Chapter 18
Land Management with the *SMURF* Planning Support System

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18.1 Introduction

Population growth, rapid urbanisation trends, climate change, ageing infrastructure, globalisation, emerging technologies, consumer involvement, energy use and costs, geo-political changes, changing patterns of land use, changes in the hydrological cycle, *et cetera,* are all important symptoms of global change. Core problems and negative impacts of global change have become increasingly visible and impact both on people and the environment, in developed and developing countries. In many respects, land management and planning need to be much more adaptive than they have been in the past. Cities and regions all over the world are confronted with an accelerated pace of changes that affects almost all aspects of land management. The need for instruments or systems to support planning at a strategic level is considerable. The approach presented in this chapter has potential applications that go far beyond its original context.

18.2 Background

West African mid-sized cities, as in many other parts of the under-developed world, are characterized by a rapid population growth and a lack of financial and human resources, which badly limits the working capacity of public authorities (Sawadogo 2002). This results in often anarchic urbanization and extensive development problems: economic weakness and increasing informal economies, infrastructure in limited quantity and often dilapidated, insufficient access to basic services, high poverty rate and growth of squatter settlements (slums),

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social disparities and numerous conflicts of governance. Development policies are continuously evolving to provide solutions to the weakness of resources and the increasing difficulties of management. In 40 years, strategies have moved from a centralizing state towards decentralized models, passing through structural adjustments (World Bank 1994), through good governance policies (World Bank 1992) and through the privatization of public services (le Galès 1998). Furthermore, technical instruments for management and coordination (needs appraisal, master planning, sector-based management) also cause problems in the context of underdevelopment, due to their rigidity and to the common failures in the reality of urban planning and management (Bolay *et al.* 2000; de Graaf and Dewulf 2002; Frérot 1999).

New urban planning and management techniques and technologies are proposed. Urban strategic planning (Borja and Castells 1997; Ingallina 2001) offers promising solutions in underdeveloped contexts (Halla 2005; Steinberg 2005). It can be reinforced with planning support systems (PSS) (Allen 2001; Geertman and Stillwell 2003; Harris and Batty 2001; Harts *et al.* 2003; Klosterman 2001) or web PSS (Kingston *et al.* 2003; Mikkonen *et al.* 2003). These techniques often enable different forms of participation: participative appraisal, participative information collection, participative mapping, development forums, participative scenarios evaluation or public observatories. The lack of adequate access to information is an important aspect in the underdevelopment syndrome. One generally agrees that the improvement of information has a positive impact on management, on economic development and on local governance (Brown 2001; UNDP 2001). At a more detailed level, decision makers make their management decisions on the basis of the information they have about the land realities and about the numerous stakeholders' initiatives. In most developing cities, this information is poor and results in management and communication failures (Repetti and Prélaz-Droux 2003).

Information and communication technologies (ICT) are powerful tools that can potentially improve the sharing of information among decision makers and stakeholders. ICT can support the appropriation of information about land use and related conflicts. Thus, it can contribute to improving local knowledge. But ICT can contribute to strengthening management processes only when they are adapted to the context (James 2002). For land planning and management, geographic information systems (GIS) and the web can be relevant support tools for information and the diagnosis of territorial realities. They can support decision making, coordination and social functionalities (Dransch 1999). Like other media, these technologies are also ambivalent (Fayman and Santana 2001), with unexpected and not always positive social repercussions of their implementation: inequalities in accessibility, inequalities in information control, deviation of information for other purposes or frustrations due to unfulfilled expectations.

The existing GIS and PSS solutions are not adapted to the context and needs of land managers: they require strong skills in computing and significant financial investment for the implementation and maintenance; they are difficult to handle for the decision makers, planners and stakeholders (often without any computer

skill) or are limited to data viewing functionalities. Following Klosterman (2001) and Geertman and Stillwell (2003), PSS for urban planning and management are generally not fulfilling the expectations of planners and managers, and are still underused.

18.3 The *System for Monitoring Urban Functionalities*

The *System for Monitoring URban Functionalities* (*SMURF*) is basically a modular GIS-based observatory. Although initially developed for the support of urban management in Africa, it has proved to be very appealing for the support of multi-thematic, multi-stakeholder resource management approaches in general. It is intended for the various stakeholders involved in planning and management (elected representatives and administrative services as well as business, association and population representatives) by providing a data exchange platform. As a communication tool, designed for end-users with often limited computer skills, the *SMURF* interface has to remain very simple and accessible.

The most essential feature of *SMURF* is to provide easy access to information: (i) for the user himself to get a intimate knowledge of the spatial dimension of his city or region and all its thematic features, in a self-appropriation process; (ii) among users to share concerns, transmit ideas, being able to better explain one's own point of view to others and vice versa; and (iii) for a public body, as a support to communicate and explain decisions to a larger audience. Indicators complement the data and offer monitoring, controlling and benchmarking functionalities as well as a support for the evaluation of strategies for the future. Thus, the second essential feature of *SMURF* can be seen in its ability: (i) to raise awareness about future trends and possible options in terms of planning and management; (ii) to support the definition, testing, comparison and evaluation of strategies; and (iii) to provide assistance in judgement and decision making at a strategic level.

18.3.1 Data and Indicators

SMURF is at once an information exchange platform and a decision-support tool. First, it consists of a database that allows the storage of information. Second, it includes spatial and statistical analysis components that process spatial and statistical indicators from the database. The design of the data to be stored is thus a central element of *SMURF*. Too much data leads to information overload and reduces the readability of the system. But, the lack of vital data limits the potential for decision making and for processing indicators. Thus, the data structure must be well balanced for land management and/or urban planning. Keeping the database both small and relevant is also an important aspect regarding: (i) data availability and data collection; and (ii) the maintenance and update of the database, especially in areas with

limited resources. *SMURF* is therefore designed to tackle missing data and allow for data collection directly by the end-users.

