Spatial information in public consultation within Environmental Impact Assessments A.N. Mwenda 2015

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Angelina Nduta Mwenda

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Spatial Information in Public Consultation within Environmental Impact Assessments

Angelina Nduta Mwenda

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Knowing where things are, and why, is essential to rational decision making

–Jack Dangermond –

Contents

in loving memory of Fidelina Wagio Mwenda (‘Mama Nduta’)

What a friend! What a priviledge!

1

General introduction

1.1 Environmental Impact Assessment

The formal beginnings of Environmental Impact Assessment (EIA) have been traced to the year 1970, when President Richard Nixon of the United States of America signed into law the National Environment Policy Act, NEPA (Jay *et al.*, 2007; Department of Environment, 2011). The motivation behind this law was an acknowledgement of the increasing environmental degradation arising from human development activities, so that through this law, a consideration of anticipated effects of any development activities on the quality of the environment was mandated. The purposes of the Act included the promotion of a productive and enjoyable harmony between humans and the environment, promotion of efforts to prevent or eliminate damage to the environment, support to human health and welfare, and improved understanding on vital ecological systems and natural resources. An additional purpose of NEPA was to establish a Council on Environmental Quality (QEL) to oversee implementation of the Act (Department of Environment, 2011).

EIA as established by NEPA adopted an interdisciplinary approach, which required Federal officials to consider environmental values alongside social, technical and economic considerations (Department of Environment, 2011). It was also understood that reasonable alternatives were to be evaluated, input solicited from organizations and individuals that could potentially be affected, and potentially direct, indirect of cumulative environmental impacts be presented in an unbiased manner (Council on Environmental Quality, 2007).

Following the establishment of NEPA in the USA, EIA began to be formally established in other countries worldwide (Jay *et al.*, 2007; Macintosh, 2010), where the principles remained the same, but specific activities were modified to suit regional and local requirements. Later, the International Association for Impact Assessment defined EIA as

> *'the process of identifying, predicting, evaluating and mitigating the biophysical, social and other relevant effects of development proposals prior to major decision being taken and commitments made'* (de Jesus, 2009).

This current definition of EIA remains largely unchanged from the principles behind the establishment of NEPA, which was the consideration of anticipated impacts of development on the environment, and the timely mitigation of these impacts to the extent possible. However, with developments in the field, EIA is now considered to be one of the processes under the wider body of Impact Assessment, IA (Morgan, 2012), with other types of IA focussing on health (Negev, 2012), visual impact (Rodrigues *et al.*, 2009; Jerpasen & Larsen, 2011), life cycle impact (Brent & Hietkamp, 2003), planning (Che *et al.*, 2011) and social impact (Tang *et al.*, 2008), among others. It is also recognized that IAs are bound in scope and extent to singular projects, leading to the development of IA tools that cater for larger proposals and plans, such as Regional Environmental Assessment (REA) for river basins (Braun,

2008), and Strategic Environmental Assessment (SEA) for policies, plans and/or programmes (Onyango & Schmidt, 2007; Geneletti, 2012; De Montis, 2013).

1.2 Public participation in EIA

Right from its establishment, EIA has sought to balance environmental concerns with social, economic and other human needs, to the extent that partnership between the various levels of government, private and public organizations, as well as individuals, is emphasized (Salomons & Hoberg, 2014). This has led to public participation being considered essential to EIA (Palerm, 2000; Hartley & Wood, 2005; Jay *et al.*, 2007; Nadeem & Fisher, 2011). To this end, public participation in the context of EIA has been defined by the International Association for Impact Assessment as

> *the involvement of individuals and groups that are positively or negatively affected by, or that are interested in, a proposed project, program, plan or policy that is subject to a decision-making process* (Andre *et al.*, 2006).

The manner in which participation takes place is not clearly identified in the above definition, where only the term 'involvement' is used. Consequently, it has been observed that not all participation is equal, leading to the identification of varying levels of participation, such as those proposed in the spectrum of public participation (International Association for Public Participation, 2007) which identifies five increasing levels, namely: inform, consult, involve, collaborate and empower. Numerous other typologies also exist to differentiate the varying levels of public participation and their impact (Arnstein, 1969; Connor, 1988; Wiedemann & Femers, 1993; Maier, 2001; McCall, 2003).

The benefits of public participation in EIA are many, and include increased efficiency in planning, transparent decision making, higher levels of commitment by those involved, identification of potential areas of conflict, avoidance of public controversy, creation of trust and mutual respect, and the identification of unique concerns otherwise unidentified by the planning or EIA team (Wang & Chen, 2006). This is further evidenced in the fact that the EIA process in most countries requires the public to be involved, and also that the final report be a public document, accessible to all (Portman, 2009).

The argument for public participation may be strong (Hartley & Wood, 2005), but this has not been without challenges to its implementation (Glicken, 2000; Abelson *et al.*, 2003; Jay *et al.*, 2007; Faircheallaigh, 2010). Factors impeding public participation include lack of public involvement (Ahmad & Wood, 2002), delayed participation, lack of access to project-related information, infrequent discussions, and not considering public opinion when arriving at decisions (Hartley & Wood, 2005), among others. Solutions proposed to address these challenges include the implementation of Free, Prior and Informed Consent (FPIC) processes, access to project-related information, the recognition and acceptance of traditional knowledge (Hanna *et al.*, 2014) and empowering marginalized groups (Faircheallaigh, 2010).

1.3 Spatial information in EIA

One of the purposes of EIA which remained largely unchanged from NEPA, was to improve understanding on vital ecological systems and natural resources (Council on Environmental Quality, 2007; Department of Environment, 2011). This purpose was further entrenched in subsequent definitions of EIA, including the one presented earlier, as developed by the International Association for Impact Assessment, where an identification of biophysical and social systems forms the basis for later prediction, evaluation and mitigation of effects arising from development proposals (de Jesus, 2009).

From the above, it may therefore be held that information related to the natural and human environment is central to the EIA process. Numerous sources of information exist that may fulfil these requirements, such as photographs, verbal descriptions, animations, and maps, among others (Montello & Freundschuh, 1995). Of these, information containing spatial elements is valuable due to its ability to not only identify features, but also position them or provide locational information (Golledge, 1995a). In addition, developments in Geographic Information Systems (GIS) have resulted in an increase in types of spatial presentations, such as satellite images, orthophotographs, photo-realistic visualizations, photo montages and virtual reality, among others (Al-Kodmany, 1999; Agrawal & Dikshit, 2002; Al-Kodmany, 2002; Harper, 2002). These variations in the presentation of spatial information are steadily increasing (Atkinson & Canter, 2011).

Spatial information has therefore been useful in EIA as it is used to assemble and represent baseline environmental and human information (Satapathy *et al.*, 2008), and identify and predict the extent of impacts (Vanderhaegen & Muro, 2005). Spatial information has also been useful in providing information for public participation where it is used to facilitate as well as support the communication process (Hammond *et al.*, 2011; Lee, 1983).

1.1 Spatial information in public participation within EIA: Problem statement

The use of spatial information within EIA has been credited with the innovative presentation of project-relevant information related to the natural and human environment (Vanderhaegen & Muro, 2005; Satapathy *et al.*, 2008). In addition, spatial information has served as a communication tool that has facilitated discussion and suggestions for change from stakeholders (Atkinson & Canter, 2011).

Despite the versatility of spatial information in addressing requirements for the presentation of project information and facilitating communication, weaknesses have been observed, such as increased levels of visual realism, which despite being largely welcomed, have been considered a hindrance in the interpretation of spatial information (Appleton & Lovett, 2005). Other limitations in the use of spatial

information include the high costs, technical requirements and time input required to prepare some spatial presentations, which causes them to be inaccessible to a large number of stakeholders (Vanderhaegen & Muro, 2005; Slotterback, 2011). This in effect locks out certain participants. Therefore, despite the increasing use of spatial information to support public participation in EIA, debate continues on its value, due to differing methods of application, differences in the spatial literacy of users, high costs, and complexity of techniques (Laituri, 2003; Vanderhaegen & Muro, 2005; Gonzalez *et al.*, 2008; Riddlesden *et al.*, 2012).

The discussion around challenges associated with the use of spatial information to support public participation within EIA as presented above was considered for further study. To begin with, the relationship between EIA, public participation and spatial information, as illustrated in Fig.1-1 was understood to be that EIA served as the wider setting, wherein public participation was considered, and finally spatial information within public participation.

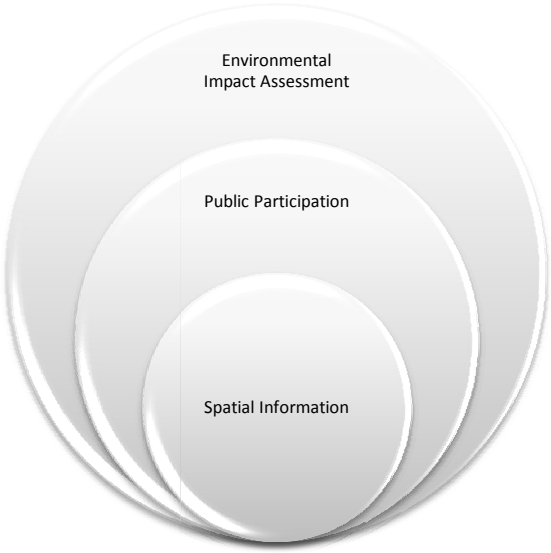

Fig. 1–1. Relationship between the key concepts in this thesis

Further, debate on the value of spatial information to public participation within EIA is not unique to a particular country, and has also been observed in developing countries, where, in addition to a deficiency of information, less developed and poorly enforced legislative, administrative, institutional and procedural frameworks for EIA and its practice intensifies the challenging circumstances. For example, in Kenya, spatial information is recommended for use during public participation within EIA (National Environment Management Authority, 2002), but whether this happens, and if so, the extent to which it does, is largely undocumented. In view of this observation,

an investigation into the situation around the use of spatial information in public participation within EIA, including possible challenges, was considered.

1.2 Objectives

The main objective of this thesis is to establish whether spatial information is used in public participation within EIA, and if so, the extent of its use. To achieve this overall objective, three sub-objectives were developed:

- To confirm the presence and extent of public participation within EIA in Kenya.
- To establish the extent to which spatial information is used in EIA in Kenya.
- To evaluate, using case studies, the use of spatial information during public participation within EIA in Kenya.

1.3 Structure of the Thesis

This thesis consists of six chapters, including this introductory chapter. The following four chapters (chapters 2 to 5) detail the steps taken, methods used, and findings arrived at with an aim of achieving the overall objective of this thesis. The final chapter synthesizes and concludes on the results from the studies undertaken, and reflects on the findings of this research, as well as offering suggestions for future research.

The structure of this thesis is illustrated in Fig. 1-2. The research was carried out in two phases: surveys to establish the existing situation relative to public participation and spatial information within EIA, and case studies. Chapters 2 and 3 present surveys undertaken to establish the existing situation for public participation and the use of spatial information therein, while chapters 4 and 5 present case studies carried out to establish the use of spatial information during public participation within EIA.

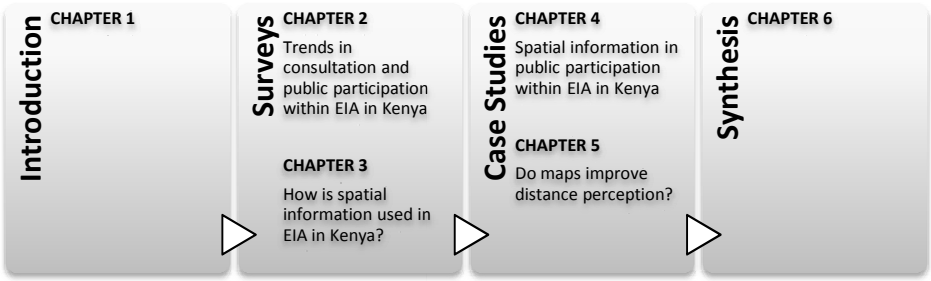

Fig. 1–1. Outline of the thesis

Chapter 2 presents a survey into the trends in consultation and public participation within EIA in Kenya. This involved a review of EIA Study Reports submitted to the

Environment Authority since the establishment of EIA in Kenya (2002) to the year 2010. A Consultation and Public Participation (CPPI) Index was developed to facilitate the analysis of public participation.

Chapter 3 also presents a survey into the use of spatial information within EIA in Kenya, through a review of EIA Study Reports submitted to the Environment Authority between 2002 and 2013.

Chapters 4 and 5 present case studies undertaken to demonstrate the use of spatial information during public participation within EIA in Kenya. The unique point of these case studies is that they were conducted in 'real-life' settings, similar to those in which actual EIAs are carried out, as opposed to highly controlled and laboratory-like set ups. In Chapter 4, a framework developed to assess the interplay between public participation and spatial information was tested during the EIA study for a petrol station in the Eastern Province of Kenya.

Chapter 5 presents a second case study undertaken to demonstrate the use of spatial information during public participation within EIA in Kenya. Here, the framework developed and used in Chapter 4 was refined further, where three maps with varying levels of visual realism were used to determine map preference and test for distance perception. This particular experiment was carried out during the EIA study for a sanitary landfill in the Rift Valley Province of Kenya.

Chapter 6 synthesizes, discusses and draws conclusions from the results of this thesis in relation to the objectives. It also presents reflections on the implications of these results and offers suggestions for future research.

2

Trends in consultation and public participation within Environmental Impact Assessment in Kenya

Mwenda, A.N., Bregt, A.K., Ligtenberg, A. and Kibutu, T.N. (2012)

Impact Assessment and Project Appraisal 30(2): 130-135

Abstract: The objective of this study was to document trends in public participation within EIA in Kenya, using a Consultation and Public Participation Index (CPPI) developed for the analysis of EIA Study Reports submitted to the Environment Authority between 2002 and 2010. Results indicated that public participation remained relatively low, with the highest score of 1.65 in 2010, out of a possible score of 5. Scores for individual dimensions within the index fluctuated during the study period, with participation methods and type of participants scoring the highest, following increased emphasis by the Environment Authority on the conducting and reporting of public participation. This was followed by venue, notification and language used, in that order, which were often times not reported, and when reported, choices per dimension were limited. This is the first time this Index has been used yet it serves as a good starting point to evaluate public participation within EIA.

2.1 Introduction

Despite the acknowledged importance of public participation to Environmental Impact Assessment (EIA) as well as challenges to its success (Glicken, 2000; Sinclair & Fitzpatrick, 2002; Hartley & Wood, 2005; Jay *et al.*, 2007), there is not much documented information on the same for Kenya, with only a handful of studies so far. Specifically, Marara *et al.* (2011) emphasise the importance of the socio-economic and political situation of a country to the effectiveness of EIA, while Kimani (2010) suggests that citizen participation is viewed as an administrative formality. Okello *et al.* (2009) presented the barriers that impede effective public participation during EIA, while Onyango and Schmidt (2007) analysed the Strategic Environmental Assessment (SEA) framework in Kenya, including public participation. Angwenyi (2004) highlighted environmental legislation in Kenya and the domestication of international environmental law, while Kameri-Mbote (2000) analysed the legal and institutional frameworks for public involvement in EIA. Finally, Duffy and Tshirley (2000) investigated the application of EIA to address chronic environmentally damaging agricultural and rural development practices in Kenya and Cambodia.

Studies to document the status of consultation and public participation since the enactment of the Environmental Management and Coordination Act, EMCA, in 1999, which established EIA in Kenya, have so far not been carried out. More specifically,

the trends in public participation within EIA since its introduction to the present time have so far not been investigated.

The overall objective of this paper was to document trends in public participation within EIA in Kenya, using a Consultation and Public Participation Index (CPPI) developed for the analysis of EIA Study Reports submitted to Kenya's environment authority, the National Environment Management Authority (NEMA) between 2002 and 2010. The results document the status of consultation and public participation within EIA in Kenya, and propose recommendations for improvement in conducting and reporting of the same.

The next section of this paper presents the context of public participation within EIA in Kenya. Data and methods used to obtain information for this paper are presented in the third section, followed by a presentation and discussion of results in the fourth section. The fifth and final section of this paper consists of conclusions derived from the study and recommendations for further study.

2.2 Public participation within EIA in Kenya

2.2.1 Legislative background

The EIA process was first formally mentioned and established by law in Kenya in 1999 (Republic of Kenya, 1999). A list outlining development projects that require an EIA was elaborated in this law, and determines which development projects are to be subjected to an EIA (Box 2-1). This list is also used to guide the submission of EIA Study Reports to the Environment Authority, and was one of the categories used, following proportionate sampling, to determine the study sample.

Box 2-1 Project requiring an EIA in Kenya.

Project type
General;
Urban development;
Transportation;
Dams, rivers & water resources;
Aerial spraying;
Mining, including quarrying and open-cast extraction;
Forestry related activities;
Agriculture;
Processing and manufacturing industries;
Electrical infrastructure;
Management of hydrocarbons;
Waste disposal;
Natural conservation areas;
Nuclear reactors;
Major developments in biotechnology.

Source: Republic of Kenya (1999)

2.2.2 Consultation and Public Participation (CPP)

Public participation within EIA in Kenya is referred to as Consultation and Public Participation, CPP (National Environment Management Authority, 2002; Republic of Kenya, 2003). Consultation and public participation is conducted during the Project Report and EIA Study stages (Republic of Kenya, 2003), but most intensively within the EIA study stage (Fig. 2-1).

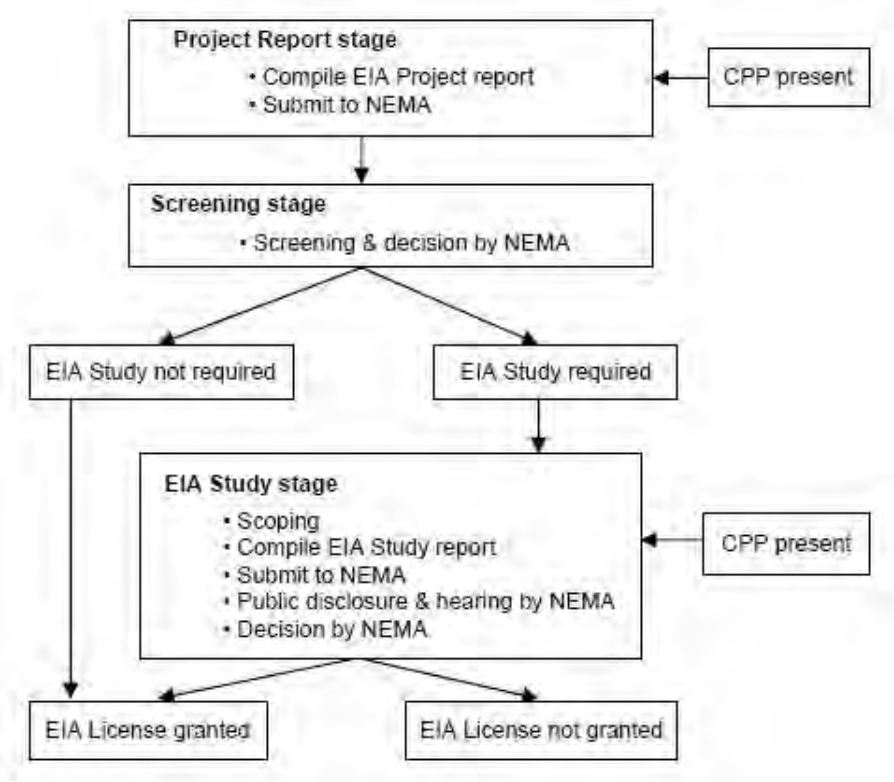

Fig. 2–1. Consultation and Public Participation (CPP) within EIA in Kenya.
Adapted from: National Environment Management Authority (2002), Republic of Kenya (2003)

2.3 Data and methods

2.3.1 Data

An EIA Study Report has been defined as 'the report produced at the end of the EIA Study process' (Republic of Kenya, 2003), and was selected for this study because it is prepared when the Environment Authority finds that the proposed project will have a significant impact on the environment (Republic of Kenya, 2003). The EIA Study Report is also expected to contain information documenting public participation carried

out in the EIA Study stage (National Environment Management Authority, 2002; Republic of Kenya, 2003)

To begin with, an inventory of all EIA Study Reports submitted to the Environment Authority was undertaken. The total number of EIA study reports received at the Environment Authority was 477, with the oldest dated 2002 (Kimani, 2010), the same time that country-specific procedures were prepared for the EIA process (National Environment Management Authority, 2002). EIA Study Reports at the Environment Authority are categorized under date of submission, type of project (Box 2-1) and province of proposed project - Kenya has eight provinces (Office of Public Communications, 2008). Proportionate (quota) sampling, a variation of stratified random sampling (McGinn, 2004; Wadsworth, 2005) was thereafter applied, following the three categories mentioned above (date of submission, type of project, and province of proposed project) to obtain the study sample.

Two hundred and thirty five EIA Study Reports submitted to the Environment Authority between 2002 and 2010 formed the preliminary study sample (Fig. 2-2), where all the 8 provinces of Kenya were represented, as well as the different types of projects (Box 2-1). A checklist was created to record the following information from each of the EIA Study Reports to be analysed: EIA number assigned by the Environment Authority; date; Province; type of project; presence/absence of public participation; notification; participation methods; venue; language(s) used; and participants.

Following an initial survey, public participation was indicated in 95% of the reports (223 reports), hence only these formed the final study sample, results of which inform this paper. The remaining 5% of reports that did not indicate public participation were not considered in this study.

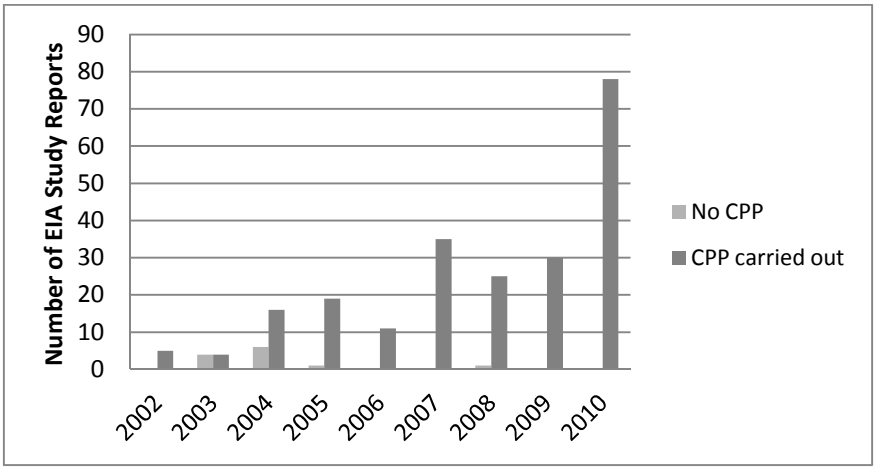

Fig. 2–2. EIA Study Reports following proportionate sampling. (n=235)

Dimensions for evaluation of public participation were identified based on (i) legal requirements, (ii) overview possibilities and (iii) measurability. Five dimensions were identified, which were: notification, participation methods, venue, language used, and type of participants. These dimensions are mentioned in the legislation guiding EIA in Kenya (Republic of Kenya, 2003), and have also been described in the public participation literature, where their importance is also elaborated (Glicken, 2000; Palerm, 2000; National Environment Management Authority, 2002; Sinclair & Fitzpatrick, 2002; Hartley & Wood, 2005; Okello *et al.*, 2009). These dimensions were thereafter used to develop a Consultation and Public Participation Index (CPPI) to enable analysis of EIA Study Reports selected in this study, for evidence of public participation within EIA in Kenya.

