4	Prddis	Preference for settlements in close proximity to roads for accessibility and infrastructure delivery	C4 = 1 – (d^2 / Max(d^2))	10
C5	Cendis	Settlements closer to employment & commercial areas preferred due to their economic opportunities	C5 = 1 – (d^2 / Max(d^2))	10

C6	Ptrdis	Distance to bus routes including a distance penalty (see *Prddis* above)	C6 = 1 – (d^2 / Max(d^2))	10
			Total of weights	100

Table: Normalisation and weights for resettlement option – flooding

No.	Criteria	Justification for normalisation	Calculation of value function	Weight
	VETO Landform & Slope	Existing settlements in river valleys and those in hilly areas on very steep slopes (> 15%) should be removed.	Select settlements for which landform = (river valley or swamp) and (hills and slope > 15%) Give each location a unique id number	-
C1	SCI98	Preference for settled areas with higher densities that represent a high demand for services and infrastructure and the likelihood of poorer living conditions	C1= CI98 / 100	20
C2	SCI9298	Preference for settled areas that have been experiencing more rapid densification as this indicates high population pressure and increasing risk	C2 = if (sci9298 > 400) then 1, else SCI9298 /400	10
C3	Ha98	Preference for larger settlements in which more people are likely to be affected	C3 = if (ha98>20) then 1, else (ha98/20	20
C4a	Rivdis	Approximate risk associated with proximity to river. Risk is assumed to be significantly higher closer to the river.[47]	C4a=if(avrivdis >= 2000), then 0, Else (1-(√(avrivdis /1000)/√2)	Inter-mediate product
C4b	Cstdis	Approximate risk associated with proximity to coastline. Risk is assumed to be higher closer to the coast	C4b= if (avcstdis>=10000), then 0, Else (1-(avcstdis/10000)	Inter-mediate product

C4	Fldrisk	Risk is a function of river side location (most important) and coastal proximity – based on work of Dawson, 1996.	C4 = C4a*0.7 + C4b*0.3	50
			Total of weights	100

Table: Normalisation and weights for resettlement option – steep slopes

No.	Criteria	Justification for normalisation	Calculation of value function	Weight
	VETO Landform & Slope	Existing settlements in river valleys and those in hilly areas on very steep slopes (> 15%) should be removed.	Select settlements for which landform = (river valley or swamp) and (hills and slope > 15%) Give each location a unique id number	-
C1	SCI98	Preference for settled areas with higher densities that represent a high demand for services and infrastructure and the likelihood of poorer living conditions	C1= CI98 / 100	20
C2	SCI9298	Preference for settled areas that have been experiencing more rapid densification as this indicates high population pressure and increasing risk	C2 = if (sci9298 > 400) then 1, else SCI9298 /400	10
C3	Ha98	Preference for larger settlements in which more people are likely to be affected	C3 = if (ha98>20) then 1, else (ha98/20	20
C4	Avslope	Priority for resettlement is a function of steepness of slopes and priority increases with increasing slope.	C4 = if (avslope<15), then 0, else (avlope-15)/max(avslope)	50
			Total of weights	100

Ultimately the overall priority for resettlement was determined by assigning the maximum score for the flood risk assessment and the slope assessment to each potential resettlement area.

Appendix J: Ranking of settlements for upgrading and GLD

Settlement	CBO	Upgrading Score	GLD Score	Rank UPG	Rank Upg + CBO	Rank GLD	Rank GLD + CBO
Kipawa		85.9		1			
Kigilagila		83.8		2			
Chang'ombe		82.7		3			
Kijitonyama	Yes	82.1		4	1		
Shimo la Udongo		81.8		5			
Mikoroshoni		81.7		6			
Hanna Nassif	Yes	80.9		7	2		
Kinondoni		80.6		8			
Mbagala Kizuani	Yes	80.1		9	3		
Jangwani		79.7		10			
Kigogo		78.9		11			
Kunduchi	Yes	78.8	38.5	12	4	52	16
Tabata	Yes	78.3		13	5		
Magomeni		78.2		14			
Mikocheni		78.1		15			
Mabibo External		78	46.3	16		44	
Ubungo		77.9		17			
Mlalakuwa		77.7	46.4	18		42	
Majaumbasita		77.2		19			
Kurasini		76.9		20			
Kawe Beach		75.8	56.1	21		28	
Msasani Village	Yes	75.7	40.4	22	6	51	15
Ilala		75.2		23			
Mbezi Salasala		75.2	48.9	24		38	
Sitakishari		74.9	54.1	25		31	
Manzese	Yes	74		26	7		
Mabibo	Yes	73.9		27	8		
Ruhanga		73.9		28			
Mbagala Kiburugwa	Yes	73.6		29	9		
Buguruni	Yes	73.5		30	10		
Makongo	Yes	73.5	43.7	31	11	48	12

