

IMPROVING THE LOCATION OF LOW INCOME HOUSING DELIVERY

IN SOUTH AFRICAN URBAN AREAS

Sharon BIERMANN
Manager: Planning Support Systems
Built Environment
Council for Scientific and Industrial
Research (CSIR)
P O Box 395
Pretoria 0001
South Africa
Tel: +27 12 841 2470
Fax: +27 12 841 4036
E-mail: sbierman@csir.co.za

Mark VAN RYNEVELD
Senior Lecturer: Traffic and
Transportation Engineering
Department of Civil Engineering Science
University of Johannesburg
P O Box 524
Auckland Park, Johannesburg 2006
South Africa
Tel: +27 11 489 3511
Fax: +27 11 489 2343
E-mail: markvr@uj.ac.za

Abstract: Recent advances of a Planning Support System (PSS) for South African planners and policy-makers to address the increasing housing backlog in improved locality within current resource constraints has included a predictive capability, consideration of density and the reduction of the component costs of delivery to common monetary terms.

Application of this PSS to Gauteng Province, South Africa shows that the total cost of higher density housing on well-located land is very similar to that of existing lower density options spread from core to periphery, with the cost of the house (largely carried by the household) being significantly higher and the cost of transport and engineering services only slightly lower for the denser option.

This finding suggests the need for a range of different housing typologies, with 'higher cost/higher potential benefit' housing typologies on scarce well-located land allocated to those with the best chance of exploiting those potential benefits.

Keywords: Low income housing, well-located land, density, development costs, planning support system.

1. INTRODUCTION

With the right to shelter being firmly embedded in the Constitution (Republic of South Africa, 1996) and accelerating urbanisation levels (Cities Network, 2006), South African planners and policy-makers are confronted with the challenges of an increasing housing backlog and meeting this growing demand in localities and forms which contribute to the spatial restructuring of South African cities, all within considerable resource constraints.

Wilson (2006) recently suggested that the South African government may be losing the battle to provide houses for all its people. While government has paid out more than R37billion (i.e. thousand million Rand) and delivered 1.9 million housing subsidies since the new democratic government came to power in 1994, the *magnitude of the housing backlog* has remained largely unchanged. Government

figures show that there were 2-million households without access to adequate housing in 1996, and that this figure rose to 2.4-million households in 2005. Although the *causes* of the backlog may be known - increased rural-urban migration and falling household size - the *facts* remains sobering, and point to the need for careful forward planning for sustainable human settlements.

Not only is delivery failing to keep pace with demand but the *locality and form* of delivery is not achieving objectives of spatial restructuring. Housing delivery has occurred mainly on the urban periphery, adjacent to existing low income settlements rather than on more well-located land in the more centrally-lying areas, with better access to urban opportunities. This peripheral housing development, which is reinforcing the apartheid city spatial pattern of development, where the poor are stranded on the peripheries, has been attributed to a number of policy and implementation factors but with the major underlying cause being cost. The subsidy amount is simply not sufficient for delivery on expensive "well located" land in the more central areas even if higher densities are used to offset higher land costs.

2. PURPOSE

Planning Support Systems (PSS) have been a key instrument used to assess the costs in relation to financial resources and to test alternative policy options for improving the affordability of better-located housing development. The purpose of this paper is to:

- describe briefly the evolution of Planning Support Systems (PSS) for the identification of well-located land in South African urban areas;
- describe the most recent advances, which have included (a) predictive capability; (b) the addition of density considerations in relation to locality, and (c) the rigorous reduction of potential costs of delivery to common monetary terms;
- describe the application of the most recent advances to a case study of Gauteng Province, and to make specific observations about the total costs and its individual components; and
- make recommendations for future research.

3. EVOLUTION OF PLANNING SUPPORT SYSTEMS (PSS) FOR THE IDENTIFICATION OF WELL-LOCATED LAND IN SOUTH AFRICAN URBAN AREAS

According to Geertman (2006), a planning support system is the framework which combines the three components of planning task specification (in response to the specific problem), models and methods of analysis, prediction and prescription and then the transformation of basic data and information, modelling and design.