2.3.2 Methods

A Consultation and Public Participation Index (CPPI) was developed for the evaluation of consultation and public participation as presented in EIA Study Reports submitted to Kenya's Environment Authority. Indexes are a popular method of determining human activities, and popular ones include the Human Development Index, Environmental Performance Index, and the Global Competitiveness Index, among others (Bellenger & Herlihy, 2009; Samimi *et al.*, 2010; United Nations Development Program, 2011). Indexes provide means for comparison between a variety of dimensions as well as countries and years. Indexes are also widely applicable to a variety of situations, and have been applied to the improvement of policy in many sectors (Ebert & Welsch, 2004).

The Consultation and Participation Index (CPPI) was computed as follows:

$$CPPI = \sum_{d=1}^{M} \left(\frac{\sum_{i=1}^{N} \left(w_d \left(\frac{s_{i_d}}{s_{d_{max}} - s_{d_{min}}} \right) \right)}{N} \right)$$

where M is the total number of dimensions (these were five), N the total number of observations (EIA Study Reports analyzed) for one year, and w_d the weight of dimension d. S_{id} is the score of observation i for dimension d, Sd_{max} the maximum possible score for dimension d, and Sd_{min} the minimum possible score for dimension d. The Index was normalized to account for variation in number of EIA Study Reports analyzed for each year between 2002 and 2010, while weights were distributed equally (a weight of 1 was assigned to each dimension) between the dimensions (Munda & Nardo, 2005; Organization for Economic Cooperation and Development, 2008).

The Consultation and Public Participation Index (CPPI) consists of five dimensions, which are: notification, participation methods, venue, language used, and type of participants. Notification methods include posters, letters, email, flyers, personal invitations, radio announcements, and newspaper adverts, and mention of more than one method was assigned a higher score. Consultation and participation methods include adverts in local newspapers, public meetings, informal discussions, telephone conversations, letters, emails, workshops, focus group discussions, interviews and opinion forms, and mention of more than one method was also assigned a higher score.

Venues are required to be convenient and accessible, and an increased number of venues were assigned a higher score as it provided increased opportunity for public participation. Kenya has two official languages, and over 40 indigenous languages (Office of Public Communications, 2008). Use of more languages was therefore assigned higher scores to cater for this diversity. Participants were classified into the following major categories: local community; civil society (including NGOs); government agencies/ministries; and business community/private sector. An increased representation by the different groups of participants was assigned a higher score. The mention of these dimensions in the EIA Study Reports, as well as the scoring method is presented in Table 2-1.

Table 2-1: Index dimensions and scoring method

Dimension	Background	Indicators	Score
Notification	Required by Kenyan law & considered an important pre-requisite to public participation	None mentioned 1 method 2 methods More than 2 types	0 1 2 3
Participation methods	Elaborated in Kenyan law as well as literature. Numerous methods available	None mentioned 1 method 2 methods More than 2 methods	0 1 2 3
Venue	Main requirements elaborated in Kenyan law as well as literature, and include convenience & accessibility to public.	None mentioned 1 site 2 sites More than 2 sites	0 1 2 3
Language used	The ability of language to enhance/limit public participation in Kenya has been elaborated by Okello *et al.* (2009) and the need for translation where necessary by Palerm (2000).	None mentioned 1 language 2 languages More than 2 languages	0 1 2 3

Dimension	Background	Indicators	Score
Type of participants	Kenyan law and the Environment Authority require that the local community and nation in general be included in public participation within EIA, but more so interested parties and affected communities	None mentioned	0
		1 category	1
		2 categories	2
		More than 2 categories	3

2.4 Results

EIA in Kenya was developed following the domestication of international environmental law (Angwenyi, 2004) and its application to development programmes has increased with time (Onyango & Schmidt, 2007; Okello *et al.*, 2009; Marara *et al.*, 2011). Overall, public participation within EIA remained relatively low, with the highest score of 1.65 in 2010, out of a possible score of five. Despite the low aggregate scores, variation between individual case studies was evident, with a single EIA Study Report of August 2010 obtaining a score of four. A steep dip was also witnessed in 2003 (Fig. 2-3), which can be attributed to 'start-up' problems, followed by an increase (with some fluctuations) in the CPPI score, to the highest level in 2010.

Guidelines and assessment procedures for EIA were established by the Environment Authority in 2002, followed by formal legislation on the same the following year. CPPI scores were high in 2002 because very few EIAs were carried out (five in number) and these were for large scale development projects, for which specific activities, including public participation, were carried out in great detail, following international and best practice guidelines. Following formal legislation of EIA in 2003, an increased number of development projects were eligible for EIA prior to approval (Box 2-1), and in a haste to meet the legal requirements, public participation was not always undertaken (Fig. 2-2). Since then, public participation within EIA continued to improve, until the last year of the study period, when it was highest.

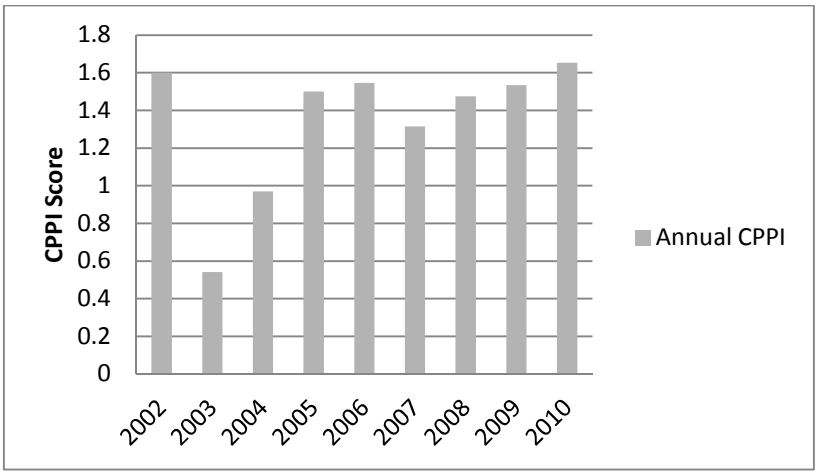

Fig. 2–3.Trends in public participation within EIA. (n=223)

The five dimensions of the Index were present in all the EIA Study Reports analysed, except language used, which was not indicated in 2003, 2004 and 2006 (Table 2-2). Methods used for public participation obtained the highest score, followed by demonstration of the type of participants. Language scored the lowest.

Variation within the dimensions was also evident during the study period, with a steep dip in 2003 for participation methods, type of participants and venue, which has been atributed to 'start-up' problems. A steady increase was thereafter witnessed in all dimensions. Language used, notification methods and venue remained consistently low during the study period, except for a sharp rise and fall in venue in 2006 and 2007 respectively.

Table 2-2: Scores for public consultation during the study period

Parameter/Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Notification	0.07	0.04	0.03	0.05	0.06	0.01	0.04	0.04	0.09
Participation methods	0.60	0.21	0.44	0.67	0.67	0.61	0.62	0.70	0.70
Venue	0.27	0.04	0.09	0.18	0.27	0.11	0.15	0.17	0.18
Language used	0.07	0.00	0.00	0.08	0.00	0.02	0.12	0.02	0.11
Type of participants	0.60	0.25	0.41	0.52	0.55	0.56	0.55	0.60	0.57
ANNUAL CPPI	**1.60**	**0.54**	**0.97**	**1.50**	**1.55**	**1.31**	**1.47**	**1.53**	**1.65**

Notification methods mentioned in the EIA Study Reports included posters, letters, flyers, meetings with government officials, newspaper adverts and radio announcements. Posters were the most popular method for notification, followed by letters. Notification methods presented in the EIA Study Reports conform to legal and

best practice requirements, but the reporting was scanty, and choice of methods used limited, hence the consistently low score during the study period. The absence of notification, as well as limited methods when used, implies that this stage is not considered important to participation within EIA. Yet lack of notification denies citizens the chance to participate in environmental decision making (Hartley & Wood, 2005), as well as indicates poor planning of the participation process (Palerm, 2000).

Public participation methods mentioned in the EIA Study Reports included interviews, questionnaires, public meetings, discussions, meetings and letters. These methods were presented in a relatively detailed manner, and a combination of methods was more often used than singular methods, hence the highest score for this particular dimension in the Index. Following increased global attention to public participation in environmental decision making (Hartley & Wood, 2005; Jay *et al.*, 2007), Kenya's Environment Authority has increasingly required that EIA Study Reports detail public participation activities undertaken (National Environment Management Authority, 2002). The detailed presentation of participation methods, as well as use of combined methods, is evidence of the attention paid to participation methods within EIA in Kenya.

Venues mentioned in the EIA Study Reports included government offices, training institutions, shopping centers, road sides, hotels, markets, churches/mosques, social halls, factories, project sites, and the consultants' offices. This particular dimension obtained a low score in the index because venues were not indicated in many of the EIA study reports, and where presented, limited choices were observed.

Language used during public participation scored the lowest in the index, yet there are two official languages in Kenya, and over 40 indigenous ones (Office of Public Communications, 2008). Further, there was no mention of language used during public participation in 2003, 2004, and 2006. Where mentioned in the EIA Study Reports, languages included English, Kiswahili, a combination of English/Kiswahili and English/local languages, and a triple combination of English/Kiswahili/local languages. It was not indicated in the EIA Study Reports whether translation was undertaken. Language plays a critical role in communicating ideas and expressing feelings (Oduori, 2002), and the large number of languages used in Kenya provides ample opportunity for this. In the absence of mention of language used during public participation, a clear distinction cannot be made between information contributed by the public, the proponent, government agencies or the consultant. Yet by its nature, the public participation process is supposed to elicit the views of all stakeholders (Palerm, 2000; Republic of Kenya, 2003) and the EIA Study Report to document this process (International Union for the Conservation of Nature, 2007).

Demonstration of type of participants during public participation scored the second highest in the index. Participants mentioned in the EIA Study Reports included the local community, community leaders, government officials, the business community, churches, media, NGOs, community groups, development and relief organizations, neighbourhood associations and project staff. Inclusion of these groups of people in

the participation process conforms to legal and best practice requirements. The high score of this dimension confirms that multiple groups were allowed to participate in the EIA process, and attention was paid to documenting participants in the EIA Study Reports.

2.5 Conclusions

The main objective of this study was to document trends in public participation within EIA in Kenya, using a Consultation and Public Participation Index (CPPI) developed for the analysis of EIA Study Reports submitted to Kenya's Environment Authority between 2002 and 2010. Dimensions within the Consultation and Public Participation Index (CPPI) included notification, participation methods, venue, language used, and type of participants. These dimensions were developed from legislative and best practice requirements.

Results indicated that public participation was relatively low, with fluctuations during the study period. Out of a possible score of 5, the highest score achieved was 1.65 in 2010. The largest dip was witnessed in 2003, following legislation of EIA regulations, and 'start-up' problems associated with trying to meet requirements for public participation. The score increased thereafter (with fluctuations) during the study period, to attain the highest level in 2010. Participation methods and type of participants scored highest, which has been attributed to increasing emphasis by Kenya's Environment Authority on public participation activities and their reporting in EIA Study Reports. The lower scores attained by venue, notification and language used, in that order, were attributed to lack of reporting and fewer choices per dimension when reported. Further investigation is recommended on the conducting and reporting of those dimensions that consistently scored poorly in the Index.

The Consultation and Public Participation Index (CPPI) developed for this study illustrates the trends in consultation and public participation within EIA in Kenya. Such an index has not been previously used to analyze public participation within EIA, and would benefit from further application to determine its usefulness, as well as confirm if the dimensions identified are adequate. It nonetheless serves as a good starting point to evaluate public participation within EIA, and could be used to direct and support policy regarding public participation within environmental decision making in Kenya.

Acknowledgments: We gratefully acknowledge the support of NUFFIC for funding the PhD study, to which this article contributes, and the institutional support provided by Wageningen University. We also acknowledge NEMA - Kenya, particularly staff within the Compliance and Enforcement Department, and the critical insights provided by four anonymous reviewers, including the suggestion to develop an index for public participation.

3

How is spatial information used in Environmental Impact Assessment in Kenya?

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Abstract: Spatial information is being increasingly used worldwide within Environmental Impact Assessment (EIA), although the extent of its use has not been established in Kenya. Using proportionate sampling techniques, EIA Study Reports submitted to Kenya's Environment Authority from 2002 to 2013 were investigated for the presence/absence of spatial presentation, levels of visual realism exhibited, and content presented. Findings demonstrated a high popularity of spatial information, and preference for the combined use of spatial presentations with low and high levels of visual realism, with no clear preference for spatial presentations with either low or high levels of visual realism. A combination of project location and activities/ details was the most popular content in the spatial presentations. Despite the lack of information, this study establishes that indeed spatial information is popular within EIA in Kenya and by so doing sets the stage for further research on its specific use and value to EIA.

3.1 Introduction

Presentation of spatial information has come a long way from the traditional map (Dransch, 2000) to include presentations such as satellite images, geovisualizations, orthophotos and sketches (Al-Kodmany, 1999; Agrawal & Dikshit, 2002; Appleton & Lovett, 2005; Bacic *et al.*, 2006; Hanzl, 2007; Kettunen *et al.*, 2012). Additional types of presentations include 3D photo-realistic visualizations and photomontages, among others (Harper, 2002; Prendergast & Rybaczuk, 2005; Lewis & Sheppard, 2006; Lai *et al.*, 2010; Corry, 2011). Within Environmental Impact Assessment (EIA), spatial information in its various forms has been increasingly used to collate and present baseline environmental information (Satapathy *et al.*, 2008; Slotterback, 2011), in the identification and prediction of impacts (Warner & Diab, 2002; Moufaddal, 2005; Vanderhaegen & Muro, 2005; Atkinson & Canter, 2011) and to inform public participation and support decision making (Appleton & Lovett, 2005; Prendergast & Rybaczuk, 2005; Bacic *et al.*, 2006; Hammond *et al.*, 2011; Lei & Hilton, 2013).

Despite an increase in the use of spatial information, debate continues on its value to EIA, due to differing methods of application, differences in the spatial literacy of users, high costs, and complexity of techniques used (Laituri, 2003; Vanderhaegen & Muro, 2005; Gonzalez, *et al.*, 2008; Riddlesden *et al.*, 2012). In addition, restricted access to existing spatial information, unavailability of some data, and time required

to perform spatial analyses are further obstacles encountered when using spatial information during EIA (Vanderhaegen & Muro, 2005; Slotterback, 2011). These challenges are not unique to developing countries, although the less developed (and in some cases poorly enforced) legislative, administrative, institutional and procedural frameworks for EIA intensifies the situation. These challenges are also augmented by poorly developed information and communication technology (ICT) infrastructure (Ebisemiju, 1993; Kakonge & Imevbore, 1993; Cheneau-Loquay, 2007; Kolhoff *et al.*, 2009; Marara *et al.*, 2011).

Nonetheless, a number of reviews have been carried out to establish the extent and use of spatial information in EIA. These include one by Drummond and French (2008) that outlined development in geospatial technologies and the opportunities as well as challenges that may arise from these developments for planners. Recommendations made included the increased use of GIS to support public participation in planning. Gonzalez *et al.* (2008) also offered an international perspective, where they acknowledged the potential of GIS to improve traditional participation processes in impact assessment by communicating information more effectively. Issues related to access as well as data quality were also acknowledged. In the UK, Riddlesden *et al.* (2012) recently examined the level of entrenchment of GIS, spatial analysis and visualization practices in impact assessment at 100 local authorities, where they found that there was a significant lack of skill in the use of GIS. In view of the increasing use of spatial information during EIA in many countries, and despite the acknowledged barriers, little is known on the extent to which spatial information is used in EIA in Kenya. To date, no review on the extent to which spatial information is used in EIA, such as those presented above, has been undertaken for Kenya, hence the need for such a study.

The overall objective of this paper was therefore to establish the extent to which spatial information is used in EIA, using Kenya as a case study. The findings of this study will contribute to existing knowledge on the status of spatial information and its use in EIA.

3.2 Study area

Studies carried out on EIA in Kenya so far include the following: the use of EIA to control industrial pollution (Rafik Hirji & Leonard Ortolano, 1991), strategies for managing uncertainties imposed by EIA (Hirji & Ortolano, 1991), implementation of public involvement in environmental decision making (Kameri-Mbote, 2000), domestication of international environmental law (Angwenyi, 2004), barriers to public participation within EIA (Okello *et al.*, 2009), provision for EIA in Kenyan environmental legislation (Kibutu & Mwenda, 2010), participatory aspirations in environmental governance (Kimani, 2010), the importance of context for effective EIA (Marara *et al.*, 2011), trends in consultation and public participation within EIA (Mwenda *et al.*, 2012) and a case study on the use of spatial information during public participation in EIA (Mwenda *et al.*, 2013). The trend here, with the exception of the

most recent study, demonstrates an emphasis on public participation in EIA, and limited interest in spatial information.

The emphasis by Kenyan literature on public participation in EIA is not unusual, and is in line with emerging trends internationally, such as issues surrounding access to environmental information (Hartley & Wood, 2005), the promotion of cooperation and consensus (Applestrand, 2002; Doelle & Sinclair, 2006; Cuppen *et al.*, 2012), effectiveness of public participation (Del Furia & Wallace-Jones, 2000; Jay *et al.*, 2007; Nadeem & Fisher, 2011), and consideration of indigenous people (Adomokai & Sheate, 2004; Booth & Skelton, 2011). Also included are best practice principles for public participation (Andre *et al.*, 2006). On the other hand, the lack of concrete information on spatial information within EIA in Kenya goes against international trends, as evidenced by the increasing use of spatial information to inform public participation and support decision making for diverse projects (Griffith, 1980; Agrawal & Dikshit, 2002; Warner & Diab, 2002; Moufaddal, 2005; Gonzalez *et al.*, 2008; Hammond *et al.*, 2011; Lei & Hilton, 2013). Even so, the situation in Kenya can be explained by the challenges mentioned earlier, particularly low spatial literacy, high costs associated with acquisition of spatial information, complexity of techniques used, and the unavailability of some data (Une *et al.*, 2003; Cheneau-Loquay, 2007; Okello *et al.*, 2009; Mwenda *et al.*, 2013). Combined with less developed frameworks and poor enforcement, it is not surprising that little is known about spatial information in EIA in Kenya, despite an official recommendation for its use (National Environment Management Authority, 2002).

3.3 Data and methods

This study followed methods adapted from a similar survey undertaken by Riddlesden *et al.* (2012) in the UK. In our case, an inventory of EIA Study Reports submitted to Kenya's Environment Authority from 2002 to 2013 was undertaken, where it was observed that nearly 870 reports were available. Due to constraints in time and resources, sampling techniques similar to those outlined in a survey by Mwenda *et al.* (2012) were employed. That is, 50% proportionate sampling (McGinn, 2004) based on three main categories established by the Environment Authority for the management of EIA Study Reports namely, date of submission, geo-political region in Kenya, and type of project (also referred to as development sector). EIA Study Reports are the most detailed reports arising from the EIA process in Kenya (National Environment Management Authority, 2002; Republic of Kenya, 2003), hence their choice for these studies. A checklist was developed, which contained the following items that were used to record pertinent details from each EIA Study Report sampled: Reference number assigned by the Environment Authority, date of submission, geo-political region in Kenya, type of project (also referred to as development sector), presence/absence of spatial information, type(s) of spatial presentations, and specific information contained in the spatial presentations.

Data was evaluated using a conceptual framework developed by Mwenda *et al.* (2013) to assess the relationship between public participation and spatial information, where seven aspects were identified, namely availability, accessibility, content, appropriateness, language, translation and technical support. Upon initial testing of this framework, it was established that the requirements for accessibility, language, translation and technical support were met, but those for availability were unsatisfactory and unconfirmed for content and appropriateness. Out of the three aspects for which satisfactory results were not obtained, namely availability, content and appropriateness, the latter aspect could not be established from a survey of EIA Study Reports in isolation, hence it would not have been possible to test it in this particular study. Consequently, the two aspects of 'availability' and 'content' were deemed relevant to this study, where 'availability' in this context refers to the presence/absence of spatial presentations, as well as the variety used (based on levels of visual realism). 'Content', on the other hand, refers to the actual information presented, such as the location of the project, its details, and areas of interest (Table 3-1). Exploratory analyses were carried out on the data obtained, using SPSS version 17.0 and MS Excel.

Table 3-1: Aspects of spatial information considered

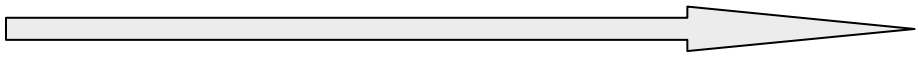
Aspects of spatial information	**Indicators**
Availability: presentation types	• Presence/absence of spatial presentations • Types observed (based on levels of visual realism)
Content: presentation of the problem	• Project location • Project activities or details • Special interest areas, e.g. administrative boundaries (political), hydrology, topography, conservation areas, distribution of endangered plant/animal species, etc.

Adapted from: Mwenda *et al.* (2013)

One of the parameters used to determine aspects of the real world that may be highlighted in a spatial presentation is the level of visual realism (Kettunen, *et al.*, 2012), which has been referred to as '*the level of visual resemblance of a geospatial image with the real world*' (Kettunen *et al.*, 2012) and '*the degree an image appears to people to be a photo rather than computer generated*' (Fan *et al.*, 2014). Despite challenges in assessing the levels of visual realism in images, it is acknowledged that the range runs from abstract to photorealistic, with mixed cases being increasingly common, due to improvements in technology and GIS (Slocum *et al.*, 2001; Al-Kodmany, 2002; Lai *et al.*, 2010). In some cases, high levels of visual realism have been observed to support the acquisition of spatial knowledge (Kettunen *et al.*, 2012).

Having confirmed that the level of visual realism is a recognized parameter to assess spatial presentation types, we developed a simple categorization that considered whether a spatial presentation exhibited high or low levels of visual realism (Fig. 3-1). Specifically, we categorized the numerous spatial presentations found in the EIA Study Reports based on their level of visual realism into two main categories, namely:

Category 1 = low visual realism and Category 2 = high visual realism. These categories also considered that spatial presentations exist that may be considered in between the low/high levels of visual realism (mixed cases). In these mixed cases, the dominant features were identified, and thereafter used to determine the appropriate category in which they would be placed (either Categories 1 or 2). The above criteria were used to determine whether the spatial presentation in a particular EIA Study report exhibited either low or high levels of visual realism.