Settlement	CBO	Upgrading Score	GLD Score	Rank UPG	Rank Upg + CBO	Rank GLD	Rank GLD + CBO
Msasani		73.5		32			
Kiwalani		73.4		33			
Mbezi		73.3	63.8	34		13	
Vingunguti	Yes	73		35	12		
Tandale	Yes	73		36	13		
Keko	Yes	72.6		37	14		
Ubungo Kisiwani		72.6		38			
Temeke		72.4		39			
Kipunguni		72.1	50.2	40		35	
Yombo Dovya		72.1		41			
Mwananyamala		71.8		42			
Mburahati		70.8		43			
Mbande		70.7	60.8	44		19	
Tandika	Yes	70.5		45	15		
Kawe	Yes	70.4		46	16		
Msewe/Kibo	Yes	70.3	41.5	47	17	49	13
Mbagala Mzinga	Yes	70.2	46	48	18	45	11
Rangi Tatu		69.6	46.4	49		43	
Kimanga	Yes	69.3	41.1	50	19	50	14
Mtoni		68.8		51			
Yombo Kipawa		68.6		52			
Charambe		68.5	56.9	53		26	
Tegeta		67.6	67.3	54		7	
Karakata		67.4	57.2	55		25	
Mbagala Kibonde Maji	Yes	67.2	61.3	56	20	18	4
Kigamboni	Yes	67.1	49.3	57	21	37	9
Mbagala Kuu	Yes	66.9	58.2	58	22	23	6
Mtongani	Yes	66.7	66.3	59	23	11	2
Mbagala Mission	Yes	66.5	48.2	60	24	40	10
Kongowe		66.4	74.2	61		2	
Boko		66.2	66.7	62		9	
Mbezi Juu		66.1	56.9	63		27	
Banana		65.9	60	64		20	
Gongo La Mboto		65.8	47	65		41	

Settlement	CBO	Upgrading Score	GLD Score	Rank UPG	Rank Upg + CBO	Rank GLD	Rank GLD + CBO
Kimara	Yes	65.7	62.5	66	25	17	3
Uninio		65.6	58	67		24	
Mtoni Kijichi	Yes	65.3	51.4	68	26	32	7
Ukonga		64.6	51.4	69		33	
Ubungo Kibangu	Yes	64.1	59.9	70	27	22	5
Chamazi		63.5	77.3	71		1	
Mjimwema		63.4	70.8	72		4	
Kibugumo		63.2	64.1	73		12	
Pugu Kajiugeni		62.9	66.5	74		10	
Mwandege		62.3	63.4	75		14	
Yasemwayo		61.5	71.4	76		3	
Bunju		60.2	67.4	77		6	
Mbezi Luisi		58.1	63	78		16	
Changanyikeni	Yes	57.8	66.8	79	28	8	1
Msongola		57.5	63.4	80		15	
Mizimbini/Mkize		57.1	69.9	81		5	
Kisiwani		56.7	54.7	82		29	
Kitunda		56.1	51.1	83		34	
Yombo Vituka	Yes	55.1	49.7	84	29	36	8
Majohe		54.9	60	85		21	
Segerea		54.8	45.2	86		46	
Goba		51.2	28.7	87		55	
Buza		48.2	54.6	88		30	
Vijebweni		45.4	48.6	89		39	
Kwembe		44.2	44.6	90		47	
Mbweni		42.1	25.9	91		56	
Nyantira		40.8	36.1	92		54	
Mabwe Pande		36.8	36.4	93		53	

Summary

The countries of the Sub-Saharan Africa (SSA) region are experiencing some of the highest urban growth rates of the world and they frequently also have shown weak economic performance over extended periods. Unlike other world regions where urbanization and economic growth are two sides of the same coin, urbanization in SSA has come to be associated with the urbanization of poverty. Public resources are highly constrained and the capacity of the urban planning system to deliver serviced urban land for housing and other private development has lagged far behind demand, giving rise to the proliferation of extensive and highly dynamic areas of informal, unplanned settlements where as much as 70% of the population may reside. Within this general setting this thesis examines the potential role of applying Geographic Information Technology (GIT) as a means to improve the effectiveness of urban planning and better manage such informal settlements.