The design of an appropriate data indicator structure should consider that the relevance of a given indicator is both due to its intrinsic qualities and to its relations to the whole indicator set (Repetti and Desthieux 2006). Furthermore, the following elements should be taken into consideration:

- the objective of the information system, which is monitoring local development at a strategic level;
- the priority themes of management that depend of each city or region (e.g. land management, mobility, water management, economy and production, social development, environment and governance);
- measuring elements that help users locate themselves in the territory (e.g. aerial pictures, maps, roads, squares, waterways);
- the strength and weaknesses of the particular city or region, as well as the difficulties and conflicts that the stakeholders face;
- the ongoing projects for local development, as determined by the authorities, non-governmental organisations (NGOs), associations and business representatives;
- the indicators selected to monitor the development and to evaluate planning strategies, for which statistical and spatial processing is run from basic data that must be collected and stored in the database; and
- the accessibility and availability of information. The structure of the dataset must be adapted to the existing and accessible data, must strictly limit the demand for supplementary data.

Since it is an open and dynamic process, the management of a city is influenced by numerous internal and external constraints and by uncertainty, which make its evolution hardly predictable. To be used as a decision support system, *SMURF* proposes a set of indicators relevant to the decisions to be made. The set of indicators aims at analysing and monitoring urban development and its evolution according to planning projects and decisions to be made. It allows control over the improvement of urban development toward the strategic objectives in time and comparison of the city with other cities.

The complexity of urban phenomena makes it difficult to establish an efficient set of indicators to cover all the aspects of urban development. Some stakeholders are responsible for strategic decisions (e.g. reduce CO_2 pollution level), others for management (e.g. development of public transportation) and others for operations (e.g. where to build new bus lines). The indicators must also correspond to the different scales of management: some indicators are requested to compare districts, neighbourhoods or areas inside the city (e.g. the distance to public facilities); others must give a more general view of city evolution through statistical values (e.g. evolution of the investment in public facilities). The set of indicators must be adapted to each specific situation, in order to support the comparison of the different priority themes of urban management (e.g. health, education, economic development). Finally, some indicators must be very aggregated to give a general idea of the state and evolution of the urban development (e.g. an index of

education) and others must be less aggregated to allow a deeper understanding of the factors that contribute to the state and evolution (e.g. literacy rate, boys/girls education rate).

18.3.2 The SMURF Interface

The *SMURF* concept starts from information sharing between local development stakeholders to improve their global knowledge about the city. The *SMURF* software is an interactive GIS mapper, adapted to the needs of its users, to their computer skills, to the locally available infrastructures and to the data quality. User-friendly and easy to use, *SMURF* allows interaction with the database and with the indicators through basic viewing and editing (modification) functionalities. The SMURF interface offers four main visual elements to its users (Fig. 18.1):

- a graphic window for displaying maps, aerial pictures and spatial data;
- a menu bar offering some basic general functionalities;
- a toolbar with a minimum choice of tools for handling the graphic window and displaying the information; and
- a modular multi-panel pane, giving access to the different interaction modules.

The core of the system, and its main originality, consists of four complementary modules (Fig. 18.2). The first module (Mode Data viewing) is an interactive viewer

Fig. 18.1 Main elements of the *SMURF* interface

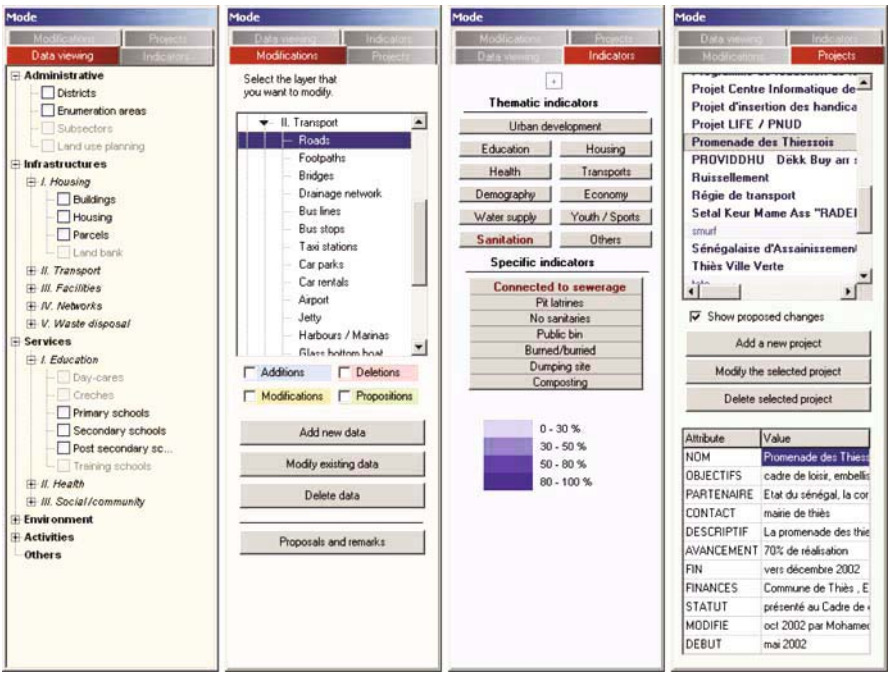

Fig. 18.2 *SMURF* interface: the four basic modules and the possible interaction for the user

for spatial and statistical data relating to the local development. The data layers are presented in a customizable hierarchical structure. Data layers identified as relevant to address the local issues, but with no available data, are present but disabled (greyed out layers). Selecting a data layer adds it to the map shown in the graphic display. The attributes of the layer's objects can then be accessed with the information button in the toolbar (Fig. 18.3). The background layers (digitized maps, aerial pictures, digital elevation model) can be switched on and off with the corresponding menu item ('Background' menu).

