Applications of Poverty Maps in Urban Planning: Examples from Liberia, in Costa Rica

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Abstract This paper introduces a new technique that uses small administrative unit poverty maps. The paper shows a pilot application of the proposed technique using census-tract data of the medium-size city of Liberia, Costa Rica in four functions of urban planning: appraisal, simulation, decision-making and assessments. The piloting of the technique made possible to identify the territorial concentration of poverty and inequality, simulate the impact on poverty reduction of alternative land-based actions, engage different actors to discuss and agree on a plan of actions and thereby promote transparency and accountability in decision-making, and assess the impact on poverty reduction of the implementation of the social housing policy in Liberia. The technique may help to promote the development and use of timely and reliable census-tract data. It also incorporates a residential segregation approach to traditional poverty analyses, which proved to be helpful for poverty analyses at small administrative unit levels.

Keywords Poverty maps · Urban planning · Poverty impact assessment · Census-tract data · Costa Rica

Introduction

Urban planning in cities of the South, also known as developing countries, can greatly benefit from the use of poverty maps in the battle against poverty. Large gains from targeting smaller administrative units, such as districts, neighbourhoods or census tracts[1], have been recognised in comparative studies. For example, Robles (2007) discusses the case of Panama, in which the application of a district targeting

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[1]INEC (2004) defines census tracts as those geographical units, part of districts, which include a number of dwellings that can be completely registered by one census surveyor.

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strategy is about 30% cheaper than a uniform targeting strategy. Likewise, Elbers et al. (2007) show that in Madagascar and Cambodia one would need, respectively, only 38% and 31% of the uniform transfer budget to achieve the same poverty reduction compared to the optimal targeting at district level.

Poverty maps are normally presented as final results of poverty assessments or academic research to illustrate poverty at global, country or regional levels. For example, a novel tool developed by the Inter-American Development Bank, EQxIS (www.iadb.org/xindicators/) does not reach city levels. However, despite the evidence, poverty maps are just occasionally used in policy making or as tools for poverty analyses.

Specifically in Latin America, poverty maps of small administrative units are seldom used to analyse, simulate or monitor the implementation of social policies or as instruments to allocate resources into targeted small administrative units mainly due to data, methodological and conceptual limitations.

Efforts to overcome data limitations have focused on data collection and processing. For example, in 1997 the Inter-American Development Bank (IADB), the World Bank and the Economic Commission for Latin America (ECLA) implemented the Program for the Improvement of Surveys and the Measurement of Living Conditions in Latin America and the Caribbean (MECOVI). Nevertheless, quality of statistics and cartography in the region is not yet at the stage required, as censuses do not include income or consumption statistics, and sample surveys are not large enough in size to permit estimates of economic poverty dimensions at a highly disaggregated territorial level.

Efforts to address methodological limitations, on the other hand, have focused on developing techniques that allow estimation of economic poverty for small administrative units by combining census and sample survey information (see for example Elbers et al. 2007).

These data and methodological efforts fail to acknowledge that the implementation of social policies at small administrative units is not a top-down process merely based on economic criteria, as in practice these processes involve different actors and include technical and political criteria as well. In particular, different studies emphasise the need to expand the concept of poverty from its economic dimension and recognize the complexity and diversity of local realities in which the poor live (Chambers 1995; Rakodi 1995; Moser 1998; Perlman 2004).

To address these conceptual and methodological gaps, this paper analyses potential applications of poverty maps in urban planning in cities of the South. This analysis is illustrated with the results of piloting a technique, developed by this author, in the medium-sized city of Liberia, Costa Rica. This technique uses census-tract-level poverty maps—drawn from census data—in four different functions of urban planning. First, it was used to determine the territorial distribution of four dimensions of poverty (housing, water and sanitation, education and consumption), and identify deprived urban areas in which to allocate limited resources in priority land-based actions. Second, it was used to simulate the impact on poverty reduction of alternative land-based actions. Third, it was used to inform decision-makers and prioritise a list of identified land-based actions to reduce poverty in targeted deprived urban areas. Lastly, it was applied to assess the impact on poverty reduction of thirteen years of the implementation of the social housing policy in Liberia.

This paper is part of an ongoing broader research endeavour leading to a PhD degree, under which previous papers have discussed in depth the concepts, methods and features of the proposed technique (de la Espriella 2007), and presented the findings of case studies in which it was applied (de la Espriella 2010, forthcoming). The fundamental contribution of this paper to the research lies in analysing the possible applications of the proposed technique in urban planning, which are discussed in "Applications of the TSTP™" and "Summary and Conclusions". These two sections are preceded by three sections: the present "Introduction", "Conceptual Framework" in which the conceptual relationship between poverty maps and urban planning is presented, and "The Tool for Strategic Territorial Planning, TSTP™" in which the concepts and potential functions of the proposed technique are described.

Conceptual Framework

Poverty Maps

As was mentioned in the introduction, this paper focuses on census-tract-level poverty maps, which are part of administrative data systems. The origins of administrative data systems are explained by Treuhaft and Kingsley (2008). A short summary of their explanation is given below to bring into context the development of poverty maps.

Treuhaft and Kingsley (2008, p. 5) traced the origin of administrative data systems in the West back to ancient Rome, *"where land surveyors inscribed bronze tablets with base maps demarcating property boundaries and ownership information"*. They further describe how during the Enlightenment property mapping re-emerged *"to become a widespread tool for land management and the taxation of real properties"*. Over time, local governments began to link census data with maps mainly for tax and military purposes, and include additional types of property conditions such as zoning and building codes. Recently, technologies such as computers and Geographic Information Systems (GIS) have revolutionised mapping and recordkeeping. As a result, local governments worldwide are now creating integrated land information systems that gather small administrative unit data from multiple agencies, becoming important instruments for the planning of any society.

In this context, the term 'poverty maps' is hereby understood as by Robles (2007, p.3) to refer to *"spatial representations that show the geographical distribution of poverty and wellbeing, generally with various disaggregated levels and with indicators that show one or more dimensions of poverty."* (free translation made by this author). The Poverty Mapping project—a joint initiative by FAO, UNEP and CGIAR—describes the main characteristics of poverty maps in their website (www.povertymap.net):

- ▪ Poverty maps show information derived from a variety of sources, most frequently from first-hand information or from national census data, household surveys or administrative agencies (e.g. tax authorities, education, health or police centres, etc).
- ▪ They organise information in indicators, such as income poverty (e.g. GDP per capita or daily subsistence levels), or wellbeing (e.g. life expectancy, child mortality, or literacy).