Three primary themes are at the core of this research: the evolution of thinking in the field of urban planning and management and the role of GIT as a planning support tool are discussed together with some problems of the land and housing supply in SSA countries. The review of these three themes reveals that much of the practice of urban planning in SSA was dependent on the development of western urban planning, including the adoption of western methodologies for plan development but also the adoption of western norms and standards as a basis for formal development. These effects have been long lasting and their legacy is still clearly evident. Similarly, the development of concepts and experiences related to Planning Support Systems is more evident and pronounced in western countries, though it is there also more often a subject for research than an operational tool. Although there is evidence of the diffusion of GIT in developing countries in general, there are to date, relatively few examples of attempts to develop operational urban PSS in SSA. It is expected that, in general, PSS developments in SSA will be driven by the transfer of such methodologies and technology as and when required and that this technology transfer may be as much driven by the requirements of foreign experts and advisors as by the expressed needs of local professionals and communities.

The linkages between western countries and SSA related to informal development are of a somewhat different nature. Land and housing are important elements of public policy making in all countries, but western planning has neither had to contend with the scale of urbanisation that is typical of SSA nor with the levels of poverty and informal development that are currently found there. Although some similarities were identified between approaches to housing issues, the adoption of instruments such as Sites and Services projects throughout SSA in the 1970's and 1980's and the more recent Guided Land Development are examples of housing policy instruments that

have no parallel in the developed countries. Finally, it is also evident that the transfer of urban planning, housing policy and land and housing delivery systems from the U.K. to SSA did not explicitly consider the specific cultural and societal conditions in the recipient countries thereby contributing substantially to the likelihood of policy failure.

Building on these issues, a framework for the analytical and design components of this research is presented in Chapter 3. The framework incorporates elements of spatial data modelling relevant to analysing informal urban development and decision making for intervening in informal settlements and some elements that are concerned with the context within which planning takes place, and in particular with some of the characteristics of some key actors involved in planning processes at strategic and local levels.

The empirical component of this research was performed via various case studies in the city of Dar es Salaam, Tanzania's largest city. An examination of the context shows that it is a typical SSA city in many respects. It has grown substantially since Tanzania obtained independence from Great Britain in 1961: current population growth rates are of the order of 4.5 % per annum, while already an estimated 70% of the residents live in informal settlements. Like many of its neighbours, Tanzania's economy which is still based primarily on agriculture it performed particularly badly in the late 1970's and 1980's. However, over the last 10 years the economy has been showing signs of recovery as a result of fundamental political and economic reforms.

The systems of urban planning and management have also been the subject of major reform process. The Master Plans of 1949, 1968 and 1979 were totally unsuited to the local conditions. The 1949 plan was, like many of the colonial period, was based upon racial segregation principles and in essence ignored the basic needs of the growing, indigenous part of the city's population that the British considered to be temporary residents of the city. Although the 1968 and 1979 plans gave more attention to the needs of other population groups, many development proposals were overly ambitious and still based largely on imported planning concepts and assumptions. The recent reform of urban planning and management has been supported by external actors and donors, but is placed within a global effort to improve local urban management capacity that aims to improve urban governance through a variety of mechanisms including decentralization, privatisation and the adoption of participatory planning processes. A parallel development has seen several public and semi-government organizations adopting GIT as a support tool for both operational and strategic planning activities. GIT use is still in its infancy. There is a small but growing GIS user community that makes the results of this research both pertinent and timely.

The research has been carried out at two spatial levels. The city-wide level is directed at strategic information and decision making related to informal development For this component use is made of an existing digital topographic database, aerial photography and SPOT satellite imagery to produce generalised data related to land use, topography, settlement expansion and densification processes. The second level concerns individual settlements or communities in which spatial information for settlement upgrading and some aspects of daily management are examined. GIT methods are applied to create large scale image mosaics that could be used in a variety of ways at settlement level, some of which have been explored both through a combination of quantitative and qualitative research methods.

Managing informal settlement development at a strategic level is examined in Chapter 6. The analysis of land use changes from 1982-1998 and the expansion and consolidation of informal settlements over this period, shows that the rate of expansion of informal settlements is increasing but that densification processes are also ongoing in all settlements, including those with the highest densities. A study of professional opinions concerning these processes however showed that the knowledge of senior urban professionals was limited to the more centrally located settlements. The methods developed could be used to improve the knowledge base a city level and provide an input into a GIS based multi-criteria evaluation procedure that could be used to select informal settlements for specific policy interventions aimed at altering their further development.

The problems of managing informal development at the local level are examined in Chapter 7. Three settlements Keko Mwanga, Hanna Nassif and Tabata are examined. The analysis shows how spatial information could be utilised at the community level in planning and administration and presents the results of an inquiry among several stakeholders on the usefulness of applying low-cost GIT based aerial photographic mosaics for community planning and management. This approach has considerable potential for further development.