The second module (Modification Mode) is a data editor for both the geometry and the attributes of spatially referenced objects. The data editor allows users to add new data, update existing data, delete data and formulate open proposals (Fig. 18.4). No data layers are now accessible since they are disabled in viewer mode. Proposals for change are registered for each user and sent to the GIS database manager for validation and subsequent database update (the validation process depends on the application case). Checkboxes allow the proposals for change for the visible data layers to be shown or hidden as required.

The third module (Indicators Mode) gives access to a set of predefined indicators, organized in thematic groups (an aggregated sanitation index for example, along with its related specific indicators). More experienced users can also set up and test new tailor-made indicators (Fig. 18.5). These indicators include spatial distributions, distance indicators (buffers) and composite feature indicators (symbols' size and colour depending on combinations of attributes). Indicators' drawing

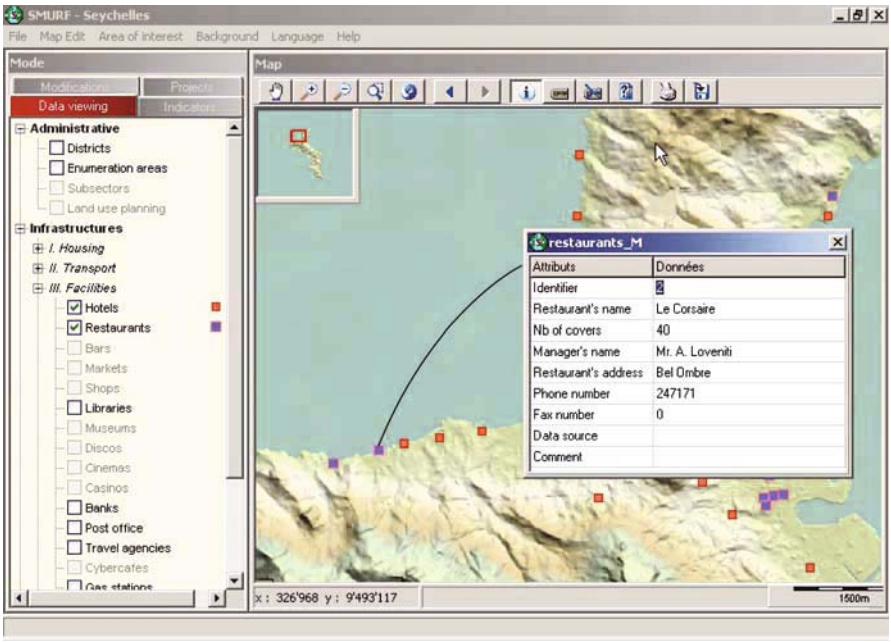

Fig. 18.3 Mode Data viewing, with the menu of the graphic display and selection of data to access the data from the graphic display

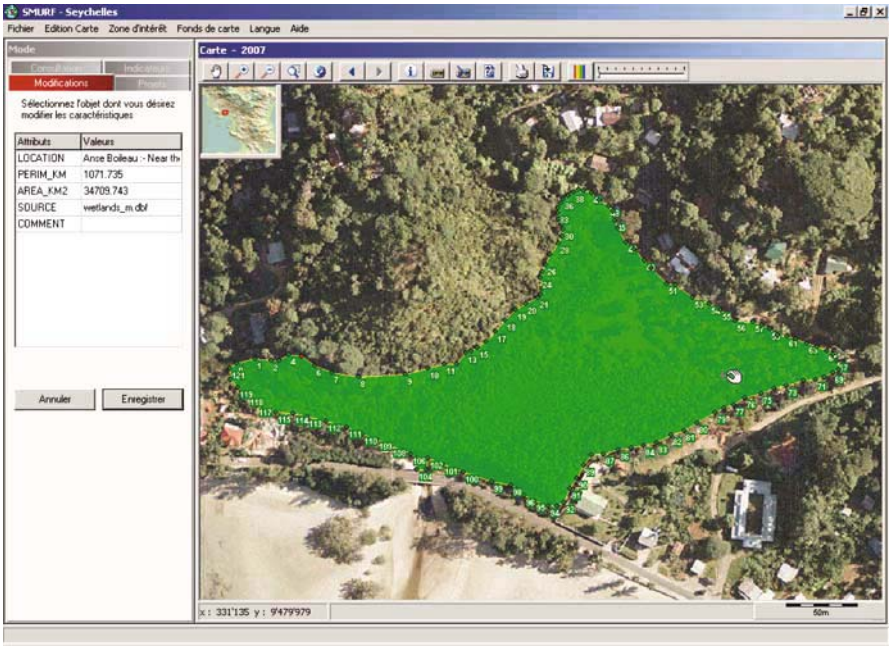

Fig. 18.4 Mode Modification, with the modification of geometry and text data for a Wetland stored in the SMURF database