- Sometimes, they combine various indicators to give indices of poverty or wellbeing, such as the Human Development Index, a composite of life expectancy, literacy and income.
- They present these indicators and indices at global, national, regional, urban and local levels.

Poverty maps are often used in poverty assessments to determine the current or past geographical distribution of one or more indicators that measure the degree of poverty or wellbeing of a country or a region (World Bank 2004). They are also used in impact assessments to identify future and likely consequences of a current or proposed policies or programmes (IAIA 2007). In both cases, poverty maps are one final result of these diagnosis or prognosis exercises. This result of poverty and impact assessments—poverty maps—is increasingly being used by policy makers at central level to identify deprived regions of a country and 'tailor' policies and programmes. This proactive use of poverty maps enables policy makers to geographically target scarce resources and become more effective in the reduction of poverty. In addition, they are now used to inform decision-makers at local levels and on the implementation of social policies. For instance, a study of PolicyLink and the Urban Institute found that 72 of the American 100 largest cities operate systems that make small administrative unit data from multiple agencies available to the public via the Internet (Treuhaft and Kingsley 2008). Another example is the use of poverty maps by the *Secretaria del Triangulo de Solidaridad*, in Costa Rica, to identify priority locations for the implementation of their programme (Smith 2004).

Urban Planning

Land is a valuable resource for society. Specifically, urbanized land is a scarce resource and even when costs of converting rural to urban land are high; its benefits for society are significantly higher and linked among others to health, security, social and cultural advantages.

Urban planning—also known as city or town planning—comprises those aspects of urban governance that deal with land-based affairs and the ways in which land is used, managed and controlled. Hence, the way the term 'governance' is conceived bears conceptual and practical differences in the ways in which urban planning is understood and applied.

Governance is hereby understood as by Paul Jenkins (cited in Smith 2004, pp 63–64) referring to *"the sphere of relations between government and other actors in civil society on non-governmental actors—including the private sector. It also refers to the processes of interaction between these in defining roles and relationships. The idea of governance is that government does not work in isolation, but in the above sphere and through these types of relations, and thus government has to be seen in the context."* This concept of governance captures the movement towards democratization and political pluralism, the rise of civil society and responds to the spread of powerful local social and environmental movements and the lack of capacity of the state to manage certain aspects normally addressed by the so called informal sector. The application of this concept implies wider participation in monitoring, assessments and decision-making than traditional top-down governmental approaches (Smith 2004), and

responds to the risk of elite local capture, for which decentralisation has been criticised (Araujo et al. 2006).

In this context, the term 'urban planning' is hereby understood as by Healey et al. (2006, p. 5), to refer to *"a social process through which a range of people in diverse institutional relations and positions come together to design plan-making processes and develop contents and strategies for the management of spatial change. This process generates not merely formal outputs in terms of policy and project proposals, but a decision framework that may influence relevant parties in their future investment and regulatory activities."* This social process is shaped by both the dynamics of urban region change and by the formal law and procedure of existing spatial and land-use planning systems. Urban planning includes, among others, the following functions:

- The design of land, property and building norms and regulations of towns and cities, and sometimes the reinforcement and conflict resolution related to these norms and regulations.
- The conduction of appraisals of past or current urban situations in terms of land-related issues.
- The simulation, design or assistance in the design (plan-making, in Healey's terms) of all kind of issues related to land use, urban expansion, urban renewal and heritage conservation.
- The assistance and information in decision-making processes related to land-based actions of towns and cities.
- The implementation, or assistance in the implementation, of land-related actions such as physical infrastructure (e.g. housing, sanitation, water and transportation), social services (centres of education and health, parks) and the built environment of towns and cities.
- The monitoring and assessment of the quality and impact of land-based actions.
- The coordination and articulation of different aspects such as aesthetics, safety, urban decay, transport, and the environment, among others (for a broader definition of urban planning see Campbell and Fainstein 2007 or Jenkins et al. 2007).

In the author's own work, it is argued that urban planning practice responds to social values in place, local dynamics and the extent of local capacities and resources to address its different functions (de la Espriella 2010, forthcoming). It is in that sense that the practice of urban planning is seen as context-driven and inscribed in the broader concept of urban governance described earlier. In that respect, urban planning is not seen as a top-down practice, but rather as the combined result of views and efforts of different actors depending on their values, interests, capacities and resources.

Relationship Between Poverty Maps and Urban Planning

The links between poverty maps and urban planning are multiple and can be applied at different levels. This strong relationship is based on the nature of urban planning, which focuses on the ways in which land is used, managed and controlled. The relationship is strong as a significant amount of the information used in various functions of urban planning, such as the design of norms, appraisals, simulation,

decision-making (plan-making), implementation, monitoring and assessment, are related to the geographic space, typically involving location or positional data. For instance, Terborgh (2006) argues that 80% of government data collected is associated with some location in space. Yet aside from the actual figure, the high rates of urbanization in cities of the South (Tannerfeldt and Ljung 2006) urges the need to embrace timely and accurate mapping methodologies for urban planning to address effectively and efficiently the increase demand of space, goods and services with limited resources.

Various authors address the relationship between poverty maps and urban planning (see for instance Ottichilo 2007 and Robles 2007). From these works, five links can be identified:

- Mapped information on the levels and geographical distribution of poverty or wellbeing makes the presentation and interpretation of data on poverty more easily understandable to a non-specialist audience, which in turns facilitates the discussion among different actors involved in urban planning practice.
- Poverty maps make easy to identify geographical factors related to poverty, which in turn helps urban planners to target scarce resources to upgrade deprived urban areas.
- Geo-referenced information can free analyses from the restrictions of complex database numeric formats. For instance, administrative data can be converted from numeric format to land-based formats—in the form of maps—which are often more meaningful in an urban planning context. This greatly assists in the targeting of resources and implementation of development projects.
- Poverty maps also allow easy comparison of indicators of poverty or wellbeing with planning-related indicators, such as access to infrastructure or services, availability and condition of natural resources, and distribution of transport and communications facilities.
- Poverty maps are helpful to conduct impact assessments in relation to the geographical targeting of policies and programmes, such as the impact on poverty reduction of the implementation of a social housing policy.

The links between poverty maps and urban planning bring up the question of the extent to which poverty maps could support pro-poor planning practices in cities of the South and if so, in which of its different functions they could be helpful (see for example Bedi et al. 2007). In other words, could poverty maps be applied to identify the territorial distribution of poverty, to simulate the impact on poverty reduction of alternative land-based actions, to engage different actors to discuss and agree on a plan of actions, and to monitor the impact on poverty reduction of the local implementation of social policies?