The implications of these findings for the development of a prototype methodology for managing informal settlements in Dar es Salaam are considered. Concepts for spatial information support at both spatial levels are developed. These involve a variety of GIT users in Dar es Salaam, but are primarily directed at the needs of the local government and settlement level actors. Several suggestions are made concerning further work required at both levels. These include improvements to the MCE approach, the development of urban growth models that could aid in the understanding and prediction of new growth areas, the development of effective land management instruments at settlement level and investigations that would lead to the creation of a sustainable local spatial data infrastructure to support decentralised urban planning and management.

Samenvatting

De landen van de regio Sub-Sahara Afrika (SSA) behoren tot de gebieden op aarde met de hoogste stedelijke groei, echter vaak in combinatie met langdurige perioden van zwak economisch presteren. In tegenstelling tot andere wereldregio's, waar verstedelijking en economische groei hand in hand gaan, is in SSA sprake van een urbanisatie van de armoede. Er zijn maar heel beperkt overheidsmiddelen beschikbaar en de mogelijkheden van de stedelijke planning om te voorzien in van infrastructuur voorziene grond voor woningbouw en bedrijvigheid blijven sterk achter bij de vraag. Dit heeft geleid tot een snelle opkomst van informele, extensieve en zeer dynamische woongebieden waar nu tot zeventig procent van de stedelijke bevolking woont. Gegeven deze ontwikkeling wordt in deze studie onderzocht welke rol de toepassing van geo-informatietechnologie (GIT) kan spelen bij het verbeteren van de effectiviteit van planning en beheer van dergelijke informele woongebieden.

In deze studie staan drie onderwerpen centraal: de ontwikkeling van het denken over planning en beheer van steden, de rol van GIT als een ondersteunend instrument voor planning en de problemen rond het aanbod van bouwgrond en woningen in landen in SSA. Het literatuuroverzicht van deze thema's toont aan dat de praktijk van de stedelijke planning in SSA afhankelijk is geweest van de ontwikkeling van de westerse stedelijke planning, inclusief het overnemen van westerse methoden voor planontwikkeling en van normen en standaarden voor formele ontwikkeling. Dit gegeven blijkt lang door te werken en is nog steeds duidelijk herkenbaar. Ook ten aanzien van de ontwikkeling van Planningsondersteunende Systemen (POS) geldt dat concepten en ervaringen vooral uit de westerse landen komen, maar zelfs daar gaat het meer om onderzoeksprojecten dan om operationele systemen. Hoewel er in het algemeen zeker sprake is van verspreiding van GIT naar ontwikkelingslanden, zijn er tot op heden in SSA weinig voorbeelden te vinden van pogingen om operationele stedelijke PO-systemen te ontwikkelen. Er wordt verwacht dat POS-ontwikkelingen in SSA overwegend gedreven zullen worden door het importeren van de betreffende westerse methodologie en technologie. Een dergelijke technologie-overdracht zal evenzeer afhankelijk zijn van de behoeften van buitenlandse adviseurs als van de behoeften vanuit locale planners en gemeenschappen.

De verbindingen tussen westerse landen en SSA met betrekking tot informele ontwikkeling hebben een wat ander karakter. Het voorzien in bouwgrond en huisvesting zijn belangrijke onderdelen van het overheidsbeleid in alle landen, maar de westerse planning heeft nooit te maken gehad met een omvang van verstedelijking die thans in SSA aan de orde is, noch met de armoedeniveaus en informele ontwikkeling die we daar nu aantreffen. Hoewel in de jaren zeventig en tachtig een aantal overeenkomsten gevonden is in de aanpak van huisvestingsvraagstukken, zijn voor het introduceren in SSA van instrumenten zoals ‘plek-en-voorzieningen’-projecten (‘Sites and Services’) en recentelijk ‘geleide bouwontwikkeling’ (‘Guided Land Development’) geen parallellen aanwezig in de ontwikkelde landen. Tenslotte is het ook duidelijk dat bij de overdracht vanuit het Verenigd Koninkrijk naar SSA van stedelijke planning, huisvestingsbeleid en systemen voor de productie van bouwgrond en woningen geen rekening is gehouden met de specifieke culturele en maatschappelijke omstandigheden in de ontvangende landen. Dat heeft in belangrijke mate bijgedragen aan de kans op falend beleid.

Voortbouwend op deze thema’s, wordt in hoofdstuk drie een kader voor de analytische en ontwerpcomponenten voor deze studie gepresenteerd. Dit kader bevat elementen van ruimtelijke gegevensmodellering die relevant zijn om informele stedelijke ontwikkeling en besluitvorming te analyseren en elementen die te maken hebben met de context waarin planning plaatsvindt. Het gaat daarbij in het bijzonder om een aantal kenmerken van sleutelactoren betrokken bij planningprocessen op strategische en locale niveaus.