In South Africa, in response to the problem, the broad planning task has been that of identifying the best localities for providing subsidized housing for the poor, taking into account resource limitations, on the one hand and in addition, with the policy objective of using the delivery of housing to contribute significantly to the restructuring of an entrenched urban spatial pattern where the poor are

predominantly located on the periphery. Through an evolving process, more specific planning tasks, or sub-tasks of the broad task, have been specified over time in response to particular emerging planning needs. Specific models, methods and designs have accordingly been developed and integrated, on a progressive basis, enhancing the level of planning support in the field.

These planning support systems consist fundamentally of the following elements: conceptual framework (in written form, supplemented by diagrams, flowcharts etc); database (spreadsheet-based); analytical tools (spreadsheet- and GIS- based); Spatial presentation of the outputs (GIS-based); output in the form of a brief report (supported and illustrated by graphs, annotated maps, diagrams, flowcharts etc). A client or local authority could theoretically operate the various tools of the planning support system themselves. Practically speaking, with current levels of skills and capacity in government, the client or local authority would need the developer or someone who is familiar with the system, to operate the system on their behalf.

The development of the conceptual framework and data collection and application of the concepts have progressed in a mutually supportive manner. Advances in the conceptual model have driven new data collection and new application of the concepts. And new results of the application of the model have in turn driven further conceptual development and data collection. Key elements, improvements and refinements of the emerging model have included:

- valuation methodology - either by dimensionless indices or in monetary terms; and breakdown of costs into: (a) capital and recurrent costs; (b) parties to whom costs accrue (e.g. household, local government, national government); (c) different components of cost (e.g. land, engineering infrastructure, social infrastructure, housing, transportation, environmental goods and services);
- valuation of benefits (primarily in the form of 5 capitals; not yet strongly developed in monetary terms);
- more comprehensive coverage of sites in different localities;
- affordability assessments by comparison of costs to government and household budgets;
- spatial referencing and presentation of data and model outputs by means of GIS;
- predictive capability; and
- consideration of density in addition to locality.

These elements have been progressively included, improved and refined in a series of publications. Multicriteria evaluation, integrated with GIS, has been used to undertake a land suitability assessment in a major metropolitan area to prioritise land for low income housing development (Biermann, 1997; Biermann 1999). While a range of multi-disciplinary criteria were incorporated, they were combined in the form of an index and therefore useful for comparative evaluation of areas. The planning support solution for the identification of well-located land has subsequently been enhanced through the introduction of bulk infrastructure costs into the multicriteria evaluation- GIS-based model (Biermann 1998, Biermann, 2002, Biermann & Landré, 2003) and the results applied to the compact city debate (Biermann, 2000). The introduction of a cost-benefit approach, with the inclusion of benefits in the form of sustainable livelihood capitals indices and instituting, albeit fairly qualitatively, the

distinguishing between capital and recurrent cost and to whom the cost accrue, has more recently been incorporated to address the specific question of the impact of peripheral housing localities on energy efficiency and sustainable livelihoods, through mainly sample surveys of existing households (Venter, Biermann & Van Ryneveld, 2004, Biermann 2006). The most recent development, introduced to address the issues of the long term affordability and policy implications of instituting a directional change in housing policy in Gauteng to support higher densities on well-located land rather than continued low density, peripheral development, has been the synchronisation of costs with affordability over various time periods, in terms of income of government and households (Biermann, 2005).

4. CASE STUDY: GAUTENG PROVINCE, SOUTH AFRICA

4.1 Study area

The province of Gauteng, the most populous and economically significant of the nine provinces in South Africa, and which comprises mainly the Johannesburg/Pretoria urban agglomeration, is experiencing a population growth rate of twice the national average, while unemployment rates on the other hand, have doubled, resulting in a significant increase in the number of urban poor (Figure 1a). In its attempt to keep pace with the growing demand, and within the policy, funding and legal constraints of the national government's subsidised housing programme, the Gauteng provincial government has, over the last 10 years, built just over 300 000 serviced housing units (Gauteng Provincial Housing Development Plan, 2004) but mainly in peripheral localities (Figure 1b).