Low visual realism	**High visual realism**
Examples of spatial presentations	
CATEGORY 1	**CATEGORY 2**
Topographic map	Photographs
Cadastral map	Google applications
CAD maps/drawings	2D/3D visualizations
Site plans/layout	
Route map	
Survey map	

Fig. 3-1. Level of visual realism (Adapted from Kettunen *et al.* (2012))

However, in some EIA Study Reports, more than one spatial presentation was observed. Further, some of these spatial presentations exhibited low levels of visual realism, and others the converse. Considering that these different types of spatial presentations were found in a single report, it was not possible to record these findings in the two categories earlier identified. This prompted the development of a third category, namely Category 3, which represented those EIA Study Reports where more than one spatial presentation type was illustrated in a single report, and these presentations were of a mix of both low (Category 1) and high (Category 2) levels of visual realism. This third category was based on a slightly different premise, that is, a combination of the first two categories in a single EIA Study Report, as compared to the first two categories that considered the specific characteristics of a single spatial presentation found in an EIA Study Report.

It is acknowledged that the range of visual realism is wide, and also characterized by mixed cases (Slocum *et al.*, 2001; Al-Kodmany, 2002; Lai *et al.*, 2010). The simple categorization employed in this study served to decrease the risk of numerous and unmanageable categories, that may have negatively influenced the analysis and interpretation of data. This modification may also be considered a limitation of this study, as the arbitrary categorization of spatial presentations into a very limited number of categories discriminates against unusual/unique data.

3.4 Results and discussion

3.4.1 Overview

Following sampling techniques similar to those employed by Mwenda *et al.* (2012), that is, 50% proportionate sampling of EIA Study Reports submitted to Kenya's Environment Authority from 2002 to 2013, and based on the three categories of date of submission, geo-political region and type of project, 434 EIA Study Reports were investigated. The overall trend indicated an increase in EIA studies undertaken during the study period, with some fluctuations (Fig. 3-2). All the main geo-political regions in Kenya were represented, with the capital city, Nairobi, having the highest representation (23%), followed by the Rift Valley region (19%) and Coast region (18%). The North Eastern and Western regions were the least represented, with 4% and 2% respectively. Nairobi is the busiest and fastest developing city in the country (Central Intelligence Agency, 2012; City Council of Nairobi, 2007; Kenya National Bureau of Statistics, 2009), as well as the capital of Kenya, hence the highest number of EIA studies and greater representation in this study. The Rift Valley region, on the other hand, is the largest region by land area, hence its second position based on number of EIA studies undertaken in the region. The Coast region is the only port city of the country, and a major tourist zone (Office of Public Communications, 2008; Kenya National Bureau of Statistics, 2009).

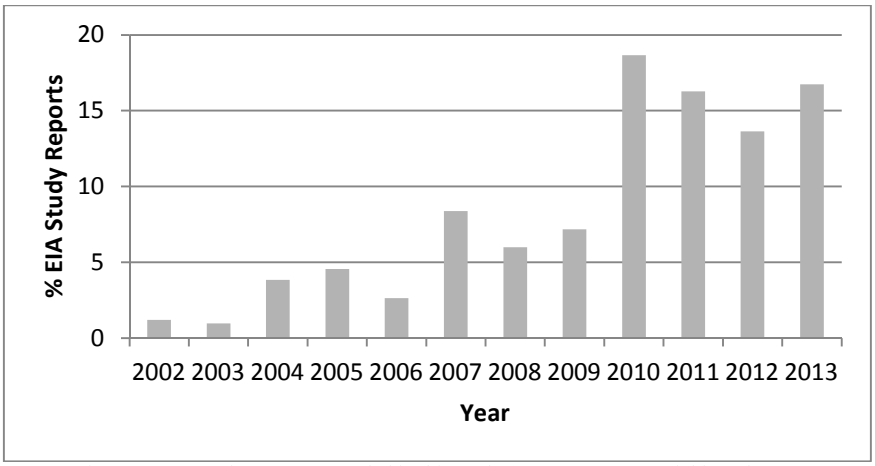


Fig. 3-2. EIA Study Reports sampled in this study (n = 434) Source: Field Study

EIA Study Reports for almost all the 12 development sectors proposed by law in Kenya (Republic of Kenya, 1999) were represented, with the exception of the forestry sector, for which no single EIA has been undertaken to date (Fig. 3-3). Urban development was the most popular sector (36%), followed by hydrocarbons (20%), electricity (9%) and processing and manufacturing (8%). A single EIA Study for biotechnology, undertaken in the year 2005, formed part of the study sample, hence

its zero score (despite its capture within the sample) when converted to a percentage of the total number of EIA Study reports sampled. Urban development, according to the law, comprises the following activities: designation of new townships, establishment of industrial estates, establishment or expansion of recreational areas, establishment or expansion of recreational townships in mountain areas, national parks and game reserves, and shopping centres and complexes. The establishment of industrial estates, residential estates, shopping centres and complexes were the most common types of urban development under this category. On the other hand, management of hydrocarbons includes the storage and trade in natural gas and combustible or explosive fuels, while the most common type of EIA Study Report under this category represented fuel stations.

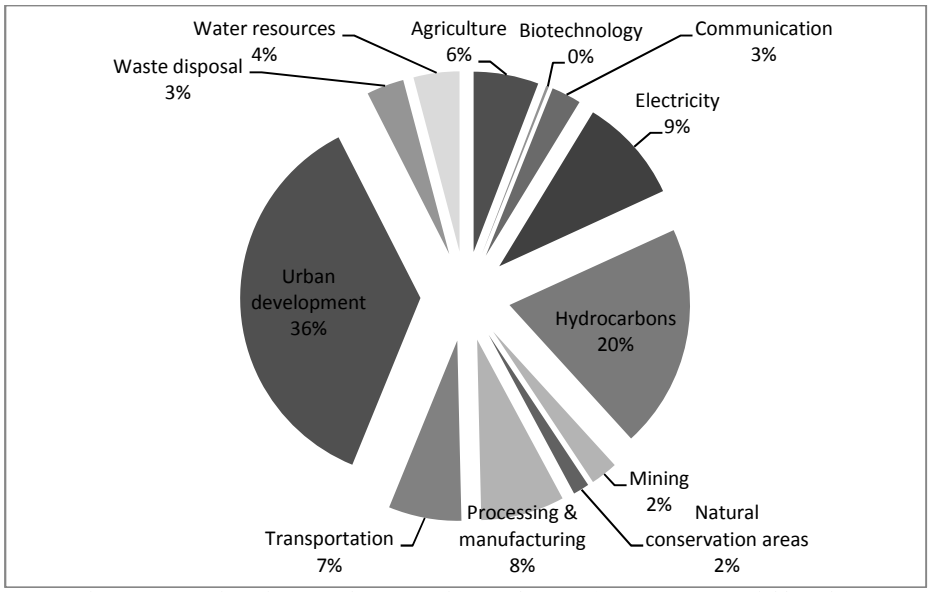


Fig. 3-3. Proportion of EIA Study Reports from each sector (n = 434) Source: Field Study

3.4.2 Presence/ absence of spatial information

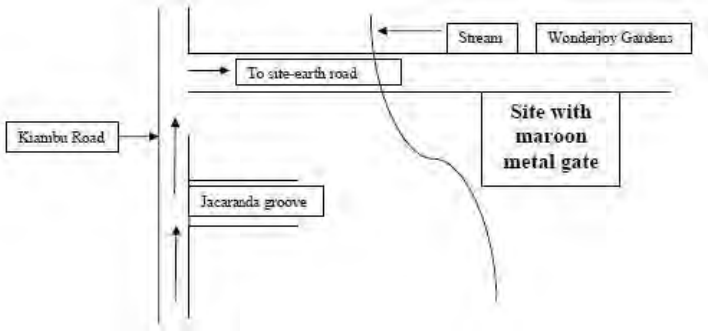
Almost all (95%; n = 413) of the EIA Study Reports sampled in this study displayed a variety of spatial presentation types. To begin with, the presence of spatial information during the study period followed the number of EIA Study Reports per year, in a manner similar to Fig. 3-2. Further, spatial information was evidenced in EIA Study Reports from all the geo-political regions, in patterns again similar to the numbers of EIA Study Reports sampled from the different regions, that is, the capital city, Nairobi, had the highest representation, followed by the Rift Valley and Coast regions. The North Eastern and Western regions were the least represented. With regard to sectors, again patterns similar to Fig. 3-3 were evidenced, where urban development was the most popular sector evidencing the presence of spatial

information, followed by hydrocarbons, electricity and the processing and manufacturing sectors.

The findings here with regard to the presence/ absence of spatial information are that the presence or absence of spatial presentations was dictated by the number of EIA Study Reports. This observation concurs with the initial observation that almost all (95%) of EIA Study Reports sampled contained spatial information hence the individual numbers of EIA Study Reports dictated the presence/ absence of spatial information, irrespective of the geo-political regions or development sectors.

3.4.3 Types of spatial information presentations

During the study period, the types of spatial presentations (based on levels of visual realism) varied (Fig. 3-4).



Low level of visual realism

High level of visual realism

Fig. 3-4. Examples of spatial presentations with different levels of visual realism. Source: www.nema.go.ke (accessed 16 December 2014)

Specifically, it was evident that some categories of spatial presentations were more popular than others (Fig. 3-5), for example, the combined use of spatial presentations with low/high levels of visual realism in any single EIA Study Report was most popular during the entire study period, except for a dip in the year 2011 (Category 3). The use of spatial presentations with either low levels of visual realism (Category 1) or high levels of visual realism (Category 2) remained low during the study period, except from the year 2011 onwards when spatial presentations with low levels of visual realism (Category 1) drastically increased in popularity, at the expense of spatial presentations with high levels of visual realism (Category 2). The drastic change in preferred levels of low visual realism from the year 2011 onwards may be attributed to administrative changes within the Environment Authority, specifically a new and decentralized system, where greater scrutiny of individual EIA Study Reports was undertaken, and a requirement given for better illustration of project location, activities/details, and special interest areas (National Environment Management Authority, 2013). In addition, spatial presentations with low levels of visual realism have been traditionally used in Kenya (Une *et al.*, 2003) and it was therefore not surprising that these were the preferred type of spatial presentations when the requirements for better illustration of project-related content were made.

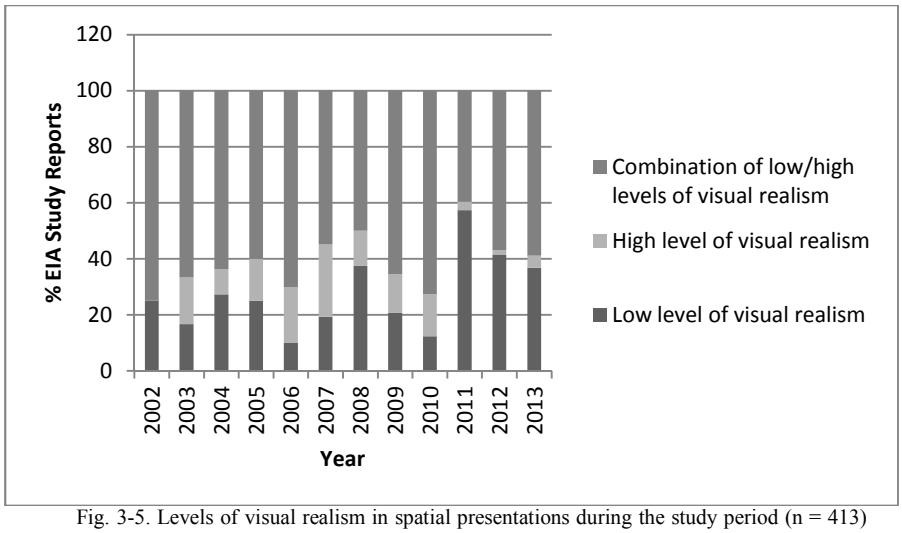


Fig. 3-5. Levels of visual realism in spatial presentations during the study period (n = 413)
Source: Field Study

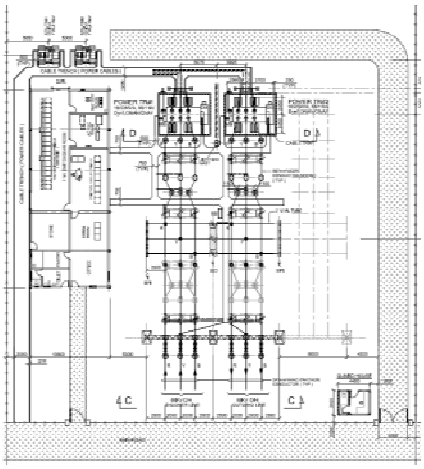
On the levels of visual realism of spatial presentations and their use in the different sectors, it was evidenced that spatial presentations with a combination of low/high levels of visual realism (Category 3) were present in EIA Study Reports from all the sectors presented in the study sample, except the biotechnology sector, for which the single report submitted in 2005 contained spatial presentations with only low levels of visual realism. Further, and similar to Fig. 3-5, it was observed that spatial presentations with a combination of low/high levels of visual realism (Category 3)

were the most popular, followed by those with low levels of visual realism (Category 1). Spatial presentations with high levels of visual realism (Category 2) were the least popular.

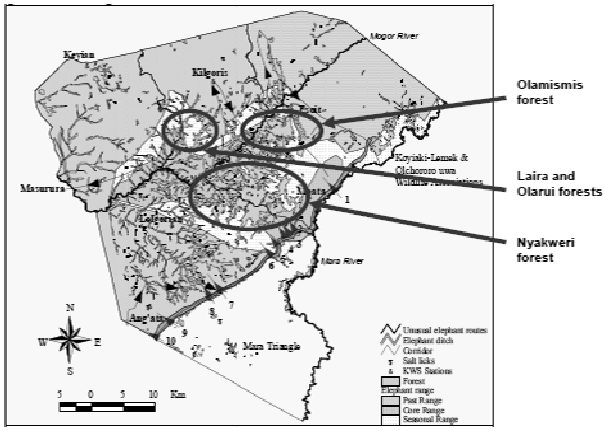
3.4.4 Content of spatial information

In order for spatial presentations to inform participants and support decision making in EIA, they are expected to present details of the proposed development project such as location, project activities/details, and special interest areas within the natural and human environment that may be impacted (National Environment Management Authority, 2002; Republic of Kenya, 2003) as illustrated in Fig. 3-6.

Project location (marked in white)



Project activities/details



Special interest areas

Fig. 3-6. Examples of content found in spatial presentations. Source: www.nema.go.ke (accessed 16 December 2014)

To this end, the specific information found in the spatial presentations was identified and 7 categories formulated for analysis and presentation purposes (Table 3-2).

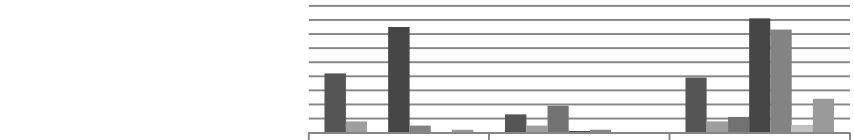
Table 3-2. Categories indicating information found in spatial presentations

Information Category	Details
1	Project location
2	Project activities/ details
3	Special interest areas
4	Project location + project activities/ details
5	Project location + special interest areas
6	Project activities/ details + special interest areas
7	Project location + project activities/ details + special interest areas

Source: Field Study

An initial investigation of the content of spatial presentations sampled indicated that spatial presentations that depicted a combination of project location and project activities/ details (information category 4) were the most popular, followed by those depicting project location (information category 1). Spatial presentations depicting a combination of project activities/ details and special interest areas (information category 6) were the least popular.

Following further exploration on the preferred levels of visual realism for presenting the information categories as outlined in Table 3-2, it was again observed that the combined use of spatial presentations with low/high levels of visual realism was most popular when presenting a combination of project location and activities/ details (information category 4), followed by a combination of project location and special interest areas (information category 5), as illustrated in Fig. 3-7. This was however not the case when presenting information on project location and special interest areas. There was no clear preference between spatial presentations with low visual realism and the combined use of presentations with low/high levels of visual realism when presenting information on project activities/ details. The popularity of combined use of spatial presentations with low/high levels of visual realism was followed by spatial presentations with low levels of visual realism and spatial presentations with high levels of visual realism. Spatial presentations with low levels of visual realism were most popular when presenting a combination of project location and activities/ details (information category 4), followed by project location (information category 1). Of note is that spatial presentations with low levels of visual realism were not used to present special interest areas (information category 3) or project activities/ details and special interest areas combined (information category 6). Finally, spatial presentations with high levels of visual realism most commonly presented special interest areas, followed by project location.



	Low visual realism	High visual realism	Combined levels of visual realism
Project location	42	13	39
Project activities/ details	8	5	8
Special interest areas	0	19	11
Project location + activities/ details	75	1	81
Project location + special interest areas	5	2	73
Project activities/ details + special interest areas	0	0	5
Project location + activities/ details + special interest areas	2	0	24

Fig. 3-7. Levels of visual realism & information found in the spatial presentations (n=413)
Source: Field Study

3.4.5 Discussion

Three major findings arise from this survey. The first major finding demonstrates the high popularity of spatial information in EIA, where almost all the EIA Study Reports investigated indicated the use of various types of spatial presentations. Contrary to initial observations where the emphasis by Kenyan literature was on public participation, this study proves that spatial information is indeed popular within EIA, which also conforms with international trends (Gonzalez *et al.*, 2008; Satapathy *et al.*, 2008; Lai *et al.*, 2010; Atkinson & Canter, 2011).

The second major finding from this study relates to the levels of visual realism of spatial presentations used in the EIA Study Reports. Here, the combined use of spatial presentations with low and high levels of visual realism seemed to be the most popular. Generally, the trend in spatial presentations has been towards increased levels of visual realism (Goodchild, 2009b; Iaria *et al.*, 2009; Chrastil & Warren, 2012), although questions have also been raised on the value, effectiveness, and applicability of spatial presentations with high levels of visual realism (Vanderhaegen & Muro, 2005; Gonzalez *et al.*, 2008; Riddlesden *et al.*, 2012). Questions have also been raised on the influence of individual and group characteristics of users such as expertise, culture, sex, age, sensory disabilities, level of education, and socioeconomic status, among others, on a viewer's ability to interpret spatial presentations with different levels of visual realism (Slocum *et al.*, 2001). In our view, the findings from this study accurately mirror the wider situation (Laituri, 2003;

Vanderhaegen & Muro, 2005; Gonzalez *et al.*, 2008; Riddlesden *et al.*, 2012), where, despite the increased popularity of spatial presentations with high levels of visual realism, preference for spatial presentations with low levels of visual realism is still quite high.

On the content in spatial presentations, the third major finding from this study indicates that a combination of project location and activities/ details was most commonly presented, followed by project location on its own. Location has been advanced as one of the most fundamental concepts of spatial knowledge (Golledge, 1995a; Kuhn 2012), and provides information on the existence of an occurrence or phenomenon. The popularity of a combination of project location and activities/ details indicates the availability of not only spatially-relevant information, but also additional project-specific information that may contribute towards the more accurate identification and prediction of impacts (Atkinson & Canter, 2011).

3.5 Conclusions and recommendations

The first conclusion that may be drawn from this study relates to the popularity of spatial information in EIA. In as much as this study was carried out in a region characterized by less developed procedural frameworks and ICT infrastructure, the findings clearly demonstrate the popularity of spatial information in EIA. The second conclusion that may be drawn from this study relates to the levels of visual realism in spatial presentations, where preference was established for the combined use of both low and high levels of visual realism, with no clear preference for spatial presentations with either low or high levels of visual realism. Similarly, wider literature points to a divergence in opinion regarding preferred levels of visual realism, for example, it has been indicated that the abstract symbology found in spatial presentations with low visual realism requires interpretation, while spatial presentations with high visual realism demand the identification and isolation of relevant features (Kettunen *et al.*, 2012), all of which impact on the cognitive processing of the viewer. Further, different levels of visualization have also been associated with better performance in certain tasks, hence the need to consider the levels of visual realism relative to the required tasks (Koua *et al.*, 2006). The third and final conclusion from this study relates to the versatility of spatial presentations in illustrating diverse themes or subjects, such as project location, project activities/ details and special interest areas, singly or in combination. The spatial presentations surveyed in this study therefore met all the requirements for 'content' as set out in the legal and regulatory framework.

In response to the question raised at the beginning of this study, on how spatial information is used in EIA in Kenya, the answer is two-fold. First, that mixed approaches on the levels of visual realism in spatial presentations are preferred, and second, that spatial information is commonly used to present a combination of project location and project activities/ details. What was not established at this point, and provides interesting opportunity for further study, is the reasons behind the observed

choices regarding preferred levels of visual realism. Further study on the specific function that spatial information performs within EIA in Kenya might also be of interest, considering that these specific functions have already been identified and investigated elsewhere, for example, the presentation of baseline environmental information (Satapathy *et al.*, 2008; Slotterback, 2011), the identification and prediction of impacts (Warner & Diab, 2002; Moufaddal, 2005; Atkinson & Canter, 2011), or support of public participation and decision making (Appleton & Lovett, 2005; Lei & Hilton, 2013). Also interesting would be an investigation into the value of spatial information to EIA in view of previously identified limiting factors such as the spatial literacy of users and high costs (Gonzalez *et al.*, 2008; Riddlesden *et al.*, 2012), among other factors. Even so, and despite the dearth of information, this study establishes that indeed spatial information is popular within EIA in Kenya and by so doing sets the stage for further research on its specific use and value to EIA.

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4

Spatial information during public participation within Environmental Impact Assessment in Kenya

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Abstract: This study set out to evaluate the use of spatial information during public participation within Environmental Impact Assessment in Kenya, through a case study. A conceptual framework developed for this study considered four key elements: the stages of EIA in Kenya (EIA study stage), public participation (limited to 'inform'), aspects of spatial information relevant for public participation (availability, accessibility, content, appropriateness, language, translation and technical support), and categories of participants (limited to 'affected persons'). It was established that a cadastral map had been used, and met the requirements for accessibility, language, translation and technical support, it was unsatisfactory in the aspect of availability, and unconfirmed for content and appropriateness. Recommendations are thereafter made for the use of spatial information during public participation within EIA.

4.1 Introduction

Established formally in 1969 in the USA through the National Environmental Policy Act, NEPA (Government of the United States of America, 1969; Jay *et al.*, 2007), Environmental Impact Assessment (EIA) has more recently been defined by the International Association for Impact Assessment (IAIA) as 'the process of identifying, predicting, evaluating and mitigating the biophysical, social and other relevant effects of development proposals prior to major decisions being taken and commitments made' (de Jesus, 2009 p.1). In Kenya, EIA was established in 1999 following enactment of the Environmental Management and Coordination Act, EMCA (Republic of Kenya, 1999). Prior to this, EIA was conducted following numerous statutes and guidelines established by the Kenyan Government as well as the international community (Horberry, 1985; Hirji & Ortolano, 1991; Kameri-Mbote, 2000; Angwenyi, 2004). The subsequent enactment of the EIA Guidelines and Assessment Procedures, EIAGAP (National Environment Management Authority, 2002) and Environmental Impact Assessment and Audit Regulations, EIAAR (Republic of Kenya, 2003), further established EIA in Kenya's environmental management activities (Kibutu & Mwenda, 2010). EIA in Kenya, like that in many countries, is modelled from NEPA, with modifications introduced to cater for country-specific requirements.

