Enhancing community participation when planning informal settlements

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Using a case study in Stellenbosch, this article reports on how geographic information systems (GIS) can be used to bridge the gap between municipalities and informal settlement communities. It presents a methodology that encourages extensive community participation in creating an end product that can be used by technical expertise in the municipality for planning purposes. This work contributes to the body of Public Participation GIS (PPGIS).

Flooding has often been problem in most informal settlements. For most urban environments, properly maintained infrastructure such as road drains and channels are adequate to prevent flooding. Unfortunately, owing to high numbers of rural-urban migrations, there has been a growth of illegal settlements in cities across the world. The migrants are often too poor to afford proper housing in the serviced parts of the city and therefore settle on risk prone land [1, 2]. In Cape Town, according to the 2007 Cape Town City Council (CTCC) census report, there were approximately 109 000 families living in informal settlements in Cape Town [3]. Many of these informal settlements are particularly prone to flooding (Table 1).

In addition, studies have shown that many of these settlements are also faced with problems such as poor sanitation, fires, and contagious diseases [1, 4]. Resolving these problems in informal settlements has come with great difficulty. Bottlenecks such as conflicting political parties, lack of available land for relocation and poor service delivery have exacerbated the situation [5, 6, 7, 8]. These studies have also shown that in tackling these problems, there has been a paradigm shift from relocation of residents to informal settlement upgrading. The upgrading of informal settlements typically involves restructuring the shacks into a pattern that can allow the provision of services such as electricity and drainage canals. Scholars have called for the participation of local communities in the planning process [1, 4, 5, 6, 9, 10, 11, 12, 13].

The consequences of inadequate participation of community members have been well documented by the press in Cape Town. For instance, in 2012, residents of Mkhaza in Khayelitsha, a suburb of Cape Town, destroyed toilets that had been newly installed by the CTCC (Fig. 1).

Research in areas such as Participatory Rapid Appraisal (PRA) and Community Action Planning (CAP) has highlighted the benefits of partnerships between local communities and local government as well as the negative effect of their absence. PRA encompasses a variety of approaches and methods that enable local people to share and analyse their knowledge of life and conditions in order to plan and to act [14]. CAP generally consists of an active, intense community-based workshop, depending on the specific goals of the workshop. The general output of such a workshop is a development plan which includes a list of prioritised problems, strategies and options for dealing with the problems, and a rudimentary work programme describing who, when and what is to be done. A key element of this method is the equal relation between the professional technical stakeholders and the community members. PRA and CAP have been used in a wide variety of projects such as land use planning, health, agriculture, fishing, forestry and food security, family planning and gender studies [15].

In South Africa, the Project Preparation Trust (PPT) is an example of an organisation that employs CAP in various projects such as informal settlement upgrading and provision of special needs housing such as community care homes for orphans and vulnerable children and accommodation for the chronically ill or those with disabilities. Between October 2010 and August 2011 PPT engaged in a project funded by the eThekwini municipality under the eThekwini Interim Services Projects [15]. This pilot study was conducted in conjunction with the Kenville (consisting of Mysore and Temple) and Redcliffe informal settlements and some of the goals included:

- Facilitating early child development by getting crèche operators in

<table>
<thead>
<tr>
<th>Flood hazard locality</th>
<th>Affected informal settlements</th>
<th>Estimated number of dwellings affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm water ponds</td>
<td>7</td>
<td>457</td>
</tr>
<tr>
<td>Environmentally sensitive wetlands</td>
<td>2</td>
<td>927</td>
</tr>
<tr>
<td>Trapped low-lying areas</td>
<td>33</td>
<td>3885</td>
</tr>
<tr>
<td>Flood plain or within 25 m of a water course</td>
<td>18</td>
<td>1848</td>
</tr>
</tbody>
</table>

Table 1: Occurrence of informal settlements in flood-prone areas [29].
both areas to register with the Department of Social Development and other resource organisations.