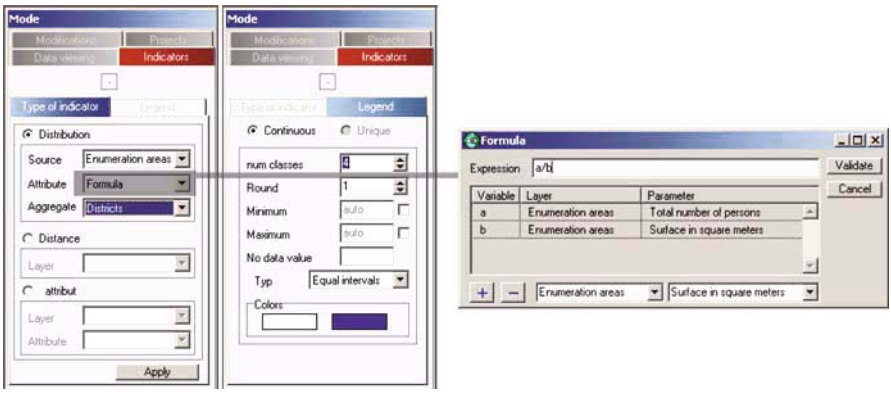

Fig. 18.5 Mode Indicators, with the possibility to create new indicators from the data

parameters such as classes' definition (number, type, limits) or colour scale can also easily be adapted to one's needs,

Finally, the fourth module (Projects Mode) is an interactive viewer for ongoing projects, working much in the same way as the data editor of the second module.

These four interaction modules are key points of *SMURF* relevance and originality. Data and indicators are complementary for the development of expertise concerning land-use. A database for ongoing projects has been setup as a response to the lack of coordination among local and international stakeholders (state agencies, multilateral and bilateral cooperation, NGO's, etc.) that results to some extent from the very limited ability of the local authorities, due to scarce human and financial resources, to manage urban development. Data editing leads to participative updating of the database. Figure 18.6 shows the main fields considered and the detailed data structure: entities, relations, attributes, spatial types (point •, line \, or area □). The general model results of several experiences and tests. It can be easily adapted through the *SMURF* setup, depending on the specific context of each city or region.

18.3.3 Setup and Management of SMURF

Starting to apply *SMURF* in different places required considerable effort to generalize and parameterize several aspects of the software that were initially very site-specific. Parameterization covers four aspects: (i) the general configuration of the software (available modules, background layers, mini-map content, language options); (ii) the organisation of the hierarchical tree displaying the available data layers; (iii) the definition of the set of predefined indicators; and (iv) the localization of the software on the basis of localization files, which facilitates the translation of the interface.