The Tool for Strategic Territorial Planning, TSTP™

Objectives of the TSTP™

The proposed technique is hereby referred to as the Tool for Strategic Territorial Planning (TSTP™). The TSTP™ is presented in an Internet-based information tool,

which shows territorially-disaggregated data on planning-related indicators for monitoring development goals related to the urban planning practice. All indicators are estimated based on census data or household surveys. For example, a prototype Internet-based tool that includes data of the city of Liberia, in Costa Rica, was drawn from the 2000 National Population Census, and it can be accessed at www.planning4equality.com.[2]

The TSTP™ aims to inform—using evidence—all actors of urban planning practices about the extent to which their actions may effectively reduce poverty. Additionally, it seeks to attract public participation into, and enhance accountability and transparency of, decision-making processes in a way that helps proposed land-based actions respond to local needs, including those of the poor.

The TSTP™ is structured on six specific objectives, which are presented below in no particular order.

One objective of the TSTP™ is to support the use of evidence in decision-making processes. The evidence is presented in the form of poverty maps. This objective is pursued in three steps: *(i)* planning-related indicators (e.g. access to water and sanitation, housing quality, etc.) are estimated from census data or household surveys; *(ii)* evidence-based poverty maps are then generated by combining each planning-related indicator to its corresponding cartographic data sets using GIS venues; *(iii)* the poverty maps can subsequently be used in decision-making processes, not only as a tool to visualise the geographical distribution of selected indicators, but also as a technique to geographically identify different dimensions of poverty and to underpin dialogue amongst different stakeholders of urban planning, both when defining the indicators and when analysing and discussing the results.

Another objective of the TSTP™ is to support the integration and articulation of land-based actions. This is the response to understanding poverty as a multidimensional phenomenon, and planning as responsible for the articulation of different sectors and agencies in relation to the design, implementation and monitoring of land-based actions (Taylor 1999 and Healey et al. 2006). Hence, the TSTP™ seeks to assist urban planners and decision-makers in the articulation of integrated land-based actions that address the multidimensional character of poverty. This is achieved by enabling them to compare evidence-based poverty maps related to different sectors and agencies in order to propose actions and projects that may lead cities to reduce poverty and inequality, which is a goal that is very seldom achieved by isolated actions and projects.

An additional objective is to promote the implementation of area-based targeting strategies for poverty reduction purposes. This is a response to the favoured implementation of group-targeted strategies, which has often led to setbacks, such as the geographical concentration of the poor, which in turns has led to the development of differentials of services and other poverty traps. Group-targeted strategies have traditionally been preferred, mainly because targeted groups (e.g. women head of households, poor or displaced households) are relatively simple to identify. In this regard, the contribution of the proposed technique is its capacity to assist urban planners in the identification of deprived urban areas with a limited territory and to better understand their characteristics. These are fundamental

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[2] The prototype tool was developed by the author as part of a PhD research, and it was made available in the Internet in 2008.

prerequisites for the effective allocation of scarce resources aiming at poverty reduction; hence, facilitating the application of area-based targeting strategies.

Furthermore, the proposed technique seeks to support a long-term approach to urban planning. This is pursued by promoting the conduction of poverty impact assessments that allow planners and policy-makers to reflect on the impact social policies, programmes and projects have on poverty reduction. In that regard, the contribution of the proposed technique consists on allowing urban planners—by comparing poverty maps drawn from historical data—to look back to the past and understand those actions that have led to the present level of achievements and failures. The TSTP™ also promotes the regular updating of historical data, by creating meaningful demand for it.

In addition to the above, the TSTP™ aims to promote public participation in decision-making. This is a response to a certain degree of disengagement of civil society to current public participation processes and their distrust in government, which in Latin America is caused in part by the manipulation in for example privatization processes and strategic planning (Boix 2005). In that regard, the contribution of the TSTP™ is to assist urban planners in the identification of the poor and their characteristics, and the inclusion of their needs in poverty analyses and decision-making processes, on top of the traditional inclusion of their voices in public meetings. As a result, the proposed technique promotes *(i)* the use of census-tract data to identify who the poor are, their characteristics, the urban areas where they live and assess the impact on poverty reduction of land-based actions; *(ii)* the study of deprived urban areas, in which normally the poor live, as a way to understand and gain insight to the needs of the poor; *(iii)* the monitoring of land-based actions as a way to measure how these actions are effectively responding to the needs of the poor; and *(iv)* the attraction of different planning stakeholders to appraisal and planning processes via the triangulation of methods and actors involved in the identification of deprived urban areas and the design of viable land-based actions to upgrade those areas.

A final objective of the TSTP™ is to strengthen accountability and transparency in urban planning and local governance. To pursue this objective, the TSTP™ ought to be available publically—in for example the Internet—in order to allow individuals and civil society organizations (e.g. NGOs, CBOs, etc.) to monitor in which urban areas resources are allocated, how land-based actions are progressing over time, and their impact on poverty reduction. As a result of the triangulation of users (decision-makers, urban planners and civil society), the TSTP™ seeks to contribute to the strengthening of local democracy by the increase of accountability and transparency.

Features of the TSTP™

The TSTP™ includes three main sets of features: diagnostic, simulation and navigation. The diagnostic features allow its user to visualise single or compounded indicators in poverty maps. Maps of single indicators are displayed in relation to the concept of 'dimensions of poverty', which defines poverty not just as lack of income, but also as lack of access to other indicators of wellbeing such as housing, education, and water and sanitation. Each dimension of poverty is produced using the 'Unsatisfied Basic Needs' method (UBN), which quantifies the number of

households that have achieved a list of basic needs in two stages: one by which single variables are calculated regarding the level of poverty/wellbeing of the households; and one by which the magnitude and depth of deprivation is obtained by synthesizing key indicators (known as 'dimensions of poverty') out of appropriated groups of single variables (Feres and Mancero 2001). Finally, each dimension of poverty is mapped in individual poverty maps.

The TSTP™ also enables its user to visualise poverty maps of three compounded indicators (Total Poverty, Territorial Inequality and Target Areas).

The Total Poverty indicator shows the proportion of total poverty in every territorial unit of the city. It is the result of calculating the standardised average of selected dimensions of poverty, which is a process that consist of standardising data of each single territorial unit in every dimension of poverty, and then calculating the media of the four standardised dimensions of poverty.