Spatial information depicts location, orientation, distance and density of objects in their environment (Thorndyke & Stasz, 1980; Hirtle & Hudson, 1991; Pfeffer *et al.*, 2013), and has proved valuable in the understanding of environmental and social problems (Lee, 1983, Appleton & Lovett, 2005; Bacic *et al.*, 2006), including EIA (Griffith, 1980; Warner & Diab, 2002; Moufaddal, 2005, Vanderhaegen and Muro, 2005; Gonzalez *et al.*, 2008; Satapathy *et al.*, 2008). Specifically, representations on spatial information have been used within the EIA process to collate and present baseline environmental information, such as land use, vegetation, geomorphology, hydrogeology, air, and socio-economic aspects (Satapathy *et al.*, 2008). They have also been associated with increased accuracy in identifying and predicting the extent of impacts, as well as presenting the anticipated impacts of a development project on the environment (Vanderhaegen & Muro, 2005). Natural and human resources that are likely to be affected by proposed developments have also been highlighted using spatial information representations within EIA (Satapathy *et al.*, 2008). Public participation has similarly benefited from spatial information representations such as maps, satellite images, spatial models, photographs, diagrams, visualizations and figures, among others, which have been used as communicative and facilitative tools (Lee, 1983; Soini, 2001; Appleton & Lovett, 2005; Prendergast & Rybaczuk, 2005; Vanderhaegen & Muro, 2005; Bacic *et al.*, 2006; Lewis & Sheppard, 2006; Hammond *et al.*, 2011).

This study was guided by one key objective: to evaluate the use of spatial information during public participation within EIA in Kenya. A case study was used. The rationale for this study was that the use and importance of spatial information during public participation, including EIA, is well documented, especially in more economically developed countries (Appleton & Lovett, 2005; Vanderhaegen & Muro, 2005; Gonzalez *et al.*, 2008), unlike less economically developed countries, where weaknesses exist in legislative, administrative, institutional and procedural frameworks for EIA (Wandesforde-Smith, 1980; Horberry, 1985; Brown *et al.*, 1991; Ebisemiju, 1993; Kakonge & Imevbore, 1993; Olokesusi, 1998; Kolhoff *et al.*, 2009; Marara *et al.*, 2011), as well as challenges in the presence and use of information and communication technology (Cheneau-Loquay, 2007, Lai et al,. 2010). In keeping with global trends, spatial information has been recommended for use during EIA in Kenya (National Environment Management Authority, 2002). No concrete studies exist, however, to confirm the presence and use of spatial information in the EIA process in Kenya, and specifically during public participation, hence its investigation and subsequent presentation in this paper.

The next section of this paper presents the conceptual background for this study, followed by data and methods, then results and a discussion. The paper ends with conclusions from this study, and recommendations for the use of spatial information during public participation within EIA.

4.2 Conceptual background

The conceptual framework developed for this study arises from four key elements: the stages of EIA in Kenya, public participation therein, aspects of spatial information relevant for public participation, and categories of participants (Fig. 4-1). EIA in Kenya consists of four primary stages: project report, screening, EIA study and licensing (Republic of Kenya, 1999; 2003). The project report stage consists of an initial environmental assessment, from which is prepared a report that is submitted to the National Environment Management Authority (NEMA) for screening to determine if environmental issues anticipated from the proposed development are adequately addressed. If it is determined that further study is required, the proponent is thereafter required to carry out detailed study, the EIA Study. An EIA Study presents environmental issues in greater detail, and is required to demonstrate increased public input regarding the proposed project (Republic of Kenya, 2003). The final decision on whether a proposed development will continue or not is also based on the EIA Study Report, hence its adoption in this study (National Environment Management Authority, 2002; Republic of Kenya, 2003).

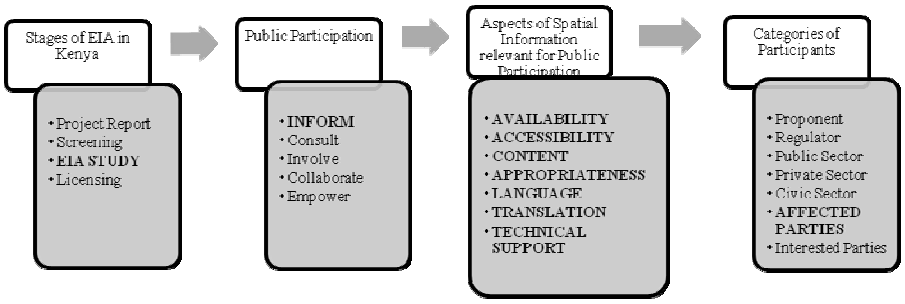

Fig. 4–1.Conceptual framework developed in this study (the aspects investigated in the case study are indicated in bold). Source: Based on publications by Tuler and Webler (1999), Glicken (2000), Republic of Kenya (1999, 2003), Abelson *et al.* (2003), National Environment Management Authority (2002), Hartley and Wood (2005), Webler and Tuler (2006), Diduck *et al.* (2007), International Association for Public Participation (2007), Faircheallaigh (2010).

The primary purpose of undertaking public participation during EIA in Kenya is to 'seek the views of the public, particularly those who may be affected by the project' (Republic of Kenya 2003, p.246). Although the exact nature and type of public participation has not been studied in detail, it has so far been claimed to be relatively low (Marara *et al.*, 2011; Mwenda *et al.*, 2012) and prone to numerous obstacles (Kameri-Mbote, 2000; Okello *et al.*, 2009; Kimani, 2010). Further afield, approaches to describe public participation in development activities (as well as EIA) include typographies by Arnstein (1969), Connor (1988), Wiedemann and Femers (1993),

Sors (2001), McCall (2003) and the International Association for Public Participation, IAP2 (2007). These typographies contrast with methods that encourage flexible and adaptive public participation, cooperation and consensus, and also encourage social learning (Tuler & Webler, 1999; Glicken, 2000; Sors, 2001; Abelson *et al.*, 2003; Lane *et al.*, 2003; Doelle & Sinclair, 2006; Kontic *et al.*, 2006; Faircheallaigh, 2010). Nonetheless, the importance of public participation in development projects is acknowledged, despite some reservations on its success (Shepherd & Bowler, 1997; Kameri-Mbote, 2000; Applestrand, 2002; Webler & Tuler, 2006; Kimani, 2010; Nadeem & Fisher, 2011). In view of the above approaches and sentiments, the focus of this study was an investigation into the presence and use of spatial information during public participation within EIA. In keeping with this approach, the more commonly known and used spectrum developed by the International Association for Public Participation, IAP2 (International Association for Public Participation, 2007) was adopted for this study. Specifically, the lowest level of the spectrum, inform, was evaluated in this study, as it relates to the presence and use of spatial information during public participation. Further, information has been commonly positioned as an important prerequisite for public participation.

Seven aspects of spatial information that are relevant for public participation within EIA were selected from literature (Tuler & Webler, 1999; Glicken, 2000 Abelson *et al.*, 2003; Hartley & Wood, 2005; Webler & Tuler, 2006; Diduck *et al.*, 2007; International Association for Public Participation, 2007; Faircheallaigh, 2010), regulatory provisions (Republic of Kenya, 1999; 2003) and formal guidelines (National Environment Management Authority, 2002). These aspects were availability, accessibility, content, appropriateness, language, translation and technical support (Table 4-1) and they were all adopted in this study because each aspect has the ability to influence public participation.

Table 4.1. Aspects of spatial information relevant for public participation within EIA.

Aspects of spatial information relevant for public participation	**Indicators**
Availability: Representation types	Variety of types of spatial information representations used
Accessibility	Numerous and easily accessible location(s) where public can access the spatial information
	Persons/institutions from whom public can gain access to spatial information (designated custodian of spatial information)
	Notification directing public to spatial information
	Amount of time required to access spatial information

Aspects of spatial information relevant for public participation	Indicators
	Amount of money required to access spatial information
Content: presentation of the problem	Spatial information required to present details of the proposed development project such as location, magnitude/extent, project activities, and impacts on the natural and human environment
Appropriateness	Spatial information presented in different formats to cater for different categories of participants
Language	The language in which spatial information is presented, as well as understood by the public
Translation	Provision for translation where necessary
Technical support	Technical assistance available during public participation e.g. dedicated telephone line, help desk

Source: Based on publications by Tuler and Webler (1999), Glicken (2000), Republic of Kenya (1999, 2003), Abelson *et al.* (2003), National Environment Management Authority (2002), Hartley and Wood (2005), Webler and Tuler (2006), Diduck *et al.* (2007), International Association for Public Participation (2007), Faircheallaigh (2010).

With regard to the first aspect, availability, the variety of spatial information types used was considered. The second aspect, accessibility, was determined by 5 sub-aspects, which were location, designated custodian, notification, time requirements and costs incurred. The third aspect, content of spatial information, was required to present the problem, through four main areas, namely the location, magnitude/extent, project activities, and impacts on the natural and human environment (Republic of Kenya 2003). These four areas therefore served as sub-aspects to analyze the content of spatial information presented during public participation within EIA.

It is recommended that spatial information be presented in formats that cater for the different abilities of the participants - the proponent, regulator, representatives of the public sectors, private sectors and civic sectors as well as affected and/or interested members of the public (National Environment Management Authority, 2002; Haklay, 2003; Diduck *et al.*, 2007). These categories of participants also form the final element of the conceptual framework. Specifically, the proponent has been defined as the individual/institution which proposes or executes a project or program and often employs a consultant to conduct the EIA on their behalf (Republic of Kenya, 2003). The regulator refers to the institution mandated with ensuring the law is upheld, which is the Environment Authority in Kenya (Republic of Kenya, 2003). Together, the proponent and regulator are also referred to as 'the practitioners' (Morrison-Saunders & Bailey, 2009) The public sector is comprised of the various government ministries, and their affiliate agencies, the private sector of commercial and manufacturing individuals/institutions, and the civic sector of advocacy and human rights groups, such as Non-Governmental Organizations (NGOs) and community

based organizations. Affected parties are those who face direct impacts from the proposed project or program (Republic of Kenya, 2003), and are also informally referred to as Project Affected Persons (PAPs). Interested parties may face impacts either indirectly or not at all. In view of the emphasis placed on participation by affected parties (National Environment Management Authority, 2002; Republic of Kenya, 2003), and their increased stake (Schlossberg and Shuford, 2005), this study focused on PAPs within the fourth element of the conceptual framework.

Going back to the third element of the conceptual framework, the aspect of appropriateness of spatial information for the different participants was considered due to the individual characteristics of each of the categories of participants, as well as their different information requirements. This particular aspect is related to the wider concept of 'usability', which has traditionally focused on Information and Communication Technology, and more recently spatial information (Hunter *et al.*, 2003; Hunter *et al.*, 2007). In our study, however, we limited this aspect to a match between the type of spatial information presented, and the different abilities of the participants, which in the literature deals with the types of users and their skill levels or competence (Palerm, 2000; Abelson *et al.*, 2003; Hunter *et al.*, 2003; Hartley & Wood, 2005; Hunter *et al.*, 2007; Harding, 2011; Konecny *et al.*, 2011).

Language was also considered, as well as the need for translation services, since there are two official languages in Kenya and over 40 local languages (Office of Public Communications, 2008). The final aspect, technical support, such as dedicated telephone lines, help desks and experts are recommended to enable members of the public to correctly interpret the spatial information presented during public participation (Abelson *et al.*, 2003; Enserink & Monnikhof, 2003).

In order to evaluate the use of spatial information during public participation within EIA in Kenya, this study therefore focused on the following specific elements within the conceptual framework: the EIA Study Stage, the 'inform' level of public participation, all the seven aspects of spatial information relevant for public participation, and PAPs. These elements are highlighted in Fig. 4-1 and Table 4-1.

4.3 Data and methods

The aim of this paper was to evaluate the use of spatial information during public participation within EIA in Kenya, using a case study. This case study was a petrol station that was proposed for development in Katani town, in the Eastern Province, which borders the capital city of Nairobi. Further, this case study was at the time of this research the only one in which spatial information was used during public participation, as compared to others where spatial information was used only in development of the final report. This particular case study was therefore unique and rare in the use of spatial information during public participation.

Field studies, including public meetings, were held between September and October 2012. Public meetings consisted of informing members of the public regarding the proposed project, as well as eliciting their views and concerns. A cadastral map was used during the public meetings.

The structured interview method, using a questionnaire, was used to obtain information from all the PAPS who attended the public meetings. This method is encouraged when testing preferences and opinions, despite concerns on reduced responder anonymity, honesty, and validity/reliability (Ackroyd & Hughes, 1981; Milne, 1999). Further, the structured interview method was considered appropriate for this research as it encourages clarification of questions and encourages participants to respond. The questionnaire consisted of four main parts, with the first, seeking personal information from the respondents, such as gender, date of birth, level of education, and occupation/livelihood. The second part consisted of seven questions, each related to the aspects of maps that are relevant for public participation, as outlined in Table 4-1 of this paper. The third part consisted of two questions that requested for additional observations on the aspects presented in the previous part. Questions in the fourth and final part of the questionnaire sought the opinion of respondents on whether the map used affected their level of participation, whether there was anything they would have liked to see done differently regarding the use of maps during public participation, a comparison of the importance of maps against other types of spatial information and whether they would recommend the use of maps during public participation in future. The questionnaire was administered during the last two weeks of December 2012.

4.4 Results and discussion

4.4.1 Results

This study set out to evaluate the use of spatial information during public participation within EIA in Kenya, using a case study. The questionnaire that was prepared for this purpose forms the basis upon which the results in this section are presented.

Responses were obtained from 28 PAPs who had attended the EIA public meetings, during which a cadastral map had been used (Fig. 4-2). The proposed project was highlighted in the map as a black square near the Catholic primary school. The larger number of respondents (64%) was male, and the remaining (36%) female. Ages of respondents ranged from 21 to 65 years, with the highest number of respondents (43%) being between 31 to 40 years old, followed by those respondents aged between 21-30 years (32%). Fifty seven percent of the respondents had acquired secondary-level education, followed by those (36%) who had acquired primary-level education. Only 8% of respondents had post-secondary education. The livelihoods of the respondents consisted mainly of informal types of activities, with the highest number of respondents (46%) engaging in small scale business activities. ‘Jua Kali’ is a Kiswahili word, literally meaning ‘fierce sun’, and has been used to depict small and

medium enterprise activities, where work is often undertaken in the open, unlike formal businesses. Eighteen percent of respondents were involved in 'Jua Kali' activities. This was followed by those respondents who stated that they were unemployed (14%). 'Boda Boda', a slang term, is derived from a mixture of English and Kiswahili and has been used to depict the smaller modes of transport, such as bicycles and motorbikes. Seven percent of the respondents were involved in 'Boda Boda' transport activities. The remaining respondents were either casual labourers, or retired.

With regard to the first aspect, availability, spatial information was present during the public participation activities in the form of a cadastral map (Fig. 4-2). Only one copy of the map was used during the presentation, as a visual aid.

The second aspect, accessibility, consisted of five parts: location, custodians, notification, time and cost. With regard to location, almost all the respondents (except one) were able to access the cadastral map during the public meeting, which was held at the town's shopping centre. The single respondent that did not see the map confirmed that he had arrived late to the public meeting. When asked for an opinion on whether the locations were easily accessible, a majority (89%) of respondents responded positively, with adjectives such as 'accessible', 'appropriate', 'fine', 'near' and 'satisfied'. A comment of an opposing view was given by an elderly female respondent, which was a complaint that the venue had no shade yet the sun was very hot. Two respondents did not offer their opinions.

Regarding the availability of custodians designated to provide access to the map, almost all the respondents (except one) confirmed that they were available. The single respondent who claimed that they were not sure if custodians were available was the same person that had arrived late for the public meeting. The main custodians of the spatial information were identified by a majority (89%) of respondents as officials from the National Environment Authority. Other custodians were identified as the proponent and local administrator (Chief). Regarding accessibility to these custodians, almost all (except two) of the respondents felt that these custodians were accessible. Out of the two respondents that differed, one respondent did not feel that the custodians were accessible, and the other was not sure. When invited to offer an opinion regarding the custodians, almost all (93%) of those interviewed responded positively, stating that the custodians were friendly and approachable. The respondent who had earlier stated that they were not sure about the accessibility of custodians did not offer an opinion, while the one who stated that the custodians were not accessible had not approached them. Other than these two respondents mentioned, all the other respondents were happy with the custodians, with adjectives such as 'friendly', 'satisfied', and 'free' being used. Some respondents (14%) additionally indicated that the custodians were ready to listen and respond to questions asked of them.

Almost all the respondents (except two) confirmed that they received notifications directing them to the public meeting and map. Specific methods of notification included announcements by the local administrator (Chief), friends, the owner and

posters. Both the respondents that differed claimed that they were not notified and had come across the meeting after it was already started. Almost all (86%) of the respondents were happy with the methods of notification used, and those who did not respond positively to the notification methods offered suggestions, such as the use of more posters, and earlier notification. Two respondents did not offer an opinion.

The time provided for the public meeting, which was approximately three hours (in the afternoon), was considered appropriate and sufficient by a majority (93%) of respondents. The remaining 7% of respondents were not sure. When requested to offer an opinion on the time allocated for the public meeting, half the respondents did not offer any opinion, while the remaining comments were positive. Regarding cost, all respondents claimed that they were not required to pay any money to access the meeting area or cadastral map, and a comment was offered by one respondent that they were happy that no money was required, as they might not have had it at the time.

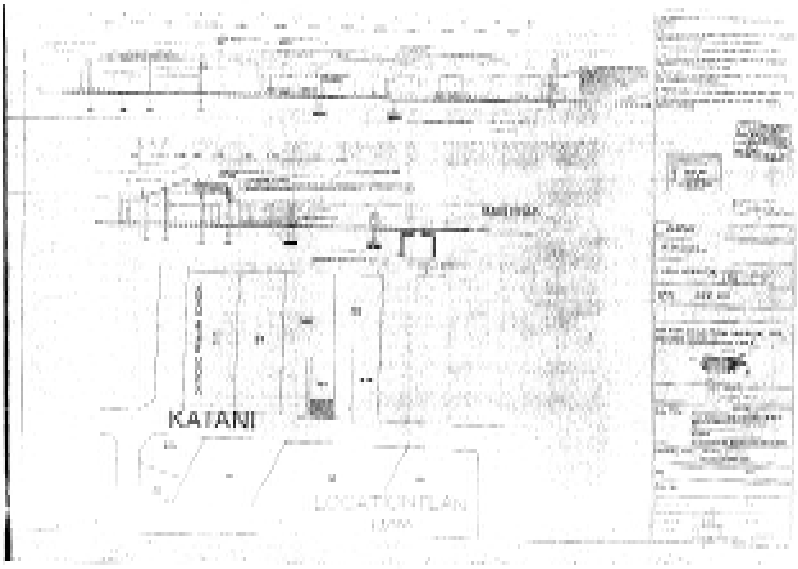

Fig. 4–2.Cadastral map indicating location of proposed project (highlighed plot near the Catholic primary school). Source: Municipal Council of Mavoko.

To evaluate for an understanding of the second aspect, content, respondents were asked whether they were able to confirm the following project-specific information from the cadastral map: location, magnitude/extent, project activities, and impacts on the natural and human environment. All the respondents selected 'yes' to the question on location of the proposed project. Different opinions were offered on the remaining three sub-aspects (Table 4-2).

Table 4.2. Responses to aspect of 'content' in spatial information.

% responses n=28	***Magnitude/extent of project***			***Project Activities***			***Impacts on the natural & human environment***		
	Yes	**No**	**Not Sure**	**Yes**	**No**	**Not Sure**	**Yes**	**No**	**Not Sure**
GENDER									
Male	50	14	4	64	4	0	54	14	0
Female	32	0	0	32	0	0	32	0	0
AGE									
21-30	23	8	0	27	4	0	23	8	0
31-40	38	0	4	42	0	0	38	4	0
41-50	8	0	0	8	0	0	8	0	0
51-60	8	0	0	8	0	0	8	0	0
Above 60	8	4	0	12	0	0	12	0	0
EDUCATION									
Primary	29	7	0	36	0	0	25	11	0
Secondary	46	7	4	54	4	0	54	4	0
University	7	0	0	7	0	0	7	0	0

Source: Field Study.

To begin with, only men expressed that they did not understand or were not sure about the sub-aspects of magnitude/extent, project activities, and impact of the project on the natural and human environment. No single female therefore indicated that they did not understand or were not sure on any of the sub-aspects related to content of the cadastral map. With regard to age of respondents, the highest indication on lack of understanding was expressed by the youngest respondents, those between 21-30 years for each of the sub-aspects. Of the older respondents, namely those between 31-40 years, 4% were not sure about the magnitude/extent of the project and a similar number (4%) did not understand the impacts of the project on the natural and human environment. A lack of understanding on the magnitude/extent of the project was expressed by 4% of the respondents aged over 60 years.

With regard to level of education of respondents and their understanding of the content presented in the cadastral map, lack of understanding was expressed on all the three sub-aspects of content by those respondents who had attained primary-level and secondary-level education. Respondents with university education expressed solely an understanding of each of the sub-aspects of content.

Respondents were thereafter asked whether the map was clear to them, as a way of evaluating the aspect of appropriateness. Ninety six percent of respondents confirmed that the map was clear. When asked again if they were able to understand the map presented, the same number of respondents (96%) said they were. Almost all (except one respondent who did not offer an opinion) of the respondents stated that the map positively affected their participation, as the information was clear, they were able to understand the project better, and also ask questions.

The cadastral map was presented in English, with verbal explanations in Kiswahili. The use of more than one language was regarded positively by a majority (89%) of respondents, with respondents claiming that they felt included in the discussion, and were able to understand the discussion as the language used was appropriate to their understanding. Regarding technical assistance, 86% of respondents confirmed that some form of technical assistance was provided to enable them understand the cadastral map during the public meeting, in the form of verbal explanations, and a physical demonstration on the location of the proposed project. This assistance was offered by officials from the National Environment Authority. Unlike the aspect of 'content', there were no discernible differences in responses, based on gender, age or education to questions on the other six aspects of spatial information that are relevant to public participation.