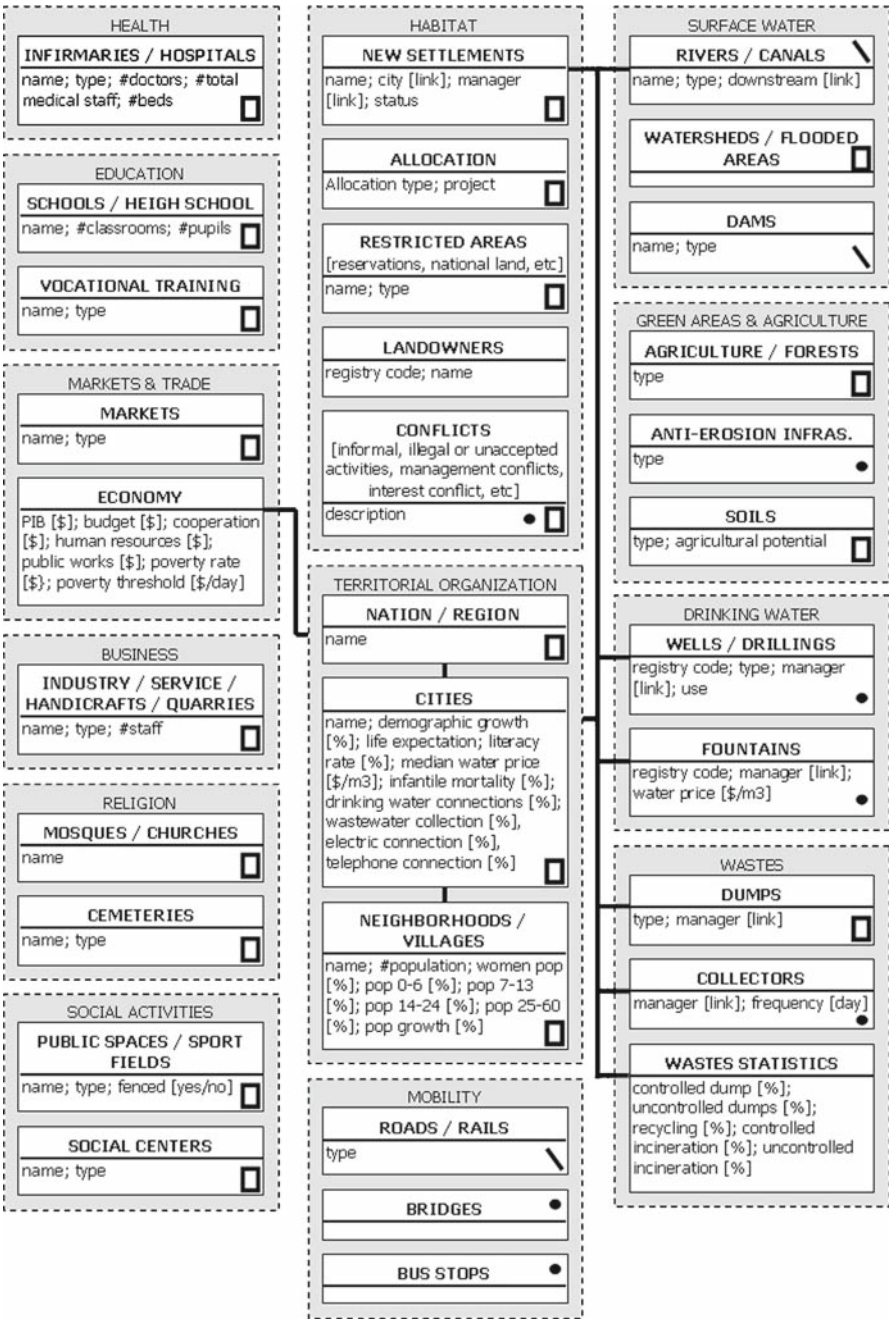

Fig. 18.6 Summary of the structure of the *SMURF* land management data

The establishment and the maintenance of *SMURF* in a city or region require some special skills, in order to ensure the operability and durability of the system. A first level of management relates to the design and coordination of the participatory process (organization, institutionalization, data validation procedures, *et cetera*). This first level will be set differently for each application case, depending on the existing structures and dynamics. At a second more technical level, *SMURF* requires some computer and GIS database management skills. A clear hierarchic assessment of the tasks is therefore essential to ease the implementation of the instrument as follows.

- A few management tasks require specific technical skills in GIS databases and computing: basically the establishment of *SMURF* for a new city or region and training of local managers. Although a *SMURF* adapted to local data and specificities can be prepared quite easily thanks to parameterization, the structures of those parameter files, even when thoroughly documented, are not that easy to understand for non-specialists.
- Ordinary data management is the main maintenance task at the city level and requires basic GIS skills. Besides the training of users, it necessitates following and centralizing the data updates that the different users propose and preparing their validation. Currently, data management is done with commercial GIS software. A specifically dedicated *SMURF* module is under development to facilitate these tasks.
- Direct contact with the *SMURF* users is a third level. It requires a good knowledge of the *SMURF* software and of the local context. It can be accomplished with the various involved organizations through a group of reference users, who get more complete training.

18.3.4 Technical Specifications

SMURF is a stand-alone application. The current *SMURF* prototype is programmed in Pascal (*Borland Delphi*) and uses the *TatukGIS* library. It runs with *Windows* (minimum *Windows 95*). Vector data are either in ESRI 'shape' format or in *MapInfo* 'tab' format, whereas images use the ECW compression standard. *SMURF* generally works offline with a CD dataset; now, depending on the local conditions, vector data files can also be downloaded from an ftp server accessible from the *SMURF* interface.

18.4 Implementation Examples

SMURF was originally developed for the city of Thies in Senegal. Some test applications were carried out in similar contexts (i.e. middle-sized cities in western Africa, such as Koudougou in Bukina Faso, Bignona and Saint-Louis in Senegal

and Nakuru in Kenya) and in one very different situation, the Seychelles islands. The *SMURF* platform is now also used as a support to Learning Alliances (Moriarty *et al.* 2005) to promote integrated urban water management, within the EU SWITCH project, with recent applications in Accra, Belo Horizonte and Zaragoza. Hereafter, we describe shortly two of these case studies, the initial implementation in Thies (described with more details in Repetti *et al.* 2006) and the more recent one in the Seychelles.

18.4.1 Thies, Senegal

Thies is a regional administrative centre, with the third largest population in Senegal (300,000 inhabitants). The economy of the city is mainly based on industries and trade. This mid-sized city faces classical problems of underdevelopment: strong demographic growth (200,000 inhabitants in 1990), a weak economy, lack of infrastructure, informal and unhealthy settlements, poverty and environmental degradation, among other things. However, the city plays a leading role in the regional exchanges and supports an important series of public and private infrastructures and services.

Since the introduction of decentralization policies in Senegal (1996), urban management is a new competence of the local government. In various sectors of local development, the state, the regional government, the local associations and NGOs play a particularly important role, some with the support of multinational backers. Thus, land-use planning and management involves a wide variety of stakeholders. The reality of the urban management of Thies bears evidence of the limits of planners to manage a fast growing city (Repetti and Prélaz-Droux 2003). Lack of information and technical skills to prepare the decisions, as well as of the means to implement them, lack of knowledge and coordination between the actors, administrative services (technical) squeezed between the central State and the decentralized authorities and mostly confining themselves to the management of their current business, are some of the reasons that can explain this situation.

In the reality, the official instruments of planning are hardly ever used (a set of classic instruments of planning exists, some inherited from the pre-decentralization period), most do not meet the needs of the various actors and have not been thoroughly negotiated. In 1999, a participatory forum arose from a demand by the municipal authorities for an experimental project utilizing new urban management instruments. In order to facilitate the information exchanges and storage, *SMURF* has been made available to the main stakeholders in urban management (elected representatives, technical services, administration representatives and services, one association and one NGO) since summer 2000. The participatory forum gathers elected representatives of the City of Thies and of the Community of Fandene, the state representatives, administrative services concerned with the local development and a couple of associations and NGOs. The general objective of the forum is to improve the development in the urban area through information sharing, consultation and co-decision. Starting from this objective, *SMURF* was integrated in the process to support appropriation of the

land-use, participatory planning and management. More specifically, *SMURF* aims at improving information on land use, monitoring urban development and exchanging information between the various involved stakeholders.

The design of the data indicator system (as well as of the interface itself) was an iterative process. The topics covered include territorial organization, markets and trade, business, health, education, drinking water, waste, habitat, social activities, public safety, religion, surface water, land registering and land-use, land conflicts, green and agricultural areas, mobility and governance. Figure 18.6 shows the various objects and attributes included in the Thies application. A set of 36 indicators (Table 18.1) completes the data. It presents the diverse themes, with various spatial scales, strategic and aggregation levels.

In Thies, *SMURF* is integrated into the activities of the development forum, coordinated by the City. The director of the technical services is in charge of the GIS database management. He collects the data updates from the *SMURF* users, controls the errors and presents the data modification information in the forum once or twice a year. Today, *SMURF* is installed on about 30 computers in the urban area: city halls (City of Thies and Community of Fandene), regional hall, local and regional administrative services (technical), associations and NGOs and a cyber café offering public access to *SMURF*. *SMURF* is also used to support participatory planning activities in the local forum.