The Territorial Inequality indicator was developed based on the concept of inequality, which is understood in the TSTP™ as the differences of opportunities of individuals in relation to an average member of the population (t) (World Bank 2006). Urban Residential Segregation (URS) is a territorial representation of inequality. The most widely used indicator of URS is the Index of Dissimilarity (D), which shows the number of population members that may need to be relocated to another territorial unit of the city, or their conditions to be improved to average city standards, in order to obtain a perfectly even distribution throughout the city (Duncan and Duncan 1955). As a result, the Territorial Inequality indicator illustrates how high (similar or low) the proportion between not-poor and poor households is in every territorial unit in relation to the general composition of the city as a whole. This indicator is computed by first calculating the Index of Dissimilarity (D) for every dimension of poverty and every territorial unit, and then calculating the standardised average of the dimension of poverties' Ds.

The results of the Total Poverty and Territorial Inequality indicators are organised in three groups using the Jenks' Natural Breaks classification scheme, which resolves the best arrangement of values into classes by comparing sums of the squared difference between observed values within each class and class means. This classification scheme seeks to partition data into classes based on natural groups in the data distribution. Natural breaks occur in the histogram at the low points of valleys. Breaks are assigned in the order of the size of the valleys, with the largest valley being assigned the first natural break.

Finally, the Target Area indicator shows the degree of poverty and inequality combined. It is calculated by overlapping the Total Poverty and Territorial Inequality maps, as illustrated in Table 1. The results are classified in three groups: *(i)* deprived urban areas, which correspond to the territorial units with high degrees of poverty and inequality; *(ii)* enclaves of poverty and inequality, which correspond to those territorial units with low degrees of poverty and high of inequality, medium degrees of poverty and medium or high of inequality, or high degrees of poverty and low or medium of inequality; and *(iii)* urban areas with low degrees of poverty and inequality, which correspond to territorial units with low degrees of poverty and low or medium degrees of inequality or medium degrees of poverty and low degrees of inequality. Results of single or compound indicators can be displayed graphically for the entire city or in a table format for single territorial unit.

Table 1 Classification groups of the target area indicator

		Total poverty		
		High	Medium	Low
Territorial inequality	High	Deprived urban areas	Enclaves of poverty and inequality	Enclaves of poverty and inequality
	Medium	Enclaves of poverty and inequality	Enclaves of poverty and inequality	Low degrees of poverty and inequality
	Low	Enclaves of poverty and inequality	Low degrees of poverty and inequality	Low degrees of poverty and inequality

The simulation features allow the TSTP™ user to modify the original census-tract data and display a 'simulated' poverty map in which a studied dimension of poverty in the given territorial unit is reduced or increased. Calculations for the single indicators are straight forward, while those for the compounded indicators required re-calculations as a change in the value of one dimensions of poverty of one single census tract influence the calculations of all three compounded indicators. For instance, the Territorial Inequality indicator is operationsalised by means of calculating the new value for the studied census tract alone. This decision is based on tests in the city of Liberia that showed that a extreme modification (down to a 0 value) of one selected census tract only modify the average, or standard deviation, of 2% of all census tracts, as values are so small and the modification applies to 1 in 156 census tracts, and in only one of the four dimensions of poverty that composed the compounded indicators. Hence, the variation of 2% of census tracts was preferred in order no to generate a circular reference formula, which is a reference within the formula that depends upon the results of that same formula. As a result, the simulation features enables the TSTP™ user to assess the effect on poverty reduction of decreasing/increasing a given dimension of poverty in a targeted territorial unit. Users can also modify several dimensions of poverty in the same territorial unit.

Lastly, the navigation features include zoom in or out to display more/less territory in the image; 'pan' to move the map to the north, east, west or south; change the display of the map to 'satellite' or 'hybrid' modes; and print the displayed map.

Applications of the TSTP™

As was mentioned in "Conceptual Framework", urban planning includes different functions such as the design of norms, appraisals, simulation, decision-making (plan-making), implementation, monitoring and assessment. This section analyses the application of the TSTP™ in four different functions of urban planning: appraisal, simulation, decision-making and assessment. These four applications of the TSTP™ are illustrated with a case study that was carried out in the medium-sized city of Liberia, in Costa Rica, between 2004 and 2007. A thorough description of the case study can be found in de la Espriella (2010, forthcoming).

The applications required statistical data of the complete population and desegregated into small territorial units for representativeness purposes. Two reliable

sources of statistical data were found in Costa Rica: household surveys and census data. Household survey data was not selected, as they gathers statistics using random sampling that for urban areas corresponds to ¼ of an estimated household population, thus lowering significantly the representativeness at small administrative unit level. The latest census, which includes the city of Liberia, was carried out in year 2000. Hence, the sources of data employed for the analysis included: *(i)* the Unsatisfied Basic Needs database of Liberia, which is based on the methodology developed by Méndez and Trejos (2000) and used the 2000 National Population Census data (provided by the National Institute of Statistics and Census of Costa Rica—INEC); and *(ii)* the map used for the 2000 National Population Census, built using Geographic Information Systems (GIS) (also provided by INEC).

This selection acknowledged data limitations of using small administrative unit data produced four years prior to the initiation of the study; hence, compromising to a certain extent the applicability of the results in current programmes and projects. Yet, the process and main findings are still relevant for the objective of this paper, and therefore, they are presented below.

Appraisal

The TSTP™ was used to conduct a poverty analysis, which sought to determine the territorial distribution of four dimensions of poverty, establish the territorial distribution of total poverty and inequality, and identify deprived urban areas where to allocate scarce resources in priority land-based actions.

First, the Unsatisfied Basic Needs database of Liberia—provided by INEC—was used to establish the territorial distribution of four dimensions of poverty (housing, water & sanitation, education and consumption). These four dimensions of poverty were selected from the INEC's database as they are related, in one way or another, to urban planning. Each dimension of poverty is composed of a series of indicators, which in turn were calculated from a series of variables collected in the 2000 National Population Census, as illustrated in Table 2. The selected dimensions of poverty were mapped to show the geographical distribution of high, medium or low proportion of poor households. Finally, the four dimensions of poverty were combined in one indicator—referred to as the Total Poverty indicator—and its territorial distribution was illustrated in a poverty map.

It was found that there are some census tracts with a high or medium proportion of households with unmet education, housing, and water and sanitation needs, regardless of whether they have unmet needs related to consumption, as illustrated with the arrows in Fig. 1.