When asked if there were other criteria that should be considered when evaluating the use of maps during public participation, 71% of respondents stated 'no', while the remaining did not respond. Overall, a majority (82%) of respondents was of the opinion that the map used during the public meeting impacted positively on their participation, such that their understanding of the proposed project was enhanced, and they were subsequently able to ask questions relevant to them. When asked if there was anything they would have liked to see done different, 79% of respondents stated 'no', while the remaining stated either 'yes' or 'not sure'. Suggestions included the provision of a greater number of maps, so that individuals can refer to the map during the discussion (as opposed to a single copy being used as a visual aid); leaving maps with an identified custodian or members of the public for future reference; and the use of photographs alongside the map. Maps were ranked highly (64% of respondents) as sources of spatial information (when compared to other sources of information, such as photographs, drawings and verbal explanations), because they were considered clear to use and understand, and depicted project location and extent. Those respondents (32%) who felt that the map was not an important source of spatial information stated that it didn't provide the exact picture of the project after completion, and photographs should be used alongside other sources of spatial information for better clarification. Four percent of respondents were not sure. Finally, 82% of respondents mentioned that they would recommend the use of maps during public participation in future because they are useful in locating the project area, they are easy to understand, and are clear and precise. Differing opinions indicated an understanding of the map would depend on accompanying explanations,

and the need for help in interpretation. Fourteen percent of respondents were not sure if they would recommend the use of maps during public participation in future

4.4.2 Discussion

4.4.2.1 Availability

Spatial information was present in the form of a single cadastral map, which was obtained from the Local Council. The use of only one copy of the map, containing information that had not been processed for its target audience is questionable. It is likely that the project had limited funding (proponent is an individual as compared to an institution), which nonetheless raises the issue of information access (Tuler & Webler, 1999; Kameri-Mbote, 2000; Haklay, 2003; Hartley & Wood, 2005; Diduck *et al.*, 2007; Okello *et al.*, 2009). It would have been prudent to provide a map depicting information that had been processed to suit the users, and more than one copy of the same.

4.4.2.2 Accessibility

This aspect consisted of five parts: location, custodians, notification, time and cost. The public meetings were held at the town's shopping centre, a venue that met the requirements for accessibility (Palerm, 2000; Republic of Kenya, 2003; Hartley & Wood, 2005; Mwenda *et al.*, 2012), particularly for the PAPs, who engage in their livelihoods at this location or nearby. The requirements for custodians were also met as the respondents viewed them as approachable and friendly. In addition, the requirements for notification about the public meeting were met (Palerm, 2000; Hartley & Wood, 2005) as a variety of methods were used, such as announcements by the local administrator (Chief), friends, the owner and posters. There was no cost required to access the meeting area or spatial information, and the time allocated for the public meeting was deemed appropriate and sufficient.

4.4.2.3 Content and appropriateness

It has been put forward that spatial knowledge is dependent on personal attributes such as age, gender, socio-economic status, level of education, and cultural background (Matthews, 1980; Herman *et al.*, 1982; Lipman & Caplan, 1992; Iachini *et al.*, 2009; Iaria *et al.*, 2009; Konecny *et al.*, 2011; International Cartographic Association, 2012). For example, increase in age (and the resulting environmental exposure) has been linked to increase in ability to process spatial information in working memory (Matthews, 1980; Herman *et al.*, 1982), while ageing has been associated with a decline in orientation skills (Lipman & Caplan, 1992; Iaria *et al.*, 2009). Further, in traditional tests of basic spatial abilities, males perform better than females (Coluccia & Louse, 2004; Coluccia *et al.*, 2007), especially tasks involving mental rotation processes (Iachini *et al.*, 2009), although an opposing view has been proposed by Newcombe and Stieff (2012), to the effect that spatial skills in both males and females can be improved through training and education. With regard to

cultural background, spatial information is usually coded or symbolic, and the selection and interpretation of these codes or symbols is culturally dependent (Konecny *et al.*, 2011). These observations have given rise to extensive research to investigate ways in which the usability of spatial information can be improved, despite challenges to the creation of both qualitative and quantitative usability tests (Hunter *et al.*, 2007; Konecny *et al.*, 2011; International Cartographic Association 2012).

To evaluate for the aspect of content, respondents were asked whether they were able to confirm the following project-specific information from the cadastral map: location, magnitude/extent, project activities, and impacts on the natural and human environment. Location of the proposed project was clearly understood, as stated by all the respondents, irrespective of their age, gender or level of education. These opinions however differed for the remaining sub-aspects of content. With regard to gender, only the male respondents indicated a lack of understanding, as compared to the female respondents who indicated that they understood the content of the cadastral map. For age, the highest understanding of content was expressed by those respondents of 31-40 years, followed by those of 21-30 years. There was a marked decrease witnessed in respondents aged 41-60 years. With respect to level of education, respondents with university-level education claimed the highest level of understanding. The findings on age-related spatial knowledge from this study concur largely with the literature, although further study is highly advised.

The finding whereby female respondents stated that they understood the basic project details from the map, and did not express any disagreement or uncertainty is inconclusive, and concurs with prevailing literature in the sense that opposing views on the spatial abilities of females relative to men prevail. The situation in Kenya is particularly interesting. On the one hand, literacy rates are generally lower for females than males (Otiso & Owusu, 2008), and the cultural scenario promotes the grooming of females to be submissive and avoid disagreement or the voicing of opposing opinions (Wane & Chandler, 2002; Creighton & Yieke, 2006; Institute of Economic Affairs (Kenya), 2008; United Nations Development Program, 2011). This submissiveness is particularly evident in the rural-setup, where this case study was undertaken. On the other hand, the spatial knowledge of the female respondents in this study should not be dismissed. Further study is advised to confirm these findings.

A major limitation with the questionnaire was the use of ‘yes’, ‘no’, or ‘not sure’ options for responses. It is therefore possible that the positive responses given by the respondents were simply to please the researcher or to show interest in the project, which would potentially boost their livelihoods (consisting mainly of small scale business activities). Further, it is not clear how much of this knowledge was obtained from the map itself, or the accompanying verbal explanations and physical demonstration. Cadastral maps mainly illustrate plot location and size, so it is most likely that the location and magnitude/extent of the proposed project was easily identified, but not the project activities, and impacts on the natural and human

environment. These last two subjects were probably obtained from the verbal explanations and physical demonstration, which are nonetheless sources of spatial information (Montello & Freundschuh, 1995; Louwerse & Zwaan, 2009).

4.4.2.4 Language, translation and technical support

More than one language was used during the public meeting, which encouraged the inclusion of members of the public during the public meeting. Language has the ability to enhance or limit public participation, and this has been documented for EIA in Kenya (Okello *et al.*, 2009), hence the use of more than one language was appropriate. Translation should be offered where necessary (Palerm, 2000), and this was the case during the public meetings. Technical support was offered in the form of verbal explanations, and a physical demonstration on the location of the proposed project.

4.5 Conclusions and recommendations

Using the case presented in this paper, it was established that spatial information can and is being used during public participation within EIA in Kenya. Further, it was established that the use of a cadastral map, in some instances (such as accessibility, language, translation and technical support) met the requirements established by the conceptual framework, was unsatisfactory in the aspect of availability, and unconfirmed in others (such as content and appropriateness).

A number of recommendations can be made from this study. First, the issue of availability of spatial information should be considered, so as to avoid presenting inappropriate and poor quality spatial information to the public. Good quality and appropriate spatial information requires financial, technical and time resources, and it would be worthwhile to include this in the planning process if spatial information is to be used during public participation. Good quality and appropriate spatial information would also most likely solve the problems encountered in this study relating to content and appropriateness. Second, access to spatial information, particularly in cases where weaknesses exist in legislative, administrative, institutional and procedural frameworks exist, should be considered. It has already been established in literature that such situations exist, including Kenya, and hence the need to integrate and consider them in the planning process. Finally, the conceptual framework developed in this study is unique in its bringing together EIA, public participation and spatial information. It can also be applied to any EIA worldwide as it has been developed from international literature. To this end, the case study investigated here is specific, but can be seen as an example for similar cases in the world.

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5

Do maps improve distance perception?

Mwenda, A.N., Khutsishvili, G., Bregt, A.K., and Ligtenberg, A. (2014)

In review: *Journal of Environmental Psychology*.

Abstract: The purpose of this study was to test for distance perception, in project affected persons in Kenya, using multiple types of spatial presentations with different levels of realism. Following a real life experimental task, the following was observed: out of three different map presentations, the topographic map was the first choice for most participants; participants older than 51 years spent the longest time locating their houses on a map, but were also more accurate than younger participants; female participants spent less time than their male counterparts on the locating task; previous map experience did not influence accuracy in the locating task. On whether maps improve distance perception, results from this study indicate that maps encourage Euclidian distance perception. The implication from this study is that higher realism in spatial presentations may not always be preferred, and age and gender related differences in spatial cognition still require further investigation.

5.1 Introduction

Spatial information is increasingly used in real-life situations by groups of people with different abilities (McCall, 2003; Bacic *et al.*, 2006; Lewis & Sheppard, 2006; Drummond & French, 2008) to the extent that traditional barriers and roles between experts and non-experts have significantly blurred - also referred to as NeoGeography (Goodchild, 2009b; Elwood, 2010). Developments in Geographic Information Systems (GIS) have recognized this phenomenon, and moved to facilitate multiple ways of presenting spatial information, such as satellite images, geovisualizations, orthophotos and sketches (Al-Kodmany, 1999; Agrawal & Dikshit, 2002; Appleton & Lovett, 2005; Bacic *et al.*, 2006). Additional types of spatial presentations include 3D photo-realistic visualizations, photomontages, (Harper, 2002; Prendergast & Rybaczuk, 2005; Lewis & Sheppard, 2006) and virtual environments (Sun *et al.*, 2004; Iaria *et al.*, 2009), among others.

Accompanying the progress made in presentation and use of spatial information have been studies on whether the different sources of spatial information influence spatial cognition and behavior (Thorndyke & Hayes-Roth, 1982; Mark *et al.*, 1999; Uttal *et al.*, 2006) or not (Newcombe & Stieff, 2012). For example, cognitive map-design research aims to understand human cognition so as to improve the design and use of maps (Kitchin, 1994; Kulhavy & Stock, 1996; Mark, *et al.*, 1999; Montello, 2002). In addition, it has also been understood that the way spatial information is perceived and understood by its users determines its usefulness and effectiveness, which is the basis of the usability debate (Freundschuh & Egenhofer, 1997; Slocum *et al.*, 2001; Hunter *et al.*, 2007).

Despite the increased access to spatial information and numerous methods of presentation, an understanding of the basic concepts of spatial knowledge by its users is critical, such as identity, location, magnitude, time and the related derived concepts such as distance, angle and direction, sequence and order, and connection and linkage, among others. These have been referred to as the 'primitives' of spatial knowledge (Golledge, 1995). Distance, for example, is considered as 'the interval between the location of occurrences' (Golledge, 1995), and in addition to the metric type of measurement, may be influenced by subjective conditions such as time spent, emotion, environmental context, visual attention, mode of transport, affection, effort required, and perceived difficulty, among others (Bailly, 1986; Lappin *et al.*, 2006; Alter & Balcetis, 2011; Wardak *et al.*, 2011; Sugovic & Witt, 2013). The result of this has been significant differences between cognitive and metric distance (Montello, 1991). There also exist copious numbers of studies on the other concepts of spatial knowledge mentioned above (Freundschuh & Egenhofer, 1997; Golledge, 2002; Kuhn, 2012).

5.2 Background

One of the real-life situations where spatial information is increasingly used is Environmental Impact Assessments (EIA), where its role has been deliberated upon and encouraged (Agrawal & Dikshit, 2002; Drummond & French, 2008; Gonzalez *et al.*, 2008). Herein, spatial information has been used to store and communicate information on environmental and social problems (Satapathy *et al.*, 2008), as well as support analysis and problem-solving (Appleton & Lovett, 2005; Prendergast & Rybaczuk, 2005; Bacic *et al.*, 2006; Lewis & Sheppard, 2006; Atkinson & Canter, 2011). Within EIA, public participation is considered a key component (Hartley & Wood, 2005; Prendergast & Rybaczuk, 2005; Booth & Skelton, 2011; Glucker *et al.*, 2013), and it is here that different members of society are exposed to spatial information. A common categorization of participants within EIA includes the proponent, regulator, representatives of the public, private, and civic sectors, interested persons and affected persons (Haklay, 2003; Diduck *et al.*, 2007; Morrison-Saunders & Bailey, 2009; Glucker *et al.*, 2013). Except for the last category, the other participants are not likely to directly experience either the positive or negative effects

of the proposed development project for which an EIA is carried out, hence affected persons are usually the ones with the highest stake (Schlossberg & Shuford, 2005). In addition, in some areas, these are also the people with the lowest socio-economic status in society (Adomokai & Sheate, 2004; Okello *et al.*, 2009; Nadeem & Fisher, 2011), hence their emphasis in this study.

It is also during public participation within EIA that the ability of spatial presentations to communicate and support analysis and problem-solving is tested (Warner & Diab, 2002; Moufaddal, 2005; Gonzalez *et al.*, 2008). By its nature, EIA may be undertaken for either potentially beneficial or hazardous projects hence the need for spatial information to facilitate participants towards identifying the benefits or threats from a proposed project. Commonly, a demonstration of distance between the proposed project and environmentally sensitive, protected or densely populated areas is required (Warner & Diab, 2002; Republic of Kenya, 2003; Atkinson & Canter, 2011). To this end, an appreciation of the cognitive perceptions of distance was a point of interest for this study.

Considering the wide range of spatial presentations available, incidents where people are exposed to more than one type are common. Similarly, experiments that test multiple spatial presentations in a single session are also common, as evidenced from the examples presented in Table 5-1.

Table 5-1

Examples of the simultaneous use of spatial presentations

Spatial presentations used	**Background**	**Source**
Two fictitious maps, that differed in both scale and content, and aptly referred to as a Town map and a Countries map. The former map portrayed typical landmarks such as a river, streets, buildings, and parks, while the latter map portrayed countries, cities, roads, railroads, and prominent terrain features	Investigation of the procedures used to acquire knowledge from maps	Thorndyke and Stasz (1980)
GIS (facilitated interactive visualization through maps and images), artistic sketches, and computer photo-manipulation	A participatory planning process in the Pilsen neighborhood of Chicago	Al-Kodmany (1999)
Three hypothetical map treatments from the same data set. Here, map scale, selection and generalization of features were held constant, while other cartographic display variables such as hue, size and shape were varied. The result was	Investigation of the influence of different cartographic displays on decision making	McKendry (2000)

Spatial presentations used	Background	Source
three different map treatments, where Map 1 displayed basic cartographic design principles (such as the use of contrast and visual variables) resulting in a map with good graphic organization. Map 2 followed some basic design principles although there was no visual hierarchy, resulting in a map with poor graphic organization. Map 3 followed few basic principles, resulting in little order or logic in the symbolization of features, the result of which was a map with poor graphic organization		
Six 3D GIS-based computer visualizations	Interviews of planning and related professionals for a real project in Norwich, UK	Appleton and Lovett (2005)
Simple GIS maps and photorealistic images	An exercise to assess the acceptability and effectiveness of photorealistic landscape visualizations with First Nations	Lewis and Sheppard (2006)
Satellite (LANDSAT 7) false-color composite image, orthophotos mosaics from three different viewpoints, and satellite false-color composite images from three different viewpoints	Presented to farmers and extensionists in Brazil so as to improve collective understanding of shared environmental problems at watershed level	Bacic *et al.* (2006)
Colored raster cells, 2D icons and 3D icons	To explore users' accuracy and efficiency, appreciation of the interface and visualization, and affective appraisal of the environment	Van Lammeren *et al.* (2010)
Six different map types: a terrain map with hill shading (Map A), a topographic map including contour lines (Map B), two	Investigation of individual and group differences on the	Wilkening and Fabrikant

Spatial presentations used	Background	Source
types of road maps (Maps C and E), and two satellite images, one oblique (Map D) and one in orthographic perspective (Map F)	efficiency and effectiveness of map-based decision making under varying map use contexts	(2011)
20 homogenous screen maps	Exploration of cognitive processes of expert and novice users	Ooms *et al.* (2012)

The purpose of these studies and experiments has been to establish the influence of different spatial presentations on spatial cognition as well as use the information obtained from these experiments to further improve spatial presentations and their use (Kulhavy & Stock 1996; Mark *et al.*, 1999; Montello, 2002). So far, a number of areas requiring further study have been highlighted, which include, among others, appropriate levels of realism (Appleton & Lovett, 2005; Kettunen *et al.*, 2012). Consequently, the influence of differing levels of realism on spatial cognition also served as a point of interest for this study.

Using public participation within EIA in Kenya as our setting, we sought to test for spatial cognition, specifically distance perception, in project affected persons, using multiple types of spatial presentations with different levels of realism. Here, spatial information is recommended for use during public participation within EIA (National Environment Management Authority, 2002), although studies on this are limited, except a recent one by Mwenda *et al.* (2013), which served as a starting point for this study. In the said study, a conceptual framework was developed which brought together four elements, namely: the EIA process in Kenya, levels of public participation, aspects of spatial information that are relevant for public participation, and categories of participants. Out of the 7 aspects of spatial information that were deemed relevant to public participation, the aspect of 'content' required further investigation. This aspect, as compared to the others that dealt with administrative or organizational issues surrounding the provision of spatial information to public participants, was concerned with spatial cognition. The other three elements of the conceptual framework, which are highlighted in Fig. 5-1, remained unchanged in this study, namely, the EIA Study stage, level of 'inform' for public participation and those participants who are likely to be directly affected by the proposed development project (affected persons).

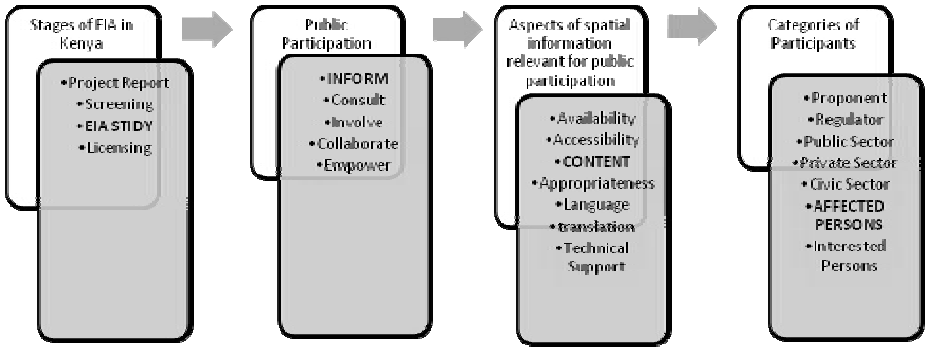


Fig. 5–1.Conceptual Framework. Source: Mwenda *et al.* (2013)

This study therefore sought to build on the aforementioned one in three ways: first, to refine the focus from investigating the 'content' of spatial information to testing for a specific element of spatial cognition, namely, distance perception. Second, through exposing participants to multiple spatial presentations with differing levels of realism as opposed to a single type of spatial presentation as was the case in the study. Third, unlike most experiments on spatial cognition, this one was carried out in conditions similar to the real world (and EIA), as opposed to highly controlled lab-like set ups. All in all, the objective of this study was to test for spatial cognition, specifically distance perception, in project affected persons in Kenya, using multiple types of spatial presentations with different levels of realism.

5.3 Study area

The location for this study was a proposed sanitary landfill in Kericho County, within the Rift Valley Province of Kenya (Fig. 5-2), for which an EIA study is currently being undertaken. The site for the proposed project is locally known as 'Chemutum' or 'pundo' which was traditionally an area with mineral salts for livestock and wild animals, and falls within Sigowet/Soin administrative region. The site comprises a total land area of 19.02 hectares, out of which the project will make use of 4.05 hectares. The project will consist of landfill cells, and a leachate treatment system (made up of an aeration pond, settling pond, filtration pond, leachate recovery pit, and sludge drying beds). Other components of the project will include a site administration office, peripheral track around the site, and a fence around the whole site (GIBB International Ltd, 2013).

It is mandatory for projects of this nature to undergo EIA studies (Republic of Kenya, 1999; National Environment Management Authority, 2006) due to the severity and irreversibility of potential environmental impacts. These impacts, arising from the construction, operation and decommissioning phases of the project, include pollution of nearby groundwater and surface water, air pollution from odor, and loss of biodiversity, among others. The proposed project must also not be located close to

environmentally sensitive, protected or densely populated areas (Republic of Kenya, 2003; GIBB International Ltd, 2013).

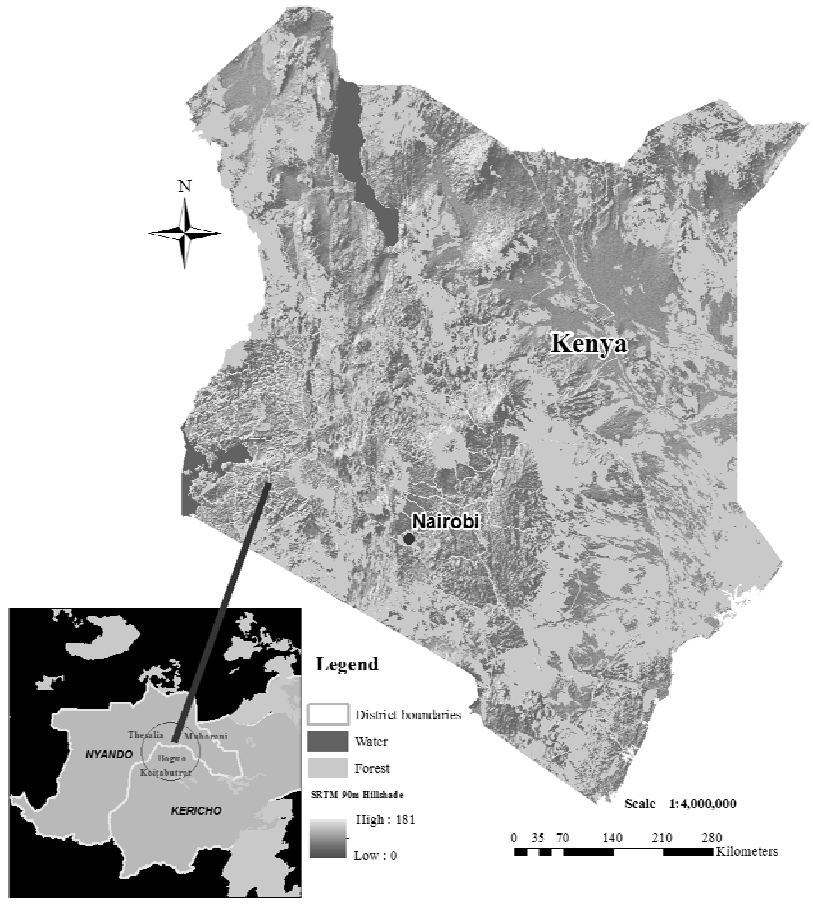


Figure 5–2.Project location. Source: Open Topography Facility (2014)

5.4 Data and methods

In preparing for this study, we noted that studies testing for spatial cognition and skills are often undertaken in experimental or lab-like set ups, which are characterized by the ability to highly control the learning and testing environment (Thorndyke & Hayes-Roth, 1982; Taylor & Tversky, 1992; Kulhavy & Stock, 1996; Brunye *et al.*, 2008; Willis *et al.*, 2009). Further, the test subjects are predominantly homogenous, usually university-level students. The situation is very different during public participation activities within EIA in Kenya, where the setting is largely informal, and the participants heterogeneous (Okello *et al.*, 2009; Mwenda *et al.*, 2013). Considering this situation and the difficulty of setting up complex and tightly controlled lab-like experiments, we sought to formulate a simple yet thorough experiment that would be able to test for the study's objective in a real-world set-up.