18.4.2 The Seychelles

The Seychelles are a set of 115 Islands (32 granitic and 83 coralline), spread over almost 400,000 sq km in the Indian Ocean. The granitic inner islands group, with the three main islands Mahe, Praslin and LaDigue (192 sq km), hosts some 95 per cent of the overall population (~82,000 inhabitants in 2007). The largest city is the capital Victoria (Mahe) with a little more than 20,000 inhabitants. Population is 60 per cent urban, with a growth rate of 0.43 per cent. The main resources are fisheries and tourism (30 per cent of employment and 70 per cent of GDP), with an income per capita at $8,682 (2006), by far the highest in Africa. The country became independent in 1976. Socialist rule was brought to a close with a new constitution and free elections in 1993. The political evolution along with the resources gained from tourism, allowed for the development of, among others, relatively efficient health and education systems and much awareness regarding the preservation of environment.

Although there is no demographic urban explosion as in other parts of the world, land allocation is a very central issue which leads to conflicts. On the rocky tropical islands, with a narrow coastal strip and steep slopes almost everywhere else, there are great pressures on useable land: development and diversification of the economy, changes in lifestyle (more space for housing and roads needed) are in the balance with the necessity to preserve the environment (biodiversity, but mainly landscape to maintain tourist attraction). The need for flat land is so great that several development

Table 18.1 Set of indicators designed for Thies

Indicators	Type
Population density	Spatial [grid 1 × 1km] [hab/sqkm]
Age distribution	Statistical [0–6; 7–13; 14–25; 25–60; >60]
Rate of poverty	Statistical [population under poverty threshold]
Demographic growth	Statistical [% per year]
Total population	Statistical [graph]
School population	Spatial [per infrastructure] [pupils/classrooms]
School repartition	Spatial [distance to closest school]
School age population	Spatial [grid 1 × 1 km] [child 7–13/sqkm]
Education rate	Statistical [primary school pupils/child 7–13]
Illiteracy	Statistical [% of total population]
Education index*	Statistical [average (literacy, primary, secondary and university education)]
Health staff	Spatial [grid 2 × 2 km] [total staff/sqkm]
Clinics repartition	Spatial [distance to closest hospital/infirmary]
Hospital bed availability	Statistical [population/bed]
Doctor density	Statistical [population/doctor]
Medical staff density	Statistical [population/staff]
Infantile mortality	Statistical [rate of death in child 0–1]
Health index*	Statistical [0.833 (life expectation − 25) + 1.566 (32 − infantile mortality)]
Drinking water distribution	Spatial [neighbourhood] [connection rate]
Fountains repartition	Spatial [distance to closest fountain]
Water consumption	Statistical [m3/population]
Water price	Statistical [median [$/m3]]
Waste management	Spatial [solid waste collection typology]
Waste elimination	Statistical [solid waste elimination types] [%]
Waste index*	Statistical [50 wastewater treatment rate + 50 solid wastes treatment rate]
Habitat	Spatial [habitat typology]
Mobility	Spatial [access time to city centre]
Infrastructure index*	Statistical [average connection rate on the mains (water, sewage, electricity and telephone)]
Markets repartition	Spatial [distance to closest market]
Product index*	Statistical [0.833(log(PIB)−4.61)]
Decentralization	Qualitative
Public participation	Qualitative
International cooperation	Qualitative
Public spending on staff	Qualitative
Public spending	Statistical [$/population]
Urban development index*	Statistical [average (education, health, waste, infrastructure and product indexes)]

* Indicators proposed by UN-Habitat (2001).

projects on reclamation areas (gained from the sea) are underway (including a new city of 10,000 inhabitants). The mayor of Victoria, along with the ministry of local government initiated a project to adapt the *SMURF* platform to the local context. Initially the local *SMURF* was meant to support several experiences of participative planning that were going on in some of the 25 districts of the inner islands.

Implementing *SMURF* in the Seychelles was challenging, since the geographical, social and institutional background is drastically different from the one in middle-sized cities in western Africa. A first major difference related to scale, since *SMURF* had to be prepared not for a single city and its surroundings, but simultaneously for 25 districts on three islands, with quite heterogeneous spatial data coverage (among islands). The solution of one common platform was quite obvious regarding the needs and interests of the central administration, but new functionalities allowing one to work specifically on a given 'isolated' district (especially to produce district specific maps) were added.

Thanks to an efficient and open-minded administrative structure, access to the quite large set of existing data (in great part centralized at the GIS office of the Ministry of Land Use and Housing) was not a problem. This has to be emphasized since one of the major difficulties often faced in setting up a common GIS platform consists of convincing stakeholders that sharing data will be a win-win process. The data structure (layers and attributes) was developed by a group of stakeholders from district administrations, from the Ministry of Local Government that supports district administration and from several other interested ministries (Land Use and Housing, Transport, Environment, Agriculture, Fisheries, *et cetera*) during a three day workshop.

The final data structure, grouping of the various spatially referenced objects and their attributes (Fig. 18.7), is quite different than that of the Thies case, which was quite logical since major problems to be addressed and available data were not the same in this emerging country. The Seychelles data structure also includes layers identified as necessary, but without any data available so far (greyed out). Indicators were not yet matter of discussion, so that the indicator set used in Thies was kept almost unchanged: the thematic fields remained the same, but, taking advantage of the huge amount of information coming along with the detailed census data, the specific indicators available were enriched, especially regarding water use or economic activity. Furthermore, in response to the interest showed by many stakeholders that were not initially meant as end users of *SMURF,* the indicator module was extended to support the exploration of tailor-made indicators. The creation of new layers has also been added as a new functionality to allow district administrators to address local needs or interests, such as, for instance, the follow-up of Chikungunya disease cases.