Subsequently, the compound indicators of Total Poverty and Territorial Inequality were calculated and mapped (see Fig. 2). It was found that most territorial units with high degrees of Total Poverty or Territorial Inequality are located in the northern section of the city. For example, 11% and 35% of all census tracts of the city have high or medium degrees of Total Poverty respectively, and 43% of all Liberian households live there. Therefore, the possibility to assign priorities to the allocation of scarce resources and investment is limited, due to the fact that available resources can seldom cope to address needs of such a significant proportion of the territory of the city.

Table 2 Dimensions of poverty, its urban indicators and variables

| Dimensions of poverty	Indicators	Variables from census information
Housing	Poor housing qualities	Households living in transitory shelters or slums
		Households living in shelters with non-durable materials on walls, roof or floor
		Households living in shelters with materials of walls, roofs and floors in poor condition
	Overcrowding	Households with more than 2 persons per room
	No electricity	Households with no electricity for lighting
Water & sanitation	No water	Households consuming water from standpipes, wells on plot, existing water-courses or ponds, or rain-water
	No sewage	Households with pit latrines or without other on-plot disposal options
Education	Low attendance	Households with at least one member aged 7–17 not attending school
	Low achievements	Households with at least one member aged 7–17 attending school regularly, but behind by at least 2 years
Consumption	Low consumption capacity	Households with one regular income, incomplete primary education and more than three dependants
		Households with two regular incomes, less than five years of education in average and more than three dependants
		Households with more than three regular incomes, less than three years of education in average and more than three dependants

Source: translated by the author from Méndez and Trejos (2000)

Finally, poverty and inequality maps were overlapped to identify deprived urban areas with a limited territory in which to concentrate pro-poor land-based actions as a function of urban planning practices. Four deprived urban areas were found in the city of Liberia (see Fig. 3), three of them located in the northern section of the city.

In conclusion, the existence of households with unmet education, housing, and water and sanitation needs, but with no unmet consumption needs, suggests that those needs go beyond individual household capacities, and therefore should be a competence of public institutions or civil society organizations. Additionally, poverty and inequality maps alone show large sections of the territory in need for investment. However the combination of poverty and inequality maps successfully identifies deprived urban areas with a limited territory in which to allocate scarce resources and investments in priority land-based actions.

Simulation

The TSTP™ was applied to simulate the impact on poverty reduction of alternative land-based actions in Liberia. These simulations allow urban planners to compare
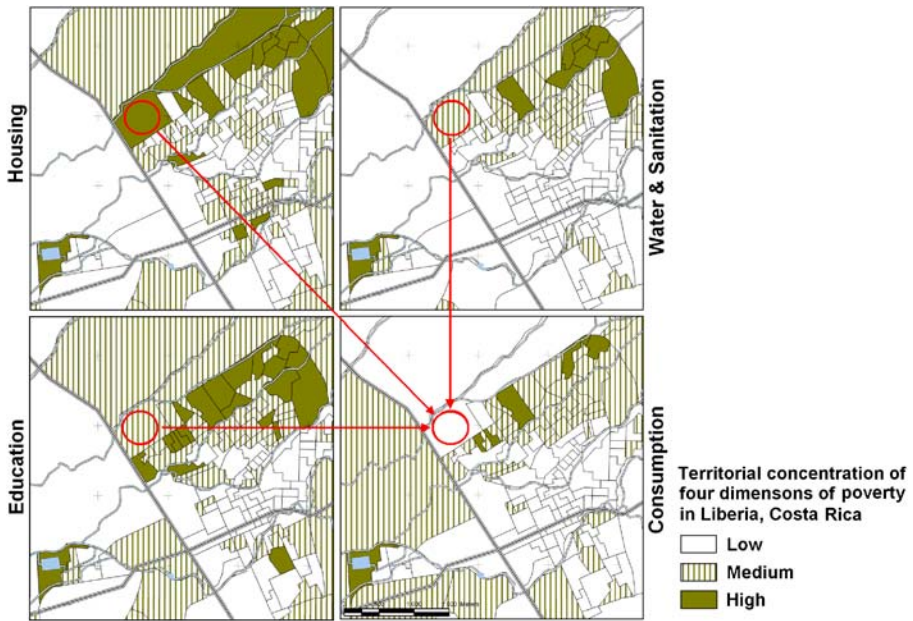
Fig. 1 Territorial concentration of four dimensions of poverty in Liberia, Costa Rica. Based on: www.planning4equality.com

different land-based actions in terms of their impact on poverty reduction in targeted deprived urban areas. The results of such comparison provide vital information to decision-makers for the allocation of scarce resources and investments. The process and main findings are presented below.

As an illustration of this simulation process, census tract 1130—located in the north-east corner of Fig. 4—was selected to assess the minimum proportion of households whose unmeet housing-related needs (non-durable housing materials, overcrowding and/or no electricity) must be attended in order to move down this
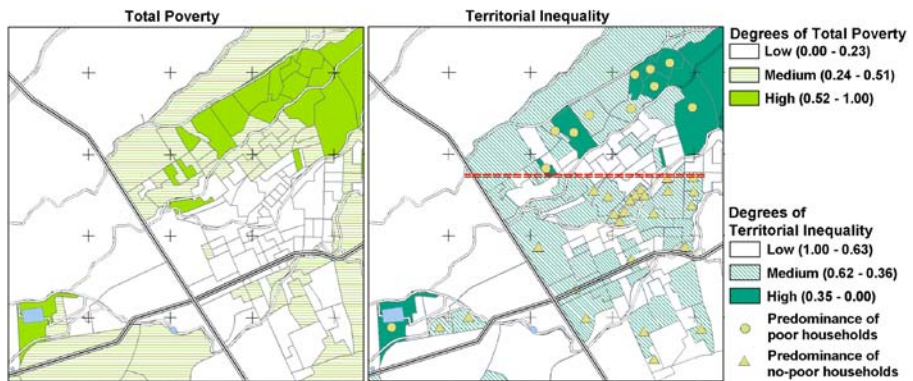

Fig. 2 Territorial concentration of Total Poverty and Territorial Inequality in Liberia, Costa Rica. Based on: www.planning4equality.com
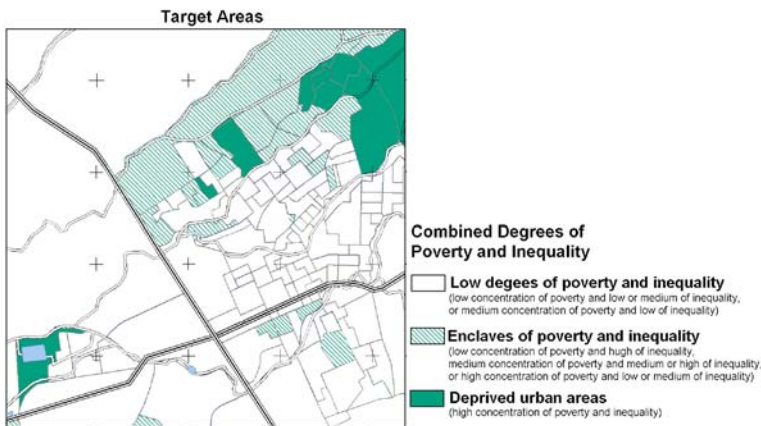
Fig. 3 Combined degrees of poverty and inequality in Liberia, Costa Rica. Based on: www.planning4equality.com

given census tract from 'deprived urban area' to 'enclave of poverty and inequality'. A series of simulations were conducted, but only the optimal result is presented here.