- Developing strategies to mitigate against vulnerability to serious illnesses since unskilled people depend on their wellbeing to generate income.
- Facilitating community gardens such that access to food security could be encouraged through training in organic farming and maximising the available space.

While PPT did not address informal settlement upgrading in this project, the methods they used are generic and the lessons from the project can be used to facilitate other partnerships between local municipalities and communities. The project report prescribed that where possible, the participatory processes should be initiated in advance of infrastructure and housing investment so as to (ibid):

- Inform and optimise such investment (e.g. by informing local planning and design considerations).
- Establish improved local communication and understanding.
- Build local commitment, social capital and "self-help" (instead of a paradigm of pure reliance on government).

Establishing a paradigm shift towards "self-help" is pivotal to the success of partnerships between communities and local government. The Community Organisation Resource Centre (CORC) and Slum Dwellers International (SDI) are partnering non-governmental organisations (NGOs) that also use PRA in upgrading communities. They use questionnaires to help communities identify issues of concern; chart potential solutions and create links between the local community of interest and the local government officials [1, 16].

In general, the technological gap between local communities and experts such as planners in the local municipality has often been a hindrance to the participation of local communities. The information collected from local communities is relevant but often in a format that cannot be used by professionals in local government. Scholars have called for novel ways of bridging the gap in order to enhance participation of all stakeholders and subsequently facilitate sustainable development. This study will show that geographic information systems (GIS) can be used as a bridging technology.

The case for GIS

GIS has routinely been used to facilitate decision making. A GIS may be defined as a computer-based tool for storing, mapping and analysing spatially referenced data [20]. Since GIS technology is a common choice for the capture and display of location based data, it has been used in various institutions to facilitate the comprehension of spatial aspects of social and economic development. However, the potential of GIS to facilitate dialogue between stakeholders at various scales has often been unrealised, mainly because GIS development and analysis has traditionally been carried out exclusively at a technical level by various professionals without input from communities located in the actual geographical space being analysed [17, 18, 19, 20]. Recent studies have created more "democratic" GIS platforms that allow communities to participate. This body of research is what has come to be known as Participatory GIS (PGIS) and Public Participation GIS (PPGIS). Participatory GIS can be described as [21]:

"A confluence of social activity such as grassroots organisations and government decision making with technology in specific places or grounded geographies".

Although definitions vary, they all address the development of a link between a locality and the sharing of information between stakeholders in that locality. Naturally, the body of research on Participatory GIS can be split into two broad themes. Some scholars address the issues involved in enabling access of the various stakeholders to information in the GIS [17, 21, 22], whilst others advocate the inclusion of information from various stakeholders including communities in a GIS [23, 24, 25]. PPGIS is employed mostly in the planning profession and is essentially a component of PGIS that focuses on empowerment of communities [17]. The primary aim of PPGIS is to use GIS to provide information that can strengthen the involvement of communities or marginalised groups in actual decision making [26, 27]. This study will focus on facilitating the mapping of community decisions in a GIS and it specifically contributes to the body of PPGIS.

There have been a number of studies focusing on using GIS in informal communities. For instance, one study explored the possibility of including community gathered information in a GIS for in-situ informal settlement upgrading in New Rest, an informal settlement in Cape Town [24]. The study used questionnaires to gather demographic information from community members, which was subsequently integrated into a GIS containing spatial data, such as storm water drainage routes, roads, foot paths, shack outlines and geological data from the CTCC. Subsequently, they generated thematic maps and statistical reports from the demographic data and produced indicators of vulnerability. It was shown that, by overlapping these thematic maps with the spatial data showing areas prone to disasters, such as flooding and fires, one could identify the people most likely to suffer the brunt of a disaster [24]. Additionally, by looking at current socio-economic activities in the
settlement, the planned infrastructure could be laid out to facilitate even access to transportation hubs and to identify locations that were suitable for business opportunities.