In the Seychelles, the management of the system is coordinated by the Ministry of Local Government. The detailed workflow of the data update and validation process has still to be flattened down, since the responsibility of the various data layers is shared among many different public bodies. Today, *SMURF* is installed in all district administrations, as well as in many offices of the various ministries and other public services.

18.5 Experiences

In Thies, a survey was run to evaluate the interest in *SMURF*, as well as its possible influence on the local urban governance (Repetti *et al.* 2006). In the Seychelles, confirmation of interest was seen in the healthy attendance (and passionate involvement) at training workshops and in the role that will in future be given to *SMURF* in two major projects of the government, one to address natural hazards and the other on setting up an e-government structure.

In general, data viewing is the most frequently used mode. Information serves as support for knowledge, for stakeholder discussions and arguments, and is consulted for the design of on-ground projects. In Thies, the most consulted information layers are the land ownership and administrative limits, the data on surface water and on solid wastes (which correspond to the local priorities and conflicts). Information was used for designing several projects (new neighbourhoods planning, flood control reservoirs realization, new public health infrastructures creation, freeway scenarios analysis, etc.). Indicators, either in the form of aggregated statistical values or in the form of thematic maps, remain difficult to understand for the majority of the users. However, they provide an interesting added value for some technicians with a good understanding of the situation, good analytic skills and a deep knowledge of urban planning and management.

Unlike in Thies, where the interactive on-ground project viewer module is regularly consulted (mainly by local authorities), offering valuable information to all stakeholders and impacting positively on the coordination, this element only received very little echo in the Seychelles. Part of the explanation for this could be the fact that the central and local administration are efficient enough to control and coordinate on-ground projects.

The use of the data editing mode varies a lot, depending on stakeholders. Some are regularly augmenting the database as they get an interest in sustaining the instrument, but clearly without institutionalized validation process, enthusiasm might decrease rapidly, since the end-user would like to see the updates he provides becoming part of the 'real' database as quickly as possible. In the Seychelles version, the possibility to create new data layers was added in response to a demand from some district administrators willing to use the *SMURF* tool to monitor different specific aspects at the local scale, such as for instance the spreading of Chikungunya cases. In Thies, the survey also shows that database enrichment is sometimes impaired by the lack of willingness of officials to share the information they detain, this for various reasons such as hesitation to open official data to the public, fear of losing political leverage, or its link to informal or illegal activities. At a more global level, the association of *SMURF* with a forum has a positive impact on urban management in Thies: knowledge of the land realities and of the views and actions of the other stakeholders has increased. The suitability is thus reinforced between the development projects and the needs of the land users. Furthermore, the *SMURF* users are spontaneously attempting to define a common strategic plan as a result of their interactions. Their objective is to ensure a better integration of their individual initiatives at the city level. In the Seychelles, the process is too recent for such an observation.