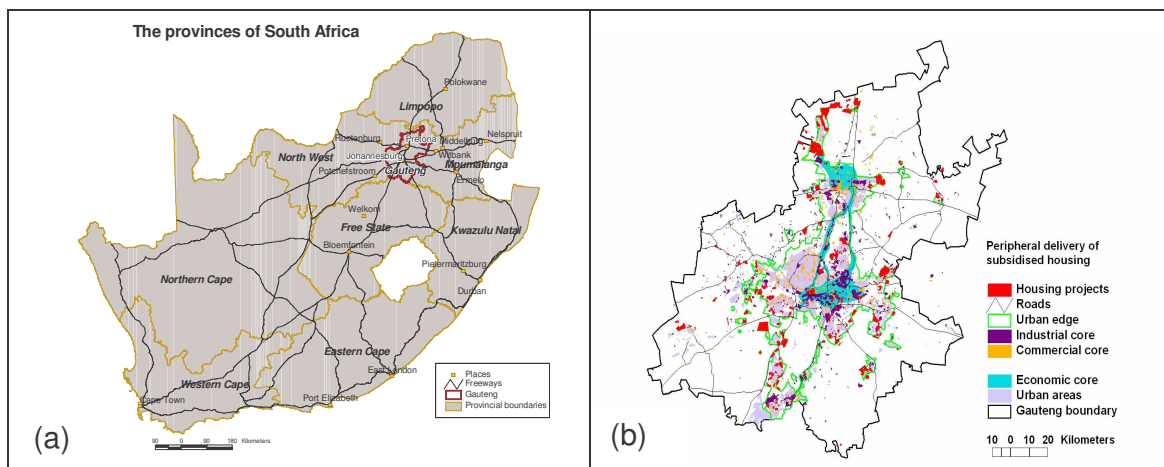


Figure 1: (a) Gauteng Province in the context of South Africa (b) Housing projects delivered in Gauteng Province since 1994

4.2 Site selection

A representative sample of possible low income housing sites, throughout the province, was required. A two step process was followed whereby available sites were firstly identified and then stratified according to the “suitability” of sites using an existing index-based land suitability assessment system to ensure a representative sample of high, medium, low and very low suitability for housing development according to currently available information. Due to the strategic nature of this study,

the site selection identified the general areas for potential housing development and did not identify specific legal parcels of land. As the study progressed, and different portions of the indicative areas perform differently in terms of cost results, site area boundaries were refined.

The selection of “available” sites, both within and outside of the existing urban fabric, was informed by a previous provincial land availability study and strategic development planning framework, local municipality priority housing areas, informal settlement localities, state-owned land and recent project proposals. To ensure that the selected sites broadly represented a range of “suitabilities”, the previous multicriteria evaluation, index-based land suitability assessment was used, which allocated a 40 percent weight to macro-accessibility, 20 percent to geotechnical suitability and 20 percent to agricultural and ecological importance respectively (Gauteng Province Land Task Team, 2002). A total of 30 sites were selected: 3 sites with a very low suitability, 9 with low suitability, 10 with medium suitability and 8 with high suitability index scores (Figure 2).