Het empirische deel van het onderzoek is uitgevoerd aan de hand van diverse gevalstudies in Dar es Salaam, de grootste stad van Tanzania. Een analyse van de geografische context laat zien dat dit in vele opzichten een typische SSA-stad is. Dar es Salaam is aanzienlijk gegroeid sinds Tanzania onafhankelijk werd van Groot-Brittannië in 1961: de tegenwoordige bevolkingsgroei ligt rond de 4,5 procent per jaar, terwijl naar schatting al zeventig procent van de inwoners in informele woongebieden leeft. Net als in veel buurlanden heeft de economie van Tanzania, die nog steeds vooral op de landbouw is gebaseerd, aan het eind van de jaren zeventig en gedurende de jaren tachtig bijzonder slecht gepresteerd. Echter, de laatste tien jaar laat de economie tekenen van herstel zien als gevolg van fundamentele politieke en economische hervormingen.

Ook de planning en het beheer van steden zijn de afgelopen decennia ingrijpend hervormd. De structuurplannen voor Dar es Salaam (‘Master Plans’) van 1949, 1968 en 1979 waren totaal ongeschikt voor de lokale situatie. Het plan van 1949 was, zoals zoveel plannen uit de koloniale periode, gebaseerd op principes van raciale segregatie en negeerde de basisbehoeften van de inheemse bevolking, die de Britten als tijdelijke stadsbewoners beschouwde. Hoewel de plannen van 1968 en 1979 meer aandacht schonken aan de noden van andere bevolkingsgroepen, waren veel voorstellen bovenmatig ambitieus en nog steeds gebaseerd op geïmporteerde planningsconcepten en aannamen. De recente hervorming van stedelijke planning en beheer is gedragen door externe actoren en donoren, maar is ingekaderd in een algemene poging om de locale capaciteit voor stadsbeheer te verbeteren met het oog op een beter bestuur. Instrumenten als decentralisatie, privatisering en introductie van participatieve planning zijn daarbij ingezet. Een parallelle ontwikkeling is het in gebruik nemen van GIT als een ondersteunend hulpmiddel voor zowel operationele als strategische planningactiviteiten. Het gebruik van GIT staat nog steeds in de kinderschoenen. Er is een kleine maar groeiende GIS-gemeenschap wat betekent dat de uitkomsten van dit onderzoek zowel relevant als tijdig zijn.

Het onderzoek is op twee ruimtelijke schaalniveaus uitgevoerd. Op stedelijk niveau gaat het om strategische informatie en besluitvorming ten aanzien van informele ontwikkeling. Voor dit aspect is gebruik gemaakt van een bestaande digitale topgrafische databank, luchtfoto's en SPOT-satellietbeelden teneinde gegeneraliseerde informatie te verkrijgen over grondgebruik, topografie, stedelijke groei en processen van verdichting. Het tweede niveau betreft individuele woongebieden of gemeenschappen waarvoor het gebruik van ruimtelijke informatie ten behoeve van buurtverbetering en dagelijks beheer van de woonomgeving is onderzocht. GIT-methoden zijn toegepast om grootschalige beeldmozaïeken te vervaardigen voor verschillende beheeractiviteiten in woongebieden. Experimenten met het gebruik zijn onderzocht met een combinatie van kwantitatieve en kwalitatieve methoden.

Over de analyse van het beheer van informele woongebieden op strategisch niveau wordt in hoofdstuk zes gerapporteerd. De analyse van veranderingen in grondgebruik tussen 1982 en 1998 en de groei en consolidering van informele woongebieden gedurende die periode toont aan dat het groeitempo van informele woongebieden toeneemt maar dat tevens in al die woongebieden sprake is van verdichting, ook in de gebieden met de hoogste dichtheden. Onderzoek naar beroepsmatige opinies over deze processen toont echter aan dat de kennis van seniore stedelijke professionals beperkt was tot de centraal gelegen woongebieden. De ontwikkelde methoden kunnen gebruikt worden om de kennisbasis op het stedelijke niveau te verbeteren en om te voorzien in invoergegevens voor een op GIS gebaseerde multi-criteria evaluatieprocedure die gebruikt kan worden om informele woongebieden te selecteren voor specifieke beleidsinterventies gericht op wijziging van hun ontwikkelingsrichting.

Het beheer van informele woongebieden op lokaal niveau komt in hoofdstuk zeven aan de orde. Drie gebieden – Keko Mwanga, Hanna Nassif en Tabata – zijn onderzocht. De analyse toont aan hoe ruimtelijke informatie binnen kleine gemeenschappen voor planning en administratie gebruikt kan worden en geeft de resultaten van een onderzoek onder verschillende belanghebbenden naar het nut van de toepassing van goedkope, op GIT-gebaseerde luchtfotomozaïeken voor gemeenschapsplanning en beheer. Deze aanpak houdt beloften in voor verdere ontwikkeling in de toekomst.