The objective of this study was to test for spatial cognition, specifically distance perception, in project affected persons in Kenya, using multiple types of spatial presentations with different levels of realism. To begin with, we considered that spatial information presented during public participation within EIA in Kenya is required to present details of the proposed development project, including its location and magnitude/extent (National Environment Management Authority, 2002; Republic of Kenya, 2003). Consequently, due to the possible severity and irreversibility of potential environmental impacts, demonstration of distance by the project to environmentally sensitive, protected or densely populated areas is critical (Republic of Kenya, 2003; GIBB International Ltd, 2013). In addition, we considered that due to prevailing socio-economic conditions, there is limited exposure to spatial presentations (particularly more advanced types) and limited technological and financial resources available to enable increased use and interaction by society (Cheneau-Loquay, 2007; Mwenda *et al.*, 2013) hence the need to keep the spatial presentations used in this study as simple as possible. Finally, the benefits of exposing participants to more than one type of spatial presentation have been investigated, and we sought to test this using spatial presentations with different levels of realism, following Kettunen *et al.* (2012).

Based on the above considerations, three maps (A, B and C) representing the project area were prepared through the manual digitization of satellite images derived from open access sources, namely a topographic map, overlay map and aerial map (Fig. 5-3). Map A was designed based on traditional cartographic rules, through manual digitization from Microsoft Bing Maps Platform (Microsoft Corporation, 2014) in Arc Map 10.1 of the software package Arc GIS 10.1 (ESRI, 2014) at a scale of 1: 20,000, resulting in a typical topographic map. Also included in the map was a specific symbol and label indicating the proposed sanitary landfill project. The result was evaluated for consistency against a topographic map of the wider area (Directorate of Overseas Surveys, 1971) together with the assistance of the regional Government Surveyor. Map B was designed using the same interface and geovisualization techniques as Map A, but with an additional background of satellite imagery (aerial

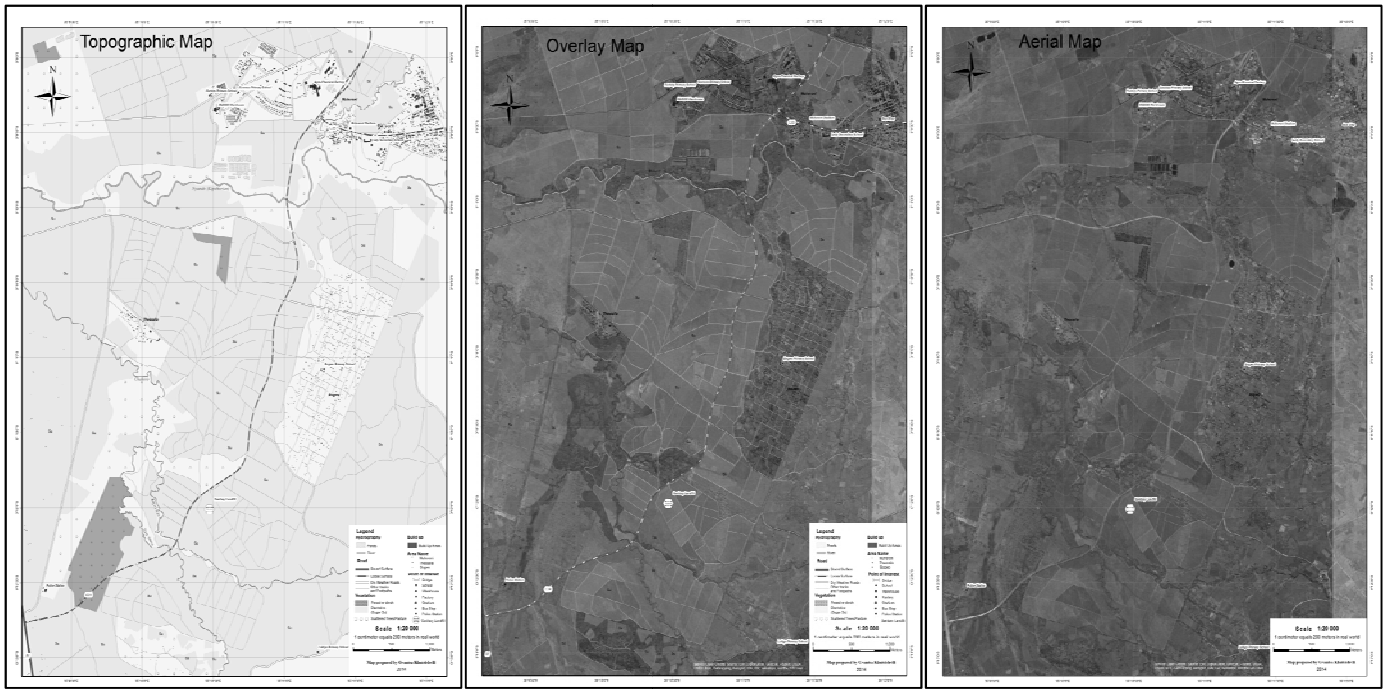
base images) also from Microsoft Bing Maps Platform (Microsoft Corporation, 2014). Map C was designed solely from satellite imagery (Microsoft Corporation, 2014), with a North arrow and scale.

Stratified random sampling based on spatial distribution of the population living in the area was adopted for this study. Specifically, following guidance from local administrators, participants were randomly selected from the existing settlement areas situated within a 6 Km radius of the proposed project (Muhoroni, Thessalia, Bogwo and Koitaburot), and hence those most likely to be affected by the proposed project - affected persons (Republic of Kenya, 2003; GIBB International Ltd, 2013). The experiment was carried out between 27 March 2014 and 11 April 2014 at individual participants' homes, in three parts: in the first, information was sought from each participant on their knowledge of the proposed sanitary landfill project, so as to ensure that they had an accurate understanding of the project's location. Also included here were questions on their perception of distance from their home to the project. The second part of the experiment consisted of questions to establish the participant's previous experience with spatial information. It was during this part that Maps A, B and C were presented to the participant, who was then asked to rank the maps in order of preference. This ranking was recorded, following which the participant was requested to indicate the location of their house on the most preferred map and the time taken to complete this task was also recorded. The participant was thereafter required to answer questions on their perception of distance of their house to the project, based on their indication on the map. The third and final part of the experiment consisted of recording the participant's socio-demographic information, such as age, gender and level of education. It was also at this point that GPS coordinates were taken of the true location of the participant's house, where the experiment took place.

Following completion of the experiment, responses were entered into a database. Exploratory analyses were initially carried out, followed by a check for normal distribution using the Shapiro-Wilk test (Razali & Wah, 2011). W-values were very low for all groups, leading to the assumption that normality of the data had been violated, therefore non-parametric tests were conducted. To confirm whether participants changed their perception of distance after reading the maps, the Sign Test was used for paired samples (Elliott & Woodward, 2007), as it does not assume data to be symmetrical. The Kruskal-Wallis H test (Lund Research Ltd, 2013a) and Mann-Whitney test were applied to detect differences in time spent to locate houses on the maps, as well as compare the calculated errors for distance and location, among the different ages, gender, levels of education, and previous map experience characteristics of participants. The Kruskal-Wallis H test was also applied to detect differences in calculated errors for distance and location between the different map types. In cases where no significant differences were detected, analysis of median scores was undertaken. Finally, Spearman's correlation (Lund Research Ltd, 2013b) was applied to analyze the relationship between the calculated errors for distance and

location, and also between different ages, gender, levels of education, and previous map experience of participants.

The main limitation of this study relates to the setting on which this study is based, where public participation as carried out within EIA in Kenya is often informal. This limitation was also the unique point of this study, which sought to replicate a real world setting. Consequently, we retained the participant type (those persons most likely to be affected) and concentrated on testing for spatial cognition, and specifically distance perception.



Map A Topographical map Map B Overlay map Map C Aerial map

Fig. 5–3.Map of study area with different levels of realism. Source: Microsoft Bing Maps Platform (Microsoft Corporation, 2014) and Arc GIS 10.1 (ESRI, 2014).

5.5 Results and discussion

5.5.1 Results

5.5.1.1 The participants

Participants were identified through stratified random sampling based on spatial distribution of the population living in the settlement areas of Muhoroni, Thessalia, Bogwo and Koitaburot. Sixty nine participants were involved in the experiment, from which 52% were female, and 48% male. Ages of participants ranged from 20 to 61 years, with the mean age being 34 years. Levels of education ranged from those with no education or only primary level, and those with secondary/ high school education, to college or higher. The largest numbers of participants (43%) in this study were educated to the high school or secondary level.

5.5.1.2 Previous experience with spatial information

Fifty eight percent of participants had previously used maps, albeit only at school, followed by 39% who had used maps in different conditions such as work, travelling, and purchasing land. Only 3% had never previously used maps. We thereafter tested this variable against map preference, location of house exercise, response time, and perception of distance prior to and after map exposure, for which the results are presented in subsequent sections.

5.5.1.3 Map preference

When asked to rank their preference of the three maps presented to them, the highest choice by participants was made for the topographic map (74%), followed by the overlay map (20%) and lastly the aerial map (6%) (Table 5-2). This choice was consistent irrespective of the participants' gender, age, level of education and previous experience with spatial information.

Table 5-2.Preference for maps and reasons for choice

Map Type	**% of Participants**	**Reasons for Choice**
Topographic	74	Clarity
		Easy to understand
		Bright colours
Overlay	20	Clear labels
		Realistic impression
		Clear differentiation of features
Aerial	6	Clear labels

Source: Field Study

5.5.1.4 Location of house exercise

Participants were requested to indicate the location of their houses on the map they ranked as first. Using Map A as a template, the perceived versus true (using GPS coordinates) locations of houses are presented in Fig. 5-4.

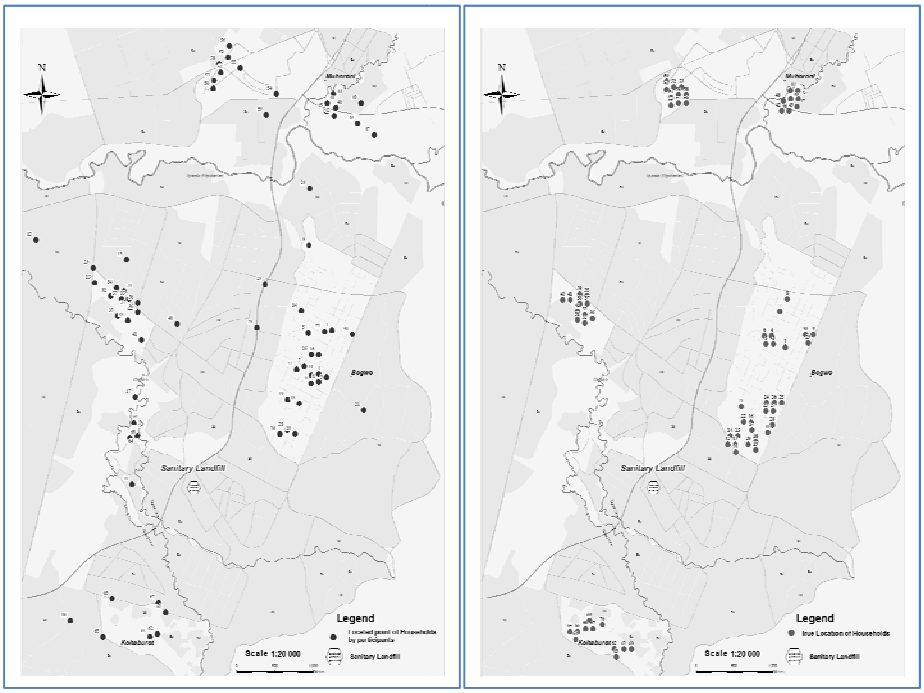


Fig. 5–4 Distribution of perceived and real locations of participants' houses. Source: Field Study

Initial analysis using the Kruskal-Wallis Test indicated no significant differences between the different map types (topographical, overlay, aerial) and locating error (χ^2 (2, N=69) = .389, p=.82). Further analysis using median scores however indicated the lowest locating error with the aerial map, as compared to the topographic and overlay maps (Fig. 5-5). The small sample size of 6% of participants who chose the aerial map led us to consider that the result may have been inconclusive and requires further investigation. With regard to the other maps and locating error, there was also less variability with the topographic map, but significant outliers, which still pointed to high variability in responses. The overlay map had the highest variability in locating error. In addition, it was also observed that there were no significant differences between previous map experience and locating error (χ^2 (2, N = 69) = .539, p = .76).

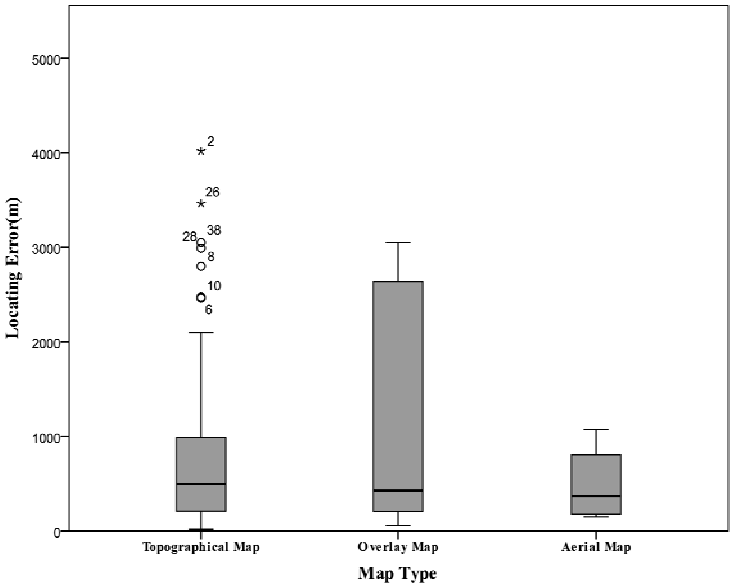


Fig. 5–5 Locating error and different maps. Source: Field Study

There were no significant differences detected between gender and locating error (U = 477.5 p = .162, two tailed, and also no significant differences detected between level of education and locating error (χ^2 (2, N = 69) = 1.472, p = .48). There were, however, significant differences between age and locating error (χ^2 (2, N = 69) = 6.943, p = .03). Specifically, high variability was observed with participants aged between 15 and 30 years, while the next age group of 31-50 years had a lower median error score, but some outliers. The last age group of participants older than 51 years also had a low median error, and no outliers (Fig. 5-6).

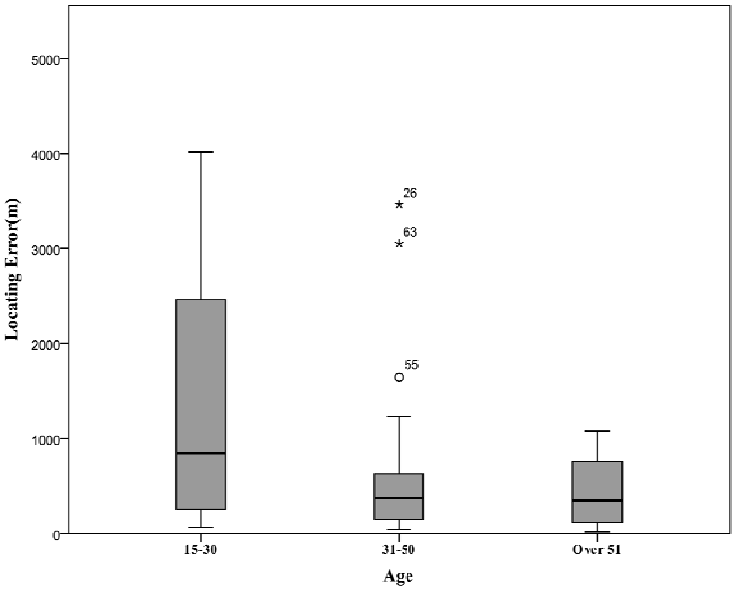


Fig. 5–6 Locating error and age. Source: Field Study

5.5.1.5 Response time

While the participants indicated the location of their home on the preferred map, the time taken to complete this task was recorded (response time). Kruskal-Wallis and Mann-Whitney tests were applied to detect differences between time spent on the task and the different socio-economic characteristics of participants. No statistically significant time differences were shown between participants with different education levels and previous experience with spatial information. Gender, however, presented a statistically significant interaction (U=353, 5, p=.004, two tailed) with a mean rank time spent score of 28.32 for females and 42.29 for males. Here, females located their houses on the map faster than males. Differences between age groups were also statistically significant (χ^2 (2, N=69) = 6, 51, p=.03), where older participants spent more time on the task than younger participants. With regard to response time and different map types, initial analysis (Kruskal-Wallis Test) indicated no statistical significance, but further analysis using Median Absolute Deviation revealed that the least time was spent on the overlay map followed by the aerial and topographic maps respectively.

5.5.1.6 Perception of distance prior to and after map exposure

In the first part of the experiment, participants were asked to estimate the distance from their houses to the proposed sanitary landfill project, namely cognitive distance (Montello, 1991). Following exposure to the maps prepared during the study, participants were again asked to estimate the same distance using their preferred map

(map-derived distance). The purpose of these activities was to determine if perception of distance changed prior to and after exposure to a map.

It was observed that 62% of participants changed their perception of distance after studying the map. Out of these participants who changed their perception of distance after studying the map, 51% increased their estimation of distance (Fig. 5-7). Differences between groups (gender, level of education, age, previous experience with spatial information) were statistically not significant ($p > .05$). No significant difference was also found in cognitive distance between the topographic map ($p > .05$), overlay map ($p > .05$) and aerial map ($p > .05$). Generally, more than half of the participants changed their perception of distance after using the maps, where they tended to increase their estimation of distance to the sanitary landfill, thereby mentally locating themselves further away from the project area.

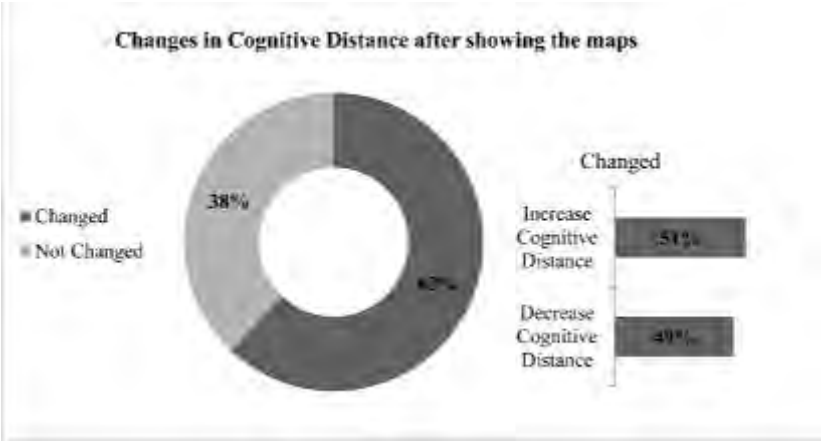


Fig. 5–7 Changes in cognitive distance after map exposure. Source: Field Study

For further analysis, a comparison of the cognitive distance (given prior to map exposure) was made against the map derived distance (given after map exposure) using Spearman's rank-order correlation (0.673, p=.000). The finding was significant, and as well, it was observed that the cognitive distance had a correlation of 0.557 with the route distance, and a correlation of 0.505 with the Euclidian distance (Table 5-3). However, the reverse was observed with the map derived distance, where a higher correlation was evidenced for Euclidian distance (0.490), and a lower one for route distance (0.386). This may be interpreted to mean that cognitive distance was closer in accuracy to route distance while map derived distance was closer in accuracy to Euclidian distance.

Table 5-3. Correlation between cognitive distance and map derived distance.

		Route Distance	Euclidian Distance
Cognitive Distance	Correlation Coefficient	0.557	0.505
	Sig. (2-tailed)	0.000	0.000
Map derived distance	Correlation Coefficient	0.386	0.490
	Sig. (2-tailed)	0.001	0.000

Source: Field Study

5.5.2 Discussion

5.5.2.1 The participants

In this study, we sought to replicate as much as possible the characteristic affected persons that are typically exposed to spatial information during public participation within EIA (National Environment Management Authority, 2002; Republic of Kenya, 2003). Heterogeneity was evident through variations in gender, age and level of education.

5.5.2.2 Previous experience with spatial information

Numerous studies have been undertaken on the strategies adopted by novice and experienced persons in map learning. On the one hand, it has been established that no significant differences exist (Thorndyke & Stasz, 1980; Kulhavy & Stock, 1996) while on the other hand this has not been the case (Ooms *et al.*, 2012). In our case, we sought information on participants' previous experience with spatial information so as to enable us establish which of the two scenarios above would be realized, and particularly in view of the real-life situation in which the experiment was carried out.

5.5.2.3 Map preference

The spatial presentations employed in this study varied in their level of realism, from the more abstract topographic map to the highly realistic aerial map. Generally, the trend has been a move from abstract/symbolic 2D presentations to more realistic 2D and 3D spatial presentations and in some cases virtual environments (Goodchild, 2009a; Iaria *et al.*, 2009; Chrastil & Warren, 2012). Interestingly, the opposite was experienced in this study. A consideration of two scenarios may be useful in understanding this finding. First, the socio-economic context in Kenya, where the use of spatial presentations is generally low (Mwenda, *et al.*, 2013), compared to other societies where exposure to spatial presentations begins quite early and continues throughout one's lifetime (Goodchild, 2009a; Elwood, 2010; Apostolopoulou &

Klonari, 2011). In addition, access to information and communication technology is generally low (Cheneau-Loquay, 2007), with exposure to newer and more advanced methods of spatial presentation being limited to professionals and planning experts who have the financial and technological resources (Slotterback, 2011). Second, where access is possible for the wider population, it is mostly confined to the formal school environment, as expressed by participants, where the topographic map and atlas are used (Une *et al.*, 2003). It is probably for this reason that participants chose a map type that they were already familiar with, the topographic map. The influence of familiarity and prior knowledge on spatial cognition has been acknowledged in literature (Kulhavy & Stock, 1996).

The results from this study also indicate a preference made by a target population that is representative of the real-world yet not the typical study subjects found in other experiments. In essence, the results may have been different if another segment of society was examined (Fig. 5-1), irrespective of the prevailing socio-economic context. Nonetheless, the results indicate the need by professionals and planning experts who have access to a wide range of resources and information to consider the preference of populations similar to those encountered in this study, the affected persons. Finally, the reasons given by participants for their preference of spatial presentations indicate a need for equal visual appeal between the different spatial presentations, which may not have been the case in this study, and provides opportunity for further investigation.