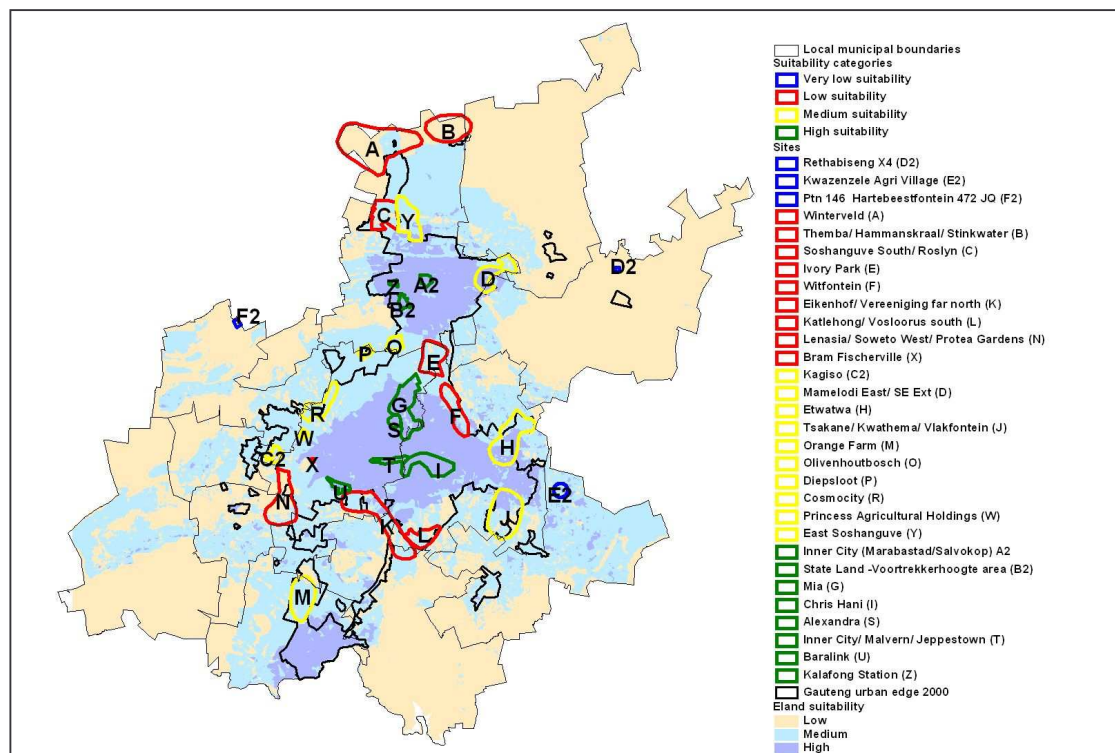


Figure 2: Locality of sample sites

4.3 Housing backlog

The total housing backlog at the time of the study was estimated at approximately 280 000 households. The cost calculations assumed an allocation of 30000 additional low income people to each of the 30 sites which converts to 9375 households per site at a household size of 3.2 persons per household, which is the average household size for low income households in Gauteng, according to Census 2001.

4.4 Housing typologies and delivery options

Three different delivery options were applied and costed over the 30 sites using suites of housing typologies (Table 1). These suites are predicated on the inter-relationships between the density and scale variables based on the delivery unit of 30000 persons.

Table 1: Housing typology suites applied in delivery options

	Percentage distribution of Gross Residential Density			
	% of units @ 25 / ha	% of units @ 40 / ha	% of units @ 80 / ha	% of units @ 95 / ha
Suite 1	100	0	0	0
Suites 2	30	30	30	10
Suite 3	0	25	50	25
Typology description	Site area 250m ² ; Frontage 15m, Standard plot, 1 dwelling unit per plot.	Area 120m ² ; Frontage 15m, Standard plot, 1 dwelling unit per plot.	Area 8000m ² ; Frontage 65m, 2 storey walk-up.	Area 10000m ² Frontage 150m, 4 storey walk-up.

Delivery Option 1, or the Baseline Delivery option, applies housing typology Suite 1 to all 30 locations. This calibrates the cost model for a business as usual outcome, delivering housing units at 25 units per hectare gross residential density, being the general gross residential density achieved in current subsidy scheme projects in Gauteng. This option establishes the baseline land demand of 10850 hectares.

Delivery Option 2, or the Mixed Delivery option, applies housing typology Suite 2 to all 30 locations. It establishes changed circumstances from Option 1 in all sectors. Calculations cover the same land area as Option 1 (10 850 hectares) of which 6 960 hectares are developed and 3 890, undeveloped. The undeveloped land is 'costed' in each cost sector where appropriate.