Currently, 3.2% of the total number of households of the city claiming unmet housing-related needs live in census tract 1130. After conducting various simulations—in a simplified 'what if form'—, it was found that this proportion must be reduced at least to 1.98% in order to move down tract 1130 from 'deprived urban area' to 'enclave of poverty and inequality'. This is an atypical example, as the reduction of only one dimension of poverty is enough to decrease the Target Area indicator (composed of Total Poverty and Territorial Inequality indicators) in this given targeted area. This
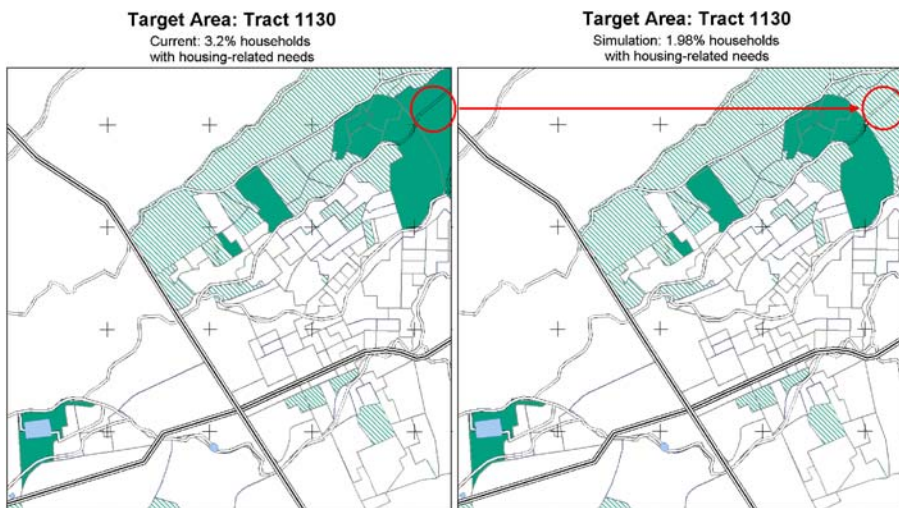
Fig. 4 Simulation of housing-related actions on census tract 1130 in Liberia, Costa Rica (before and after). Based on: www.planning4equality.com

means that priority should be given to actions and projects which seek to improve housing materials, reduce overcrowding, and provide domiciliary electricity in order to raise housing characteristics of census tract 1130 to city standards, and in that sense reduce poverty of the households living there.

In conclusion, the use of the TSTP™ to simulate the impact on poverty reduction of alternative land-based actions enables its users to propose actions that may lead Liberia to prevent failed investments or overcome their current situation, with awareness of the resources, capacities and limits, and in line with the concept of governance that was presented in "Conceptual Framework".

Decision Making

The TSTP™ was used to inform decision-makers and prioritise a list of identified land-based actions to reduce poverty in targeted deprived urban areas. This process included two stages: identification of a list of land-based actions, and definition of a prioritised list of actions.

First, the identification of land-based actions needed to upgrade the deprived urban areas was done by means of comparing the Target Areas map with the three maps of dimensions of poverty. For example, Fig. 5 shows the analysis done for a small deprived urban area located in the centre of Liberia, in which it was found that land-based actions should focus on raising education-related variables and on upgrading housing-related variables. It also shows that it is not a priority to raise water and sanitation-related variables in this given deprived urban area. As a result, an un-weighted list of actions was prepared by the author, to later weight each proposed action together with different actors that should take part of the decision-making process.

Next, the un-weighted list of actions was discussed in a workshop conducted in Liberia, with the participation of the newly elected mayor, five members of the Municipal Council, the city planning officer, three officials responsible for the social, environment and geographic units of the Municipality, a local businessman, an external consultant on urban planning issues and the local press. Each action was assessed in relation to availability of resources, policies and local politics, in order to decide the order and urgency. At the end of the workshop, a prioritized list of actions was agreed and a plan of actions was elaborated.

As a result of the workshop, the Municipality put together a project to raise the physical characteristics of some deprived urban areas located in the northern section of the city, in line with the new 'neighbourhood upgrading and poverty eradication programme' launched at the end of 2007 by the Ministry of Housing and Human Settlements of Costa Rica (MIVHA).

In conclusion, it was found that the TSTP™ can be used to better understand the conditions under which the poor live, propose land-based actions that respond to local needs, including those of the poor, and promote dialogue between different actors involved in urban planning to reach a feasible plan of actions. It is in that sense that the TSTP™ can promote public participation, not only as a mechanism to include as many different voices as possible in the decision-making process, but also as a technique to take into account all sectors of society in appraisal, simulation and decision-making processes.
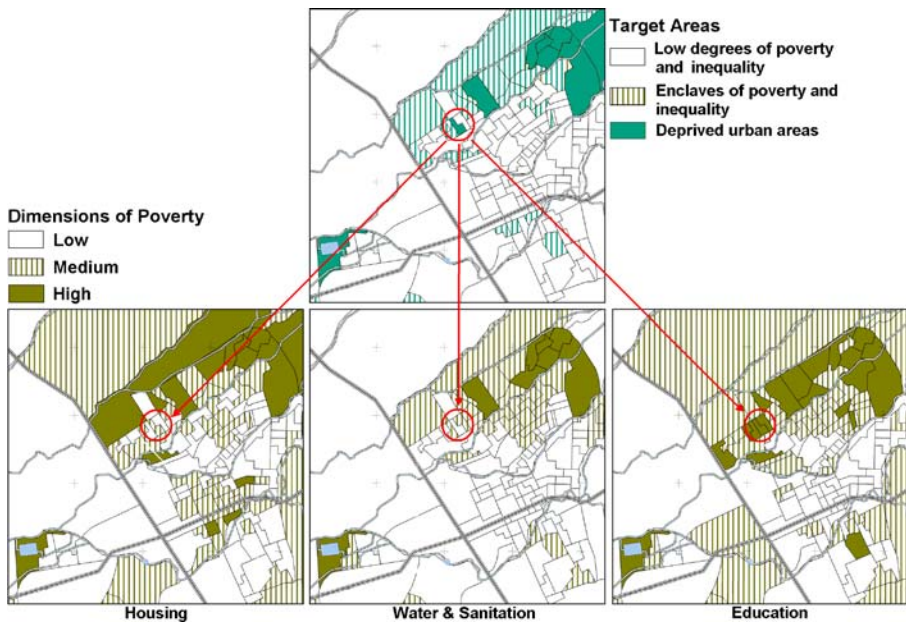
Fig. 5 Identification of a list of land-based actions in a selected deprived urban area, in Liberia, Costa Rica. Based on: www.planning4equality.com