Tenslotte worden de implicaties van deze uitkomsten voor de ontwikkeling van een prototype-methodologie voor het beheer van informele woongebieden in Dar es Salaam onderzocht. In dat kader zijn conceptuele modellen voor informatie-ondersteuning op beide ruimtelijke schaalniveaus ontwikkeld. Hierin spelen diverse GIT-gebruikers in Dar es Salaam een rol, maar de modellen zijn gericht op de behoeften van de lokale overheid en de actoren in de gemeenschappen. Voorts worden verschillende suggesties gegeven voor verdere ontwikkeling van deze ideeën op de beide schaalniveaus. Dit betreft verbetering van het gebruik van multicriteria-analyse, de ontwikkeling van modellen die behulpzaam kunnen zijn bij het begrijpen en voorspellen van stedelijke groei, de ontwikkeling van doelgerichte instrumenten voor grondbeheer op het niveau van woongebieden en onderzoek dat moet uitmonden in het realiseren van een duurzame locale infrastructuur voor ruimtelijke gegevens om gedecentraliseerde stedelijke planning en beheer te kunnen ondersteunen.

Muhtasari

Nchi za Afrika Kusini mwa jangwa la Sahara zinakumbana na kiwango cha juu cha kukua kwa miji, aidha zimeonesha kiwango cha chini cha uwezo wa kiuchumi kwa muda mrefu. Tofauti na sehemu nyingine ambapo ukuwaji wa miji pamoja na maendeleo ya kiuchumi ni sawa na sehemu moja ya sarafu, ukuaji wa miji katika nchi zilizo kusini mwa jangwa la Sahara umekwenda sambamba na umasikini mwa mijini. Huduma za umma ni kidogo sana kiasi kwamba hata uwezo wa mfumo wa mipango miji kutoa huduma kwa ardhi za mijini kwa ajili ya nyumba na maendeleo zimebaki nyuma sana. Hali hii imepelekea kuwepo kwa maeneo yasiyokuwa rasmi, maeneo yasiyopimwa kiasi kwamba asilimia 70% wanaishi katika maeneo hayo. Kwa kuzingatia hali hii taarifa hii ya utafiti inachunguza fursa muhimu ya kutumia teknologia ya taarifa za jiografia ikiwa kama njia ya kuboresha uthabiti wa mipango ya miji na usimamizi mzuri wa maeneo yasiyopangwa vizuri.

Yapo mambo matatu muhimu katika utafiti huu: chimbuko la fikra katika taaluma ya mipangomiji na uongozi na nafasi ya tekinologia ya kijiografia kikiwa ni chombo cha kuunga mkono mipango ya miji vinajadiliwa pamoja na baadhi ya matatizo ya ardhi na uzalishaji wa nyumba katika hizo. Mapitio ya hizi mada yanaonesha kuwa sehemu kubwa ya taratibu za mipango ya miji katika nchi za kusini mwa Afrika yanategemea sana mifumo ya mipango ya miji ya nchi za magharibi, hasa tekinologia pamoja na viwango vya kupanga mipango iliyo rasmi. Matatizo ya taratibu hizi yamekuwepo kwa muda mrefu na yanajinesha kwa uwazi kabisa. Vivyo hivyo, makuzi ya dhana pamoja na uzoefu kuhusiana na mifumo ya kuunga mkono mipango ya miji ni dhahiri katika nchi za magharibi japokuwa yapo zaidi kwa ajili ya utafiti kuliko chombo cha kutumia. Japokuwa kuna ushahidi wa kuingia kwa Tekinolojia ya habari za Kijiografia katika nchi zinazoendelea kwa ujumla, hadi sasa hakuna mifano inayoonesha juhudi za kutumia mifumo hii katika nchi zinazoendelea. Inatarajiwa kuwa, kwa ujumla mifumo itakayotekelezwa katika nchi hizi itaambatana na tekinolojia hizi wakati muafaka na kuwa mapokeo ya mbinu hizi yanaweza kuwa yamesukumwa na matakwa ya wataalaamu wa nje pamoja na washauri tofauti na maelezo ya wataalaam wenyeji pamoja na jamii. Mahusiano kati ya nchi za magharibi pamoja na nchi zinazoendelea kuhusiana na maendelezo holela yana historia tofauti. Ardhi na nyumba ni vitu muhimu kisera katika nchi nyingi, lakini mipango ya nchi za magharibi haijawahi kwenda na kiwango cha makuzi ya mji hali ambayo ni kawaida kwa nchi zina, wala hawajahi kujishughulisha na hali ya umasikini na makuzi yasiyo rasmi ambayo yanaonekana huko. Japokuwa kuna usawa katika hali ya nyumba kuwepo kwa mifumo kama mradi wa viwanja na huduma katika nchi zinazoendelea kwenye miaka ya 1970 na 1980 na ule wa hivi karibuni wa kusimamia maendelezo ya ardhi ni mifano ya sera za nyumba ambazo