Delivery Option 3, or the Densification Focus option, applies housing typology Suite 3 to six focus areas that were chosen because they are closer or integral to the existing denser urban fabric. The six areas are listed with their map label in brackets: Alexandra (S), Baralink (U), Pretoria Inner City (Marabastad/Salvokop) (A2), Johannesburg Inner City (Malvern/Jeppestown) (T), Mamelodi East/South East Extension (D), State Land – Voortrekkerhoogte area (B2) (Figure 2). The remaining 24 sites were assigned Suite 2 housing typology proportions.

4.5 Cost calculations

Using the costed-norms approach, costs of adding 9375 housing units of the housing

backlog were calculated for each site, for each delivery option, accounting for context-specific conditions. The costed – norms approach is a formula-based method for calculating the financial resources necessary to provide social services to mandated or recommended norms or standards (Financial and Fiscal Commission, 2000). Capital and recurrent costs to household and government were distinguished for housing and related service components: land, engineering services, social, amenities, travel, top structure, environmental resources, retail goods and services. Cost and services data was obtained predominantly from government sources, but considerable analyses were undertaken to determine existing levels of service within service catchment areas related to the selected sites, to calculate the additional services required to service the backlog allocated to those sites to the required levels of service and then to determine costs. Recurrent costs were calculated over a 20 year period and then converted to present costs. All costs are expressed in 2004 Rand value, per household, per month.

5. CASE STUDY RESULTS

5.1 Average costs

The total cost of all cost components averaged over 30 sites is R4942/hhld/month of which 80% are recurrent costs and 71% are costs which accrue to government (Table 2). The difference in cost between delivery options is marginal and options 1 and 3 differ by less than 3% with an absolute cost advantage in the case of option 3, of only R137/hhld/month. Total costs are highest for option 1 and lowest for option 2. The reason why the option 3 costs are not quite as low as option 2 is attributable to the higher housing unit costs associated with higher density housing forms (Figure 3).

Table 2: Average combined cost (R/hhld/month) per delivery option for 30 sites

	Option 1	Option 2	Option 3
Total - Av	5036	4891	4899
Capital - Av	826	1026	1043
Recurrent - Av	4210	3864	3856
Household - Av	981	1456	1535
Government - Av	3963	3343	3272

Other than housing unit costs which significantly increase with increasing density, and retail and social amenity costs which remain constant for all delivery options, costs generally decrease with increasing density. Of those cost components which decrease with increased density, the highest percentage decrease is in land cost and the smallest percentage decrease is in transportation cost. The greatest absolute decrease in cost is in environmental resource cost reduction and again the smallest absolute decrease is in transport costs (Table 3). The increase in housing unit cost in option 3, however, significantly reduces the benefit obtained by reduction in the other cost components. The increased cost of higher density housing forms thus outweighs the benefit of lower land costs of higher densities associated with less land requirements.

A consideration of the cost components in the form of capital and recurrent costs and whether the cost is borne by the household or government, it is clear that both capital cost and cost to households increase with increase in density (between options 1 and 3) and that the major cost component responsible is the increase in housing unit cost (Figure 4). Recurrent costs and costs to government reduce with increasing density mainly as a result of decreasing environmental resource costs.