5.5.2.4 Location of house exercise

The findings from this exercise indicate that although most participants (74%) chose the topographic map followed by the overlay map (20%), their ability to accurately locate their house was low, hence the high variability and presence of outliers. These findings indicate low spatial cognition skills which may again be explained by the socio-economic context of Kenya, characterized by low usage of spatial presentations, usually confined to the formal school environment, and which are often outdated. Interestingly, the participants in this study represent the typical participants in public participation exercises within EIA in Kenya, hence the findings of this study on their spatial abilities are insightful, particularly in the use of spatial information.

Another finding of this study was that there were no significant differences between previous map experience and locating error. Despite the real world setting of this study, the findings on previous map experience and locating error concur with wider literature, such as Thorndyke and Stasz (1980), Kulhavy and Stock (1996). On the other hand, the findings on gender and locating error are inconclusive and reflect the mixed opinion evident in wider literature (Golledge *et al.* 1993; Coluccia & Louse, 2004; Newcombe & Stieff, 2012; Campbell *et al.*, 2014). On age of participants and locating error, our finding that advanced age did not negatively influence accuracy in the location exercise contradicts some popular literature on declining spatial skills associated with the ageing process (Iaria *et al.*, 2009; Campbell *et al.*, 2014). Our

finding is also inconclusive on the influence of direct environmental experience on spatial cognition (Thorndyke & Hayes-Roth, 1982; Chrastil & Warren, 2012).

5.5.2.5 Response time

It has been argued that 'spatial reasoning requires time' (Brockmole & Wang, 2003) and this factor is featured in numerous studies (Noordzij *et al.*, 2006; Brunye *et al.*, 2008; Ooms *et al.*, 2012). In our case, females took a shorter response time than males to locate their houses, older participants spent a longer time, and the least time was spent on the overlay map. Females in our study may have taken a shorter response time than males as they have been associated with good knowledge of landmarks (Coluccia & Louse, 2004; Campbell *et al.*, 2014). That the older participants (over 51 years) spent more time on the location task than younger participants in this study is an indicator of age-related decline in spatial and cognitive skills (Iaria *et al.*, 2009). This observation was however counteracted by the increased accuracy of their performance as witnessed in lower locating error.

5.5.2.6 Perception of distance prior to and after map exposure

Slightly more than half of the participants (51%) increased their estimation of distance after studying the map, irrespective of their gender, level of education, age, previous experience with spatial information or the type of map. From this finding, it was observed that participants tended to mentally locate themselves further away from the project area after using the maps. This may be attributed to the allocentric or survey type of view associated with spatial information (Thorndyke & Hayes-Roth, 1982; Kettunen *et al.*, 2012), and comparable to cognitive distances that are often acquired through routes (Thorndyke & Hayes-Roth, 1982; Brunye & Taylor, 2008). This was also confirmed where it was observed that cognitive distance had a higher correlation with route distance, and map derived distance a higher correlation with Euclidian distance.

5.6 Conclusions

A number of findings from this study may be considered inconclusive when compared with wider literature, which is hardly surprising, considering the real world study setup. For example, participants' choice of the topographic map as the most preferred map went against the general trend towards more realistic spatial presentations. Further, female participants spent less time on the locating task than male participants. Age was an interesting variable in this study as it was seen that the older participants (over 51 years) spent a longer time on the experimental task, but were more accurate. In response to the question raised at the beginning of this study, whether maps improve distance perception, it may be said that maps encourage Euclidian distance perception.

A few lessons may be derived from this study: first, higher levels of realism in spatial presentations may not always be preferred. Second, age and gender related differences

in spatial cognition are still uncertain, and provide ample opportunity for further study. Third, valuable lessons may be learnt from testing for spatial cognition under real-world circumstances such as this study, where spatial information is increasingly being used. Overall, the findings from this study demonstrate the opportunities available for the use of spatial information, as well as the importance of considering the socio-economic context, individual characteristics, preferences and abilities when developing and using spatial presentations in real life situations.

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6

Synthesis

6.1 Introduction

The main goal of this thesis was to establish whether spatial information is used in public participation within EIA, and if so, the extent of its use. Through surveys and case studies, which are presented in Chapters 2, 3, 4 and 5 of this thesis, the three sub-objectives proposed in Chapter 1 were investigated and assessed. The purpose of this Chapter is to revisit the sub-objectives and findings of the surveys and case studies, and offer reflections on the use of spatial information in public participation within EIA. Directions for further research are also suggested.

At the onset of this study, three specific sub-objectives were developed, aimed at addressing the overall objective. These sub-objectives were:

- To confirm the presence and extent of public participation within EIA in Kenya.
- To establish the extent to which spatial information is used in EIA in Kenya, and
- To evaluate, using case studies, the use of spatial information during public participation within EIA in Kenya.

The main findings from surveys and case studies undertaken to address the above sub-objectives are presented in the subsequent sections of this Chapter, and as well, reflections on the findings and suggestions for further research.

6.2 Main research findings

Surveys and case studies were undertaken to address the sub-objectives developed in this study. In this section, the main research findings from each sub-objective are presented and discussed.

6.2.1 The presence and extent of public participation within EIA in Kenya

Public participation within Environmental Impact Assessment (EIA) in Kenya is referred to as Consultation and Public Participation (CPP) and is conducted through the seeking of views of persons who may be affected by the project (National Environment Management Authority, 2002; Republic of Kenya, 2003). Following initial investigation, it was noted that only a handful of studies existed on public participation within EIA in Kenya (Kameri-Mbote, 2000; Okello *et al.*, 2009; Kimani, 2010; Marara *et al.*, 2011), contrary to international literature on the same (Palerm, 2000; Doelle & Sinclair, 2006; Faircheallaigh, 2010; Glucker *et al.*, 2013). This situation was evident despite the fact that EIA was not new in Kenya, having been established in 2002 (Republic of Kenya, 1999). Further, it was also established that public participation was already being carried out within the Project Report and EIA

Study stages (National Environment Management Authority, 2002; Republic of Kenya, 2003) although documentation was scarce, and the extent unknown.

A survey was undertaken on the status and trends in public participation within EIA in Kenya, details of which were presented in Chapter 2. To begin with, five dimensions for the evaluation of public participation within EIA were identified from legal and best practice requirements, namely: notification, participation methods, venue, language used, and type of participants. First, notification considered that participants needed to be informed prior to the actual public participation exercise so that they were aware and could participate. Methods for notification were varied, and included posters, letters, email, flyers, personal invitations, radio announcements, and newspaper advertisements, among others. Second, participation methods included a number of ways that enabled the public to air their opinions and views, such as public meetings, informal discussions, telephone conversations, letter exchanges, email exchanges, workshops, focus group discussions, interviews and opinion forms, among others. Third, the dimension on venue considered that any place where public participation was to take place should be convenient and accessible. Multiple venues were encouraged. Fourth, Kenya has two official languages (English and Kiswahili) and over 40 indigenous languages. A consideration of this diversity was expected in the dimension of language, so that participants would be involved in public participation activities without a hindrance due to language. Finally, the dimension of participants included the following major categories: local community, civil society, government agencies/ministries, and business community/private sector. For all the dimensions mentioned above, the score obtained depended on the choices made in each dimension, with more choices resulting in higher scores.

The above mentioned five dimensions were then constituted into a Consultation and Public Participation Index (CPPI), developed within this research to analyze a sample of 223 EIA Study Reports submitted to the Environment Authority between 2002 and 2010. Out of the two EIA stages that public participation is carried out, the EIA Study stage was selected as it is during this stage the most intensive public participation activities are undertaken. The record for activities at this stage, the EIA Study Report, served as the source of data for the survey.

Following analysis of the dimensions presented in the CPPI, it was found that public participation was relatively low, with the highest score of 1.65 in 2010, out of a possible score of 5. The five dimensions of the index were present in all the EIA Study reports analyzed, except language used, which was not indicated in 2003, 2004 and 2006. Variation within the dimensions was also evident during the study period, with a steep dip in 2003 for participation methods, type of participants and venue, which was attributed to ‘start-up’ problems. A steady increase was thereafter witnessed in all dimensions, although the dimensions of language used, notification methods and venue remained consistently low during the study period, except for a sharp rise and fall in the dimension of venue in 2006 and 2007 respectively.

Overall, the dimensions of 'participation methods' and 'type of participants' scored the highest, followed by 'venue', 'notification' and 'language used', in that order. Despite a 95% mention of public participation in the EIA Study Reports, the low CPPI scores recorded against the individual dimensions were attributed to gaps in reporting, and limited choices per dimension.

The main contribution of this survey was a documentation of the status of consultation and public participation within EIA in Kenya, which had previously not been done. An improvement in the conducting and reporting of consultation and public participation activities within EIA was recommended and further evaluation on the adequacy of the five dimensions identified in the CPPI.

6.2.2 The extent to which spatial information is used in EIA in Kenya

Spatial information is increasingly used within EIA to collate and present baseline environmental information (Satapathy *et al.*, 2008; Slotterback, 2011), in the identification and prediction of impacts (Warner & Diab, 2002; Moufaddal, 2005; Vanderhaegen & Muro, 2005; Atkinson & Canter, 2011), and to inform public participation and support decision making (Appleton & Lovett, 2005; Prendergast & Rybaczuk, 2005; Bacic *et al.*, 2006; Hammond *et al.*, 2011; Lei & Hilton, 2013). In Kenya, an official recommendation for the use of spatial information within EIA exists (National Environment Management Authority, 2002), although the extent to which it was used was previously unknown, hence the need for a survey, the details of which were presented in Chapter 3.

Kenyan literature on EIA was seen to focus on public participation (Kameri-Mbote, 2000; Okello *et al.*, 2009; Kimani, 2010; Marara *et al.*, 2011), with hardly any information on the use of spatial information. Using methods similar to a survey on the use of GIS in EIA in the UK by Riddlesden *et al.* (2012), a sample of 434 EIA Study Reports submitted to Kenya's Environment Authority between 2002 and 2013 were investigated for the presence/absence of spatial presentations, levels of visual realism exhibited and content presented in the spatial presentations.

Almost all (95%) of the EIA Study Reports sampled displayed a variety of spatial presentation types, with preference for the combined use of spatial presentations with low and high levels of visual realism. The use of spatial presentations with either low levels of visual realism or high levels of visual realism remained low during the study period, except from the year 2011 onwards when spatial presentations with low levels of visual realism drastically increased in popularity, at the expense of spatial presentations with high levels of visual realism. The drastic change in preferred levels of low visual realism from the year 2011 onwards was attributed to administrative changes within the Environment Authority, specifically a new and decentralized system, where greater scrutiny of individual EIA Study Reports was undertaken, and a requirement given for better illustration of project location, activities/details, and special interest areas (National Environment Management Authority, 2013). The demand for spatial presentations was therefore greater, and may have led to increased

pressure on time and resources, hence the preference for spatial presentations with low levels of visual realism. In addition, spatial presentations with low levels of visual realism have been traditionally used in Kenya (Une *et al.*, 2003) and it was therefore not surprising that these were the preferred type of spatial presentations when the requirements for better illustration of project-related content were made.

On the content presented, information on the project location, project activities/details, and special interest areas (e.g. administrative boundaries - political, hydrology, topography, conservation areas, distribution of endangered plant/animal species, etc.) was assessed. It was observed that a combination of project location and activities/details was most popular.

The main contribution of this survey was to establish that indeed spatial information is appreciated within EIA in Kenya, although largely undocumented. In response to the question raised at the beginning of the study, on how spatial information is used in EIA in Kenya, the response was that mixed approaches on the levels of visual realism in spatial presentations were preferred, and that spatial information was commonly used to present a combination of project location and project activities/details. Further investigation on the reasons behind the observed choices of spatial presentations regarding preferred levels of visual realism was recommended, as well as the specific function of spatial information within EIA in Kenya.

6.2.3 Case studies on the use of spatial information during public participation within EIA in Kenya

The overall elements in this thesis were initially identified as EIA, public participation and spatial information (Fig. 1-1), where EIA served as the wider setting, followed by public participation within EIA, and finally spatial information within public participation. To enable further assessment on the use of spatial information during public participation within EIA, a consideration of the participants was important. This necessitated the development of a conceptual framework with the four key elements of EIA, levels of public participation, aspects of spatial information relevant for public participation, and categories of participants (Fig. 6-1), with the sub-components of each of the four elements outlined.

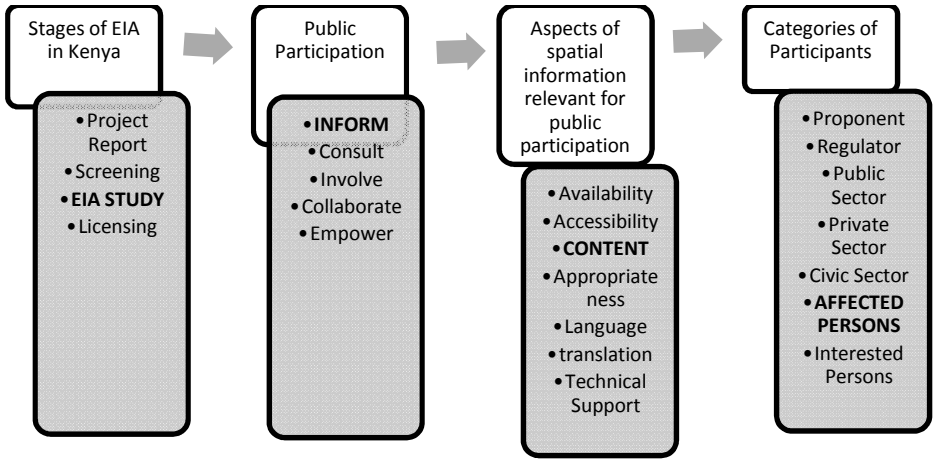

Fig. 6–1 Conceptual Framework

Two case studies were carried out to evaluate the use of spatial information during public participation within EIA in Kenya. The justification for these case studies was an absence of concrete studies to confirm the presence and use of spatial information within EIA in Kenya, particularly during public participation. The first case study, presented in Chapter 4, was based on the conceptual framework developed within this research (Fig. 6-1). From this conceptual framework, the study was limited to the EIA Study stage (stages of EIA in Kenya), 'inform' (public participation), all the aspects of spatial information relevant for public participation (availability, accessibility, content, appropriateness, language, translation and technical support) and 'affected persons' (categories of participants). A cadastral map was used, which was the exact same one prepared for use in the public participation exercise. Using the structured interview method, information on the seven aspects related to the use of spatial information during public participation was sought from 'affected persons' who had attended an EIA public meeting held earlier.

The cadastral map was seen to meet the requirements for accessibility (almost all the participants were able to access the map during the public meeting), language and translation (the map was presented in English, with verbal explanations in Kiswahili, the national language), and technical support (verbal explanations and a physical demonstration on the location of the proposed project was offered by officials from the Environment Authority). The cadastral map was unsatisfactory in the aspect of availability (only one copy was available), and unconfirmed for content and appropriateness. Suggestions from participants were related to availability and access to spatial information, and the possible simultaneous use of more than one type of spatial presentation, such as maps and photographs. Maps were ranked highly as a source of spatial information, particularly when clear and precise. In addition, the quality of the cadastral map was questionable, and the need to consider this aspect when planning for the future use of spatial information during public participation within EIA emphasized.

The second case study, presented in Chapter 5, was also based on the conceptual framework (Fig. 6-1) developed within this research and evaluated in the first case study, but with emphasis on the dimension of 'content' of spatial information, specifically, distance. The other three elements of the conceptual framework were kept constant, namely the EIA Study Stage (stages of EIA in Kenya), 'inform' (public participation), and 'affected persons' (categories of participants). Three maps with different levels of visual realism were used, namely, topographic map, overlay map (topographic map on background of satellite imagery) and aerial map (satellite imagery only). Participants most likely to be affected by the proposed development project ('affected persons') were requested to indicate their preferred map, following which previous experience with spatial information was established, and thereafter a task on locating their houses was undertaken, with response time being recorded. True (GPS coordinates) location of the houses was also recorded, for purposes of analysing participant responses.

Interestingly, the topographic map, with the lowest level of visual realism, was most appreciated, more so when considered against continued developments in GIS and the presentation of spatial information (Goodchild, 2009a; Iaria *et al.*, 2009; Chrastil & Warren, 2012). Two scenarios were useful in understanding this finding: the socio-economic context in Kenya, where access to spatial information is generally low, and consequently its use. Second, participants attributed their exposure to spatial information mainly in the formal school setting, where the topographic map and atlas were used, following their popularity in Kenya (Une *et al.*, 2003).

When requested to locate their homes on the map of choice, participants' ability to correctly locate their homes was low, as evidenced by high variability and the presence of outliers. Previous map experience, gender and level of education did not influence accuracy in the locating task. However, participants older than 51 years were more accurate in this task than younger participants. On the time taken to carry out the house location exercise (response time), it was observed that female participants spent less time than their male counterparts, while participants older than 51 years spent the longest time.

On the perception of distance prior to maps exposure (cognitive distance) and after map exposure (map-derived distance), it was observed that more than half of the participants tended to increase their estimation of distance after using the maps. In addition, further analysis established that cognitive distance had a higher correlation with route distance, and map-derived distance with Euclidian distance. Therefore, in response to the question raised at the beginning of the study, on whether maps improve distance perception, it was observed that maps encouraged Euclidian distance perception.

The main contribution of these case studies was the evaluation of a conceptual framework that uniquely brought together the elements of EIA, public participation, spatial information and types of participants. Further, both case studies were carried out in a real world setting, with typical participants (affected persons) which was

different from the more common laboratory setting and closer to the actual EIA public participation activities. A useful contribution by the first case study was a demonstration of the importance of good quality spatial information and the simultaneous presentation of more than one type of spatial presentation, such as maps and photographs. The second case study demonstrated preference for low levels of visual realism in spatial presentations, and the differences in age (older participants were more accurate) and gender (females were faster than males) as relates to spatial cognition, although further investigation on these was recommended.

6.3 Reflections

The surveys presented in the 2nd and 3rd Chapters of this thesis set out to establish the presence and extent of public participation, and the use of spatial information within EIA, respectively. Essentially, these studies were exploratory in nature, and aimed to provide background information that was previously unavailable in Kenya. This may be considered a logical first step if deeper understanding is to be gained on spatial information use in public participation within EIA in Kenya, as has been done elsewhere (Webler & Tuler, 2006; Sinclair *et al.*, 2008; Elwood, 2010; Faircheallaigh, 2010; Morgan, 2012; Riddlesden *et al.*, 2012; De Montis, 2013).

On the presence and extent of public participation, the findings reported in this research - that public participation was relatively low - were surprising, considering that available Kenyan literature on EIA had previously focussed almost exclusively on public participation. This research represented the first time that public participation activities were analyzed in detail, through the five dimensions of the CPPI, namely, notification, participation methods, venue, language used, and type of participants. The dimensions offer a first step for the improved conducting and reporting of public participation activities within EIA in Kenya. Thereafter, more detailed evaluations would be possible, such as one carried out by Nadeem and Fischer (2011) on the effectiveness of public participation in EIA in Pakistan.

On the extent to which spatial information is used in EIA in Kenya, the findings of this research are quite significant, considering that this was the first study of its type in Kenya. Consequently, information is now available on the extent to which spatial information is used in EIA in Kenya, the preferred levels of visual realism in spatial presentations, and the content most commonly presented, namely, a combination of project location and project activities/details. Again, this is only a first step, and further research is encouraged. Nonetheless, the findings of this research now enable the Kenyan situation to be placed in the wider context of literature, where developments and study are more advanced, and increasing rapidly.

The case studies presented in the 4th and 5th Chapters of this thesis explored the use of spatial information by members of the public (specifically affected persons) in the context of EIA, through the conceptual framework developed in this research. The first case study highlighted the importance of using good quality spatial information

during public participation. From the second case study, the findings indicated a preference for topographic maps, and that maps encourage Euclidian distance perception. In an exercise on location identification in the same case study, it was also observed that participants older than 51 years were more accurate than younger participants, and females spent a shorter time on the task than males. The findings from the case studies, despite their real-life setting and characteristics of participants (affected persons), were largely consistent with wider literature. For example, the preference for topographic maps coincides with recent findings on the continued usefulness of spatial information that follows basic cartographic rules, despite rapid developments in geovisualization (Harding, 2011; Konecny *et al.*, 2011). Similarly, the support by maps for Euclidian distance perception was also consistent with wider literature (Thorndyke & Hayes-Roth, 1982; Kettunen *et al.*, 2012). On the influence of age and gender on spatial cognition tasks, it was observed that opinion in wider literature stands strongly divided, hence it was considered prudent to avoid making overarching conclusions, particularly in view of the different setting (real-life) and participants (heterogeneous mix of affected persons) in this research, against the more controlled settings and homogenous participants in comparable experiments (Coluccia & Louse, 2004; Iaria *et al.*, 2009; Newcombe & Stieff, 2012; Campbell *et al.*, 2014). This decision should however not be taken as a dismissal of the results of this research, particularly on the influence of age and gender on spatial cognition, but rather as an encouragement for similar real-world experiments, where spatial information is being increasingly used.

A combination of approaches was used in this research, namely surveys and case studies. At the beginning of this study, it was observed that only little information was available on public participation within EIA in Kenya, and hardly any information on the use of spatial information therein. Considering that spatial information is increasingly used to support public participation in EIA in other countries, the question of its use in Kenya was timely. There was however a need to establish information that would serve as a baseline for further investigation, hence the choice of the survey method, which established the presence and extent of public participation in EIA and the use of spatial information therein. The second challenge was related to the setting of public participation activities within EIA, which are usually carried out in informal settings, particularly when affected persons are involved. A consideration of the most appropriate methods led to the decision to carry out case studies, which enable situation-specific investigation. Also, compared to highly controlled and laboratory type experiments that are the typical approach for testing spatial cognition skills such as those that were tested in the second case study, the case studies provided a real-world test of otherwise laboratory-based phenomena.

Two main innovations are evident in this thesis: the consultation and public participation index (CPPI) and the conceptual framework developed in this research. The CPPI brought together, for the first time dimensions that are specifically relevant to public participation within EIA, that is, notification, participation methods, venue, language used, and type of participants. These dimensions offer the opportunity for

deeper and more structured analysis of public participation within EIA, the results of which may be applied towards the improvement of practice. The second innovation, the conceptual framework, was valuable because it uniquely brought together the elements of EIA, public participation, spatial information and types of participants. A number of studies have been undertaken on the elements of public participation, spatial information, and types of participants, singularly or in combination. The novelty of this study was the combination of these elements and their placement within the framework of EIA, which provides a new perspective on the already existing mix of public participation, types of participants and the use of spatial information. The combination of these elements into a framework will encourage in-depth investigation on their quality and effectiveness to EIA.