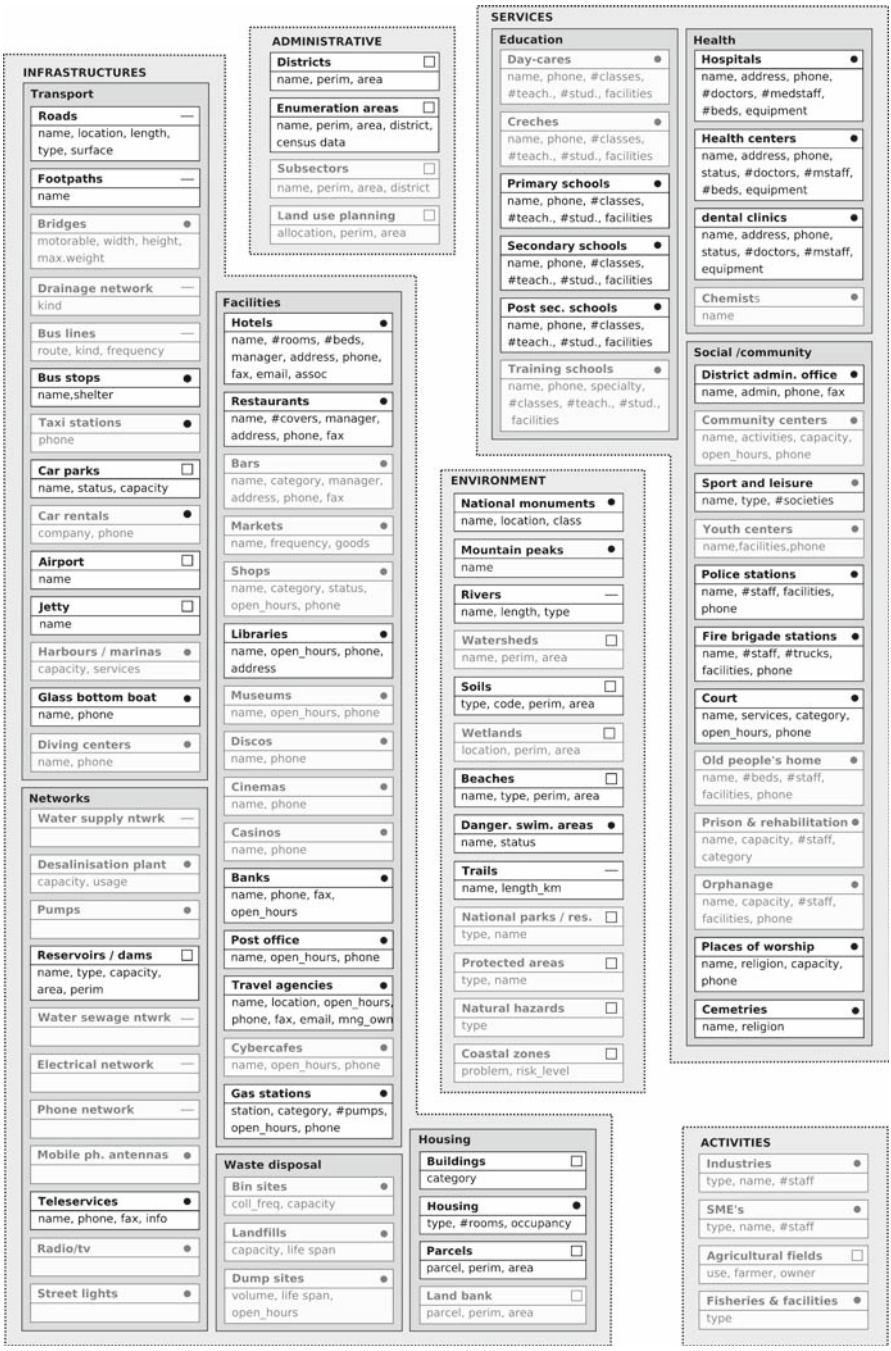

Fig. 18.7 Data structure of the Seychelles' implementation of *SMURF*

The absence of a clear and precise role assignment for the involved participants can raise high expectations that may not be fulfilled and result in some frustration. This is, however, a general issue in public participation processes: public authorities seek visibility for their action and are therefore reluctant to move towards strong consultation and co-decision. For the same reason, dealing with data about informal or illegal activities might be problematic: public authorities receive such information from other stakeholders and are not inclined to publish it under their responsibilities, as it points out complex problems and conflicts that they are not able to solve. Intended to support planning and governance, *SMURF* will not alone resolve the complex equations of underdeveloped cities dealing with legislative vagueness, with informality and with scarce means. Its relevance will depend on the political willingness to implement and use such collaborative management processes, as well as on the allocated resources.

The needs for GIS based communication tools as a support to multi-stakeholder management issues will continue to grow, since such approaches are intrinsically linked to a sound implementation of governance and sustainability principles. In the developing world, however, setting up a forum and implementing *SMURF* might often take a back seat to more immediate local priorities. The required resources, even if very modest (a half time position and a small budget line to organise forums), are still too important with respect to other more immediate tasks. Thus, the sustainability of *SMURF*, depending much on political willingness, remains an open question. In the developed world, the need for simplified GIS-based communication tools, complementing 'technical' GIS systems, is more oriented towards the support of the decision-making process. There is, therefore, a clear trend to a diversification to integrate more specialized modules into the SMURF platform (data validation, time management, generation of alternative strategies, evaluation and decision processes, simple modelling to derive indicators, links to high end models, *et cetera*).

The main lesson gained from the experiences in Thies and in the Seychelles, and the recommendations for further implementations of such tools, is the outstanding importance of the maintenance and update process. This has several implications in terms of simplicity and design of the developed tool, or in terms of availability of local resources to anchor the whole process in the local agenda. It also underlines that the tools we might develop and provide are, in themselves, only of a limited importance. The real cornerstone is in fact the institutional and social setup of the participatory approach.

18.6 Conclusions and Future Directions

The system for the monitoring of urban functionalities (*SMURF*) aims at reinforcing the decision-making processes. It has developed from the needs of the managers of mid-sized African cities and follows a complete methodological approach (diagnosis, instrument development, instrument evaluation and impacts assessment). *SMURF*

does not try to automatically identify the best management scenario, but aims to reinforce the stakeholders and their interrelationships through various supplementary sub-objectives: improve knowledge of land and development projects, serve as a data exchange platform, instrumentalize participatory and collaborative structures through cartographic support, monitor the evolution of the land with indicators and inform and consult the public. *SMURF* does not try to revolutionize the stakeholder system by imposing dogmatic participation. It aims at getting public authorities, land technicians, business representatives and citizens' rights defenders to coordinate as much as possible through a formalized exchange space.

In comparison with existing works in the field, the proposed approach is focusing on building consensual information and strategic objectives, rather than on scenario evaluation which is a second step. In our experimentation, participation is used to constitute a knowledge base that supports decision making and consensus building. The process results in better knowledge for all participants and in a strong consensus about the diagnosis of the actual situation and about the strategic objectives for the local development. The role of the forum is central, as some information cannot be shared through a database. Yet, the field studies show that decision makers and stakeholders are using a SMURF-based diagnosis and the discussed strategies into account during their planning action, even if they do not model scenarios.

In addition to the implementation of a new technology, the research and user experience with *SMURF* is an attempt to integrate the social and technical sciences. *SMURF* can thus be seen as an observatory of urban development available for local stakeholders. It is complementary to the more global programs of international urban observatories. Finally, *SMURF* does not aim to reduce the complexity of urban management, but to offer an interactive tool, easy to use, which provides assessment monitoring, comparisons, communication and finally knowledge to the decision-makers.

As stated previously, *SMURF* offers a more or less formalized exchange space. Future research should aim at providing support for other aspects involved in the decision making process at a strategic level. These elements include:

- the generation of alternative scenarios, according to global trends (demography, economy, climate, etc.) and to various options, covering the political, economical and technical fields;
- the extension of the thematic fields covered by indicators and links to modelling tools to evaluate those indicators; and
- the linking to decision support schemes such as multi-criteria techniques and/or life-cycle assessment techniques.

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