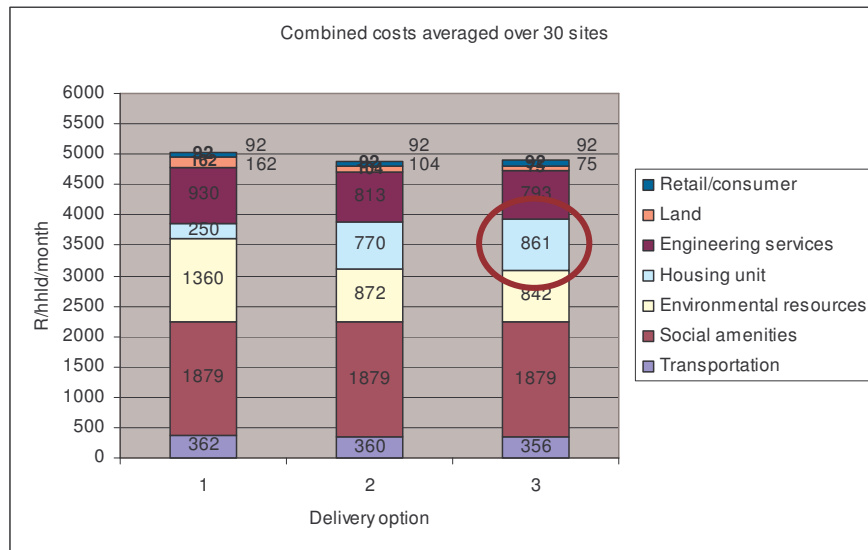


Figure 3: Combined costs averaged over 30 sites for each delivery option

Table 3: Percentage and absolute variation in cost between options 1 and 3

Variation between Ops 1 and 3	%	R/hhld/m
Transportation	0.02	5.65
Environmental resources	0.62	518.35
Housing unit	-0.71	-610.65
Engineering services	0.17	136.90
Land	1.15	86.79

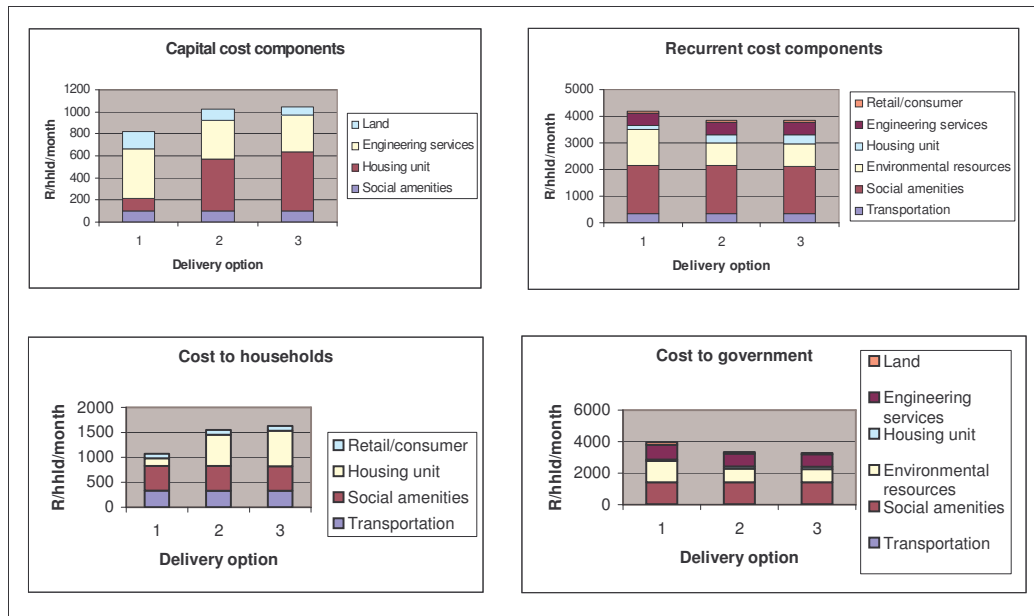


Figure 4: Breakdown of cost per component and type for each delivery option

5.2 Costs and locality

While total cost is similar for all options, except for a slightly lower cost in the case of options 2 and 3, the spatial cost pattern is also similar between options, with the lowest cost consistently occurring at site W (Princess AH) and the highest cost, at site E2 (Kwazenzele Agri Village) (Table 4). The variation in costs between locations, within options, between the highest and lowest cost, ranges between around R2760/hhd/month for options 2 and 3 and R4200/hhd/month for option 3. This suggests that with lower density delivery options as is presently the situation, cost is more sensitive to location than in the case of higher density options, where the housing unit cost increase becomes significant.