Still related to the conceptual framework was the type of participants, who include the proponent, regulator, public/private/civic sectors, and affected/interested parties/persons (National Environment Management Authority, 2002; Republic of Kenya, 2003; Morrison-Saunders & Bailey, 2009). Unlike the other categories of participants, affected persons face direct impacts from development projects (Republic of Kenya, 2003), hence their increased stake (Schlossberg & Shuford, 2005). For this reason, their participation is particularly encouraged (National Environment Management Authority, 2002; Republic of Kenya, 2003). In view of the above, affected persons were chosen to participate in the two case studies presented in the 4th and 5th Chapters of this thesis. Affected persons, more often than not, particularly in developing countries, come from the lower socio-economic groups, which may not have the ability to quickly relocate when adverse impacts of a development project are anticipated. In addition, due to their low socio-economic status, their ability to contribute to debate and influence decision-making is hampered. Further, they are not considered a very 'interesting' demographic for study due to challenges in communicating with them, particularly if they are illiterate, which requires additional resources and time for translators, and may affect the accuracy of information received. Accessing their living areas may also be a challenge, particularly if these areas lack proper roads infrastructure, or may be considered insecure, hence the increased risk associated with accessing them, and a need for security resources. Consequently, these persons often find themselves involved in studies on social ills, such as illiteracy, crime, drugs, disease, and poverty. Their consideration in a research such as this, which evaluated their opinion on spatial information, and encouraged their participation in EIA activities, is not very popular. However, considering their increased stake in any decision made as relates to a development project, it is precisely for this reason that their opinions were sought, irrespective of their socio-economic status.

6.4 Further research

In this thesis, baseline information has been presented on public participation and spatial information, within EIA, as well as two case studies on the use of spatial

information during public participation within EIA in Kenya. In order to further understand and encourage improvements in these areas, a number of suggestions are made for further research.

To begin with, a frequent but nonetheless valid suggestion for further research would be that the CPPI and conceptual framework developed in this thesis be further studied in Kenya and elsewhere, so as to test and refine the individual components and further inform practice.

The two case studies presented in this thesis duplicated the real world setting where public participation within EIA in Kenya is usually carried out. In addition, the study population of affected persons, despite being encouraged, is not very popular for research. A suggestion for further research includes a consideration of more real world settings for case studies, comparable to more controlled and laboratory-like set ups. This would be particularly useful for EIA, which is carried out in such circumstances. Also to be considered would be further inclusion of affected persons, who, due to their socio-economic characteristics, may offer different perspectives to otherwise well known opinions.

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Summary

Established in the United States of America in 1970, Environmental Impact Assessment (EIA) is an interdisciplinary approach that considers the anticipated impacts of development on the environment, and proposes timely mitigation of these impacts to the extent possible. Since then, EIA has continued to be established in countries worldwide, with modifications being made to suit regional and local requirements. Essential to EIA is an attempt to balance environmental concerns with social, economic and other human needs, which has led to partnership with society, to the extent that public participation is deeply incorporated into EIA. Also central to the EIA process is information related to the natural and human environment. Sources of this information, particularly those that contain spatial elements, are valuable due to their ability to provide information on location. Sources of spatial information are numerous, and may include photographs, maps, satellite images, orthophotographs, verbal descriptions, animations, and virtual reality, among others.

Despite its innovative presentation of project-relevant information and communication function during public participation, debate exists on the value of spatial information to EIA. For example, high levels of visual realism may hinder the interpretation of spatial information, while high costs, and technical demands may cause certain types of spatial information to be inaccessible to a large number of stakeholders. These challenges are not unique to any one country, and have also been observed in developing countries, where, in addition to a deficiency of information, less developed and poorly enforced legislative, administrative, institutional and procedural frameworks for EIA intensify the challenges. For example, despite an official recommendation for the use of spatial information during public participation within EIA in Kenya, whether this happens, and the extent, was largely undocumented. In view of this observation, an investigation into the use and status of spatial information during public participation within EIA in Kenya was considered.

The main objective of this research was to establish whether spatial information is used in public participation within EIA, and if so, the extent of its use. Three specific sub-objectives were developed, namely: to confirm the presence and extent of public participation within EIA in Kenya; to establish the extent to which spatial information is used in EIA in Kenya; and to evaluate, using case studies, the use of spatial information during public participation within EIA in Kenya. Combined methods of surveys and case studies were used to address the sub-objectives earlier developed.

In response to the first sub-objective, namely, to confirm the presence and extent of public participation within EIA in Kenya, five dimensions for the evaluation of public participation within EIA were identified from legal and best practice requirements. These five dimensions were: notification, participation methods, venue, language used, and type of participants, which were then constituted into a Consultation and Public Participation Index (CPPI), developed within this research to analyze a sample

of 223 EIA Study Reports submitted to the Environment Authority between 2002 and 2010. EIA Study Reports record activities during the EIA Study Stage, where public participation activities are most intensive, hence their choice as a source of data for the survey. Following analysis of the five dimensions presented in the CPPI, public participation was found to be relatively low, with the highest score of 1.65 out of a possible score of 5. The dimensions of 'participation methods' and 'type of participants' scored the highest, followed by 'venue', 'notification', and 'language used', in that order. Variations within the dimensions were also evident during the study period. Despite a 95% mention of public participation in the EIA Study Reports, the low CPPI scores were attributed to gaps in reporting and limited choices per dimension.

In response to the second sub-objective, namely, to establish the extent to which spatial information is used in EIA in Kenya, survey methods similar to those used to address the first sub-objective were employed, where a sample of 434 EIA Study Reports submitted to the Environment Authority between 2002 and 2013 were analyzed for the presence/absence of spatial presentations, levels of visual realism exhibited, and content presented in the spatial presentations. Almost all (95%) of the EIA Study Reports sampled displayed a variety of spatial presentation types, with preference for the combined use of spatial presentations with low and high levels of visual realism. On the content, information depicting a combination of project location and project activities/details was most popular.

In response to the third sub-objective, namely, to evaluate, using case studies, the use of spatial information during public participation within EIA in Kenya, two case studies were conducted, the first in Katani, in the Eastern Province of Kenya, and the second in Kericho, in the Rift Valley Province of Kenya. Both case studies were based on a conceptual framework developed in this research to assess the interplay between EIA, public participation, spatial information and type of participants. In both studies, EIA stages was limited to the EIA Study stage, levels of public participation was limited to 'inform', and categories of participants was limited to 'affected persons'. Seven aspects of spatial information were deemed relevant to public participation, namely: availability, accessibility, content, appropriateness, language, translation, and technical support. In the first case study, all the seven aspects were evaluated, using a cadastral map, where it was established that the requirements for accessibility, language, translation and technical support were met, but those for availability were unsatisfactory, and unconfirmed for content and appropriateness. Out of the 7 aspects of spatial information that were deemed relevant to public participation, the second case study was limited to the aspect of 'content', and specifically distance perception. It was argued that distance perception is critical when determining potential benefits or threats from a proposed project. Three types of spatial presentations with different levels of visual realism were used, namely a topographic map, overlay map and aerial map. From this case study, preference was noted for topographic maps, indicating that higher levels of visual realism in spatial presentations were not always preferred. On whether maps improve distance

perception, the results indicated that they encourage Euclidian distance perception. The unique point of the case studies was that they were conducted in 'real-life' settings, similar to those in which actual EIAs are carried out, as opposed to highly controlled and laboratory-like set ups.

Two main innovations are evident: the consultation and public participation index (CPPI) and the conceptual framework developed in this research. The CPPI brought together, for the first time dimensions that are specifically relevant to public participation within EIA, that is, notification, participation methods, venue, language used, and type of participants. These dimensions offer the opportunity for deeper and more structured analysis of public participation within EIA, and the opportunity to improve practice. The second innovation, the conceptual framework, brought together the elements of EIA, public participation, spatial information and types of participants. The novelty of this conceptual framework was the combination of these elements and their placement within the framework of EIA, which will encourage in-depth investigation on their quality and effectiveness to EIA. Still related to the conceptual framework was the emphasis on 'affected persons', who often face direct impacts from development projects, yet are often not included in EIA public participation activities due to their low socio-economic status and challenges in accessing them, e.g. poor infrastructure and insecurity. It is due to their increased stake in any decision made that we specifically sought their opinions in this research.

Ufupisho

Shirika linalokadiria athari za mazingira lilianzishwa nchini Marekani mwaka wa 1970. Shirika hilo linahusu maeneo ya taaluma zaidi ya moja, ambayo hutilia maanani athari zinazotarajiwa mazingira yakistawishwa, na hutoa mapendekezo ya kupunguza athari hizo. Tangu wakati huo, shirika hilo limeendelea kuanzishwa kote ulimwenguni kukiwa na mabadiliko yanayolingana na mahitaji ya maeneo mbalimbali. Shirika hilo linajaribu kusawazisha maswala yanayohusu mazingira na mahitaji ya kijamii, kiuchumi na pia yanayomhusu binadamu. Haya yanachangia katika kuleta ushirikiano na jamii, kwa vile jamii hushirikishwa katika shirika hilo linalokadiria athari za mazingira. Nguzo muhimu katika swala hili ni ujumbe unaohusu mazingira asili na mambo yanayomhusu binadamu. Asili ya ujumbe unaohusiana na vitu vinavyohusu anga ni muhimu, kwa vile hutoa ujumbe unaohusu eneo. Asili ya vitu vinavyohusu anga ni kama vile, picha, ramani, picha za setilaiti, maelekezo kwa njia ya mdomo, katuni, ukweli bayana miongoni mwa nyingine. Licha ya kuwasilisha ujumbe muhimu unaohusu mradi huo, swala la umuhimu wa vitu vinavyohusu anga linaendelea kujadiliwa. Kwa mfano, kuwepo kwa vielelezo halisi katika kukadiria athari za mazingira kwa kiwango kikubwa kunaweza kuzuia ufasiri wa vitu vinavyohusiana na anga. Gharama ya juu pamoja na mbinu za kiufundi za hali ya juu zilizotumiwa zinaweza kuzuia wanaoshiriki baadhi ya habari inayohusu anga. Changamoto hizi si za kipekee kwa nchi moja kwa vile nchi zinazoendelea zina changamoto nyingi. Licha ya ukosefu wa taarifa, kuna sheria hafifu ambazo hazijatekelezwa ipasavyo pamoja na tawala, asasi, na taratibu zilizowekwa za shirika linalokadiria athari za Mazingira, ambazo hazijatiliwa nguvu ipasavyo. Kwa mfano, hata ingawa kulikuwa na pendekezo rasmi la kutumia ujumbe wa anga wakati wa kushirikisha jamii nchini Kenya, hakukuwa na hati za kudhibitisha kama hayo yalifanyika na kama yalifanyika ni kwa kiwango kipi. Kufuatia wazo hilo, uchunguzi kuhusiana na matumizi pamoja na hali ya taarifa inayohusu anga wakati wa kushirikisha jamii katika kukadiria athari za mazingira nchini Kenya ulitiliwa maanani.

Lengo kuu la utafiti huu ni kuthibitisha kama taarifa inayohusu anga inatumika kuihusisha jamii katika kukadiria athari za mazingira na ni kwa kiwango gani inatumika. Malengo madogo matatu yalibuniwa, nayo ni; kudhihirisha kuwepo na kiwango cha kuishirikisha jamii katika kukadiria athari za mazingira nchini Kenya, kudhihirisha kiwango cha matumizi ya taarifa kuhusu anga wakati wa kukadiria athari za mazingira nchini Kenya, na kutathmini kwa kutumia uchunguzi kifani matumizi ya taarifa inayohusu anga wakati wa kuishirikisha jamii katika kukadiria athari za mazingira nchini Kenya. Njia kadhaa za uchunguzi pamoja na ya uchunguzi kifani zilitumika katika kushughulikia malengo hayo madogo.

Katika kushughulikia lengo ndogo la kwanza linalohusu kudhihirisha kuwepo na kiwango cha kushirikisha jamii katika kukadiria athari za mazingira nchini Kenya, vigezo vitano vya kudhihirisha kushiriki jamii katika kukadiria athari za mazingira vilitambuliwa kisheria na kupitia kwa matendo yanayokubalika. Vigezo hivyo vitano ni: taarifa, kushiriki, mahali, lugha iliyotumika na aina ya watu walioshirikishwa. Vigezo hivyo vilitumika kuanzisha kielelezo cha ushauri na ushirika wa jamii, kilichoendelezwa katika utafiti huu ili kuchanganua ripoti 223 zinazohusiana na kukadiria athari za mazingira zilizoteuliwa na kukabidhiwa shirika hilo kati ya mwaka wa 2002 na 2010. Ripoti hizo zilidhihirisha utendaji ambapo jamii ilishiriki kwa kina na hivyo kupatikana kwa data asili iliyosaidia katika uchunguzi kwa kuchanganua vigezo vile vitano vilivyokabidhiwa kielelezo cha ushauri na ushirika wa jamii. Ilidhihirika kuwa jamii ilishiriki kwa kiwango kidogo sana, kwa vile walioshiriki kwa kiwango cha juu zaidi walipata 1,65 kwa 5. Vigezo vya `njia za kushiriki' na `waliohusika' vilirekodi alama za juu, vikifuatwa na `mahali', taarifa na lugha iliyotumika. Tofauti katika vigezo hivyo zilidhihirika wakati wa uchunguzi huo. Hata ingawa iliripotiwa kuwa jamii ilishiriki katika kukadiria athari za Mazingira, ilikuwa asili mia 95. Kiwango cha chini cha kushirikisha jamii kilitokana na pengo lilitokea wakati wa kuripoti na pia uteuzi finyu uliokuwepo katika kila kigezo.

Katika lengo ndogo la pili ambalo lilidhamiria kudhihirisha kiwango cha matumizi ya taarifa kuhusu anga katika kukadiria athari za mazingira nchini Kenya, njia za utafiti zilizotumika katika lengo ndogo la kwanza zilitumika. Ripoti 434 za kufanyiwa uchunguzi zilikabidhiwa shirika linalokadiria athari za mazingira kati ya mwaka wa 2002 na 2013, na kuchanganuliwa kwa kuwepo au kutokuwepo kwa vitu vinavyohusiana na anga, viwango vya ukweli bayana pamoja na yaliyomo vikionyeshwa katika uchunguzi huo. Karibu asili mia 95 ya ripoti zilizochunguzwa, zilionyesha aina nyingi za vitu vinavyohusu anga vikiegemea zaidi katika kutumia vitu vyote vinavyohusu anga vikiwa na viwango vya chini, na juu vya ukweli bayana. Katika yaliyomo, ujumbe ulioonyesha mahali na shughuli zilizofanywa katika utafiti huu ulipendeza zaidi.

Lengo la tatu ambalo linahusu kutathmini kwa kutumia uchunguzi kifani matumizi ya taarifa inayohusu anga wakati wa kushirikisha jamii katika kukadiria athari za mazingira nchini Kenya, uchunguzi kifani ulifanywa Katani katika Mkoa wa Mashariki na wa pili ulifanywa Kericho katika Mkoa wa Bonde la Ufa. Uchunguzi huo ulifanywa kwa kutumia kielelezo cha nadharia kilichobuniwa katika utafiti huu ili kuchunguza uhusiano kati ya kukadiria athari za mazingira, kushirikisha jamii, taarifa inayohusu anga na aina ya washiriki. Katika uchunguzi ulifanywa, upeo wa hatua za kukadiria athari za mazingira ulifika kikomo katika hatua ya kukadiria athari za mazingira, hatua ya kushirikisha jamii ilifika upeo wa kufahamisha na kategoria ya washiriki ilihusu `walioadhirika'. Vipengele saba vya taarifa kuhusu anga vilionekana kuwa na uhusiano na kuishirikisha jamii navio ni: upatikanaji, ufikiaji, yaliyomo, ufaafu, lugha, tafsiri na usaidizi wa kiufundi. Katika uchunguzi wa kwanza, vipengele hivyo saba vilichanganuliwa kwa kutumia ramani ambapo ilidhihirika kuwa mahitaji ya ufikikaji, lugha, tafsiri na usaidizi wa kiufundi yaliridhisha, lakini yale ya

upatikanaji hayakuridhisha na yaliyomo na pia ufaafu hayakuthibitishwa. Kati ya vipengele hivyo saba vya taarifa inayohusu anga ambavyo vilikuwa muhimu katika kuihusisha jamii, uchunguzi wa pili ulikuwa na ufinyu katika kipengele cha yaliyomo. Ilijadiliwa kuwa kufasiri umbali ni muhimu wakati wa kuamua manufaa yanayotarajiwa au tishio kutokana na utafiti uliopendekezwa. Aina tatu za taarifa inayohusu anga zilizowasilishwa zilikuwa na viwango tofauti vya ukweli bayana vilivyotumika. Ilidhihirika kuwa matumizi ya ukweli bayana hayakupendeza. Swala la ramani lilizosaidia katika kufasiri umbali na matokeo yakawa ni ya kutia moyo. Yaliyokuwa ya kipekee katika uchunguzi kifani ni kwamba ulifanyiwa mandahari `yaliyo hai' sawa na ule wa shirika linalokadiria athari za mazingira ambao ni halisi na hufanywa kinyume na ule unaofanywa ukiwa umedhibitiwa kama wa maabarani.

Uvumbuzi mara dufu unadhihirika yaani, kielelezo cha ushauri na ushirika wa jamii na kielelezo cha nadharia kilichobuniwa katika utafiti huu. Kielelezo cha ushauri na ushirika wa jamii kilileta pamoja kwa mara ya kwanza vigezo ambavyo vinahusisha kushirikisha jamii katika kukadiria athari za mazingira, navyo ni, kujulisha, njia ya kushirikisha, mahali, lugha inayotumika na aina za washiriki. Vigezo hivyo vinatoa nafasi ya uchanganuzi wa kina na ulio na muundo wa kushirikisha jamii katika kukadiria athari za mazingira na pia kutoa nafasi ya marekebisho zaidi katika utendaji. Kielelezo cha nadharia kilileta pamoja elementi ya kukadiria athari za mazingira, kushirikisha jamii, taarifa kuhusu anga, na aina ya washiriki. Wazo jipya la kielelezo cha nadharia ni kuleta pamoja elementi na kuziweka katika msingi wa kukadiria athari za mazingira ambao utahimiza uchunguzi wa kina katika ubora wa matokeo yanayotarajiwa na shirika hilo. Katika kielelezo cha nadharia, walioathiriwa walitiliwa maanani kwa vile wao huathiriwa moja kwa moja na miradi inayostawishwa, ingawa hawashiriki katika shughuli za kukadiria athari za mazingira kutokana na umaskini na changamoto za miundo msingi na swala usalama. Kwa sababu wao hushiriki katika maamuzi yoyote kwa kiwango kikubwa ndio maana tuliuliza maoni yao katika utafiti huu.

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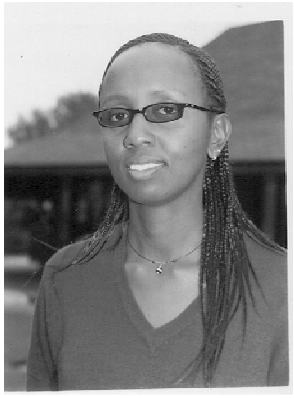
About the author

Angelina Nduta Mwenda was born on 6th November 1973 in Nairobi, the capital city of Kenya. In 1991, she completed her secondary education at Loreto Convent Valley Road, following which she obtained a Bachelor of Education Degree in Geography/Biology from the University of Eastern Africa, Baraton in 1996. After teaching at the secondary school level in Kianda School for three years, she decided to pursue further education, where she gained an MSc degree in Environmental Sciences from Kenyatta University in 2003. This was followed by another teaching stint, this time at the Catholic University of Eastern Africa. In 2008, she started her PhD at Maastricht School of Management in the Netherlands, and moved to Wageningen University in 2010 under the supervision of Arnold Bregt and Arend Ligtenberg.

Presently, she is an independent consultant specializing in public participation, EIA, and social assessments/surveys for a variety of development projects and programs in Kenya and the wider Eastern Africa region.



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Mwenda, A.N., Bregt, A.K., Ligtenberg, A. (2013). Spatial information during public participation within environmental impact assessment in Kenya. *Impact Assessment and Project Appraisal*, 31 (4) 261-270.

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With the educational activities listed below the PhD candidate has complied with the educational requirements set by the C.T. de Wit Graduate School for Production Ecology and Resource Conservation (PE&RC) which comprises of a minimum total of 32 ECTS (= 22 weeks of activities)

Review of literature (5.6 ECTS)

- Spatial cognition; sources of spatial knowledge; different types of spatial information acquired; cognitive maps; environmental impact assessment; public consultation and public participation; visualization techniques; map properties

Writing of project proposal (4.5 ECTS)

- Role of spatial information in public consultation within environmental impact assessment (2009)

Post-graduate courses (7.5 ECTS)

- Quantitative methods; MsM (2008)
- Economics; MsM (2008)
- Behavioural sciences; MsM (2008)

Competence strengthening / skills courses (3.9 ECTS)

- Research methods; MsM (2008)
- PhD competence assessment; WUR (2011)
- Information literacy course; WUR (2011)
- Mini-Symposium “how to write a world-class paper”; WUR (2011)

- **PE&RC annual meetings, seminars and the PE&RC weekend (1.5 ECTS)**
  - PE&RC Day: intelligent nature – on the origin of communication (2009)
  - PE&RC Weekend (2011)
  - PhD Day (2012)

- **Discussion groups / local seminars / other scientific meetings (5.3 ECTS)**
  - Presentation of discussion paper on ‘Environment and Culture’; Forum on Governance, Citizenship and Economics at the Goethe Institute, Nairobi, Kenya (2009)
  - Seminar for handing over the Regional Centre of Expertise, Greater Nairobi, from the National Environment Management Authority (NEMA) to Kenyatta University (2011)
  - Seminar around PhD dissertation on ‘Pastoralist seasonal land rights in land administration’; ITC, Enschede (2011)
  - Environmental Management Seminar; Catholic University of Eastern Africa, Geography Club (2011)
  - Seminar for the development of Incident Management in Kenya, under the National Environment Management Authority (NEMA); Nairobi, Kenya (2012)
  - Nature Kenya lecture series (2012)
  - Friends of Nairobi Arboretum monthly lecture series (2012/2013)

- **International symposia, workshops and conferences (5.4 ECTS)**
  - Workshop on Food Security and Environmental Sustainability in a World of Changing Climate; Bondo University College, Kenya / Cape Peninsula University of Technology, South Africa (2011)
  - Applied Geo-informatics for Society and Environment; fourth international summer school and conference; Jomo Kenyatta university of Science & Technology, Kenya / Stuttgart University of Applied Sciences, Germany (2011)
  - First International Research and Innovation Conference; Mount Kenya University (2013)

- **Supervision of MSc Student**

Understanding spatial information during public participation within environmental impact assessment in Kenya, Gvantsa Khutsishvili (2014)

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