Assessment

The TSTP™ was also used to assist the impact assessment on poverty reduction of thirteen years of implementation of Costa Rica's social housing policy in Liberia. This poverty impact assessment analysed the relationship between deprived urban areas and the territorial location of social housing projects implemented in Liberia between 1987 and 2000. The main findings are presented below.

The census of year 2000 shows that there were approximately 9600 households in Liberia, and 9200 housing units, of which 1800 are state-promoted social housing units built between 1987 and 2004 (INEC 2001). Three distinctive typologies of social housing units were established.

The 'free housing' typology targets the housing needs of the poorest and most vulnerable households, by providing new and privately owned houses totally free of charge. This programme has been implemented since 1987 and covers almost 70% of the total number of social housing units of the city. This typology includes eight new housing projects with a total of 1241 housing units, most of which are located in the northern section of the city, due to low land values.

The 'housing improvements' typology addresses the housing needs of poor households that already own a plot, by providing a housing subsidy to finish paying for their own plot, improve their dwelling or build a basic housing unit. This programme has been implemented since 1987 and covers some 5% of all social housing units of the city. These housing units are distributed throughout the whole city, although most of them are concentrated in northern settlements such as

'Nazareth' and '25 de Julio', the residents of which are known for being very active in political-demand making at municipal and national levels.

The 'ABC housing' typology addresses the housing needs of households with stable income, but below the income threshold defined by the law for allocation of housing subsidies. It provides a partially subsidised dwelling to be fully paid in combination with savings and a housing mortgage. This programme has been implemented in Liberia since 2001 and includes almost 25% of all social housing units of the city. This typology includes four housing projects with a total of 483 housing units, most of which are located to the north-east of the city centre. This typology was not included in the analysis, first because it targets middle income households, and second because it has been built since 2001, one year after the statistical data used in this analysis was gathered, as mentioned in the poverty analysis in the appraisal function.

When comparing the location of the studied social housing units with the Target Areas map (see Fig. 6), it was found that 65% and 13% of the land occupied by 'free housing' and 'housing improvement' units respectively are located in 'enclaves of poverty and inequality'. As the Target Areas map is composed of poverty and inequality maps, it was found that 63% of the land occupied by all studied social housing units is located in census tracts with a high or medium degree of poverty, and 69% is located in census tracts with a high or medium degree of territorial inequality. In particular, it was also found that 57% and 19% of the land occupied by 'free housing' units are in census tracts with a high or medium degree of territorial inequality respectively, and 53% and 16% of the land occupied by 'housing improvement' units is situated in census tracts with a high or medium degree of territorial inequality respectively.

In conclusion, this poverty impact assessment provided a clear picture which shows that some ways in which social housing policies have been implemented in Liberia concentrate territorially the poor, generating 'enclaves of poverty and inequality', which in turn attract lower level urban services, creating poverty traps that limit their opportunities for upward social mobility and perpetuate poverty.
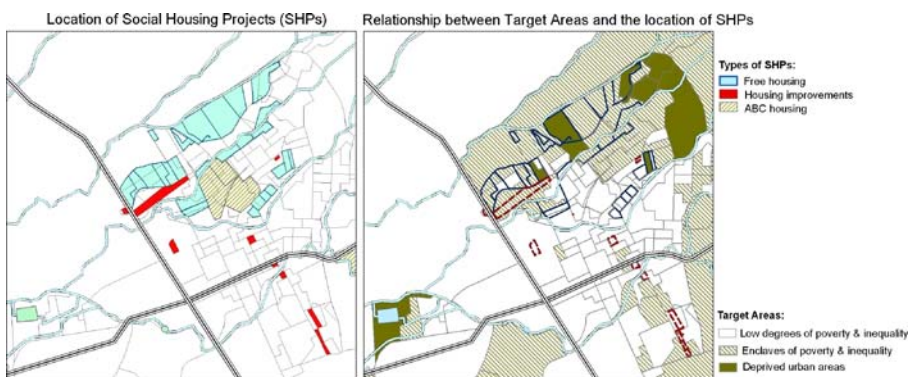
Fig. 6 Relationship between Target Areas and the location of low-income housing projects implemented in Liberia between 1986 and 2000. Based on: de la Espriella (2010, forthcoming)

Summary and Conclusions

The two major strengths of the proposed technique is that it incorporates a residential segregation approach to traditional poverty analyses, which proved helpful for poverty analysis at small administrative unit levels, together with its flexibility to address different functions of urban planning. The following conclusions were reached in relation to the pilot applications of the TSTP™ in four different functions of urban planning.

The application of the TSTP™ in relation to the appraisal function showed that the combination of poverty and inequality maps successfully helps to identify deprived urban areas with clear boundaries and a limited territory in which to allocate scarce resources in targeted land-based actions. In addition, it was discussed that there are unmet needs that cannot be addressed individually, and therefore need to be addressed commonly by institutions or civil society organizations. An example was presented in which a high proportion of households in some census tracts cannot solve their own unmet education, housing, and water and sanitation needs, despite having economic means, which points to the fact that some degrees of unmet needs go beyond household accusation capacities.

Concerning the simulation function, it was shown how the application of TSTP™ helped urban planners and decision makers to propose actions that may lead Liberia to prevent failed investments or overcome their current situation, with awareness of the resources, capacities and limits, but inspired by the model of a city that serves as a point of reference from which to judge, not so much how they are reaching the goal, but how things are progressing from the point of departure.