Table 4: Percentage and absolute variation between highest and lowest cost (R/hhd/month) for all options

	Combined	Option 1	Option 2	Option 3
Total - Av		5036	4891	4899
Highest total (E2)		8151	6976	6976
Lowest total (W)		3973	4214	4209
% Variation		1.05	0.66	0.66
Absolute variation		4178	2762	2767

Regarding which are the most cost-efficient locations, in terms of total cost, other than the best location of Princess AH in the west of the province (R3973/hhld/month for option 1), the far northern and southern parts of the province seem to have the lowest costs (lower than R4500/hhld/person), while there is a more expensive region in the centre of the province in the Ivory Park/Witfontein area, Bram Fischeville and Lenasia South/Soweto West/Protea Gardens (>R6000/hhld/month) (Figure 5). The higher cost of these areas is attributable to high recurrent, environmental resource costs to government especially in option 1 but in the case of options 2 and 3, social amenity and engineering services costs become more important. The highest cost is to the far west of the province at Kwazenzele Agri Village (R8151/hhld/month for option 1 and R6976/hhld/month for options 2 and 3). The relatively high cost in some of the more central areas is due mainly to environmental resource cost, social services cost and engineering services cost. The higher cost of some of the central areas can be ascribed to higher capital costs of predominantly land in the case of option 1 but with housing unit cost becoming very important in the case of options 2 and 3. Cost to household is greatest in the far peripheral sites where social amenity, transport and retail costs are high.