hazijawahi kuwepo katika nchi zilizoendelea. Mwisho, ni dhahiri kuwa kuhamisha taratibu za mipangomiji, sera za nyumba na mifumo ya utoaji wa ardhi na nyumba kutoka Uingereza kwenda nchi zinazoendelea haukuzingatia kabisa hali ya utamaduni na jamii hivyo kuchangia kwa kiasi kikubwa kushindwa kwa sera hizo.Kwa kuzingatia hali hii, muundo wa uchambuzi na mpangilio mzima wa utafiiti huu unajionesha katika sura ya tatu. Mpango mzima unahusisha namna ya kuchambua taratibu za ardhi kuhusiana na maendelezo holela ya miji na utoaji wa maamuzi ili kuthibiti makuzi holela ya miji, aidha, taratibu nyingine zinajihusisha na jinsi mipango inavyofanyika na hasa hasa tabia za wadau katika taratibu za mipango miji katika ngazi za mikakati na kwa wenyeji. Mpango mzima wa utafiti umeegemea tafiti ndogondogo katika jiji la Dar es Salaam, jiji la kwanza kwa ukubwa katika Tanzania. Ukaguzi wa jumla unaonesha kuwa jiji hili ni mfano halisi wa miji iliyoko katika nchi za Afrika. Jiji hili limekuwa sana tangu Tanzania ilipopata uhuru wake toka kwa Mwingereza mnamo mwaka 1961: kiwango cha ongezeko la watu kiko kwenye asilimia 4.5 kwa mwaka, wakati huo huo inakisiwa 70% ya wakazi wake wanaishi katika maeneo yasiyopimwa.kama zilivyo nchi nyingine jirani na Tanzania, uchumi wake bado unategemea kilimo umeonesha kufanya vibaya hususani kwenye miaka ya 1970 na 1980.Pamoja na hayo hali ya uchumi kwa miaka ya hivi karibuni umeonesha kuimarika kufuatia uboreshaji wa mifumo ya kisiasa na kiuchumi.

Kumekuwepo na maboresho ya mifumo ya usimamizi na upangaji wa miji.Mipango mikuu ya miji ya miaka ya 1949,1968 na 1979 imeonesha kutokuwafaaa wenyeji.Mpango wa miji wa mwaka 1949, kama ilivyo mingine ya kikoloni ulizingatia misingi ya kibaguzi na kubeza matakwa ya msingi ya wenyeji ambao kimsingi waingereza waliwaona kama wakazi wa muda mijini.Japokuwa mipango ya miaka ya 1968 na 1979 ilitoa mwanya kwa makundi mengine, mapendekezo mengi yalikuwa na tamaa kwa kujazwa mitazamo ya nchi za nje. Mabadiliko ya hivi karibuni yameungwa mkono na watu wa ndani pamoja na wale wa nje, lakini yanawekwa katika juhudi za dunia katika kuboresha uwezo wa jamii kupangilia miji lengo likiwa kukuza utawala bora kupitia nyanja mbalimbali kama vile kupeleka madaraka karibu na wananchi, kubinafsisha shughuli na kuweko taratibu za kupanga miji kwa njia za ushirikishwaji.Sambasamba na hili tunashuhudia taasisi za serikali na zisizo za serikali zikitumia tekinolojia ya habari ikiwa na nyenzo muhimu katika kupanga na kuendesha mikakati mbalimbali.Tekinolojia ya habari za kijiografia bado ni changa.Kuna jamii ndogo lakini inayokuwa katika matumizi ya tekinolojia kiasi kwamba matokeo ya utafiti huu ni muhimu na yamekuja wakati muafaka. Utafiti huu umefanyika katika nyanja mbili kijiografia.Kwa kiwango cha jiji utafiti umejielekeza taarifa za mikakati pamoja na utoaji wa maamuzi kuhusinaa na ukuaji wa mji usio rasmi.Ramani za hali halisi ya nchi, picha za anga na picha za satellite za SPOT(kampuni ya wazungu) zimetumika kwa ajili ya kutengeneza taarifa za matumizi ya ardhi, hali ya nchi, upanukaji wa jiji na hali ya msongamano wa watu. Sehemu ya pili imeangalia hali sehemu mbalimbali ambapo taarifa za kijiografia kuhusiana uborehsaji wa maeneo hayo na taratibu za kuyasimamia vimechunguzwa. Tekinolojia ya habari imetumika kutengeneza ramani kubwa zinazowezw kutumika katika maeneo hayo, baadhi yake zimepatikana kwa kutumia njia za kiutafiti.