Another study was conducted in partnership with the local community, an NGO and a savings group in an informal settlement in Kisumu, Kenya with the aim of soliciting information for upgrading and provision of secure tenure for that settlement [25]. Demographic data was collected from the various households and linked with maps of the existing house structures that had been extracted from satellite imagery. The updated maps including the shack identity numbers were digitised into a GIS database and presented back to the informal settlements. Although in the preceding study it was indicated that, with training, communities could be given access to data in the GIS [24], this study actually allowed the community to engage with the GIS from the enumeration in order to verify the data and to stir debate within the community on its own needs, thus giving them an opportunity to set priorities collectively [25].

A different study was undertaken with the aim of improving flood risk management in informal settlements in Cape Town [28]. The research involved using the GIS data from the CTCC to investigate the trends in rainfall and flooding in informal settlements in order to analyse biophysical vulnerability. In addition, they used interviews and case studies to investigate current mitigation and coping techniques within the community. In this study, the information from the settlement was not wholly captured in the GIS; however, it was used in the weighting of risk indices. For example, the topography of areas where the community members reported the most severe incidents of flooding was analysed in order to tease out the elements that might amplify the severity of the hazard. A major critique of this study is that, although the data collection initially involved some community participation, the analysis was done by experts without any input from the community. For instance, flood risk weights were generated subjectively without any theoretical background or partnership with the communities, and the subsequent risk maps therefore did not necessarily represent the views of the community. In this instance, the data collection was participatory, but access to and application of the GIS was not.

A recent study in Cape Town studied social vulnerability as an indicator of risk in informal settlements [4]. In the study a PRA approach was taken based on discussions with community leaders. The community leaders assessed a number of factors that contributed to vulnerability in the settlement such as disparities in income levels, variations in exposure to diseases and hazards and efficiency of methods of mitigation. A multi-criteria analysis was then used to translate these opinions into quantitative data that could be mapped. The resulting maps represented the voice of the community in a GIS format that the local municipality officials could appreciate. The various studies highlighted above all show that GIS has the potential to be used as a bridging technology in community-driven projects when various stakeholders are concerned. The use of GIS in such projects itself
represents a paradigm shift from an era when GIS technology was seen as discriminatory [18].

The case study area
Langrug is a large informal settlement on the slopes of Mont Rochelle Nature Reserve on the outskirts of Franschoek in Stellenbosch. It is approximately 16 years old and is located on municipal land. It is 5 km north-west of the town centre of Franschoek and 50 km north-east of Cape Town city centre (Fig. 2). It comprises 4088 residents most of whom are native IsiXhosa speakers and are immigrants to the Western Cape [16]. There are 91 communal toilets, 83 of which are functional. There are also 57 water taps of which only 45 are functional. The area is prone to widespread flooding and has also experienced a number of fires (ibid). During initial discussions with the community, they highlighted an urgent need for accessible streets in the settlement and the extension of services such as electricity, water taps and toilets.

Methodology and results
The methodology used in this study was meant to foster as much community participation as possible, from data collection to actual community upgrading. The methodology is summarised in Fig. 3.

Data collection
The methodology used to collect the data incorporated the methodologies used in a number of studies on informal settlements [1, 9, 11, 16, 23, 25]. The data collection, carried out between March and May 2011, consisted of two main parts: capturing the social information from the communities and capturing the spatial information using GIS. The data collection was driven by Slum Dwellers International (SDI) in partnership with the Stellenbosch municipality as well as other affiliated non-government organisations (NGOs). The process is summarised in Fig. 3.

Firstly, partnerships were formed with the community in the informal settlement in order to reach consensus on the outcomes of the data collection. The settlement was subsequently split into 19 sections, lettered from A to T, based on existing walk ways (Fig. 4). A questionnaire was developed through discussions between all the partners including the local community. It was designed to capture social/demographic information such as a profile of the inhabitants’ education levels, employment and skills, coping mechanisms, health, and frequency of exposure to hazards such as flooding and fire. The social information was subsequently digitally captured by means of spreadsheets, whereas the spatial information was derived from aerial imagery of Langrug from the CTCC.