In relation to the policy-making function, it was shown that the nature of the TSTP™ is not seen as another technocratic tool which fails to connect and respond in a timely way to contextual changes, but as a tool that is inscribed in urban governance theory, which in that sense, may help to promote dialogue between different actors of urban planning. In that regard, the proposed technique is presented as a two-fold tool that, on the one hand, aims to assist planners in coping with new land-related functions drawn from decentralization processes and local political forces; and on the other hand, seeks to promote transparency and accountability by means of attracting public participation, as for example in Liberia, in which case it was used to identify different dimensions of poverty, better understand the poor and their living condition, propose actions that respond to local needs, including those of the poor, and discuss appraisals, findings and proposed actions with different stakeholder including urban planners, decision-makers, researchers and civil society organizations to agree on a plan of actions to raise to city standards the conditions of targeted deprived urban areas. Thus, the real value of integrated information systems of smaller administrative units such as the TSTP™ comes when residents, community organizations, and urban planning offices are able to access, review and use the information to inform on decision-making processes.

The application of the TSTP™ in relation to the assessment function of urban planning made evident the need to pay more attention to the long-term effects of the implementation of social policies by means of urban planning (housing in this case) with the aim of reducing poverty. In that sense, the use of the TSTP™ can help to set the bases for implementing more pro-poor social policies, programmes and projects.

As a final remark, this paper highlights data limitations and the need to further develop statistical and cartographical information systems that reach small administrative units in cities of the South and use them to promote the dialogue between actors involved in governance and specifically in urban planning, in order to attract public participation in, and enhance accountability and transparency of, decision-making processes in a way that proposed land-based actions respond to local needs, including those of the poor. In addition, statistical information systems, on the one hand, are constrained by data limitations, and on the other hand, they could promote data development as producers of data realize they get effectively used.

References

Araujo, C., Ferreira, F., Lanjouw, P., & Özler, B. (2006). Local inequality and project choice: Theory and evidence from Ecuador. World Bank Policy Research Working Paper 3997.

Bedi, T., Coudouel, A., & Simler, K. (eds). (2007). *More than a pretty picture: Using poverty maps to design better policies and interventions*. Washington DC: The World Bank.

Boix, C. (2005). *Privatization and public discontent in Latin America*. Washington DC: Inter-American Development Bank, Sustainable. Development Department.

Campbell, S., & Fainstein, S. (eds). (2007). *Reading in planning theory*. Oxford: Blackwell.

Chambers, R. (1995). *Poverty and livelihood: Whose reality counts?*. Brighton: Institute of Development Studies. Discussion Paper No 345.

de la Espriella, C. (2007). Designing for equality: conceptualising a tool for strategic territorial planning. *Habitat International, 31*, 317–332.

Duncan, D., & Duncan, B. (1955). A methodological analysis of segregation indexes. *American Sociological Review, 20*, 210–217.

Elbers, C., Fujii, T., Lanjouw, P., & Özler, B. (2007). Poverty alleviation through geographic targeting: how much does disaggregation help? *Journal of Development Economics, 83*, 198–213.

Feres, J., & Mancero, X. (2001). El método de las necesidades básicas insatisfechas (NBI) y su aplicación en América Latina. *CEPAL, Series: Estudios Estadísticos y Prospectivos, 07*, 1–56.

Healey, P., Khakee, A., Motte, A., & Needham, B. (eds). (2006). *Making strategic spatial plans: Innovation in Europe*. Taylor and Francis Group.

IAIA. (2007). About IAIA. [Online]. (www.iaia.org/modx/index.php?id=318).

INEC. (2001). *Censo del 2000*. [Online]. (www.inec.go.cr/REDATAM/censo2000Set.htm). Accessed 26 June 2006.

INEC. (2004). *Documento metodológico censo nacional de población 2000*. [Online]. (www.inec.go.cr/05Censos/01CensoDePoblacion/metodologia/archivosMetodologia/01.%20Documento%20metodológico/MetodologíaCensoPoblación.pdf). Accessed 14 September 2008.

Jenkins, P., Smith, H., & Wang, Y. P. (2007). *Planning and housing in the rapidly urbanising world*. Oxon: Routledge.

Méndez, F., & Trejos, J. (2000). Costa Rica: Un mapa de carencias críticas para el año 2000, 205–233. In L. Bisbly (ed.), (2000). *Costa Rica a la luz del Censo del 2000*. San José (s.n)

Moser, C. (1998). The asset vulnerability framework: reassessing urban poverty reduction strategies. *World Development, 26*(1), 1–19.

Ottichilo, W. (2007). An overview on the Goe-Information technologies in urban planning and management. Paper presented at the Penn IUR Urban Research Conference: Towards a 21st Century Urban Agenda, July 1–6, Penn Institute for Urban Research, Philadelphia.

Perlman, J. (2004). Marginality: From myth to reality in the Favelas of Rio de Janeiro, 1969–2002. In A. Roy & N. Alsayyad (Eds.), *Urban informality: Transnational perspectives from the Middle East, Latin America, and South Asia*. Oxford: Lexington Books.

Rakodi, C. (1995). Poverty lines or household strategies? A review of conceptual issues in the study of urban poverty. *Habitat International, 19*(4), 407–426.

Robles, M. (2007). *Alcances, limitaciones y usos de los mapas de pobreza*. Paper presented at the Regional Seminar: La medición de la pobreza del Istmo Centroamericano (Managua, May 30 and 31).

Smith, H. (2004). Costa Rica's triangle of solidarity: can government-led spaces for negotiation enhance the involvement of civil society in governance? *Environment & Urbanization, 16*(1), 62–77.

Tannerfeldt, G., & Ljung, P. (2006). *More urban, less poor: An introduction to urban development and management*. Bath: Bath.

Taylor, N. (1999). Anglo-American town planning theory since 1945: three significant developments but no paradigm shifts. *Planning Perspectives, 14*, 327–345.

Terborgh, C. (2006). Introduction to Geographic Information Systems (GIS)—with a focus on localizing the MDGs. Presentation at the World Urban Forum WUF3. [Online]. (www.unhabitat.org/downloads/docs/wuf3/Intro_GIS.ppt). Accessed 15 January 2009.

Treuhaft, S., & Kingsley, T. (2008). *Transforming community with land information systems*. Cambridge: Policy Focus Report, Code PF016, Lincoln Institute of Land Policy.

The World Bank (2004). *Guidance notes on poverty assessments*. Washington DC.

The World Bank (2006). *World development report 2006: Equity and development*. Washington DC.