Usimamizi wa maeneo yasiyoendelezwa rasmi umejadiliwa katika sura ya sita.Upembuzi wa mabadiliko ya matumizi ya ardhi tangu mwaka 1982-1998 pamoja na upanukaji wa maeneo holela katika kipindi hicho, vinaonesha kuwa kiwango cha kuongezeka kwa maeneo yasiyopimwa rasmi kinaongezeka, lakini hali ya mkandamizo inaendelea katika sehemu zote ikiwa ni pamoja na sehemu ambazo tayari zina watu wengi.Uchunguzi kutoka kwenye maoni ya wataalaam unaonesha kuwa uelewa wa wataalaamu waandamizi umekomea katika maeneo ya katikati ya miji.Taratibu zilizotengenezwa zaweza kutumika kuboresha msingi wa uelewa ngazi ya jiji na kutoa nyenzo katika kufanya tathimini inayozingatia vigezo mbalimbali ikitumia tekinolojia ya kisasa kwa ajili ya kuchagua maeneo yasiyoendelezwa vyema kwa ajili ya kuweka sera za kuyathibiti ili yaweze kukua vyema. Matatizo ya kusimamia maendeleo yasiyo rasmi kwa kiwango cha chini yanaaangaliwakatika Sura ya Saba.Maeneo yanayoangaliwa ni ya Kekomwanga, Hanna Nassif na Tabata. Uchunguzi unaonesha jinsi taarifa za ardhini zinavyoweza kutumika kwa kiwango cha mitaa katika shughuli za mipango na utawala, aidha, uchunguzi unaonesha mahojiano na washika dau yanaonesha jinsi vifaa vya tekinolojia ya gharama za chini hasa picha za anga zinavyoweza kusaidia uongozi na mipango ya kijamii. Mtazamo huu una umuhimu mkubwa sana kwa ajili ya maendeleo zaidi.

Kwa kuzingatia matokeo haya, utaratibu wa kutengeza chombo cha mfano kwa ajili ya kusimamia maeneo yasiyoendelezwa katika jiji la Dar es Salaam yanaangaliwa.Zana za kuweka taarifa za ardhi kwa sehemu zote mbili zinatengenezwa. Zana hizi zinahusisha wataalaamu mbalimbali wa tekinolojia ya habari katika jiji la Dar es Salaam lakini hasa hasa kimsingi zinaelekezwa katika mahitaji ya serikali za mitaa na wadau wengine.Utafiti unatoa mapendekezo mbalimbali kuhusu kazi zinazohitajika katika ngazi zote mbili. Hii ni pamoja na kuboresha namna ya kufanya tathimini ya vigezo vingi, kukuza mtazamo ya jinsi jiji linavyoongezeka ili kusaidia katika uelewa na utambuzi wa maeneo mapya yanayokua, kutengeneza chombo cha usimamizi wa ardhi ulio madhubuti kwa ngazi ya mitaa na utafiti unaoweza kusaidia kuwepo kwa muundo ulioendelevu kwa ajili ya kuunga mkono upelekaji wa madaraka katika kupanga na kusimamia maeneo ya jiji.

Prepared by Mr. Alphonce Tiba

Curriculum Vitae

Ričardas (Richard) Vytautas Šliužas was born in Adeliade, South Australia on 26 November 1956. After completing high school in 1973 he commenced his studies in Town Planning at the University of South Australia (formerly South Australian Institute of Technology) in 1976. During this course he was fortunate to have been taught Cartography by Martin Spitzer, a graduate of ITC's course in Urban Surveys. With Martin Spitzer's encouragement he gained a place in the post-graduate course in Urban Surveys and Human Settlements in 1979. After completing this course in 1980, he returned to Adelaide, and worked for 3 years as a planning officer with a private planning consultant and as a development control officer with the District Council of Stirling, a local authority located in the Mount Lofty Ranges, within the Adelaide Metropolitan area. In December 1983 he joined ITC as a research assistant, working on applications of USEMAP (a raster based GIS developed at ITC) working closely with Ir. C.A. (Kees) de Bruijn. He completed his MSc at ITC based on informal development in Dar es Salaam in 1988 and has since been working as a lecturer in subjects related to GIS applications for urban planning and management. In his career at ITC he has been involved in projects in India, Tanzania, China, Thailand, Malawi and Egypt. His current research interests are related to monitoring and modelling of urban development, GIS applications related to informal settlements and the development and use of participatory GIS applications.

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