Aerial images were printed and given to the data collectors. The data collectors consisted of SDI volunteers and community leaders. The data collectors were required to mark the shack number of each visited shack on a print-out of the aerial photographs, as well as on the corresponding questionnaire. In addition, any differences between the actual appearance of the shack on the ground and the aerial image were marked on the printed aerial photographs. This data was subsequently captured in a GIS. Furthermore, the spread sheets containing the demographic information were linked with the digitised shacks...
in the GIS so that the data in the questionnaire was the attribute information for the corresponding digitised shack.

The captured data was required for various micro projects in Langrug. The community was interested in mapping the locations of:

- All the toilets in order to assess which ones were still functional
- All the underground and surface drains in order to assess their efficiency
- All the garbage collection points
- All business establishments such as shops, spazas and shebeens

Fig. 5 shows the hand drawn maps with all the information that the community required. It was important though to ensure that this data was accurately captured to scale using GIS. This article will only report on the use of GIS in the re-blocking phase of the settlement upgrading. The application of GIS in the vulnerability assessment will be presented in a forthcoming paper.

**Upgrading the settlement**

Block E was used as a pilot section in re-blocking the settlement. The aim was to restructure the shacks to create streets. These streets would subsequently host new services like canals to mitigate flooding as well as electricity poles and water lines.

It was agreed that the new shacks would have an equal footprint; hence, the area would be uniform. The shacks would also stay as close as possible to their original locations. Fig. 6 shows the original layout of the shacks and paths in Block E after digitisation.

The original layout of the shacks was then printed on an A0 sheet. Cardboard boxes were then used to create standard shacks. Based on the printed map, a layout of the new shacks was designed by the community members in conjunction with SDI and the municipality. In so doing, the community members were actively involved in planning the restructuring of the settlement. Fig. 7 shows the new layout of Block E as proposed by the community. The streets have been structured to allow for provision of services and access of vehicles. The shacks at the corners of the block were maintained in their original location.

The new layout was then photographed and imported into the GIS software. The image was subsequently geo-referenced to fit the shacks at the corners of the block. Fig. 8 shows the layout after being geo-referenced.

The new layout was then digitised to create a map that the municipal planners could use for their planning. Fig. 8 shows the new layout, with the original foot paths. Fig. 9 shows a comparison of the old and new layouts.

**Discussion and conclusions**

Sustainable development can only happen when all parties are involved in the decision making process. However, the involvement of communities is often inhibited by the lack of technical expertise. Community members are often unable to communicate in the technical language of professionals such as planners and surveyors. In addition, they cannot use the software that the professionals use. For these reasons, the professionals often overlooked local communities during the planning activity.

The methodology presented in this paper details the participation of local communities in planning the layout of their settlement by taking a different approach. The software, in this case GIS, was used to simplify the planning process for the community members. The community interacted with simplistic blocks in order to plan their settlement. The blocks were then digitised for use by the professionals. In this case study, GIS acted as a medium to translate the community’s opinions into a product that the professionals could utilise. Moreover, GIS ensured that the proposals of the local community were captured to the correct scale in the absence of which the municipal engineers would have been unable to assess the proposed locations of the shacks.

From a social perspective, the application of GIS in this micro project empowered the community to actually engage in planning their settlement and in so doing, facilitated...
shows how GIS facilitated a successful initiative between the local municipality, NGOs and the local community in informal settlement upgrading. It is worth pointing out that community participation must still be partnered with technical expertise. Block E was chosen as a pilot study area because of its flat terrain. Blocks A, B, C, D and T are located on higher ground that makes it difficult to construct proper accommodation. The engineering department of Stellenbosch municipality had to investigate various factors that could impact on the location of the shacks such as topography and flood lines before final approval could be given. There will be varying levels of success in the different blocks based on such conditions and the technical contribution of the engineering team will be greatly required.

The application of GIS was not limited to re-blocking of the shacks. Since all the demographic data was captured in the GIS, thematic maps on other issues such as vulnerability to disasters and disease were also studied in order to identify areas that were particularly at risk. This research will form the focus of a forthcoming paper.

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