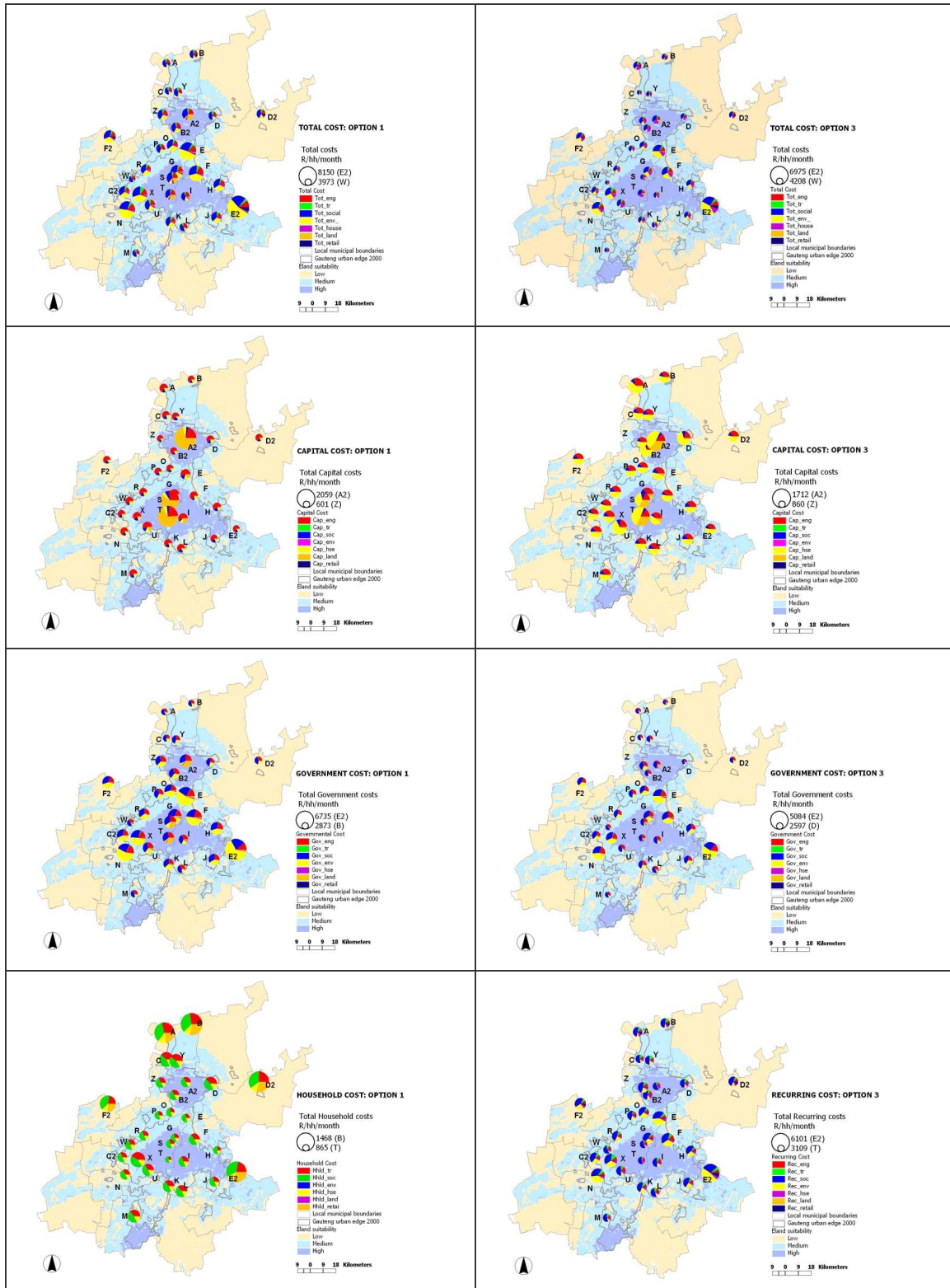


Figure 5: Spatial pattern of total cost, capital cost, government cost, household cost and recurring cost for Options 1 and 3.

6. CONCLUSION

Costs have proved to be the major reason why patterns of settlement planning which locate poor people on the periphery have continued in post-apartheid urban South Africa. Valuation of costs - and their various facets, including (a) capital and recurrent costs, (b) parties to whom the costs accrue (e.g. household, local government, national government), (c) different components of cost (e.g. land, engineering infrastructure, social infrastructure, housing, transportation) - has therefore been a core component of a spreadsheet/GIS-based Planning Support System, developed for assessment of locality for low-cost housing developments in South Africa. (Similar approaches have been applied to the valuation of benefits, although less well developed).

The most recent advances to PSS have included: (a) predictive capability; (b) the addition of density considerations in relation to locality, and (c) the rigorous reduction of potential costs of delivery to common monetary terms; (d) GIS element for assessing spatial patterns of cost.

Applying these advances to a case study of Gauteng Province, the following specific observations are made:

- The *total* costs of all 3 delivery options are virtually the same, with the additional costs of denser housing in Option 3 offsetting the gains obtained from other sources, mainly environmental resources.
- Breaking these costs down further, certain topics have emerged as critical, while others topics have emerged as less critical: In particular, transport costs are not significantly reduced by the denser options; nor are there very substantial gains to be made in the capital costs of the engineering services for the denser well-located land options. The recurrent costs of social amenities (education and health care) dominate the recurrent cost component of all options.
- The reduced environmental cost of Option 3 does not easily translate into improved government or household income. It is very indirect, whereas the additional cost of housing translates very directly into immediate cash outlay. Government or household or both has to lay out more disposable cash for Option 3. Option 3 therefore requires a greater cash outlay than the other options.
- While the opportunity for earning better incomes exists for households in Option 3, there is no guarantee that this is actually realised for the households who end up living there. In fact, they are *worse* off than in Option 1 if they cannot realise the better incomes. Option 3 is therefore a 'high cost/high potential benefit' option, while Option 1 is a 'lower cost/lower potential benefit' option.

The implication of these findings is that there appears to be a need for a *range* of different housing typologies: (a) 'higher cost/higher potential benefit' housing typologies on scarce land close to established urban areas, allocated to those with the best chance of exploiting the potential benefits; (b) 'lower cost/lower potential benefit' housing typologies on peripheral land allocated to those who have not yet developed the capacity to exploit those potential benefits.

Recommendations for further research follow the outcomes of the application of the most recent model to Gauteng Province:

- consolidate the predictive costing models with improved data collection and modelling;
- strengthen the analytical role of GIS. While the translation of the above costs into comparable format has been crucial in obtaining an overall or *consolidated* view of the costs, the GIS element has proved crucial in assessing *spatial* patterns of cost; and
- start exploring a more comprehensive approach to land-use that incorporates the requirements of employment generators in relation to those of poor households.

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